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Improving onion production in Bom Jesus-PI: A study on the use of decomposed buriti chest

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ABSTRACT
The onion is a vegetable of extreme economic importance in Brazil, having originated in Central Asia. However, for the crop to present the best results, it is essential to be grown in soils with medium texture and high organic matter content. After all, soil quality can make all the difference in the success or failure of production. With this objective, a study was conducted to evaluate the response of the onion crop to the use of regional organic matter, specifically the buriti chest, as a cultivation technique to be applied to family farming in the region of Bom Jesus-PI. The experiment was conducted in the experimental area of the Horticulture sector of the Prof.ª Cinobelina Elvas Campus (CPCE), belonging to the Federal University of Piauí (UFPI), located in the municipality of Bom Jesus-PI, from July 14 to December 17, 2019. The randomized block design (DBC) was adopted, with seven treatments (0, 10, 20, 30, 40, 50 and 60 t ha-1 of buriti chest), four replications and ten plants per experimental plot. The following phytotechnical variables were evaluated: plant height and number of leaves per plant; and productive, such as total bulb productivity, commercial bulb productivity, non-commercial bulb productivity, longitudinal and transverse diameters, average bulb mass, dry mass of leaves and bulbs and bulb classification. The use of increasing doses of buriti chest improved the productive attributes of the onion cv. Ibiapaba in soils with sandy texture. The most recommended dose for the first year of cultivation was 60 t ha-1, but for the second year it may be necessary to increase to 80 t ha-1. However, further studies are needed to validate this recommendation and evaluate possible side effects on soil fertility and final product quality. The study reinforces the importance of seeking new cultivation techniques for family farming in the region of Bom Jesus-PI.

Keywords: Vegetables, Sustainable production, Organic fertilization.

1 INTRODUCTION

The onion (*Allium cepa* L.), originally from Central Asia, is a vegetable of great economic importance in Brazil. In 2021, national onion production reached about 1.5 million tons, with an average productivity of 30.7 tons per hectare in a planted area of 64,000 hectares. According to IBGE, Santa Catarina and Bahia were the states that produced the most onions in 2020, with 478.4 and 180 tons, respectively. Piauí occupied the 11th position in the national production ranking, with about 33.5 thousand tons in the same period.

Onion cultivation is important for small and medium-sized farmers in the northeast region of Brazil, generating income and employment. Studies that aim to reduce costs and maintain plant productivity are relevant in this context. (Kurtz, 2008; SOUZA et al., 2008).

The productive behavior of a crop is directly related to its local adaptation and the management practices employed (MENEZES JÚNIOR & VIEIRA NETO, 2012). According to Kurtz et al. (2018), the productivity and quality of onion bulbs result from the interaction of several factors, among which the genetic potential of the varieties stands out. The use of hybrid cultivars and the use of highly technified techniques have been determining factors for increasing onion productivity (YURI et al., 2021).

In addition, it is important to mention that success in onion cultivation depends not only on the choice of varieties and management techniques, but also on the quality of the growing soil. The onion crop develops best in soils of medium texture and rich in organic matter, and the addition of organic residues to the soils can increase the fertility, biodiversity and productivity of the vegetables grown in it (FINATTO et al., 2013). Another relevant practice is organic fertilization, which improves the physical, chemical and biological characteristics of the soil, reducing the erosive process, increasing the availability of nutrients, the aggregation of particles and water retention, as well as decreasing the temperature variation in the soil (SANTIAGO & ROSSETTO, 2009).

In this context, Bandeira et al. (2013) evaluated onion cultivars in the Submédia do Vale do São Francisco and obtained yields between 40.8 and 54.8 t $^{ha-1}$, especially the Serena hybrid. Vilas Boas et al. (2011) obtained higher productivity for the hybrid Optima F1. Souza et al. (2008) did not observe productive differences between the cultivars Alfa São Francisco and the hybrid Granex 429. The addition of organic residues to the soil favors the development of onion plants and increases productivity, according to Finatto et al. (2013). Organic fertilization improves the physical, chemical and biological characteristics of the soil, according to Santiago & Rossetto (2009).

Therefore, considering the importance of using regional materials as a source of organic matter for the soil of cultivation, it is essential to carry out studies aimed at the use of these materials, especially in regions where their abundance is significant, as is the case of the decomposed stem of buriti in the Southern Region of the State of Piauí. However, there is a lack of information on the use of this material in onion culture, which highlights the need for local studies that consider the requirements of the crop and the edaphoclimatic conditions of the region.

Thus, the objective of the study was to analyze how the onion crop responds to the use of regional organic matter (pau de buriti) as a cultivation technique in the region of Bom Jesus-PI, aiming at its application in family farming.

2 MATERIAL AND METHODS

The characterization of the experimental area took place in the horticulture sector of the Prof.ª Cinobelina Elvas Campus of the Federal University of Piauí, located in Bom Jesus-PI. The area has geographical coordinates of 09º 04' 28" South latitude and 44º 21' 31" West longitude and average altitude of 277 m. The experiment took place between July and December 2019, in hot and humid weather, classified as Awa by Köppen.

According to EMBRAPA (2013), the soil of the experimental area is classified as a Yellow Latosol. Before the installation of the experiment, a soil sample of 0-20 cm depth was collected, which presented the following chemical characteristics: pH in water (1:2.5) of 5.2; 131.5 mg dm3 of P; 21.27 mg dm³ of K+; 0.06 Na+; 2.15 of H+ + Al+3; 0.00 of Al+3; 1.02 Ca+2; 0.14 Mg+2; 1.49 of SB; 3.64 CTC (all in cmolc dm-3); and 15.18 g $^{kg-1}$ of organic matter (M.O). The particle size analysis revealed the presence of 759 $^{g\ kg-1}$ of sand, 23 g kg-1 of silt and 218 g kg-1 of clay, placing it in the textural sand class.

In July 2019, after the soil preparation operations that included cleaning, plowing and grading, the beds were surveyed and the liming and fertilization necessary to meet the nutritional requirements of the onion were applied. Subsequently, in each site, the doses of the compound were applied, corresponding to each pre-established treatment. The buriti chest used is an organic compound resulting from the decomposition of the stem of the dead palm and, according to Araújo (2015) cited by Costa Junior et al. (2017), presents in its dry matter the chemical composition of 18.4 g kg-1 of N, 2.4 g kg-1 of P, 8.1 g kg-1 of $^{K,\ 10.7}$ g $^{kg-1}$ of Ca, 2.9 $^{g\ kg-1}$ Mg, 2.1 g kg-1 S, 5.9 mg kg-1 Fe, 5.8 mg kg-1 Cu, 769.6 mg kg-1 Mn, 411.4 mg kg-1 Zn $^{and\ 25.6}$ mg kg-1 B.

The experimental design used in this study consisted of randomized blocks (DBC) with seven treatments, which consisted of increasing doses of buriti chest (0, 10, 20, 30, 40, 50 and 60 t $^{ha-1}$). The experiment had four replications and ten plants per plot. Each plot had dimensions of 1.20 m wide by 2.00 m long, with four rows composed of 10 plants.

The plants in the lateral lines and at the ends of the rows were considered as borders and were not included in the useful area of the plot. The total area of each plot was 2.40 m² and the spacing used was 0.25 x 0.20 m.

For the production of seedlings of the onion variety Ibiapaba, a mixture of commercial substrate Basaplant® was used, composed of pine bark, peat, charcoal, vermiculite, NPK and micronutrients, in addition to cattle manure in a ratio of 3:1.

The seeds were planted in polyethylene cups (50x40x40cm) filled with the substrate and three seeds were placed in each cup. After 15 days, the most vigorous plant was selected in each cup and kept in the container. The seedlings were grown in an open environment and manually irrigated twice a day.

When the plants reached about 20 cm in height, they were transplanted to the field after 60 days of sowing, following the guidelines of Marin (2004). The Ibiapaba onion is a hybrid variety of intense purple color, with a short cycle of 115 days and uniform bulbs that weigh on average from 100g to 200g, according to ISLA SEMENTES (2018).

Irrigations were performed by microsprinkling with perforated tapes, with a daily irrigation shift divided into two applications (morning and afternoon). Weed control was done manually and periodically in the beds, always keeping them clean during the experiment. Pest and disease control were performed according to need and using the following products: Teldor 500 SC® (50 g/L phenhexamide), Talstar® (10 g/L bifenthrin) and Bayleton® (250 g/L triadimefon). Throughout the assay, data were collected regarding plant growth variables, including height (in cm), measured from the soil to the tip of the highest leaf in a random sample of 10 plants in the useful area, 60 days after planting, and the number of leaves per plant, obtained by counting in a sample of 10 plants, also 60 days after planting.

The harvest was carried out at 180 days after sowing (DAS), when more than 90% of the plants were tipped (snapped), representing the harvest point of the cultivar. Then the plants remained for five days in the field to carry out the curing process, being for three days exposed to the sun and five days in the shade, then cutting the aerial part, where the following characteristics were determined: total productivity of bulbs: obtained by the sum of commercial and non-commercial productivity; commercial bulb productivity: determined by the total mass of bulbs with a diameter > 35 mm, without defects; Non-commercial productivity of bulbs: obtained by the total mass of bulbs of diameter < 35 mm, and/or double and defective bulbs and the longitudinal and transverse diameter (mm), determined with digital caliper (0.01-300 mm).

Next, the bulbs without defects were classified into five commercial classes, according to the transverse diameter, where. Class 1 (scrap): Bulbs with a diameter < 35 mm; class 2: Bulbs with diameter 35 - 50 mm; Class 3: Bulbs with diameter 50 - 75 mm; Class 4: Bulbs with diameter 75 - 90 mm and class 5: Bulbs with diameter > 90.

The following variables were also performed: average mass of bulbs: obtained by dividing commercial production by the number of marketable bulbs harvested in the plot, after curing and toilet and dry mass of leaves and bulb: 5 bulbs were used per plot, washed in running water and distilled water, placed in paper bags and taken to the oven with forced air circulation at 65 °C, until it reaches constant mass.

The data were submitted to analysis of variance, by the "F" test, with a significance level of 0.05 and those variables that presented significant effect were submitted to quantitative analysis of polynomial regression, following the recommendations of Banzatto & Kronka (2006), using the statistical programs SISVAR and SIGMAPLOT 10.0.

3 RESULTS AND DISCUSSION

The analysis of variance of the phytotechnical and productive attributes of the hybrid onion Ibiapaba demonstrated that the addition of buriti fruit had a significant impact on three key indicators: dry mass of the bulb with leaves, average mass of bulbs and commercial productivity. That is, there was a clear response of the plants to the application of the compound, with statistically differences at the level of 5% probability ($p < 0.05$) in relation to the doses used (Table 1). Which is to say that these results are extremely relevant for onion producers since the improvement of these indicators can have a significant impact on the profitability of the crop.

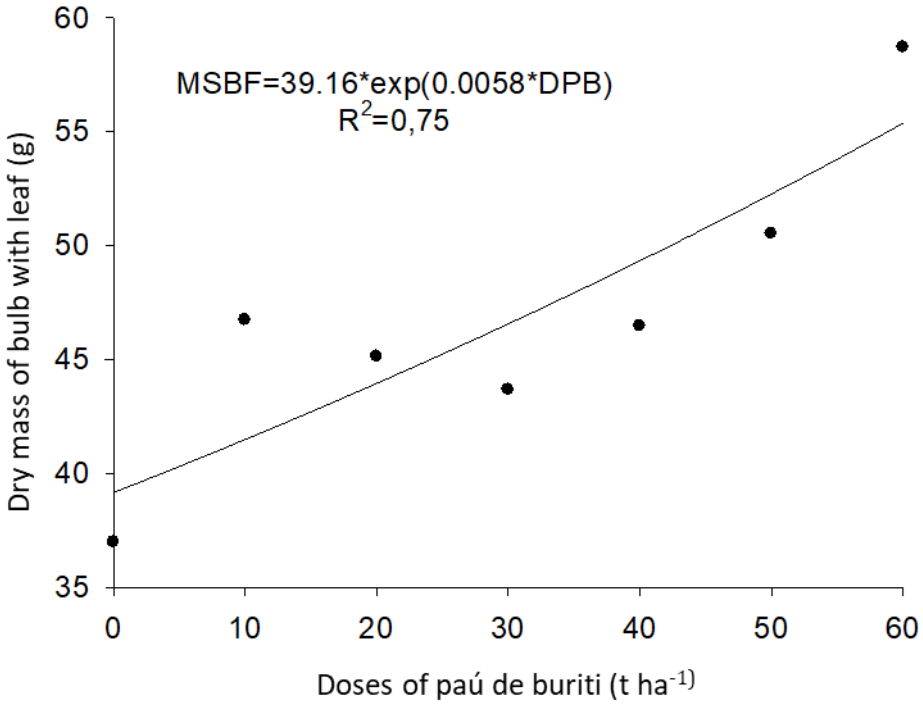
Table 1. Summary of the analysis of variance regarding plant height (LA); number of leaves (NF); longitudinal diameter (DL); dry mass of the bulb with leaves (MSBF); average mass of bulbs (MMB); leaf dry mass (MSF); commercial productivity (CP); non-commercial productivity (PNC) and total productivity (PT) of Ibiapaba Hybrid Onion as a function of different doses of buriti cash. Bom Jesus-PI, 2019.

Source of Variation	AT	NF	DL	MSBF	MMB	MSF	PC	PNC	PT
	(cm)	-	mm	----------(g)----------			---------(tons $^{ha-1}$)---------		
Paú de buriti (F)	1,93ns	1,78ns	1,36ns	2,21*	2,26*	2,02ns	2,24*	1,58ns	1,05ns
DMS	6,80	0,85	20,20	20,84	21,24	1,31	4,24	4,92	5,12
CV (%)	11,13	8,44	11,03	19,02	20,03	39,71	19,98	74,81	18,43

C.V. = coefficient of variation; ns = not significant; ** = significant at the level of 1% probability ($P<0.01$); * = *significant at the level of 5% probability ($P<0.05$).*

According to the study, the addition of buriti chest in the soil had a significant effect on the dry mass of the leaf bulb (MSBF), with a linear increase in the highest doses applied (Figure 1).

Figure 1. Dry mass of the bulb with leaves (MSBF) of Ibiapaba Hybrid Onion as a function of different doses of buriti chest. Bom Jesus-PI, 2019.

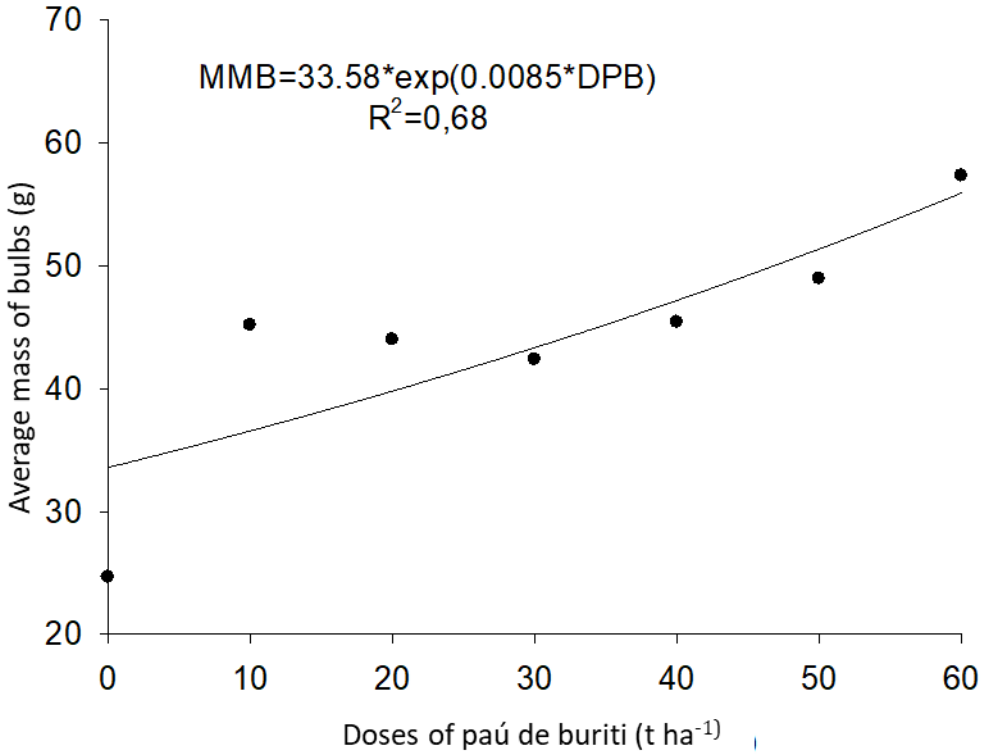


The data showed that the plants grown in the area with 60 t $^{ha-1}$ of the organic compost had an average value of MSBF of 58.70 g, representing an increase of 37% compared to those grown without addition of buriti caú, with an average of 36.98 g of MSBF.

The results suggest that the buriti chest may be an important source of nutrients for plant growth and development. In addition, the application of organic compost in the soil can promote a positive impact on MSBF production, which can be of great relevance for farmers interested in increasing the productivity of their crops.

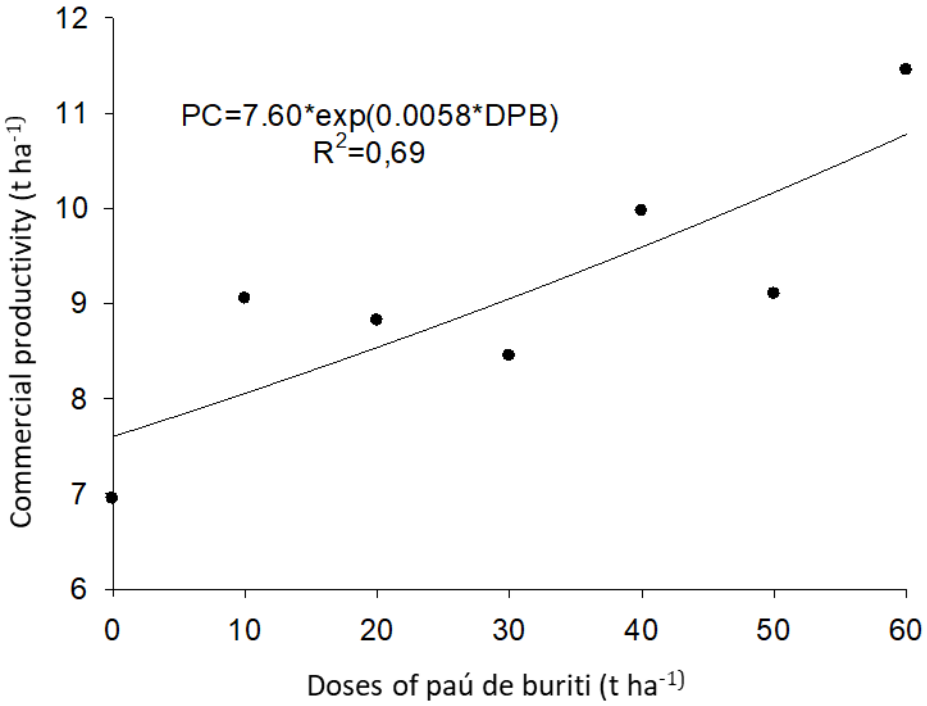
The results of the study indicated that the addition of buriti chest in the soil also influenced the average bulb mass (MMB), and bulbs with higher average mass were obtained at the highest applied doses of buriti chest (Figure 2). It was verified that the area without addition of buriti chest (0 $^{t\ ha-1)}$ presented MMB of 34.64 g, and this result was statistically lower than those obtained in the areas with application of 60 $^{t\ ha-1}$ of this organic compound.

Figure 2. Average bulb mass (MMB) of Ibiapaba Hybrid Onion as a function of different doses of buriti chest. Bom Jesus-PI, 2019.



As evidenced in Figure 3, it was observed that the higher productivity of 11.45 $^{t\ ha\text{-}1}$ of bulbs of commercial standard, when applied the dose of 60 $^{t\ ha\text{-}1}$ of the organic compound paú de buriti, these results was statistically higher when compared with the dose of (0 $^{t\ ha\text{-}1}$) whose average productivity was 7.60 t $^{ha\text{-}1}$. Despite the value obtained in this research, it is lower than the national average productivity of 25 t $^{ha\text{-}1}$ (IBGE, 2021). As the profitability of onion cultivation is directly related to productivity, it is crucial to adopt measures to increase production. Thus, it is recommended to apply the dose of 60 t $^{ha\text{-}1\ \text{of the}}$ organic compound paú de buriti in the first year of cultivation of the onion cv. Ibiapaba in the conditions of the region.

Figure 3. Commercial productivity (CP) of Ibiapaba Hybrid Onion due to different doses of buriti stick. Bom Jesus-PI, 2019. of Ibiapaba Hybrid Onion due to different doses of buriti stick. Bom Jesus-PI, 2019.



The incorporation of buriti chest in the soil showed positive effects on the productivity and quality of onion bulbs. Comparing areas with and without addition of the compound, it was observed an increase of 39.54% in the average mass of the bulbs with 60 t ha-1 of buriti chest, evidencing its potential to boost plant growth and the production of more robust bulbs. Similar results were discussed by Kurtz et al. (2013), who emphasized the importance of balanced fertilization, particularly nitrogen, to maximize onion yield. The nutrient-rich composition of the buriti chest, including nitrogen, can attenuate this limitation, providing favorable conditions for plant growth and obtaining bulbs of higher average mass. These findings suggest that the strategic incorporation of buriti paú may be an advantageous strategy for farmers interested in increasing the productivity and quality of their onion crops.

Comparing with other studies, such as that of Vidigal et al. (2010), which obtained 60.3 $^{t\ ha\text{-}1}$ in different doses of pig manure, and Pereira et al. (2002), which achieved 22 $^{t\ ha\text{-}1}$ with 20 $^{t\ ha\text{-}1}$ of cattle manure, it is evident that there is a huge potential to improve productivity. Although productivity is influenced by genetic factors, as demonstrated by Resende et al. (2005) in their studies with 11 genotypes grown in Vertisol in the São Francisco Valley, soil conditions, climate and nutrition are equally crucial.

Onion yield can be affected by soil characteristics such as sandy texture. To solve this problem, one option is to add buriti chest to the soil. This material is rich in organic matter and nutrients, which

are gradually released into the soil, improving its physical and chemical properties. In addition, the addition of buriti chest showed a statistically significant difference in production in relation to areas without the compost, evidencing its potential for successive onion crops. Thus, the use of this material can be an effective solution to increase the productivity of onions in soils with sandy texture.

4 CONCLUSION

1. The use of increasing doses of buriti chest improved the productive attributes of the onion cv. Ibiapaba in soils with sandy texture, demonstrating the potential of organic compost to improve onion production.

2. In the first year of cultivation of onion cv. Ibiapaba, in the conditions of Bom Jesus-PI, the most recommended dose of buriti chest was 60 t ha-1, resulting in good production. However, for the second year of cultivation, the previous addition of buriti chest at a higher dose (80 t $^{ha-1}$) may be necessary to maintain or even increase the productivity and quality of the bulbs produced.

3. However, additional studies are needed to validate this recommendation and evaluate possible side effects on soil fertility and final product quality. The study reinforces the importance of seeking new cultivation techniques for family farming in the region of Bom Jesus-PI.

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