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ORIGINAL ARTICLE

Physalis peruviana L. cultivated in dystrocohesive yellow latosol is responsive to organic fertilization

Physalis peruviana L. é resposiva à adubação orgânica quando cultivada em latossolo amarelo distrocoeso

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ABSTRACT: Crop production systems increasingly require sustainable practices such as organic fertilization. Crops like *Physalis peruviana* L., commonly known as Cape gooseberry, still lack information on the use of organic compost as an alternative to increase productivity. In this scenario, the aim of this study was to evaluate the effect of doses of organic compost on the growth and initial development of *P. peruviana* L. in a dystrocohesive Yellow Latosol. The experiment was carried out in a greenhouse in a completely randomized design, with six treatments of rates of the organic fertilizer (0, 15, 30, 45 and 60 t ha^{-1}) and an additional control with chemical fertilization. Each treatment consisted of 15 replications. The variables evaluated were plant height, stem diameter, number of leaves, number of flowers, number of fruits, shoot dry mass, and root volume. Cape gooseberry cultivated with organic compost showed growth comparable to those cultivated in soil without fertilization. In this study, the organic fertilizer produced from tree pruning waste and animal manure compost promoted significant gains in height (27.83 cm $plant^{-1}$), stem diameter (9.23 mm $plant^{-1}$), number of leaves (51.12 $plant^{-1}$), number of fruits (5.33 $plant^{-1}$), shoot dry mass (2.04 g $plant^{-1}$), and root volume (0.70 g $plant^{-1}$). The organic compost at the rate 45 t ha^{-1} provided the largest number of fruits, and therefore, it is recommended for the production of Cape gooseberry in dystrocohese Yellow Latosol.

RESUMO: *Alternativas sustentáveis são cada vez mais requeridas em sistemas produtivos, como, por exemplo, o uso de fertilizantes orgânicos. Culturas como a physalis ou fisális (Physalis peruviana L.) ainda apresentam lacunas a serem preenchidas na utilização de composto orgânico como alternativa para o aumento da produtividade. Neste cenário, o objetivo deste estudo foi a avaliação do efeito de doses de composto orgânico no crescimento e desenvolvimento inicial de P. peruviana L. em Latossolo Amarelo distrocoeso. O experimento foi conduzido em casa de vegetação com delineamento inteiramente casualizado, distribuído em seis tratamentos, constituído por doses de adubo orgânico (0, 15, 30, 45 e 60 t* ha^{-1}*) acrescido de uma testemunha adicional com adubação química. Cada tratamento foi composto por 15 repetições. As variáveis avaliadas foram, altura da planta, diâmetro do caule, número de folhas, número de flores e frutos, massa seca da parte aérea e volume da raiz. As plantas de physalis cultivadas com composto orgânico apresentaram desenvolvimento satisfatório em relação às cultivadas em solo sem adubação. Neste estudo, o uso de adubo orgânico produzido a partir da compostagem de podas de árvores e estercos de animais, promoveu ganhos significativos na altura (27,83 cm* $planta^{-1}$*), diâmetro do caule (9,23 mm* $planta^{-1}$*), número de folhas (51,12* $planta^{-1}$*), número de frutos (5,33* $planta^{-1}$*), massa seca parte aérea (2,04 g* $planta^{-1}$*) e raiz (0,70 g* $planta^{-1}$*). Dessa forma, a dose de 45 t* ha^{-1} *de composto orgânico proporcionou maior número de frutos, sendo, portanto, recomendada para a produção de physalis em Latossolo Amarelo distrocoeso.*

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ERRATUM

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Cape the editorial RCA AJAES wants to make the following corrections to the paper by Souza, H. B. F., *et al.* (2021) [1]:

In the English title of the article replace the word "latosol" to "Oxisol".
In the Portuguese title replace the word "latossolo" to "Latossolo".
In the abstract, replace the word "latosol" to "Oxisol" and "dystrocohese" to "dystrocohesive".
In the author names section reorder the order of the last two authors to "Antonio Leandro da Silva Conceição4; Rafaela Simão Abrahão Nóbrega5".
On page 1, correct the word "Reconcavo" to "Recôncavo". On page 2, under objective of the paper, replace the word "latosol" to "Oxisol".
On page 1, replace the corresponding email "manasses.tec@hotmail.com" to "rafaela.nobrega@ufrb.edu.br".
On page 2, under material and methods, replace the word "latosol" to "Oxisol".
On page 2, under material and methods, fourth paragraph, replace the symbol "K" to "K^+" and the terms "cmol dm^{-3}" to "cmolc dm^{-3}" and change "OM" to "OM (Organic Matter)".
On page 3, replace "cm/$plant^{-1}$" to "cm $plant^{-1}$ ", "mm/$plant^{-1}$" to "mm $plant^{-1}$ ", "g/$plant^{-1}$" to "g $plant^{-1}$ " and "mL/$plant^{-1}$" to "mL $plant^{-1}$ ".
On page 4, replace the terms "cm/$plant^{-1}$" to "cm $plant^{-1}$ ", "mm/$plant^{-1}$" to "mm $plant^{-1}$ " and "leaves/$plant^{-1}$" to "leaves $plant^{-1}$ ".
On page 5, replace the terms "g/$plant^{-1}$" to "g $plant^{-1}$" and "g/kg^{-1}" por "g kg^{-1}".
On page 6, replace the terms "g/$plant^{-1}$" to "g $plant^{-1}$" and "fruits/$plant^{-1}$" to "fruits $plant^{-1}$".
On page 6, replace the word "latosol" to "Oxisol".
And lastly in the header note replace the word "latosol" to "Oxisol".
The manuscript will be updated and the original will remain online on the article webpage.
We would like to apologize to any inconvenience caused.

Reference

1.Souza, H. B. F.; Silva, M. S.; Rodrigues, M. S.; Conceição, A. L. S.; Nóbrega, R. S. A. *Physalis peruviana* L. cultivated in dystrocohesive yellow Oxisol is responsive to organic fertilization. *Revista de Ciências Agrárias Amazonian Journal of Agricultural and Environmental Sciences*, v. 64, 2021.

1 Introduction

Cape gooseberry (*Physalis peruviana* L.) belongs to the Solanaceae family, known for its relevant economic interest, nutritional value of the fruits (vitamin A and C, iron, phosphorus, fiber and carotenoids) (Etzbach *et al.*, 2018) and medicinal properties, with high bioactive compounds present in leaves and roots (Muniz *et al.*, 2014).

In Brazil, there is a lack of technical information for supporting the production of this species, leading to adaptations of Colombian practices. Fertilizer recommendations to supply nutrient demand are based on information available for tomato or regional bulletins, which may result in lower yields and low fruit quality (Santos *et al.*, 2019).

In Brazil, the Cape gooseberry yield is low and mainly sophisticated retailers trade the fruit. The amount of Cape gooseberry traded at the São Paulo Depots and General Warehouses Company (CEAGESP), in 2020, was approximately 62 tons, imported mainly from Colombia, with around 47 tons delivered to Brazil (Muniz *et al.*, 2015; Ceagesp, 2020).

In an agricultural production system, crop nutrition is the main factor that must be considered, as it directly affects its performance, thus requiring soils with good availability of nitrogen, potassium, calcium, and boron (Rufato *et al.*, 2013). However, in conventional cropping systems, the excessive use of fertilizers and chemical fertilizers or inadequate soil management result in the contamination of water sources (Cihangir & Oktem, 2019).

In the quest to minimize these environmental impacts, the search for sustainable alternatives such as organic agriculture arises, as this practice is beneficial for the crop production as well as is associated with life quality (Xin *et al.*, 2016). The organic farming system has become increasingly important due to the supply of chemical residue-free fruit and improved quality (granting improved nutritional properties) (Oliveira *et al.*, 2013). In this scenario, some producers have also adopted organic fertilization for the cultivation of Cape gooseberry (Collazos *et al.*, 2019).

Organic fertilization can provide relevant benefits to crop productivity, including the improvement of the biological, chemical and physical properties of soils; stimulation of biological activity, greater availability of nutrients and aggregation of particles; in addition to ensuring high water retention, and less variation in soil temperature (Cihangir & Oktem, 2019). Among the sources of organic nutrients, the organic compost has been used routinely and its final product consists of the aerobic decomposition of plant and animal residues, providing nutrients to the soil, which results in the rapid rooting of plants (Henz *et al.*, 2007).

The amount of nutrients in organic composts depends on the raw material and the composting process. Although the nutrient content of these fertilizers is lower than the that in mineral fertilizers, the diversity of elements in their composition is greater, which, if lacking in the soil, results in reduced production (Rodrigues *et al.*, 2011).

Few studies report the use of organic compost in Cape gooseberry production (Collazos *et al.*, 2019), however, there are several studies related to agronomic parameters of the crop (Rufato *et al.*, 2013; Muniz *et al.*, 2014).

From the foregoing and in view of the variety of organic compounds, it is hypothesized that the organic fertilizer produced from tree pruning waste and animal manure compost promotes the growth and development of *Physalis peruviana* L.

Therefore, the aim of this study was to evaluate the effect of rates of organic compost on the initial growth and development of *Physalis peruviana* L. in a predominantly dystrocohesive Yellow Latosol in the Region of Recôncavo da Bahia.

2 Material and methods

The experiment with organic fertilization in the Cape gooseberry crop was conducted in the Federal University of Recôncavo da Bahia (UFRB), Cruz das Almas, BA (12º40'19" S and 39º06'23" W, at 220 m altitude), from February 2020 to June 2020.

The climate of the region is tropical wet, warm and humid, according to Köppen's classification, with average annual rainfall of 1170 mm, average annual temperature of 24.5°C, and relative humidity of 80% (Rezende, 2004). Ripe fruits were collected from mother plants grown at UFRB. The seeds were removed from the fruits, washed in tap water to remove mucilage, and dried on filter paper at room temperature.

The trial was conducted in a greenhouse, with support structure of concrete, iron and aluminum covered with transparent material and 50% shading screen (Sombrite ®). Seeds were sown in polypropylene trays (50 cells; 8.68 liters). The substrate consisted of sand, vermiculite and organic compost made from cattle and goat manure, and tree pruning waste (Table 1) in the ratio 2:1:1. Three seeds were planted per cell, totaling 150 plants per tray. Trays were watered twice a day by an automatic irrigation system.

At 40 days after sowing (DAS), the plants were transplanted into 3.5 L pots filled with the Yellow Latosol collected in the experimental farm at UFRB, at depths of 0 to 0.20 m. The chemical characteristics of the soil were as follows: pH (H_2O) = 6.6; P = 3.55 mg dm^{-3}; K = 3.00 mg dm^{-3}, Ca_2+ = 2.2 cmol dm^{-3}; Mg_2+ = 1.0 cmol dm^{-3}; Al_3+ = 0.0 cmolc dm^{-3}; H + Al = 1.5 cmol dm^{-3}; sum of bases = 3.21 cmolc dm^{-3}; CEC (T) = 4.71 cmolc dm^{-3}; V = 68.14%; OM = 2.0%.

Data provided by the laboratory analysis showed that the soil acidity is low, therefore there was no need for liming and the content of organic matter was low. Contents of phosphorus and potassium were low, calcium and magnesium were medium, and base saturation and CEC (T) were medium, therefore, this soil has a median fertility, built over time.

The treatments consisted of five rates of organic fertilizer (0, 15, 30, 45 and 60 t ha^{-1}) and an additional control with chemical fertilization, all with 15 replications, arranged in a completely randomized design.

Fertilization was applied based on the soil analysis at recommended doses according to Trani *et al.* (2015) for the tomato crop with an expected production of 80 t ha^{-1} (200 kg ha^{-1} of P_2O_5, 300 kg ha^{-1} of K_2O, and 200 kg ha^{-1} of N). Nitrogen and potassium application were divided at planting after seven days. The organic fertilization was carried out with organic compost produced from cattle and goat manure and tree pruning waste. Table 1 shows the composition of the organic compost.

After transplanting, the seedlings were hand watered (200 ml) twice a day. No pruning, apical and lateral bud removal, and thinning of the plants were carried out during the experiment.

Three fortnightly assessments were carried out for a period of 45 days, after the seedling transplanting. After the treatments, the following variables were analyzed: plant height (H, cm/$plant^{-1}$), stem diameter (SD, mm/$plant^{-1}$), number of leaves (NL), number of flowers (NF), number of fruits (NFR). At 45 days after the seedlings were transplanted, the plants were harvested and divided into shoots and roots and dried in forced-air-circulation oven at 60 °C for 72 hours to constant mass. Then, shoot dry mass (SDM, g/$plant^{-1}$) and root dry mass (RDM, g/$plant^{-1}$) were weighed. The root volume (RV, mL/$plant^{-1}$) was determined by the test tube method (Laurett *et al.*, 2017).

The variables height and diameter were analyzed over the three periods of evaluation, considering a 3x5 factorial design, with three evaluations (15, 30 and 45 days) and five rates of organic fertilization (0, 15, 30, 45 and 60 t ha^{-1}). The interaction between these variables seeks to analyze the vegetative growth of plants, since it is at this stage that the structure to produce energy and support the weight of the production is formed. For the other variables, only the evaluation at 45 DAT (days after transplantation) was considered.

Data were subjected to analysis of variance (ANOVA) by the F test at 5% probability, and multiple comparisons of means by the Tukey's test. The polynomial regression analysis was performed for the variables as a function of the rates of the organic compost, at 5% probability. Data were adjusted to the polynomial regression model when significant. The $\sqrt{(x+1)}$ transformation was used for the count data and the variables SDM, RDM and RV. The multiple comparison of means between the reference treatment (Chemical Control) and the rates of the organic compost was tested with the Dunnett test at 5% probability. The analyses were performed using the R statistical program.

Table 1. Physicochemical characteristics of the organic compost made from cattle, goat manure and tree pruning waste (1:1:3).

Tabela 1. Caracterização físico-química do composto orgânico elaborado a partir de estercos bovinos, caprinos e podas de árvores (1:1:3).

Determinations	Unit
pH ($CaCl_2$ 0,01 M)	7,6
Humidity (Organic Waste) 60 - 65ºC	0,11
Organic Matter (Combustion) (%)	13,96
Nitrogen (%)	0,60
Phosphorus (P_2O_5) (%)	1,36
Potassium (K_2O) (%)	0,75
Calcium (Ca) (%)	0,98
Magnesium (Mg) (%)	0,21
Sulfur (S) (%)	0,07
C/N relation	9,0
Copper (Cu) mg kg^{-1}	2
Manganese (Mn) mg kg^{-1}	200
Zinc (Zn) mg kg^{-1}	85
Iron (Fe) mg kg^{-1}	10089
Boron (B) mg kg^{-1}	5
Sodium (Na) mg kg^{-1}	1274

* Methods $CaCl_2$ 0.01 M pH; Total organic matter and mineral residue based on dry combustion (muffle furnace); potassium (K_2O), calcium (Ca), magnesium (Mg) by atomic absorption spectrophotometer, CH 1l + 1 extraction; total nitrogen, sulfur digestion (Kjeldahl); carbon by dichromate oxidation followed by titration; phosphorus (P_2O_5): HCl 1 + 1 extraction by spectrophotometer (reading at 430 nm) using vanadomolybdate solution; sulfur (S) Gravimetric Barium Sulfate; iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), sodium (Na), HCl 1 + 1 extraction, by atomic absorption spectrophotometer. Boron (B) with Azomethine-H Spectrophotometry (MAPA, 2014).

* Métodos $CaCl_2$ 0,01 M pH; Matéria orgânica total e resíduo mineral na combustão em mufla; potássio (K_2O), cálcio (Ca), magnésio (Mg) por espectrofotômetro de absorção atômica, extraído com CH 1l + 1; nitrogênio total, digestão sulfúrica (Kjeldahl); carbono por oxidação de dicromato seguida por titulação; fósforo (P_2O_5): Extração com HCl 1 + 1, determinado por espectrofotômetro (leitura no comprimento de onda de 430 nm) pelo método com solução vanadomolbídica; enxofre (S) Gravimétrico Sulfato de Bário; ferro (Fe), manganês (Mn), cobre (Cu), zinco (Zn), sódio (Na) para um espectrofotômetro de absorção atômica extraído com HCl 1 + 1. Boro (B) com espectrofotômetro Azometina H monossódica (MAPA, 2014).

3 Results and Discussion

A height gain was recorded during the three assessments carried out at 15, 30 and 45 DAT, with estimated means varying from 16.25 cm/$plant^{-1}$ (60 t ha^{-1}), 25.01 cm/$plant^{-1}$ (42 .61 t ha^{-1}), and 27.38 cm/$plant^{-1}$ (49.73 t ha^{-1}) (Figure 1A). Plants cultivated with chemical fertilizer (additional control) presented a mean height of 28.66 cm/$plant^{-1}$ (Figure 1A), that is, they showed an increase of approximately 32% in relation to plants cultivated without fertilization. The results of the chemical fertilization compared to the organic fertilization were not different from those with the rate of 60 t ha^{-1} ($p > 0.05$)

(Table 2), thus, the organic fertilization provided the same gain compared to chemical fertilization.

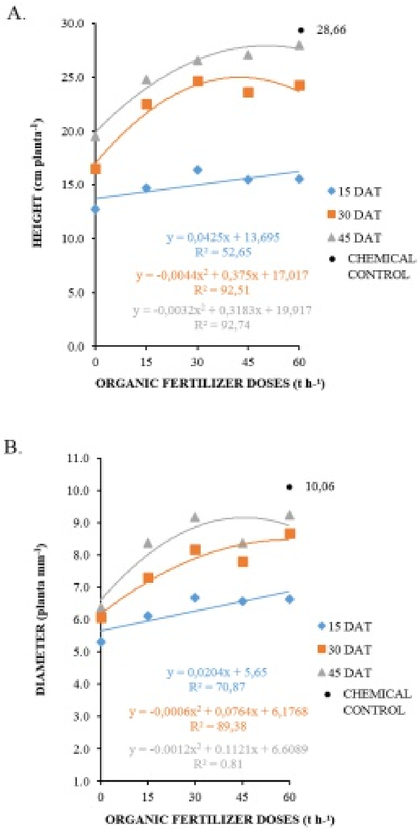

Figure 1. Plant height (A) and stem diameter (B) of *Physalis peruviana* L. evaluated at 15, 30 and 45 DAT (days after transplanting) cultivated with increasing rates of organic compost; (●) Chemical control.

Figura 1. Altura de plantas de *Physalis peruviana* L. (A) e Diâmetro do caule (B), avaliadas aos 15, 30 e 45 DAT (dias após o transplante) quando cultivadas sob doses crescentes de composto orgânico; (●) Controle químico.

According to Escobar (2000), seedlings of Cape gooseberry have an average growth of 15 cm per month, with a balanced nutrition, and similar values were obtained in this study, with an increase of 12.48 cm (dose 60 t ha^{-1}) in each two weeks. The results obtained in this study indicated that the organic compost promoted the growth (in height) of the plants during the three assessments.

Bagatim (2017) obtained similar results with organic fertilization for the production of *Physalis angulata* L., with a significant response in the initial growth of plants cultivated with a mixture of soil, sand and composted cattle manure (3:1:1). The author observed an increase of 73.6% compared to substrate of vermiculite, attributing its performance to the nutrient composition.

Carvalho *et al.* (2011) also obtained satisfactory results with organic fertilization with seedlings *P. angulata* L. cultivated in organic substrate of poultry manure in combination with soil (50% chicken manure, 30% plant humus soil, and 20% earth), showing significant increase in seedling height when compared with substrate containing only topsoil (27 cm/plant^{-1} at 40 DAT).

In the present study, the use of organic compost with soil provided a positive response in height of Cape gooseberry plants. These results agree with the reports carried out by the authors mentioned above, in which the fertilization carried out with organic material increased the plant height above 20 cm, which is considered satisfactory, considering the days after planting, which proves the efficiency of the organic compost as a source of nutrients.

The stem diameter (SD) varied during the evaluations (15, 30 and 45 DAT), with maximum means estimated at 6.87 mm/plant^{-1}, (60 t ha^{-1}), 8.76 mm/plant^{-1} (60 t ha^{-1}), and 9.23 mm/plant^{-1} (46.71 t ha^{-1}), respectively (Figure 1B). Plants cultivated with chemical fertilization (additional control) showed a mean value of 10.06 mm plant^{-1} (Figure 1B), which correspond to an increase of 35.59% in relation to plants cultivated without fertilization. The results obtained with the chemical fertilization in relation to the organic fertilization were not different from the results obtained with the rates of 30 t ha^{-1} and 60 t ha^{-1} ($p > 0.05$) (Table 2).

According to Souza *et al.* (2014), the growth of the stem diameter is desirable, as it ensures greater support for the aerial part of the plants. This is an important characteristic for Cape gooseberry, whose growth habit can reach between 1.0 m and 1.5 m of height (Fischer *et al.*, 2014). The branch growth diameter varies from 0.50 to 0.60 mm every two weeks, depending on the growing conditions (Zuang *et al.*, 1992).

The organic fertilization at the rate of 45 t ha^{-1} provided results close to those reported by Zuang *et al.* (1992). It is inferred, in the present study, that satisfactory results for plant height and stem diameter at 45 DAT were found at the estimated optimal doses of 49.73 and 46.71 ha^{-1} of organic compost, respectively.

A similar effect was found by Oliveira *et al.* (2020), investigating organic substrate (sugarcane bagasse, peat, limestone, organic residue, poultry manure and poultry litter, ash and plant residue) on the initial growth of *P. peruviana* L. The authors reported seedlings that reached 29,19 cm plant^{-1} at 56 days DAT. The substrate Provaso® (organic residue rich) provided greater performance compared to other substrates (Solo and Bioplant®) for stem diameter of *P. peruviana* also at 56 DAT (5.24 mm/plant^{-1}).

The rates of organic fertilizer also influenced the number of leaves, number of fruits, shoot dry mass, root dry mass and root volume. However, the number of flowers was not significantly affected by the rates of the organic compost.

The number of leaves (NL) increased (Figure 2) with the addition of the organic fertilizer at the estimated rate of 44.86 t ha^{-1}, providing the maximum number of 51.12 leaves /plants^{-1}. The chemical fertilization presented a higher mean for NL (64.31 leaves plant^{-1}) with an increase of 63.25% compared with plants grown without fertilization, and 21.47% when compared with the organic compost (Table 2).

According to Marenco (2005), it is desirable that seedlings have greater leaf development, since leaves account for the process of converting light energy into chemical energy (photosynthesis), which results in greater productivity. These results are related to the fact that organic fertilization contributes to the supply of mineral and chemical elements that plants need to complete their development (Maia *et al.*, 2013).

Table 2. Comparison of variable means (plant height-H, stem diameter-SD, number of leaves-NL, number of flowers-NF, number of fruits-NFR, shoot dry mass-SDM, root dry mass-RDM and root volume-RV) subjected to chemical fertilization as against rates of organic fertilization, at 45 DAT (days after transplantation).

Tabela 2. Comparação dos valores médios das variáveis (Altura da planta, diâmetro do caule, número de folhas, número de flores, número de frutos, massa seca da parte aérea, massa seca da raiz e volume das raízes) submetidas a adubação química x doses da adubação orgânica, avaliado aos 45 DAT.

Organ. Fertilization vs Chemical Fertilization	P-Value Dunnett Test							
	H	SD	NL	NF	NFR	SDM	RDM	RV
0 x C. Fert.	<0.001	<0.001	<0.001	0.028	<0.001	<0.001	<0.011	<0.001
15 x C. Fert.	<0.001	<0.001	<0.001	0.249*	0.009	<0.001	0.022	0.006
30 x C. Fert.	0.007	0.0453*	0.003	0.914*	0.727*	<0.001	0.997*	0.085*
45 x C. Fert.	0.015	<0.001	<0.001	0.706*	1.000*	<0.001	0.621*	0.016
60 x C. Fert.	0.059*	0.0599*	0.005	0.535*	0.364*	<0.001	0.909*	0.084*

* Without significant difference (α=5%).

* Não há diferença significativa (α=5%).

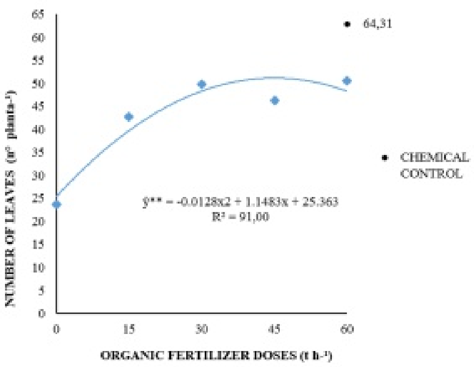

Figure 2. Number of leaves (NL) of *Physalis peruviana* L. evaluated at 45 DAT (days after transplantation), under increasing rates of organic compost; (●) Chemical control.

Figura 2. Número de folhas (NF) de plantas de *Physalis peruviana* L. avaliadas aos 45 DAT (dias após o transplante), quando cultivadas sob doses crescentes de composto orgânico; (●) Controle químico.

Shoot dry mass reached a maximum estimated value of approximately 2.01 g/plant^{-1} at the estimated rate of 60 t h^{-1} of the organic compost (Figure 3A). Plants cultivated with chemical fertilization presented an mean value of 4.1 g/plant^{-1}, corresponding to an increase of 84.94% in relation to plants cultivated without fertilization and compared to cultivation with organic compost (Table 2). The results of organic fertilization for the variable are inferior to the chemical treatment.

The analysis of root dry mass, showed an increase with the rates of organic compost, and the estimated optimal dose of 60 t ha^{-1} had the highest maximum mean values of 0.78 g/plant^{-1} (Figure 3B). The chemical fertilization provided a mean value of 0.81 g/plant^{-1}, which correspond to an increase of 66.05% in relation to plants cultivated without fertilization, and the results obtained are not differ from organic fertilization for the rates of 30, 45 and 60 t ha^{-1} (Table 2).

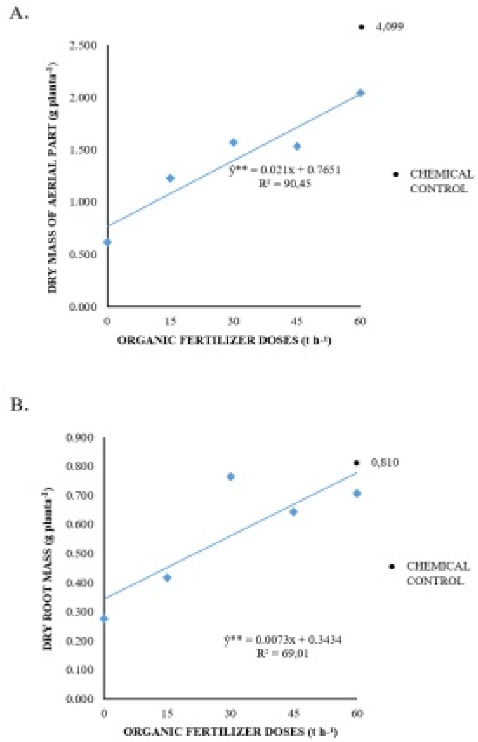

Figure 3. Dry mass of aerial part (A) and dry root mass (B) of *Physalis peruviana* L. evaluated at 45 DAT (days after transplanting), under increasing rates of organic compost; (●) Chemical control.

Figura 3. Massa seca da parte aérea (A) e massa seca de raízes (B) de plantas de *Physalis peruviana* L. avaliadas aos 45 DAT (dias após o transplante), quando cultivadas sob doses crescentes de composto orgânico; (●) controle químico.

The production of dry mass is related to factors such as fertilization, planting density, solar irradiation, and trailing system (Muniz e*t al.*, 2014). According to Maia *et al.* (2013), the dry matter of leaves, fruits and stems showed a linear increasing response with increasing rates of organic fertilizer (cattle manure) providing greater amounts of organic nutrients. These authors reported means for stem dry matter (8.24 g/plant^{-1} at 45 DAT), root volume (53.33 g/plant^{-1} at 45 DAT) and root dry matter (2.38 g/plant^{-1} at 45 DAT) when applying the rate of 300 g/kg^{-1} manure. Plants cultivated with chemical fertilizer had the lowest means for all variables analyzed.

Oliveira *et al.* (2020) evaluated the effect of different substrates (Solo, Provaso® and Bioplant®) on the initial growth of *P. peruviana* L. The authors reported that the substrate Provaso® presented the highest performance for shoot dry matter (mean 1.61 g/plant^{-1} at 56 DAT) and root dry matter (mean 0.57 g/plant^{-1} at 56 DAT). These results are possibly due to the composition of the substrate, which contains poultry manure, one of the richest sources of nutrients, allowing better nutritional support for the seedlings.

The rates of organic fertilizer used in this study had a positive influence on the mass of the aerial parts, mass and volume of the roots. In addition, the means obtained are similar to those found in the study by Oliveira *et al.* (2020), considering the increment in the period of time allocated to the experiment. According to the authors, the increase provided by the organic fertilization is related to the nutrient-rich content of the organic fertilizer used, considering the diversity of elements present in its composition.

For root volume, the estimated optimal rate was 45.40 t ha^{-1}, which resulted in an estimated maximum mean of 1.70 g/plant^{-1}. Plants cultivated with the chemical fertilizer presented mean value of 2.33 g/plant^{-1} (Figure 4), corresponding to an increase of 74.25% in relation to plants cultivated without fertilization and the comparison of the results showed they were similar to those obtained with the organic fertilizer for the rates of 30 t ha^{-1} and 60 t ha^{-1} (Table 2).

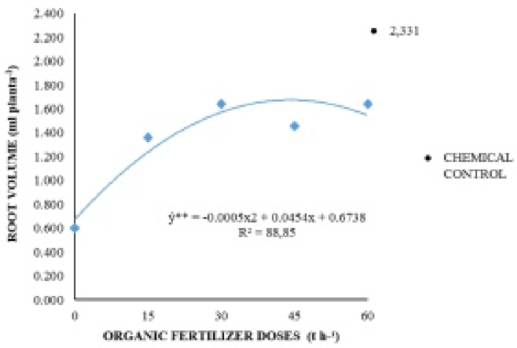

Figure 4. Root volume (RV) of *Physalis peruviana* L. evaluated at 45 DAT (days after transplantation), under increasing rates of organic compost; (●) Chemical control.

Figura 4. Volume de raízes (VR) de plantas de *Physalis peruviana* L. avaliadas aos 45 DAT (dias após o transplante), quando cultivadas sob doses crescentes de composto orgânico; (●) controle químico.

The number of fruits, at the estimated rate of 44.28 t ha^{-1} (organic compost), provided a maximum estimated value of 5.33 fruits/plant^{-1} (Figure 5). The treatment with the lowest negative result had no organic compost applied, that is, considering the nutrient stocks and soil pH (6.6) interpreted as ideal, the crop did not return well. Therefore, the cultivation of Cape gooseberry in a Yellow Latosol without any fertilization is not recommended, this negative behavior is related to the low levels in the Phosphorus (P), Potassium (K) and medium levels of Magnesium (Mg) and Calcium (Ca) stocks, which contributed to the fall of the productive potential.

The rates of organic compost applied resulted in an increase of 92.62% in relation to cultivation without fertilization and the chemical fertilization provide a mean of 6.27 of fruits plant-1 with an increase of 92.83% in relation to plants cultivated without fertilization. These results are not different from those obtained with organic fertilization in treatments with rates of 30, 45 and 60 t ha-1 (Table 2).

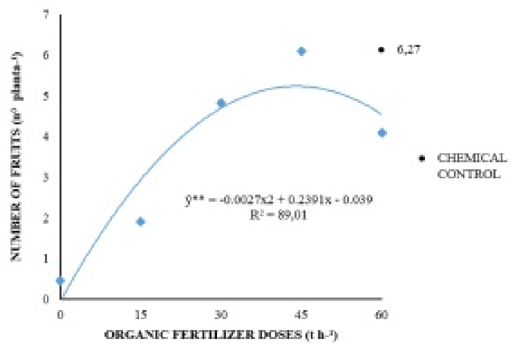

Figure 5. Number of fruits (NFR) of *Physalis peruviana* L. evaluated at 45 DAT (days after transplantation), under increasing rates of organic compost; (●) Chemical control.

Figura 5. Número de frutos (NFRU) de plantas de *Physalis peruviana* L. avaliadas aos 45 DAT (dias após o transplante), quando cultivadas sob doses crescentes de composto orgânico; (●) controle químico.

Fertilizers and organic substrates have been used and can provide a good initial and productive growth for the species Physalis peruviana L.compared to conventional fertilization. The application of increasing amounts of organic matter in the form of organic compost promoted effects on growth and productivity of the crop.

The organic fertilization provided increases in the crop equivalent to values by the conventional fertilization carried out with synthetic fertilizers, therefore field tests are recommended to validate the results achieved in the present study. It should be considered that batches of organic composts may have variable compositions, justifying that rates must be adjusted according to the chemical composition of the batches.

4 Conclusion

In this study, the use of organic fertilizer produced from tree pruning waste and animal manure composting for the cultivation of Cape gooseberry (*Physalis peruviana* L.) promoted significant gains in height, stem diameter, number of leaves and number of fruits in the rate of 45 t ha^{-1} and can be recommended for the production of the crop in a dystrocohesive Yellow Latosol.

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