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Morphological analysis of cabbage (*Brassica oleracea* L. var. acephala) grown in pots under different manure dosages

Análise morfológica da couve *(Brassica oleracea* L. var. acephala) cultivada em vasos sob diferentes dosagens de esterco

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A B S T R A C T

Butter cabbage (*Brassica oleracea* var. acephala) is a vegetable originating from the Mediterranean coast and belongs to the Brassicaceae family. Its consumption in Brazil has increased due to its nutritional properties and different ways of using it in cooking, thus favoring its cultivation in the country. The objective was to analyze the morphological development of cabbage grown in pots in response to different doses of avian manure. The work was conducted from November 2019 to January 2020, in a greenhouse at the State University of Alagoas, Campus I, located in the county of Arapiraca - AL. The experiment was performed DIC (completely randomized design) was carried out using four treatments (T_1 - soil without manure, T_2 - soil + 50g of manure, T_3 - soil + 75g of manure and T_4 - soil + 100g of manure) and 5 repetitions. Morphological monitoring was carried out in 12 weeks, initially observing the following variables (pre-harvest): plant height, stem diameter and number of leaves; then, in the post-harvest, the following were evaluated: root length, root fresh mass, plant fresh mass, root dry mass and plant dry mass. All analyzed variables were submitted to analysis of variance, and for comparison of means, the Tukey test was used ($p < 0.05$). With the results obtained, it was verified that there were no significant differences between the treatments in response to the manure dosages.

R E S U M O

A couve manteiga *(Brassica olerácea* var. acephala) é uma hortaliça originada da costa do Mediterrâneo e pertence à família da Brassicaceae. Seu consumo no Brasil tem aumentado devido a suas propriedades nutritivas e diversas maneiras de utilização na culinária, favorecendo assim o seu cultivo no país. Objetivou-se analisar o desenvolvimento morfológico da couve cultivadas em vasos em respostas à diferentes doses de esterco aviário. O trabalho foi conduzido durante o período de novembro 2019 a janeiro de 2020, em casa de vegetação da Universidade Estadual de Alagoas, Campus I, localizada no município de Arapiraca - AL. O experimento foi realizado em DIC (delineamento inteiramente casualisado) utilizando quatro tratamentos (T_1 - solo sem esterco, T_2- solo+ 50g de esterco, T_3- solo + 75g de esterco e T_4 - solo + 100g de esterco) e cinco repetições. O monitoramento morfológico foi realizado em 12 semanas sendo observadas, inicialmente, as seguintes variáveis (pré-colheita): altura da planta, diâmetro do caule e número de folhas; em seguida, na pós-colheita, avaliou-se: comprimento da raiz, massa fresca da raiz, massa fresca da planta, massa seca da raiz e massa seca da planta. Todas as variáveis analisadas foram submetidas à análise de variância, e para comparação de médias, utilizou-se o teste Tukey ($p < 0,05$). Com os resultados obtidos, verificou-se que não houve diferenças significativas entres os tratamentos em resposta às dosagens de esterco.

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Introduction

Butter cabbage (*Bassica olerácea* L. var. acephala) is a vegetable from the Mediterranean coast and belongs to the Brassicaceae family. Its consumption in Brazil has increased due to its nutritional properties and various ways of use in cooking (Camargo Filho & Camargo, 2009).

Brazil has a diversified climate, which favors the production of vegetables, but the presence of pests and other aggravations in the crops is an obstacle to the outdoor cultivation of these vegetables. Therefore, greenhouses are an effective alternative, decreasing several factors such as temperature, luminosity, humidity, disease control, among others (Fernandes, 2017).

Cabbage is very rich in nutrients, with a high content of dietary fiber, calcium, phosphorus, magnesium, manganese, potassium and vitamins A, B1, B2, B3 and C. In Europe and the USA, it´s more common to consume curly leafy cabbage (Lana, 2010).

The use of organic fertilizers, in addition to improving soil quality, contributes significantly to plant development in general (Levrero, 2020). Fertilization, and its effect on the production of different olive species, are important for the rational realization by producers, because the great characteristic of olericulture is precisely the intensive use of the soil, raising a large amount of nutrients per unit of area, which correspond to a considerable portion of production costs (Silva et al., 2014).

For the production of cabbage, it´s very common to use manure of animal origin, which promotes an environment inside the containers where a favorable humidity for the root system is grown, thus having a greater uptake of nutrients for the proper development of the species (Cunha et al., 2014).

According to the study by Klein (2015), referring to the use of different substrates in the cultivation of plant species, several organic materials were described that constitute low-cost and very effective alternatives for the development of seedlings when compared to the substrates available in the trade, such as coconut fiber, sisal, pine bark, composting, sugarcane bagasse and among others.

Thus, in view of the importance of vegetable production in agricultural greenhouses for scientific research, as well as the use of fertilizers of organic origin, this research aimed to monitor the development of the morphological characteristics of cabbage, in response to different amounts of avian manure.

Material and Methods

The research was conducted in a greenhouse (figure 1) of the State University of Alagoas (*Universidade Estadual de Alagoas*), *Campus* I, located in the county of Arapiraca - AL, from November 2019 to January 2020. The climate of the region is of type 'As',

determining the tropical and warm climate, according to the classification of Köppen Geiger (1928).

Figure 1.
Area of the experiment execution.

The experiment was carried out in DIC (completely casual design) with the cultivation of cabbage in 20 polyethylene pots with a capacity of 2.5 L, divided into four treatments and five replications, with different doses of avian manure. The treatments were: T1 - soil without manure, T2- soil + 50g of manure, T3- soil + 75g of manure and T4 - soil + 100g of manure. The seeds used were from the brand Isla(R).

The variables analyzed in the pre-harvest were: plant height (AP), stem diameter (DC) and number of leaves (NF), already in the post-harvest: root length (CPR), fresh root mass (MFR), fresh plant mass (MFP), root dry mass (MSR), plant dry mass (MSP), the experimental design was adapted from Silva (2017).

All variables that were analyzed were submitted to analysis of variance (ANOVA), and for comparison of means the Tukey test ($P < 0.05$) was used, through the SISVAR software, version 5.6 (Ferreira, 2011).

Results and Discussion

Table 1 shows the summary of the analysis of variance of the variables. There was a high dispersion of the data in the variable fresh root mass (MFR) and dry mass of the root (MSR), however, the other variables presented an intermediate coefficient of variation (CV%).

Santos et al. (2021) when working with the phenological development of castor bean (*Ricicnus communis* L.) grown in organic matter of goat management, verified in their research a high dispersion of the data in the variable stem diameter (DC) and a low dispersion in plant height (AP) and number of leaves (NF).

Table 1.
Summary of the analysis of variance of the variables in the treatments.

Causes of variation	L	SQ	QM	F	P	CV%
Plant height	2	0.932	0.977	0.982	0.054	5.39
Stem diameter	0	0.004	0.001	0.8537	0.259	1.31
Number of leaves	7	0.464	2.488	1.126	0.680	4.37
Root length	1	77.31	59.103	0.918	0.454	7.32
Fresh root dough	6	72.16	24.052	1.878	0.741	8.78
Root dry mass	1	1.072	3.690	1.238	0.286	9.39
Fresh pasta of the plant	2	16.64	2.215	1.594	0.300	1.92
Dry mass of the plant	2	5.580	18.526	4.446	0.187	2.91

GL - degree of freedom; (SQ) sum of squares; (QM) average frame; (CV) coefficient of variance; *F - test at 5% probability.

Source: The author (2023).

In Table 2, the results showed that there was no statistically significant difference between the treatments, that is, all plants cultivated with different levels of avian manure showed similar effects.

Araújo et al. (2018) obtained similar results when working with the phenology of the Sunflower (*Helianthus annuus* L.) dwarf variety, they found that the treatment with avian manure also did not differ statistically from the other treatments (bovine and goat).

Table 2.
Comparison of means using the Tukey test at 5% probability for pre-harvest cabbage (*Brassica oleracea* L. *var. acephala*) avian manure.

Treatments	AP (cm)	DC (cm)	NF (u)
Soil without manure	27.59 a	0.32 a	9.64 a
Soil + 50% of manure	28.06 a	0.34 a	10.16 a
Soil + 75% of manure	26.99 a	0.36 a	11.32 a
Soil + 100% of manure	27.63 a	0.33 a	10.24 a

Means followed by different letters in the same column show a significant difference at the significance level of 5% by the Tukey test, plant height (AP), stem diameter (DC), number of leaves (NF), centimeter (cm), unit (u).

Source: The author (2023).

In the post-harvest (Table 3), it´s also noted that there was no statistical difference between the treatments in the following variables: root length (CPR), fresh root mass (MFR), root dry mass (MSR) and fresh plant mass (MFP).

In addition, the variable dry mass of the plant (MSP) presented static difference in the treatment with the addition of 50g of avian manure, while the treatments without and with the addition of 75g, differed from the treatment with 100g of manure, but did not differ from each other.

Table 3.
Comparison of means using the Tukey test at 5% probability for post-harvest cabbage (*Brassica oleracea* L. *var*. *acephala*) avian manure.

Treatments	CPR (cm)	MFR (g)	MSR (g)	MFP (g)	MSP (g)
Soil without manure	32.60 a	6.086 a	1.65 a	9 2.77 a	16.58 ab
Soil + 50% of manure	31.940 a	1 9.91 a	3.45 a	1 01.54 a	17.30 a
Soil + 75% of manure	27.340 a	1 8.96 a	3.46 a	11 1.14 a	16.36 ab
Soil + 100% of manure	25.588 a	1 0.50 a	3.05 a	8 3.026 a	12.98 b

Means followed by different letters in the same column show a significant difference at the significance level of 5% by the Tukey test. Root length (CPR), fresh root mass (MFR), root dry mass (MSR), fresh plant mass (MFP), plant dry mass (MSP), grams (g) and centimeter (cm).

Source: The author (2023).

Final considerations

All treatments had beneficial effects for the variables evaluated, however, there was no significant difference between the treatments in the pre and post-harvest, however, the adoption of organic substrates is important to keep the plant healthy and the soil fertile. Further research is suggested in order to evaluate the performance of cabbage in different organic substrates under natural field conditions.

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