SEVEN
publicações acadêmicas

BRS platinum banana trees grown with macaxisto rock powder

Crossref doi
https://doi.org/10.56238/uniknowindevolp-029

Cicero José da Silva
Federal Institute of Goiano – Campus Morrinhos – GO
Doctor in Agricultural Systems Engineering

Saulo Felipe Brockes Campos
Commercial Manager at TRATTO AGRO.
Master in Agronomy, post graduate in Soil Fertility and Plant Nutrition.

Leticia Pontes Santos
Federal Institute of Goiano – Campus Morrinhos – GO
Bacharel in Agronomy

Luiz Felipe Menezes de Oliveira
Federal Institute of Goiano – Campus Morrinhos – GO
Bachelor student in Agronomy

Mateus Antonio Souza Silva
Federal Institute of Goiano – Campus Morrinhos – GO
Bachelor student t in Agronomy

Emmerson Rodrigues de Moraes
Federal Institute of Goiano – Campus Morrinhos – GO
Doctor in Plant Science

Joicy Vitoria Miranda Peixoto
Federal Institute of Goiano – Campus Morrinhos – GO
Doctor in Plant Science

Janete Golinski
Federal Institute of Goiano – Campus Morrinhos – GO
Master's Degree in Plant Production

ABSTRACT
The banana (*Musa* spp.) is one of the fruits most consumed by the population and has great importance in fruit growing. It is a very nutritionally demanding crop and depends on an adequate ratio of nutrients for its development. The objective of the research was to evaluate the development and productivity of the banana tree "BRS Platina" with the use of micaxiste rock powder (soil remineralizer) in the first cultivation cycle. The experiment was conducted at the Federal Institute of Goiano – Campus Morrinhos (-17◦48'50.4" S, 49◦12'16.5" W, altitude of 902 meters) in a randomized block design. The treatments consisted of fertilization with and without micaxiste rock powder, with seven plants per plot and 12 replications. The plants of the first cycle (mother) were evaluated at 230, 275 and 320 days after transplanting the seedlings. Plant height, pseudostem circumference and number of leaves were measured. When they entered the productive phase and reached the point of harvest, the mass of the bunch, the number of feathers and bananas were evaluated, performing manual counting. The fertilization with micaxiste rock powder favored the vegetative development of the plants, but did not significantly influence the productivity of banana trees "BRS Platina".

Keywords: *Musa* spp., Soil remineralizer, Rocking, Rock dust.

1 INTRODUCTION

The banana (*Muse* spp.) it is native to Southeast Asia, with evidence of its cultivation since 8000 BC. Belonging to the Musaceae family, it is one of the most consumed fruits by the population. It is a source of vitamins and nutrients, rich mainly in potassium, besides presenting great economic and social importance in fruit growing (FERREIRA et al., 2016).

One of the relevant factors for the development of the crop is to maintain the nutritional balance of the soil, because it is a plant quite demanding and dependent on an adequate relationship between

the nutrients: Potassium (K), Calcium (Ca) and Magnesium (Mg) for its development (MORAIS et al., 2014). Due to the rising cost of inputs, producers are looking for alternative options to replace chemical fertilizers and improve soil quality and nutrient replenishment. The micaxiste powder has become an option for nutritional supplementation and improvement of soil structure and can be an advantageous alternative for nutritionally demanding crops, such as banana (MEDEIROS et al, 2020).

The use of soil remineralizer It has shown benefits in improving soil fertility indices (macro and micronutrients), adding improvements to the physical or physicochemical properties of the soil. This can be an alternative to reduce the use of industrial fertilizers, in addition to promoting good productivity and production quality of many crops in Brazilian agriculture (BRITO et al, 2019). There are several studies regarding the use of rock dust as a source of fertilization. Aguilera et al. (2022) concluded that it is advantageous to use basalt rock powder in maize crops. Malta et al. (2018) who used rock powder in guava culture, found an increase in fruit pulp and firmness, when compared to cultivation only with chemical fertilizers. Li et al. (2021) using rock dust from the mining and quarrying industry verified a significant increase in the amount of nutrients such as Ca, Mg, Fe, Mn, Zn, B and Al, compared to the compound without the rock dust, however, without causing phytotoxicity. Conceição et al. (2022) concluded that basalt powder improved soil chemical properties by increasing phosphorus, potassium, calcium and magnesium levels in proportions of about twenty, ten, fifteen and thirteen times, respectively, compared to its absence. In addition, they verified accumulation of macro and micronutrients of up to five times higher than the treatments with absence of basalt powder.

Rock dust has a low cost and its use contributes to the reduction of environmental impact. This product consists of residue that has the potential to improve fertility and soil structuring. It is essential to discuss and research on the use of these products, since there are studies that show benefits for agriculture in terms of productivity, economy, social and environmental impact (LI et al., 2021; Theodore et al., 2021; CONCEIÇÃO et al., 2022; RAMOS et al., 2022). However, studies are still incipient, especially for crops that are highly demanding in relation to soil nutritional levels, such as banana trees.

Based on this context, this research aimed to evaluate the development and productivity of the banana tree "BRS Platina" with the use of micaxiste rock powder (soil remineralizer) in the first crop cycle, in areas of Cerrado do Sul de Goiás.

2 MATERIAL AND METHODS

The research was conducted in the field, in the Experimental Area of Fruit Growing of the Federal Institute Goiano Campus Morrinhos Goiás, latitude 17◦48'50.4" S, longitude 49◦12'16.5" W, altitude of 902 meters, with the banana crop "BRS Platina". The climatic classification of the site

according to Köppen falls under the AW type, with rainy summer and dry winter, average temperature of 23.3 °C and precipitation of 1346 mm $^{year-1}$. The experimental area since 2018 had been cultivated with the corn crop in the rainy season and in the dry season it was fallow with brachiaria (Table 1).

Table 1- Result of chemical and physical analysis of the soil of the experimental area, 2021

	2020											
Sample	Chemical analysis									Granulometric		
	pH water	P	K	Ca	Mg	Al	H+L	In	Organic matter	Sand	Tags	Clay
		---mg dm^{-3}--		------- $cmolcdm^{-3}$ ------ ---				------- %------		---------- %----------		
0 - 20 cm	5,9	3,0	75,0	2,6	1,2	0,0	4,3	49	1,9	44	30,2	25,8

Methodology used: pH – electrode in suspension soil: water (1:2.5); P, K – Mehlinch 1; Ca, Mg and Al – Potassium chloride; H+AL – calcium acetate at pH 7.0; Organic Matter – wet oxidation (organic carbon content x 1.724).

The transplanting of the banana seedlings took place in the month of January 2021. The treatments consisted of fertilization with (R) and without remineralizer (SR) of soil with 12 replications. The plots were composed of seven families of plants, being conducted with "mother, daughter and granddaughter". The crop was planted with spacing of 3 meters between plants and 5 meters between rows of plants. The experiment was carried out in a randomized block design. The experimental area was surrounded by a border of a row of plant in order to avoid advection external to the experimental area.

The seedlings of "BRS Platina" used in the experiment were obtained via micropropagation (tissue culture) from specialized nurseries. The plants initially arrived at the institute in trays and were transplanted into polystyle pots. The vessels were filled with substrate mixed with one and a half kilograms of simple superphosphate for each cubic meter of substrate. To obtain one cubic meter of substrate, 0.5 m3 of ravine soil + 0.3 m³ of medium sand + 0.2 m³ of tanned cattle manure were used. The seedlings were conducted in a nursery under conventional sprinkler irrigation at the Instituto Federal Goiano Campus Morrinhos, during the period of 5 months, when they were transplanted to the experimental area in January 2021.

The experimental area was prepared with two gradings and two leveling with a destorroadora leveling grid. At 120 days before transplanting the seedlings, liming was performed with 1.0 t ha-1 of dolomitic limestone, applied to a section in a total area and incorporated with a large leveler at a depth of 20 cm. On the same day, 4kg of rock powder per pit (2666.66 kg ha-1) $^{+ 2.5 kg per chicken bed pit (1666.66 kg ha-1)}$ was applied to the pits of the treatments with remineralizer (R) (Micaxisto powder$^{).}$ And in the treatment without remineralizer, only chicken litter was applied in the same amount (1666.66kg $^{ha-1}$) (Table 2).

Table 2. Result of chemical and physical analysis of the soil remineralizer (Micaxiste Powder) and amounts of N-P-K present in chicken litter used in the experiment

Parameters of the remineralizer analysis	Unit	Result
Potassium Oxide (K2O)	%	3,7
Abrasion Ph	-	7,95
Calcium Oxide (CaO) - (HF)	%	3,22
Magnesium Oxide (MgO) - (HF)	%	2,26
Phosphorus - P2O5 (HF)	%	<1,0
Silicon - SiO2 (HF)	%	30,2
Boro - B (HF)	%	0,1
Zinc - Zn (HF)	%	<0,05
Copper - Cu (HF)	%	<0,05
Ferro - Fe (HF)	%	3,96
Manganese - Mn (HF)	%	<0,05
Total Molybdenum - Mo (HF)	%	25,2
Cobalt - Co (HF)	mg/kg	22,4
Nickel - Ni (HF)	mg/kg	64
Selenium (Se) - (HF)	mg/kg	<0,2
Chlorine - Cl (HF)	%	<1
Arsenic - As (HF)	mg/kg	13,7
Cadmium - Cd (HF)	mg/kg	2,3
Mercury - Hg (HF)	mg/kg	<0,1
Lead - Pb (HF)	mg/kg	80,1
% of the sample passing through sieve No. 06 (3.35 mm)	%	100
% of the sample passing through sieve No 07 (2,80 mm)	%	100
% of the sample passing through sieve No 16 (1,00 mm)	%	99,96
% of the sample passing through the sieve 4,00 mm	%	100
% of the sample passing through sieve No 20 (0,85 mm)	%	99,96
Nutrient parameters in chicken litter	**Unit**	**Result**
Nitrogen – (N)	%	3
Phosphorus – (P)	%	1
Potassium – (K)	%	1,5

[1] Reference according to the specification of Normative Instruction No. 5 of MAPA, of March 10, 2016
*Analysis carried out by the Field Laboratory – Center for Agricultural and Environmental Technology

The seedlings were planted in pre-prepared pits with dimensions of 40x40x40 cm, where the fertilization of planting each pit with chicken litter and chicken litter plus remineralizer was carried out. Still in the preparation of the pits for the moment of transplantation, in all plants were applied 300g per pit of simple superphosphate and 100g of MIB per pit, which provided the following micronutrients (0.05% Boron, 0.02% Copper, 0.06% Manganese and 0.29% Zinc).

In April and November 2021 and February 2022, new applications of remineralizer and chicken litter were made in the plants of each treatment, in the same quantities as at the beginning of cultivation (4 Kg of rock powder per pit (2666.66 kg ha-1) + 2.5kg per chicken litter pit (1666.66kg ha-1) in the treatment with remineralizer and in the treatment without remineralizer was applied only to chicken litter in the same amount (1666.66kg ha^{-1}). In November 2021, 100g of potassium chloride was added to all the caps.

In September 2021, a fertilization was made with the formulation 14-00-15 of NPK, with 15% sulfur and 0.85% boron, being applied 100g in each plant of the experiment. This formulation was repeated in January 2022 in the same amount. In August 2022, polyblen® fruits were used, which is a cover fertilizer with formulation 12-08-27, with 7.7% sulfur, 0.14% boron and 0.7% zinc, being used

100g in all plants. Aiming at the second cycle plants of the experiment (2nd Year – daughter plant), in November 2022 double the previous amounts of remineralizer and chicken litter were performed, being 5kg of chicken litter per pit in all plants and 8kg of remineralizer in the treatments with rock powder, because the plants were more developed and with good stability.

To avoid proliferation of pests and diseases, prioritize the good health of the plants and the productivity of the crop, the conduction was carried out with the objective of always maintaining 3 plants per pit, mother, daughter and granddaughter. The control *of yellow Sigatoka (*Mycosphaerella musicola*), which is one of the most harmful diseases to the banana tree, is also known as cercosporiosis or Sigatoka*'s disease. This disease can cause losses that reduce on average 50% of production. For its control, the fungicide Unizeb Glory® (Mancozeb and Azoxystrobin) 2.0 Kg ha-1 and Comet® (Piraclostrobin) 0.5 L ha-1 were sprayed, with a syrup volume of 200 Lha-1. Due to the attack of ants, general control was made of the way of scouting scouts, applying Regent® insecticide (Fipronil).

The experiment was irrigated by drip. All plants received the same water depth, with self-compensating drippers (1 plant-1 dripper). The replacement of irrigation was performed according to the Evapotranspiration of the Culture, aiming to leave the soil with moisture content close to the field capacity. The meteorological variables were monitored by an automatic station, located about 300 meters from the experimental area. From the third cultivation cycle (Planta neta) one more drip was installed per plant and with the use of manifold adapters, microtubes and drip cuttings.

The evaluations contained in this work were carried out in the plants of the first cycle ("mother" plants). At 230, 275 and 320 days due to the transplantation (DAT) of the seedlings, plant height was evaluated, measured with soil tape at the end of the "flag leaf". In the last evaluation performed for this variable, due to the height of the plant, a metric ruler (talking sight used in topography) of up to 5 m was used. The number of live leaves was quantified by counting.

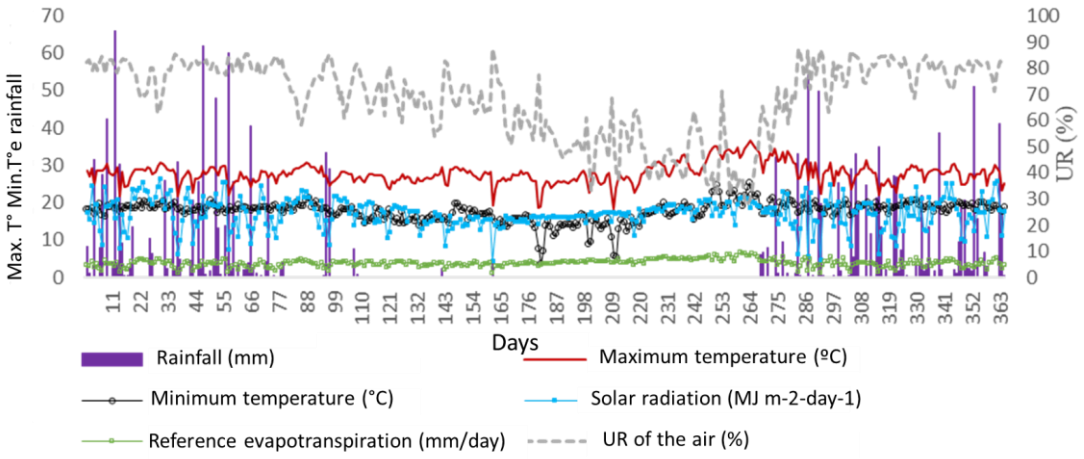
The harvests were carried out in a staggered manner, starting in June 2022, being done once a week. The harvest point of the fruits was determined with the change in color and rounded fruits. The harvest was made with a cut in the middle of the pseudostem, leaving approximately one and a half meters of the height of the soil and made the separation of the bunch and the plant, so that the bunches did not touch the soil to avoid lesions in the fruits and obtain a good maturation. The part of the pseudostem attached to the soil was kept so that its nutritional reserves were translocated to the other plants and next to the cap. The felled part of the plant stayed in the soil in the spacing between plants, where they were chopped into smaller pieces and left for decomposition of organic matter. To evaluate the productivity of the plants, the bunches were weighed after cutting and the number of feathers and bananas per bunch was quantified.

After the evaluations, the data were tabulated and submitted to analysis of variance, F test ($p<0.05$) of probability. When there was a significant effect of the treatments on the variables analyzed, the data were submitted to Scott-Knotta5% designability mean test.

3 RESULTS AND DISCUSSIONS

During the conduct of the experiment, in the first year (2021), the maximum temperature observed was 36.6 °C and the minimum of 3.7 °C, with the accumulated precipitation in that year of 1620.4 mm, accumulated Reference Evapotranspiration (ETo) of 1388.03 mm with an average relative humidity (RH) of 68.44% and the average global solar radiation of 17.11 MJ m-2 day-1 (Figure 1).

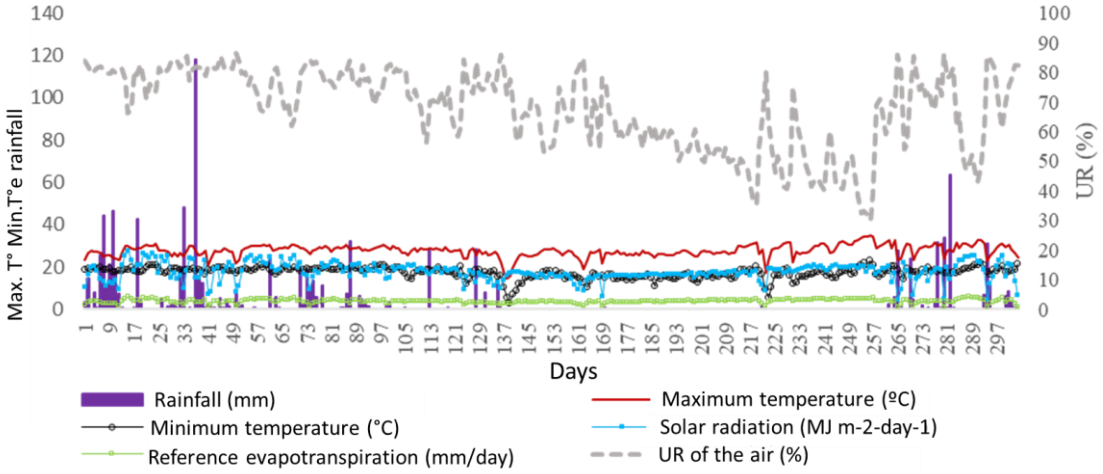
Figure 1. Meteorological variables of the site, during the conduct of the experiment – Morrinhos/GO, 2021.



Source: AUTHOR (2023)

In the second year of the experiment, until the date of 10/31/2022 where the evaluations had already been completed, the maximum temperature observed was 34.7 °C and the minimum of 2.8 °C, with accumulated precipitation of 1021.2 mm, Reference Evapotranspiration (ETo) accumulated in the period of 1135.6 mm, average relative humidity (RH) of 67.6% and global solar radiation of average of 17.6 MJ m-2 day-1 (Figure 2).

Figure 2. Meteorological variables of the site, during the conduct of the experiment – Morrinhos/GO, 2022



Source: AUTHOR (2023)

The climatic conditions in both years were mostly favorable to the banana crop. The average temperature for the proper development of banana plants is around 28°C. The highest yields of the fruit is associated with an annual rainfall of 1900 mm, well distributed throughout the year (BORGES; SOUZA, 2021).

There was a significant effect of the treatments ($p<0.05$) on the variables plant height, number of leaves per plant and pseudostem circumference at 230 DAT. In the second evaluation, there was a significant effect of the treatments only for plant height. While, in the third evaluation, the treatments significantly influenced the height of plants and the circumference of the pseudostem. The variables productivity bunch weight, number of bunch feathers per bunch and number of bananas per bunch did not present significant differences ($p<0.05$) (Table 3).

Table 3. Summary of the analysis of variance on the variables: plant height (m) (AP), pseudostem circumference (cm) (CP), number of leaves per plant (NFP) during the first (A1), second (A2) and third (A3) evaluation, respectively and weight of the bunches (Kg) (PC), number of feathers per bunches (NPC), number of bananas per bunches (NBC), in fertilization functions with and without soil remineralizer, Morrinhos – GO.

Mean square	Sources of Variation		
	Treatment	Block	Residue
GL	1	11	11
AP (m) (A1)	0,4959*	0,0217NS	000,0276
CP (cm) (A1)	118,9040*	8,6612NS	14,8115
NFP (A1)	1,9267*	0,3230NS	0,5267
AP (m) (A2)	0,3290*	0,0436NS	0,0457
CP (cm) (A2)	22,9713NS	296,1488NS	173,4926
NFP (A2)	2,1600 NS	0,9491 NS	0,8473
AP (m) (A3)	0,2709*	0,1049*	0,0382
CP (cm) (A3)	126,1792*	39,8403*	13,3710
NFP (A3)	0,8067 NS	0,7884 NS	0,3885
PC (kg)	4,4634NS	1,9491NS	2,9335
NPC	0,3314NS	0,1834NS	0,1150
NBC	20,4611NS	38,9522NS	60,5080

* Significant at 5% probability, by the F test; NS - Not significant; [1] GL - Degrees of freedom; CV - Coefficient of variation. A1 – first evaluation; A2- second evaluation; A3 – third evaluation;

The highest values of plant height were found with fertilization via rock dust (1.68, 2.03 and 2.95 m), compared to the results observed in fertilized plants without rock dust, which presented average heights of 1.39, 1.80 and 2.73 m, respectively at 230, 275 and 310 days after transplanting the seedlings. The variable diameter of the stem circumference also presented the highest values (32.60 and 56.57 cm), when the plants were fertilized with rock powder, compared to the non-fertilized plants, respectively at 230 and 310 DAT of the seedlings. The variable number of leaves presented significant minimum differences only at 230 DAT, where the treatments with micaxiste powder had a higher average number of leaves (9.17), compared to plants fertilized without rock dust (8.60 leaves). In the other evaluation periods, there was no significant effect of the treatments on the number of leaves, although the data showed evidence of higher leaf averages when the plants were fertilized with rock dust (Table 4).

The variables bunch weight, number of bunch and number of bananas per bunch had no significant effects of the treatments. However, it is possible to observe evidence of greater results when micaxiste powder is used in the fertilization of plants (Table 4). These results demonstrate how promising the use of rock dust as a source of fertilization is.

Table 4.Plant height (AP), pseudostem diameter (DC) and number of leaves (NF) of banana trees, Weight of bunches (PC), Number of feathers in the bunch (NPC), Number of bananas in the bunch (NBC)"Platinum Silver" as a function of fertilization with Rock Powder, Morrinhos –GO, 2021.

Characteristics Evaluated	No Rock Dust	With Rock Powder	Average	CV
	Evaluation 01 (230 days after transplanting seedlings)			
Plant Height(m)*	1.39b	1,68a	1,53	10,85
Stem Circumference(cm)*	28,15b	32,60a	30,38	12,67
Number of Sheets*	8,60b	9,17a	8,88	8,17
Evaluation 02 (275 days after transplanting the seedlings)				
Floor height (m)*	1,80b	2,03a	1,92	11,14
Stem Circumference(cm) ns	36,26	38,21	37,23	35,38
Number of Folhasns	10,30	10,90	16,60	8,68
Evaluation 03 (310 days after transplanting the seedlings)				
Floor height (m)*	2,73b	2,95a	2,84	6,88
Stem Circumference(cm)*	51,99b	56,57a	54,28	6,74
Number of Folhasns	14,40	14,77	14,58	4,27
Harvest				
CachoNS Weight (kg)	11,57	12,44	12,01	14,27
Number of non-pencas	6,04	6,28	6,16	5,51
Númerodebananas no cachons	77,18	79,03	78,10	9,96

*Significant at 5% probability, by the F test; NS – Not significant. Means followed by distinct letters in the line differ from each other by the Scott-Knott test at 5% significance.

The results of vegetative development of plants corroborate those found by Dalmora et al. (2020). These authors found that the use of andesitic rock in the eucalyptus crop is advantageous, given the improved fertility and soil quality indexes, ensuring plants with larger trunk diameter and breast height. These authors concluded that the use of soil remineralizers promotes increased productivity, in addition to reducing the environmental impacts caused by the overuse of soluble sources of fertilization. These results are consistent with those observed by Malta et al. (2018) in guava culture, in which the use of rock powder promoted an increase in fruit pulp and firmness, when compared to the other forms of fertilization tested. Li et al. (2021) observed an increase in the diversity of microorganisms present in the soil, an increase in apple fruit yield, and a reduction in disease symptoms and fruit fall. These authors concluded that rock dust associated with NPK fertilizers is a more economic way to provide macro and micronutrients to crops, in addition to providing better vegetative growth and yield increments. Amaral et al. (2020) found that the application of micaxiste rock powder in soybean crop is promising, both as a source of fertilizer and as a replacement or complement to highly soluble sources. The results are also in agreement with the statements of Medeiros et al. (2020), who state that the use of alternative sources of fertilizers has grown in agricultural production systems, with excellent results for numerous crops.

The results found in the present research are in agreement with those observed by Marques et al. (2018 and 2022). These authors evaluated the effect of the addition of doses of cattle manure and rock powder in the banana trees Prata Anã and BRS Platina and did not observe an increase in production yield during four cultivation cycles. The results are also consistent with those found by

Borges et al. (2010), who evaluated the use of silicate rock powder and phlogopitite in the cultivation of banana trees Prata Anã and also did not observe differences in the productivity of banana trees.

However, in other cultures satisfactory results have been observed from the use of rock dust in increasing yields, as in the studies conducted by Almeida Junior et al. (2020). These authors concluded that rock dust is a viable alternative for corn production, with increased dry matter of shoots, length, weight and ear diameter. As well as the results found by Aguilera et al. (2022) analyzing the residual basalt rock dust in the corn crop, they observed improvement in its agronomic characteristics and productivity, in addition to the increase in soil fertility.Conceição et al. (2022) studying basalt powder in beans, corn and soybeans, showed positive results in crop development and productivity. Mendes et al. (2020) concluded in their work that the mixture between soil, manure and rock dust promoted an increase in the quality of peppers, influencing higher total and commercial production when used in the proportions 3-3-3 and 3-2-2, respectively.

4 FINAL CONSIDERATIONS

The fertilization with the remineralizer (Micaxisto Rock Powder) did not significantly influence the productivity of banana trees "BRS Platina".

The fertilization as a remineralizer (Micaxisto Rock Powder) provided greater initial development of banana trees "BRS Platina", providing larger and more vigorous plants.

Further evaluations and new research are needed to observe the effects of Micaxisto Rock Powder on the development and productivity of "BRS Platina" banana trees.

REFERENCES

AGUILERA, J. G.; ALVES, Z.; ZUFFO, A. M.; RATKE, R. F.; SILVA, L. N.; SILVA, C. E. S.; MARTÍNEZ, L. A.; GONZALEZ, H. H. S. Efeito residual de doses de pó de basalto no milho segunda safra. Ensaios e Ciências, v.26, n.2, p. 281-288, 2022. DOI: https://doi.org/10.17921/1415-6938.2022v26n2p281-288.

ALMEIDA JUNIOR, J.; SMILIANIC, K. B. A.; MATOS, F. S. A.; PEROZINI, A. C.; de SOUZA, J. V. A.; RIBEIRO JUNIOR, L. F.; SILVA, R. F.; ARAÚJO, S. L.; DUTRA, J. M.; LIBERATO, P. V. Análise das variáveis tecnológicas do milho em função das doses crescentes de condicionador pó de rocha. Brazilian Journal of Development, v, 6. n, 11, p. 88440-88446, 2020. DOI: https://doi.org/10.34117/bjdv6n11-315.

AMARAL, G. C.; BERTI, M. P. S.; SILVA, A. A.; SILVA JUNIOR, G. S.; CUSTÓDIO, J. P. C.; PEIXOTO, W. A. Características agronômicas da soja em função da adubação com pó de rocha e biofertilizante. Revista Cultura Agronômica,v. 29, n. 4, p. 437-447, 2020. DOI: https://doi.org/10.32929/2446-8355.2020v29n4p437-447.

BORGES, A. L.; SOUZA, L. S. Banana: Relações/clima. Embrapa 50 anos. 2021. Disponível em: https://www.embrapa.br/en/agencia-de-informacao-tecnologica/cultivos/banana/pre-producao/especie/relacoes/clima. Acesso em: 16 mai 2023.

BORGES, A. L.; SOUZA, L. S.; MELO, F. C. M. Índice de qualidade de solos cultivados com bananeira nas regiões oeste da Bahia e no norte de Minas Gerais. Cruz das Almas: Embrapa Mandioca e Fruticultura. Boletim de Pesquisa e Desenvolvimento 94,2018, 29 p.

BRITO, R. S.; BATISTA, J. F.; MOREIRA, J. G. do V.; MORAES, K. N. O.; SILVA, S. O. Rochagem na agricultura: importância e vantagens para adubação suplementar. South American Journal of Basic Education, Technical and Technological, v.6, n.1, p. 528-540, 2019.

DALMORA, A. C.; RAMOS, C. G.; OLIVEIRA, M. L. S.; OLIVEIRA, L. F. S.; SCHNEIDER, I. A. H.; KAUTZMANN, R. M. Application of andesite rock as a clean source of fertilizer for eucalyptus crop: Evidence of sustainability. Journal of Cleaner Production, v. 256, p. 1-9, 2020. DOI: https://doi.org/10.1016/j.jclepro.2020.120432.

FERREIRA, C. F.; SILVA, S. O.; AMORIM, E. P.; SEREJO, J. A. S. O Agronegócio da banana. 1 ed. Brasília: Embrapa, 2016. 832 p.

MALTA, A. O.;ARAUJO, R. da C..; MEDEIROS, J. G. F.; COSTA, N. P.; SILVA, S. I. A. Produção da goiabeira (*Psidium guajava* L.) em sistema convencional e orgânico. Pesquisa Agropecuária Pernambucana, v.23, n.1, p. 1-4, 2018.

MARQUES, P. R. R.; DONATO, S. L. R.; JOSE, A. R.; ROSA, R. C. C.; ARANTES, A. de M.; Nutritional status and production of 'Prata-Anã'(AAB) and 'BRS Platina'(AAAB) banana plants with organic fertilization. Nativa Pesquisas Agrárias e Ambientais,v.10, n. 1, p.60-68, 2022. DOI: https://doi.org/10.31413/nativa.v10i1.13160.

MARQUES, P. R. R.; DONATO, S. L. R.; SÃO JOSÉ, A.R.; ROSA, R. C. C. Gas exchange and yield of Prata-type banana plants with fertilizer sources for organic management. African Journal of Agricultural research, v. 13, n. 5, p.272-280, 2018.

MEDEIROS, P. F., CARDOSO, I. M., & de SOUZA, V. M. S. Experimentação participativa com pó de rocha. Cadernos de Agroecologia V Simpósio Mineiro de Ciencia do solo, v.15, n.1, p.5, 2020.

Mendes, K. L. F.; Vieira, H.; Pereira Jr., E. B.; Moreira, J. N.; Vale, K. S.; Caiana, C. R. A.; Bezerra Neto, F. C.; Medeiros, A. C.; Maracajá, P. B. Production pepper cultivated with stone dust and manure in semi-arid region. Research, Society and Development, v.9, n. 7, p. 1-15, 2020. DOI: https://doi.org/10.33448/rsd-v9i7.4360.

MORAIS, E. R. C.; OLIVEIRA, A. A. S.; MAIA, C. E. Qualidade do solo cultivado com banana irrigada e sua relação com áreas de caatinga. Revista Brasileira de Engenharia Agrícola e Ambiental, v. 18, n. 9, p. 887–891, 2014. DOI: http://dx.doi.org/10.1590/1807-1929/agriambi.v18n09p887–891.

RAMOS, C. G.; HOWER, J. C.; BLANCO, E.; OLIVEIRA, M. L. S.; THEODORO, S. H. Possibilities of using silicate rock powder: An overview. Geoscience Frontiers, v. 13, n. 101185, p. 1-11, 2022. DOI: https://doi.org/10.1016/j.gsf.2021.101185.

THEODORO, S. H.; MEDEIROS, F. P.; LANNIRUBERTO, M.; JACOBSON, T. K.B. Soil remineralization and recovery of degraded areas: Anexperience in the tropical region. Journal of South American Earth Sciences, v. 107, p. 1-10, 2021. DOI: https://doi.org/10.1016/j.jsames.2020.103014.