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Use of Biofertilizers in Lettuce Growing (*Lactuca sativa* L.)[1]

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Abstract:

The present research has, as object of study, the action of biofertilizers, of vegetal and animal origin, in the development of lettuce (Lactuca sativa L.). For this, the general objective of the work was to compare the influence of different types of biofertilizers (bovine; poultry; vegetable) on lettuce cultivation. The experiment was carried out in the horticulture sector (ICA) of the Federal Rural University of Amazônia – UFRA, where 6 applications of biofertilizers were carried out in 5 uniform beds of 1.2 m², therefore 20 lettuce seedlings spaced 0.25 m apart. To obtain the results, there was the measurement, with the aid of a scale, of variables related to plant development, namely: leaf fresh mass, stem fresh mass, total fresh mass and number of leaves. It was possible to observe with this study, differences in the development of lettuce from the measurement of the predicted variables (total mass, number of leaves, leaf mass and stem mass) according to the type of treatment applied, with emphasis on the biofertilizer based on of chicken manure, which presented the best results.

Keywords: Horticulture. Productivity. Biofertilizers

1. INTRODUCTION

Lettuce (*Lactuca sativa* L.) is one of the most consumed vegetables in the country, and from the 1980s onwards, the curly variety gained most of the market (SALA *et al*, 2005). It is a leafy vegetable sensitive to climatic factors such as temperature (average of 25° C) and luminosity. Of probable origin in the Mediterranean, it belongs to the

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Asteraceae family, which was introduced in Brazil by the Portuguese in 1650. It has a short reproductive cycle, ranging from 45 to 60 days, and with the development of new varieties, more resistant to climate, lettuce is widely produced throughout the country (MALDONADE *et al*, 2014).

This vegetable is well appreciated in Brazil, containing essential vitamins and minerals for the human body and its cultivation can be reduced in a number of days, adopting nutritional practices during production, such as: fertilization, use of biofertilizer and application of agro-industrial inputs (SILVA *et al*, 2008). As Chiconato (2013) states, based on the need to ensure high productivity and meet market demand, the development of inputs capable of providing significant levels of nutrients to plants has become extremely important for agriculture.

According to Roel (2007), the use of chemical or synthetic inputs offers great risks, not only to the producer or rural worker, but also to the surroundings where such products are used, as contamination of water bodies and even the environment may occur. biosphere in general, in addition to the fact that such fertilizers considerably increase the final value of production.

Biofertilizers, which come from organic matter, appear, in this scenario, as a viable, financial and ecological alternative, since their production does not depend on raw materials that are difficult to access or artificial, and therefore there are several ways to obtain them. According to Medeiros (2007), this input, as it is based on animal manure or plant remains, can be produced by the producers themselves, thus generating savings and proposing a balance between the development of agriculture and the protection of the environment.

In studies such as Santos (2014) and Lopes (2017), it was possible to verify the efficiency of the use of biofertilizers in the supply of nutrients to the plants, relating their application to the general characteristics of the cultivars. Santos (2014), in his experiment of approximately 21 days of analysis in arugula plants, observed, mainly, the growth of the root system of the plants directly related to the increase in the dilutions of the biofertilizer. Lopes (2017), after evaluating, for 3 years, the growth of the fruit of the Nanicão banana tree, subjected to the application of 4 different types of biofertilizers, reached results considered optimal in cultivation. However, the author points out that vegetable cultivars react differently to the application of organic inputs, given the particular needs of each vegetable.

Thus, based on the development of the research and study of the literature, the hypotheses raised are: with the addition of biofertilizers, there was an increase in the productivity of the lettuce crop, due to an increase in essential nutrients to the plant; the development of the lettuce crop is independent of the characteristics of the applied biofertilizer, whether of animal or vegetable origin.

The objectives of this study consisted, mainly, in comparing the efficiency of biofertilizers of vegetal and animal origin in the development of the lettuce culture (*Lactuca sativa* L.), besides evaluating the effect of biofertilizers, of animal and vegetal origin, in the production of lettuce; evaluate productivity using the following variables: fresh leaf mass, fresh stem mass, total fresh mass and number of leaves.

2. MATERIAL AND METHODS

The research has an experimental character and consists of the evaluation of liquid residues formed from the anaerobic fermentation of manure and vegetables in

biodigesters (biofertilizers). The type of animal biofertilizer selected for the analysis consists of cattle and poultry manure, taken from the cattle and poultry sectors respectively of the university itself. With all the raw materials already obtained, the organic material was transferred to 9 units of PET bottles (3 bottles with bovine manure, 3 bottles with chicken manure and 3 bottles with plant material) PET of 2 liters each, completing half of each container with the main material (manure and vegetables). After this stage, 600 ml (milliliters) of water containing terra preta were added to start the fermentation process and the bottle was sealed with a lid containing a small hole, where the hose passes, releasing methane gas and preventing the entry of oxygen, concluding the manufacture of the biofertilizer in at least 30 days. Figure 1 shows the bottles used in the production of plant and animal biofertilizers.

Fig1. Bottles containing biofertilizers produced from vegetables, chicken manure and cattle manure.

For the production of seedlings, the variety chosen for the biofertilizer test was lettuce. The germination of the seedlings occurred in a seedbed, containing 3 seeds in each cell, in which 80 seedlings were produced in total. After the juvenile period, the seedlings were transplanted to the field, requiring a spacing of 0.25m (meters) between plants. Five beds were produced (4 for experimentation and 1 for reserve seedlings) with dimensions of 1.2 m² each, holding 20 lettuce seedlings evenly divided on the ground. In addition, all beds have, among the 20 plants, 5 classified as controls, which did not receive biofertilizer application.

The bed received an initial fertilization with an organic substrate (chestnut bark) and urea – in order to obtain a uniform crop for the analysis of the biofertilizer test, in addition to the application of mineral fertilizer and tobacco, in order to eliminate parasites present in the soil. The use of biofertilizer began in the juvenile period, after the vegetables were already located in the field, being irrigated twice a day, using a watering can. The application was carried out every four days, for four weeks, with six applications in total. The leaf mass variable refers to the weight of the leaves only, while the total mass refers to the weight of the leaves plus the weight of the stem.

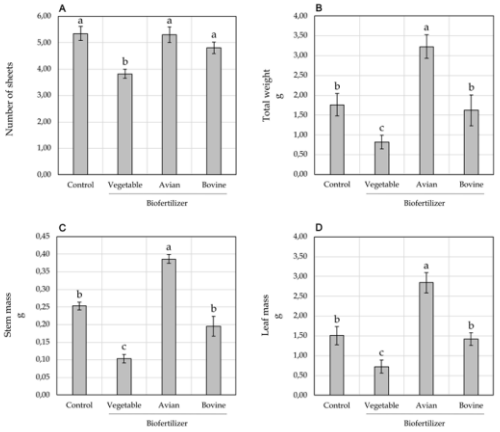
After collecting the plants, the established variables were analyzed (leaf fresh mass; stem fresh mass; total fresh mass; number of leaves) in order to determine which type of biofertilizer was more effective. For this, a precision scale was used to gather such data and they were arranged in averages, in order to facilitate their visualization.

Statistical analysis of the variables and generation of graphs was performed using the R-Studio software, version 1.3.1093, using the ExpDes.pt package and the "dbc" function. This package performs analysis of normality of the residues by the Shapiro-Wilk test and equality of variances by the Oneillmathews test, also performing the ANOVA. Subsequently, the data were submitted to Tukey's Post-Hoc test. These analyzes were considered at a significance level of 5%. For the multivariate analysis of principal and factor components, the package factoextra and FactoMineR were used.

3. RESULTS AND DISCUSSION

During the biofertilizer fermentation cycle, it was observed that the organic matter present in the bottle began to decompose around the 3rd day of storage, releasing methane gas. Around day 35, the biofertilizer stabilized, characterizing a well-conducted fermentation process (SANTOS, 1991; NETO, 2006).

Fig2. Number of leaves (a), total weight (b), stem weight (c) and leaf weight (d) of *Lactuca sativa* submitted to different types of biofertilizers. Different letters indicate statistical differences between treatments (p < 0.05) based on Tukey's test.

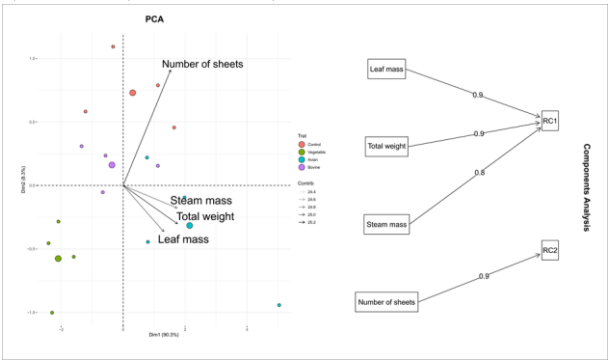


It can be seen in Figure 2 that the avian biofertilizer had a significantly higher total, stem and leaf weight than the control, with respective increases of 86.5, 56 and 88.1%. However, no statistical differences were verified between the number of leaves when compared to the control.

According to Silveira Júnior (2015), who carried out an experiment based on biofertilizer produced with poultry manure in pasture production, the use of the input showed positive data, since the variables analyzed by the authors contrasted between the application of biofertilizer and the control group.

For Sousa (2013), during the course of his experiment with Jatropha culture, from the addition of bovine biofertilizer, a significant increase was observed in relation to the established variables, while, in this research, similar results were not obtained.

Fig 3. Principal Component Analysis (PCA) Dim1 x Dim2, indicating the contribution of the variables in the dimensions and weight of the contribution of the variables (RC1 and RC2) of lettuce (*Lactuca sativa*) submitted to different biofertilizers.



The relationships between the variables number of leaves, total mass, stem and leaf under different biofertilizers can be visualized from the multivariate analysis introducing the Principal Component Analysis method in figure 3. The variability of the data is explained in 90% on axis 1 and 8% on axis 2, totaling 98% of the total data variability.

Roel (2007), in his studies on the use of biofertilizers in lettuce cultivation, found positive results for the established variables (fresh mass, dry weight, dry mass and head diameter). According to the author, the use of plant and avian biofertilizers did not interfere with the development of the plant, as well as in the present experiment.

Although the literature points out different benefits in the use of biofertilizers, as aids in the development of vegetables, at the end of the experiment, it was observed that, for the most part, the plants did not grow considerably, nor did they reach measurements compatible with harvest measurements. Chiconato (2013), from the use of biofertilizer produced with bovine manure, obtained averages of fresh mass around 22.6g and number of leaves, on average, 10.2 leaves in the period of 55 to 70 days of experiment.

Roel (2007), in his experiment carried out from the use of biofertilizer based on poultry and vegetable manure, did not obtain different results between the applications and the control, corroborating, in part, with the result of this study. According to the author, such results may have arisen from the availability of nutrients present in the soil before the biofertilizer applications.

Thus, it is understood, from the results obtained, that the use of biofertilizers in the cultivation of lettuce (*Lactuca sativa* L.) was efficient, specifically in the poultry substrate.

4. CONCLUSION

It was possible to observe with this study, differences in the development of lettuce (*Lactuca sativa* L.) from the measurement of the predicted variables (total mass, number of leaves, leaf mass and stem mass) according to the type of treatment applied,

with emphasis on the biofertilizer based on chicken manure, which presented the best results.

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