Research, Society and Development, v. 10, n. 3, e57910313704, 2021
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v10i3.13704

Doses of organic compost in top dressing in the production of chives

Doses de composto orgânico em cobertura na produção de cebolinha

Dosis de abono orgánico en cobertura en la producción de cebollino

Received: 09/03/2021 | Reviewed: 17/03/2021 | Accept: 20/03/2021 | Published: 27/03/2021

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Abstract
Despite the great importance of vegetable production in the organic system, researches with organic fertilization in top dressing are rare. The objective of this work was to evaluate the effect of the organic compost applied in top dressing in the production of chives. The experimental design was a randomized complete block, with five doses of organic compost in top dressing (35.0, 52.5, 70.0, 87.5 and 105.0 t ha^{-1}) and four replicates. Two harvests were made, the first at 60 days after transplantation and the second 30 days after the first. The following characteristics were evaluated: plant height, leaf number and fresh matter weight per plant. The higher the dose of organic compost, the greater the production of chives. The yield per plant in the first harvest ranged from 172 to 334 g, in the second harvest from 206 to 310 g and total production from 378 to 644 g for the lowest (35 t ha^{-1}) and the highest (105 t ha^{-1}) doses, respectively, results that confirm the importance of the organic fertilization in top dressing in the production of chives.
Keywords: *Allium fistulosum*; Organic fertilization; Nitrogen; Vegetables.

Resumo
Apesar da importância crescente da produção de hortaliças no sistema orgânico, são raras as pesquisas com adubação orgânica em cobertura. Objetivou-se com este trabalho avaliar o efeito do composto orgânico aplicado em cobertura na produção de cebolinha. O delineamento experimental utilizado foi em blocos ao acaso, sendo cinco tratamentos (doses de composto orgânico em cobertura: 35,0; 52,5; 70,0; 87,5 e 105,0 t ha^{-1}) e quatro repetições. Foram feitas duas colheitas, a primeira aos 60 dias após o transplante e a segunda 30 dias após a primeira. Foram avaliadas as seguintes características: altura das plantas, número de folhas e massa de matéria fresca por planta. Quanto maior a dose de composto orgânico, maior a produção de cebolinha. A produção por planta na primeira colheita variou de 172 a 334 g, na segunda colheita de 206 a 310 g e a produção total de 378 a 644 g da menor (35 t ha^{-1}) para a maior (105 t ha^{-1}) dose, respectivamente, resultados que confirmam a importância da adubação orgânica em cobertura na produção de cebolinha.
Palavras-chave: *Allium fistulosum*; Adubação orgânica; Nitrogênio; Hortaliças.

Resumen
A pesar de la creciente importancia de la producción de hortalizas en el sistema orgánico, la investigación sobre abono orgánico en cobertura es rara. El objetivo de este trabajo fue evaluar el efecto del compost orgánico aplicado en cobertura sobre la producción de cebollino. El diseño experimental utilizado fue en bloques aleatorizados, con cinco tratamientos (dosis de abono orgánico en cobertura: 35.0; 52.5; 70.0; 87.5 y 105.0 t ha^{-1}) y cuatro repeticiones. Se realizaron dos cosechas, la primera a los 60 días después del trasplante y la segunda a los 30 días después de la primera. Se evaluaron las siguientes características: altura de la planta, número de hojas y materia fresca por planta. Cuanto mayor sea la dosis de abono orgánico, mayor será la producción de cebollino. La producción por planta en la primera cosecha varió de 172 a 334 g, en la segunda cosecha de 206 a 310 g y la producción total de 378 a 644 g desde la más pequeña (35 t ha-1)

hasta la más alta (105 t ha -1) dosis, respectivamente, resultados que confirman la necesidad de fertilización orgánica en cobertura en la producción de cebollino.
Palabras clave: *Allium fistulosum*; Fertilización orgánica; Nitrógeno; Hortalizas.

1. Introduction

The chive is a vegetable belonging to the family Alliaceae, of considerable value and importance in several regions of Brazil. It has an important social role, because it is cultivated in small areas by family farmers (Filgueira, 2013; Martins et al., 2020), and some of these producing is in the organic system. However, researches with chives in this production system are scarce.

Organic fertilization favors the soil in several meaning, improving its structure, aeration and infiltration of water, favors water retention and absorption of nutrients, reduces soil loss and pest and disease incidence (Souza & Resende, 2014). Moreover, organic fertilization becomes more current and necessary in tropical soils, because, in these conditions, degradation of the organic matter becomes faster.

There has been an increase in the number of researches with organic fertilizers, such as manures, composts and various types of organic waste. There are many reports of increasing productivity and quality in various vegetables with organic fertilization (Magro et al., 2010, 2015; Candian et al., 2015; Corrêa et al., 2016; Silva et al., 2016; Lanna et al., 2017). However, most of this research has been done with fertilizer applied before planting, and researches on organic fertilizers in top dressing are scarce (Silva et al., 2016).

Due to the nitrogen being a nutrient easily lost in the soil, either by volatilization or by leaching, it is indicated that its supply is splitted and that it occurs with the application of materials rich in organic matter, since they have the capacity to store nitrogen for a longer time in the soil (Kiehl, 2010). Organic fertilizers provide the plant nutrients more slowly when compared to inorganic ones, and the rate of release depends on several factors, such as the climatic conditions, microorganisms in soil and source of organic material applied (Monsalve et al., 2017). The lack of research on the application of this nutrient in top dressing in the organic system may be limiting the productivity of vegetables, especially when the soil is poor in nutrients.

Among the organic fertilizer options used by producers of vegetables are castor bean cake, manure from different sources and organic compost. Castor bean cake is an excellent source of nutrients, being widely used as top dressing fertilizer (Silva et al., 2016). However, it is more expensive than organic compost, besides the difficulty to produce it in the property, unlike the organic compost, which can be made using different organic residues by the producer.

Considering the scarcity of information on the response of most vegetables to organic fertilization in top dressing, this research aimed to study the effect of fertilization with organic compost in top dressing in the production of chives.

2. Methodology

The experiment was conducted at the São Manuel Experimental Farm, located in the municipality of Sao Manuel-SP, belonging to the School of Agriculture (FCA) of the Sao Paulo State University (UNESP), Botucatu Campus, Brazil (22° 46'S, 48° 34'W and altitude of 740 m). The climate of the municipality of Sao Manuel is considered of type *cfa*, temperate warm mesothermic, humid, with rains concentrated in the months of October to March (Cunha & Martins, 2009).

It was obtained the following results in the chemical analysis of soil (0-20 cm depth) where the trial was installed: $pH_{(CaCl2)}$= 5.3; M.O.= 16 g dm^{-3}; P_{resin}= 205 mg dm^{-3}; H+Al= 21 $mmol_c$ dm^{-3}; K= 2.0 $mmol_c$ dm^{-3}; Ca= 33 $mmol_c$ dm^{-3}; Mg= 5 $mmol_c$ dm^{-3}; S= 4.0 $mmol_c$ dm^{-3}; bases sum= 40 $mmol_c$ dm^{-3}; CEC= 61 $mmol_c$ dm^{-3} and base saturation (V)= 72%. Liming was done to raise the base saturation to 80% and fertilization of planting with organic compost was done with the dose recommended

by Raij et al. (1997): 60 t ha^{-1}. The organic compost was spread over the soil surface and incorporated with a hoe to a depth of 20 cm, one week before transplanting the seedlings.

Five doses of organic compost in top dressing (35.0, 52.5, 70.0, 87.5 and 105.0 t ha^{-1}) were studied in the randomized blocks experimental design, with four replicates. The total doses of each treatment were divided in three times, at 19, 34 and 49 days after the transplant (DAT) of the seedlings, applying 1/3 of the total dose at each date. The organic compost used contained (dry matter base) 0.7% N, 1.70% P_2O_5, 1.78% K_2O, 1.3% Ca, 0.8% Mg and 0.7% of S, and humidity of 27.95%.

Seeds of cultivar Ano Todo were sown on 06/22/2016 in polypropylene trays with 200 cells, containing Carolina Soil substrate. The seedlings were transplanted on 07/22/2016, in the longitudinal direction of the bed, in four lines (spaced 20 cm each other), with eight holes (spaced 10 cm) per line in each plot. Only the eight central holes of each plot were harvest and analyzed.

There was no need to control pests and diseases. The irrigation was by sprinkling, performed every day with about 3 mm of water, except when the daily precipitation exceeded this value.

At 60 DAT a first harvest was made, cutting all the leaves with knife. Plant height, number of leaves per plant and fresh matter weight of leaves per plant were evaluated.

As the plants were still healthy, the leaves re-emerged and, after 30 days, a new harvest was made, where the same characteristics mentioned previously were evaluated. In this way, in addition to the production in the first and second harvests, the total production was also obtained, adding the weights of the two harvests.

Variance and regression analysis were performed to verify the effect of organic compost doses on the evaluated characteristics. The statistical software Sisvar was used (Ferreira, 2011).

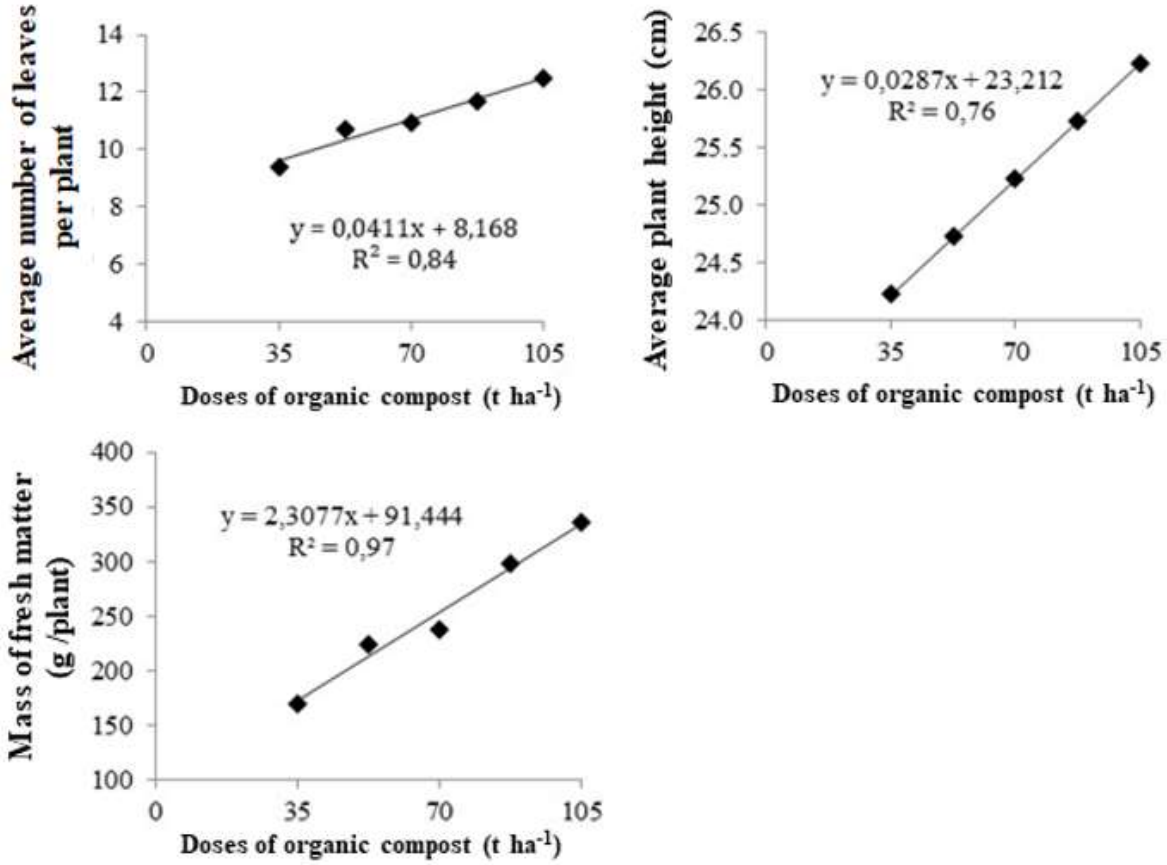
3. Results and Discussion

During the production cycle, it was observed that the average temperature was 19.5º C, which is considered an adequate temperature for the production of chives, according to Filgueira (2013).

First harvest at 60 days after transplantation

All the evaluated characteristics were influenced by the doses of organic compost, with linear increases for the number of leaves per plant, fresh matter weight per plant and plant height (Figure 1), which confirms the beneficial effect of the application of this fertilizer on the production of chives. For the fresh weight per plant, the estimated increase was 2.31 g per plant for each 1.0 t ha^{-1} of organic compost applied. Comparing the weight at the lowest dose (172.21 g for 35 t ha^{-1}) with the highest (333.75 g for 105 t ha^{-1}), an increase of approximately 93.8% was observed. For the average number of leaves and height of the plants, the increases comparing the highest and the lowest dose were less significant, 29.9 and 8.3%, respectively, that is, the increase of the fresh weight per plant was provided not only by the greater number of leaves, but mainly by the greater weight of each leaf.

Figure 1. Average number of leaves, height and fresh weight per plant in the first harvest as a function of the doses of organic compost in top dressing fertilization.



Source: Authors.

Zárate et al. (2002) reported an increase in chives productivity with the use of 700 g m^{-2} of chicken manure at planting. Araujo Neto et al. (2010) also obtained a linear increase in productivity with doses of up to 105 t ha^{-1} of organic compost in planting fertilization. These works confirm the importance of organic fertilization in the production of chives. However, the mode and time of application were different concerning this research, where de organic compost was applied at top dressing.

Probably, the effect of the organic compost was to release nutrients to the plants, besides the probable improvement in the physical characteristics and the biological activity of the soil (Kiehl, 2010; Cardoso et al., 2011; Souza & Rezende, 2014; Monsalve et al., 2017). No studies were found in which organic fertilizer was studied in top dressing on chives. In beets, Silva et al. (2016) also reported linear increases in diameter, length and weight of fresh matter with the use of up to 600 g m^{-2} of castor bean cake in top dressing.

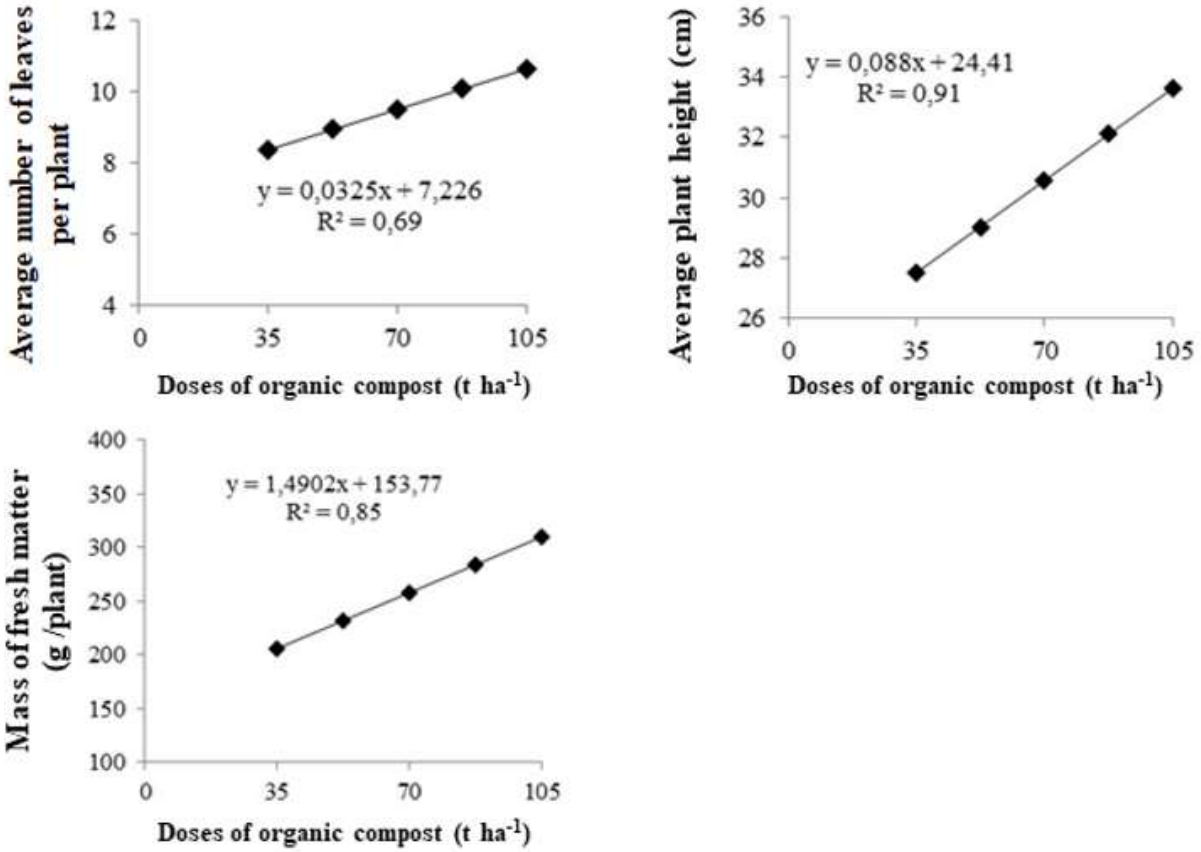
Zárate et al. (2010), using chicken manure partially decomposed as soil cover applied immediately after planting the chives, observed increase in plant height, diameter and yield. The authors report that the probable reasons for these increases were soil protection, with lower heating and dryness of the topsoil layer provided by the addition of chicken manure. Probably, the organic compost applied in the present research also functioned as soil cover, because in the larger doses a layer was formed covering the whole surface of the soil.

The productivity values obtained in this study can be considered high, ranging from 172.2 (dose 35 t ha^{-1}) to 333.7 g per plant (dose 105 t ha^{-1}). Araújo Neto et al. (2010) obtained from 25 to 75 g per plant using up to 105 t ha^{-1} of organic compost before planting.

Second harvest at 30 days after first harvest and total yield

In the second harvest, linear increases were also obtained, the higher the dose of organic compost applied in top dressing higher the number of the values of leaves per plant and fresh matter weight per plant (Figure 2), confirming the beneficial effect of the application of this product in the production of chives, even after the first harvest. For fresh weight per plant, the estimated increase was 1.5g per plant for each 1.0 t ha^{-1} of organic compost applied. Comparing the weight at the lowest dose (206 g for 35 t ha^{-1}) with the highest (310 g for 105 t ha^{-1}), an increase of approximately 104 g per plant was observed, that is, an increase of 57.6 %. For the number of leaves, the increase when comparing the highest with the lowest dose was 37.8%, that is, in this second harvest the increase of the fresh weight per plant was also provided by the greater increase of the number of leaves, besides the higher weight per leaf. However, there was no effect on plant height, with an average of 25.2 cm.

Figure 2. Average number of leaves, height and fresh weight per plant in the second harvest as a function of the doses of organic compost in top dressing fertilization.

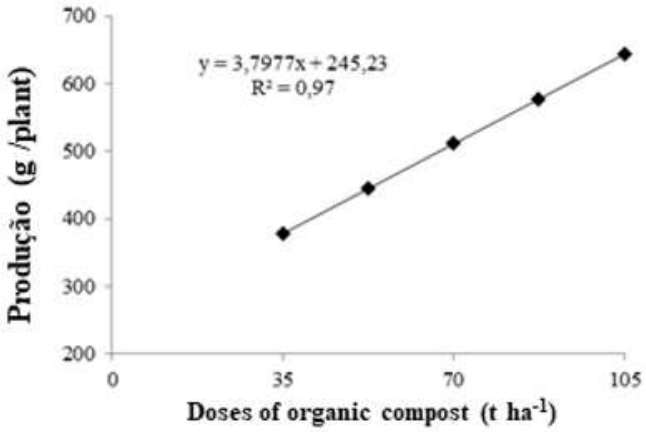


Source: Authors.

There was exploitation of the organic compost by the chive plants in the second "productive cycle" due to the residual effect of the decomposition and mineralization of the organic matter by the microorganisms in the soil, increasing the amount of available nutrients, organic matter content and better aeration and water retention (Araújo Neto et al., 2010; Lanna et al., 2018).

For the total production (first + second harvest) a linear increase was observed with the doses of organic compost (Figure 3). When comparing the estimated production of the lowest dose (378.2 g $plant^{-1}$) with the highest (644.0 g $plant^{-1}$), an increase of approximately 265.8 g $plant^{-1}$ is observed, that is, an increase of 70.3%, confirming the importance of organic fertilization in top dressing during all plant cycle.

Figure 3. Total production per chive plant (first + second harvests) as a function of the doses of organic compost in top dressing fertilization.



Source: Authors.

Considering that the nitrogen (N) content in the organic compost was 0.7% in the dry weight and the humidity was 27.95%, for each ton of this compost there is the release potential of 5.04 kg N per hectare. The highest dose (105.0 t ha^{-1}) would be about 529.2 kg of N per hectare, that is, a much higher value than the recommended inorganic fertilization (120 kg ha^{-1}) for the crop by Trani et al. (1997). However, it should be considered that the organic fertilizer does not present immediate release (Kiehl, 2010; Monsalve et al., 2017), besides that, the application was made at the soil surface, without incorporation. In this way, the mineralization by microorganisms presented in the soil is smaller about the application followed up by incorporation to the soil, which would increase the microbial activity, indispensable for the mineralization and availability of the nutrients by the organic matter (Monsalve et al., 2017). But this top dressing application favored higher yield even in the second harvest, without a new application of fertilizer.

4. Conclusion

The production of chives was positively influenced by the addition of organic compost in top dressing, with the maximum production achieved in the highest dose (105 t ha^{-1}) of organic compost.

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