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Quality of Organic Compost for Vegetable Planting †

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Abstract: Composting is a technique used to obtain a nutrient-rich, plant-like organic compost. Considering that there are few studies that shows the efficiency of these composts in the cultivation of vegetables, the objective of this study was to evaluate, in the cultivation of lettuce, the quality of the final compost obtained from tree pruning, dairy sludge and coffee grounds—compost 1; grass, dairy sludge and coffee grounds—compost 2; grass, dairy sludge, coffee grounds and boiler ash—compost 3. Lettuce (*Lactuca Sativa* L.) were planted for the study with the three composts and a control object-without compost, and a portion with NPK fertilizer. The evaluated parameters were plant growth, head diameter, leaf number, dry mass and fresh mass. The results shows statistical similarities between the organic fertilizers and NPK fertilizer in the evaluated parameters and the control plot presented inferior results to the other plots, emphasizing the need for fertilization at each planting.

Keywords: composting; *Lactuca sativa* L.; dairy sludge; boiler ash

1. Introduction

In 2010, in Brazil, the National Solid Waste Policy was implemented, which, together with other determinants, provides for the treatment of municipal solid waste via composting in the country [1].

Composting is a technique for recycling organic waste that, from carbon and nitrogen source materials, provides a propitious environment for degradation of organic matter at high efficiency [2]. One of the advantages of composting is the formation of a more humid, soil conditioner-quality organic matter that can be applied as organic fertilizer because it is more easily assimilated to plants [2,3]. Soil conditioners are products that improve the chemical, physical and health characteristics of the soil, and in the case of organic matter also provide nutrients to plants [4].

In studies relating vegetable planting and development to the use of organic composts, [5–7] used crop diameter, leaf number, plant height, fresh and dry mass to study the performance of lettuces. These parameters are used to obtain the culture response to the adopted fertilization method.

In this sense, the objective of this study was to evaluate the development of lettuce (*Lactuca Sativa* L.) using three organic composts with different compositions.

2. Materials and Methods

The experiment was carried out at the Federal Technological University of Paraná, Londrina, Brazil, 23°18′32.1″ S latitude, 51°07′00.1″ W longitude and average altitude of 610 m.

The climate of the region, according to the Köeppen classification, is subtropical humid, with hot summers and rainfall concentrations, with average annual precipitation between 1200 and 1400 mm and little frequency of frost in winter [8].

Lettuce (*Lactuca Sativa* L.) was chosen because of its easy handling during the summer and its adaptation to tropical conditions. Cultivation followed the methodology described by [9] with some adaptations. The planting was done in the soil, as indicated for leafy vegetables. The spacing between each vegetable was 30 cm, as recommended by [10].

Three organic composts were used for planting, obtained by composting, in addition to NPK inorganic fertilizer commonly used in horticulture.

The amount of fertilizer added to the beds was determined according to the nutritional requirement of lettuce nitrogen for good development, which, according to [11] is 80 kg ha^{-1}. Considering the need for nitrogen and knowing the amount of this nutrient present in each of the composts, the dry matter fertilizer mass was calculated and added to each useful area of the plots, and their compositions are expressed in Table 1.

The parameters analyzed during and at the end of the test were head diameter (HD), leaf growth (LG), leaf number (LN), fresh mass (FM) and dry mass (DM). The experiment was conducted for 49 days, being the first data collection of HD, LG and LN 28 days after planting, and the second collection of the same parameters plus FM and DM, 49 days after planting.

To obtain the FM and DM, only the aerial part of the plant was used, as recommended by [10]. Thus, the plants were harvested, packed in properly indicated paper bags and weighed on an analytical balance, which was the FM. After weighing, the samples were taken to the forced air circulation oven at 50 °C for 72 h, obtaining the DM, according to [6,10]. Data were subjected to analysis of variance and the Tukey multiple comparison test (HSD (α = 0.05)) was performed.

Table 1. Plots and compositions.

Plot	Composition
Control object	No fertilizes
Compost 1 (T1)	Pruning tree + Dairy Sludge + Coffee Ground
Compost 2 (T2)	Grass + Dairy Sludge + Coffee Ground
Compost 3 (T3)	Grass + Dairy Sludge + Coffee Ground + Boiler Ash
NPK (T4)	Nitrogen, Phosfor e Potassium

3. Results and Discussion

Tables 2 and 3 shows the mean values and standard deviation obtained for HD, LG, LN, FM and DM.

Table 2. Average values and standard deviation for HD, CF and LN.

Plot	Head Diameter (HD) (cm)	Leaf Growth (CF) (cm)	Leaf Number (LN)
Control object	18,000 ± 2000 b [1]	11,286 ± 2059 a	15,571 ± 2370 a
T1 [2]	23,143 ± 4845 ab	14,143 ± 1574 a	23,286 ± 4957 a
T2	25,571 ± 5442 a	14,286 ± 2215 a	26,000 ± 7958 a
T3	22,286 ± 6945 ab	12,286 ± 4071 a	21,714 ± 10,436 a
T4	22,750 ± 3196 ab	13,250 ± 1581 a	24,500 ± 5632 a

[1] Equal letters in the column indicate the absence of significant differences between plots by Tukey's Multiple Comparison Test (α < 0.05). [2] T1—Tree pruning, Dairy Sludge and Coffee grounds; T2—Grass, Dairy Sludge and Coffee grounds; T3—Grass, Dairy Sludge, Coffee grounds and Boiler Ash; T4—NPK.

As expected, the control plot presented the lowest values of the HD, LG and LN parameters compared to the others, showing that only the nutrients contained in the soil are not enough for the good growth of the plants. The influence of organic compost on the soil is also observed: plots using composts 1 and 2 had higher HD values, and the values obtained by composts 1, 3 and NPK did not show significant differences, while compost 2 was significantly higher.

Moreover, regarding LG and LN parameters, no significant differences are presented between lettuce performance using NPK and organic composts, being a substitute alternative.

Table 3. Average values and standard deviation for FM and DM.

Plot	Fresh Mass (g)	Dry Mass (g)
Control object	0,058 ± 0,011 a [1]	0,020 ± 0,001 a
T1 [2]	0,104 ± 0,053 a	0,024 ± 0,004 a
T2	0,120 ± 0,053 a	0,025 ± 0,004 a
T3	0,126 ± 0,079 a	0,024 ± 0,005 a
T4	0,103 ± 0,032 a	0,023 ± 0,003 a

[1] Equal letters in the column indicate the absence of significant differences between plots by Tukey's Multiple Comparison Test ($\alpha < 0.05$). [2] T1—Tree pruning, Dairy Sludge and Coffee grounds; T2—Grass, Dairy Sludge and Coffee grounds; T3—Grass, Dairy Sludge, Coffee grounds and Boiler Ash; T4—NPK.

As in Table 2, the control plot presented lower values of FM and DM. Again, lettuces that received organic compost in their planting had the highest values in these parameters, which, despite not presenting significant differences in relation to the other plots, presents itself as a soil conditioner alternative and, consequently, acting in the best growth of the vegetation present there. According to [12] the application of organic compost generates residual effect of nutrient release, which does not happen with the application of mineral fertilizer.

According to [6] the presence of organic matter has great advantage in the cultivation of vegetables because it has an immediate and residual effect by the mineralization process, being visible the effect on the dry mass, since it shows how much the plant developed, according to with the availability of nutrients present in the soil. Thus, in the control plot it is noticed the lower availability of organic matter, having lower value of dry mass, while in the plots using organic composts (obtained by decomposition of organic matter), the dry matter contents were higher.

4. Conclusions

The control plot showed lower performance than the other plots in all parameters analyzed, as expected, highlighting the need to apply some source of nutrients to the soil. Regarding leaf growth, leaf number, dry mass and fresh mass the plots were statistically equivalent. Regarding the diameter, plot 2 obtained the best performance.

Thus, it is concluded that the organic compost has the same statistical efficiency as the commercial fertilizer, being an alternative to the use of NPK, because besides providing nutrients to the soil, the organic compost has soil conditioner characteristics, improving physical and chemical properties. In addition, the presence of fertilizer helps in the better development of vegetables.

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