AMENDMENT OF ORGANIC COMPOST PROPRIETIES THROUGH COMPOSTING-VERMICOMPOSTING INTEGRATION

MELHORAMENTO DE COMPOSTO ORGÂNICO POR MEIO DA INTEGRAÇÃO ENTRE COMPOSTAGEM E VERMICOMPOSTAGEM

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Abstract

The aim of the current study is to evaluate the effects of integrating composting-vermicomposting to improve the organic compost as from the physicochemical analyses and by their application on *Brachiaria decumbens* growth. Experiments carried out in composting unit used 30:1 ratio of nitrogen-rich organic waste (raw vegetables, fruits and cooked food) and carbon (dry grass) in 2 pile configurations (with, or without passive aeration). After 60 days, product was subjected to vermicomposting for 45 days. Composts were analyzed to check their quality (temperature, pH, moisture, organic carbon, nitrogen and phosphorus levels), as well as compared to each other as biofertilizers (10% (w/v)) for *B. decumbens* growth. Data have suggested that the vermicomposting process improved the compost pile by increasing its nitrogen (1.26% to 1.95%), phosphorus (0.64% to 1.2%) and organic carbon contents (17.1% to 18.9%). *B. decumbens* growth showed no significant differences between those treatments, which indicates that organic fraction should be increased (>10%) to release their nutrients to plant.

Keywords: Composting. Vermicomposting. Organic manure. Forage crop.

Resumo

O objetivo desse trabalho foi avaliar os efeitos da integração da vermicompostagem no melhoramento de composto orgânico a partir de análises físico-químicas e da sua aplicação no crescimento de *Brachiaria decumbens*. Os experimentos foram conduzidos em pátio de compostagem (por 60 dias) utilizando 30:1 de resíduos orgânicos ricos em nitrogênio e carbono em duas configurações de pilhas (sem aeração e com aeração facilitada); seguido de tratamento via vermicompostagem (45 dias). Os compostos foram avaliados quanto à temperatura, umidade, carbono orgânico, nitrogênio e fósforo. Após a vermicompostagem, o vermicomposto e composto das pilhas foram comparados com fertilizante sintético (8N:25P) e controle (solo *in* natura) quanto ao potencial de fertilização 10% (p/v), a partir do crescimento da *B. decumbens* (22 dias). Os

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resultados demonstraram que a vermicompostagem aumentou os teores de nitrogênio (1,26 para 1,95%), fósforo (0,64 para 1,2%) e carbono orgânico (17,1 para 18,9%) das pilhas compostadas. O crescimento da *B. decumbens* não apresentou diferença significativa entre os tratamentos, o que indica que a concentração dos compostos orgânicos deve ser acrescida (>10%), para assim disponibilizar os nutrientes para a planta.
Palavras-chave: Compostagem. Vermicompostagem. Composto orgânico. Forrageiras.

1. INTRODUCTION

Organic solid waste accounts for 50% of the total urban solid waste generated in Brazil (IPEA, 2012; ABRELPE, 2017). This fraction is often sent to landfills or improperly disposed in dumps, a fact that hinders the application of sustainable treatment techniques for (MMA, 2012; ABRELPE, 2017). Composting or vermicomposting are the technics mostly used to treat this fraction. They help reducing the volume of waste sent to landfills and generate appropriate final product to be used as nutrient for soil and plants (TOGNETTI et al., 2007; WU et al., 2014).

Composting is a biological process based on mesophilic and thermophilic microorganisms that leads to aerobic decomposition of solid organic waste (INSAM and BERTOLDI, 2007). The resulting product is rich in humus and minerals, as well as presents physical, chemical and biological features capable of improving soil proprieties (OLIVEIRA, 2001; BARTHOD et al., 2018). Vermicomposting is similar to composting; however, its degradation process takes place due to interaction between mesophilic microorganisms and earthworms, and it generates a stable material called vermicompost (WU et al., 2014; LIM et al., 2016). Both processes generate an organic compost that can be used as organic manure; however, vermicomposting enables faster organic waste degradation, which makes the integration of both techniques more attractive (NDEGWA and THOMPSON, 2001; SINGH and SHARMA, 2002; AQUINO and ASSIS, 2005; HE et al., 2016).

Several studies have investigated the likelihood of integrating vermicomposting and composting technics (NDEGWA and THOMPSON, 2001; WU et al., 2014; HE et al., 2016; LIM et al., 2016; MALIŃSKA et al., 2017; ESMAEILI et al., 2020). Vermicomposting microorganisms act as mechanical blenders that fragment the organic compost and increase the area exposed to degradation. Consequently, this process reduces C:N ratio and increases the amount of humic substances, as well as of essential macro and micronutrients (OLIVEIRA et al., 2005; USMANI et al., 2018). Furthermore, the final product presents higher CEC (cationic-exchange capacity), ability to retain water and uniform particle distribution (DOMÍNGUEZ, 2004; LIM et al., 2016).

Vermicompost use as organic manure in agricultural practices has significantly increased (ARANCON et al., 2003; ALI et al., 2007; IEVINSH et al., 2011; MORALES-CORTS et al., 2014; BALCI et al., 2019; BLOUIN et al., 2019), since chemical fertilizers can affect all ecosystems. For example, the use of expensive nitrogen-rich fertilizers can change physicochemical and microbiological proprieties of the soil and affect nitrogen (N) and carbon (C) cycles (MATOCHA et al., 2016). In addition, excess of fertilizer can lead to runoff and contaminate aquatic systems due to eutrophication (WHITE and BROWN, 2010; SÁNCHEZ et al., 2017). On the other hand, the use of organic compost helps restoring degraded soils due to introduction of organic carbon, as well as of macro and micronutrients in them. In addition, it helps reducing Brazilian soils' acidity level because the final product pH is stabilized at approximately 7 (LANDGRAF et al., 2005; SÁNCHEZ et al., 2017; BARTHOD et al., 2018).

Gramineous plants such as *Brachiaria* (*Brachiaria decumbens* Stapf.) are significantly used in Brazil, which ranks first among countries exporting beef and tropical forage crop seeds

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(ASSIS, 2009; FERREIRA and FILHO, 2019). Nonetheless, in case plant growth does not assure the conservation of soil proprieties and animal productivity, it is necessary using chemical fertilizers to maintain forage crops (VASQUES et al., 2019), otherwise deforestation is adopted to open new pasture areas (OLIVEIRA et al., 2004; ASSIS, 2009). Some scholars have suggested that gramineous planting in combination with pulses has promoted organic matter and nitrogen source in the soil, as well as that soil cover decreased erosion and nutrient leaching processes (COSTA et al., 2004; VALENTIM, 2005; VASQUES et al., 2019); however, studies focused on investigating the use of organic compost as manure source to improve *Brachiaria* growth are scarce in the literature. Thus, the production of low-cost biofertilizers based on composting or vermicomposting comprising essential nutrients to plant growth (AHMAD et al., 2008; ARANCON and EDWARDS, 2010) is an attractive alternative to treat organic waste, as well to be used in agriculture.

Thus, the aim of the current study was to evaluate the effect of organic composts resulting from the integration between composting (with, and without, passive aeration) and vermicomposting on *Brachiaria decumbens* crops, based on the analysis of physicochemical parameters.

2. MATERIALS AND METHODS

The experiment was divided into three stages, namely: composting of organic solid waste, vermicomposting application to the end product resulting from the composting process, and *Brachiaria* cultivation, as follow:

2.1 Composting of organic solid waste

The pilot-scale composting test was performed in concrete-proof area (18.49 m²), without surface coverage and 2% slope. Organic solid waste supposed to be discarded in a local landfill (Uberaba, MG, Brazil) was collected for two weeks in supermarkets, fairs and at the university restaurant of Federal University of Triângulo Mineiro (UFTM), where the experiments were conducted for 60 days.

Sieved organic wastes (size ranging from 5 mm to 7 mm) were placed in a basis built with dried leaves and disposed in layers comprising three parts of carbon (dry grass) and one part of nitrogen source (raw vegetables, fruits, cooked food and bovine manure) in two configuration types (Table 1). In this case, manure was used as source of microorganism to enable organic material degradation.

Table 1 Experimental conditions of the composting piles

Samples	Experimental conditions
Pile 1 (control)	Grass pruning, rest of raw vegetable, fruits, cooked food and 1% (w/v) of bovine manure
Pile 2 (passive aeration)	Grass pruning, rest of raw vegetable, fruits, cooked food, 1% (w/v) of bovine manure and 6 tubes PVC (250 mm)

C:N (30:1) as initial ratio

Piles were finished with mean mass of 69.2 kg (P1) and 75.7 kg (P2), 90 cm height and 80 cm diameter, by taking into consideration lateral space equal to their diameter to enable revolving them. In the first month, piles were subjected to aeration on a weekly basis (each 4 days), whenever excess/loss of moisture or temperature decrease was observed. At the end of the composting process, the final product was transferred to a dry and closed place and kept at room temperature to be properly used in the following experimental stage, as described below.

2.2 Vermicomposting integration in composted product

The product of piles 1 and 2 was subjected to new degradation process in vermicomposting system for 45 days (second stage). The initial composted material was placed in 13 L plastic containers (45 cm x 13 cm) and kept in area protected from solar radiation and aerated on a daily basis. After the material was humidified with distilled water, 80 earthworms belonging to species *Eisenia foetida* were put in it. Samples were analyzed based on physicochemical parameters throughout the composting and vermicomposting process.

2.3 Physicochemical Analyses

Temperature in the composting test was measured on a daily basis by placing a mercury thermometer (60 cm) at the center of the piles. Four representative samples (50 g) collected at different heights of the piles (top, middle up, middle down and basis) had their moisture content and pH measured on a weekly basis. Parameters such as total organic carbon (TOC) and total nitrogen (TN) were measured 30 days after the composting test and at the end of the experiments (60 days).

In addition, pH, phosphorus (P), nitrogen and organic carbon levels in samples collected (50 g) in each central point of the material were measured every two weeks throughout the vermicomposting process, based on protocol adapted from Silva (2009). Organic carbon, phosphorus and nitrogen content analyses were based on the "Standard Methods for the Examination of Water and Wastewater" by the American Public Health Association (APHA; AWWA; WEF, 2012); pH values were determined with the aid of pH-meter (MP10) by using distilled water-soluble extract at the ratio of 1:20 (w/v), whereas moisture content (M) was quantified by drying samples in oven at 105 °C until constant weight was reached. These parameters in the vermicompost and compost pile were compared to each other according to the Brazilian legislation for organic compost and biofertilizers (BRASIL, 2009).

2.4 *Brachiaria* seed cultivation

The gramineous plant was selected for two reasons, namely: 1) it plays a significant role in the national scenario of beef cattle breeding since it accounts for 85% of pasture lands in Brazil; and 2) it has strong potential to be used for forage crop and is highly adaptable to low-fertility acid soils (ASSIS, 2009; VALLE et al., 2009). Biomass accumulation rates recorded for *Brachiaria* seedlings (root and shoot dry mass) were compared among six treatments based on manure type (Table 2).

The soil *in natura* used in these treatments is classified as dystrophic Red Nitosol typical of the Brazilian Southeastern and Center-Southern regions. This soil has acid pH (5.1), high iron content (38.8 g dm^{-3}), as well as low contents of organic matter (29.3 g dm^{-3}), total organic carbon (16.99 g dm^{-3}), phosphorus (4.8 g dm^{-3}) and of other micronutrients such as calcium (Ca) (10.2 mmolc dm^{-3}), potassium (K) (0.85 mmolc dm^{-3}), magnesium (Mg) (3.7 mmolc dm^{-3}) and zinc (Zn) (0.4 mg dm^{-3}). Soils like this one present high porosity level (>50%) and respond to fertilizer

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and corrective agent applications in a positive way due to its high CEC; therefore, they are suitable to be used in crops and in other practices such as agropastoral activities (SANTOS et al., 2018).

Brachiaria seeds (15 g) were added to 18 pots (8.64 cm³) filled with Red Nitosol subjected to irrigation on a daily basis for 22 days; this stage comprised three repetitions for each treatment, as described in Table 2. Organic composts and synthetic fertilizer were diluted in distilled water, based on method adapted from Gonçalves et al. (2014). These dilutions were based on values of synthetic fertilizers often used to grow *Brachiaria* plants (1 t ha^{-1}); thus, they used 1% (w/v) of synthetic fertilizers and 10% (w/v) of vermicompost and pile composts (1:100 and 1:10, respectively).

Table 2 Treatments (manure types) to evaluated the growth of *Brachiaria*

Treatments	Experimental conditions
CP1	Compost pile 1 + soil *in natura*
CP2	Compost pile 2 + soil *in natura*
VC1	Vermicompost pile 1 + soil *in natura*
VC2	Vermicompost pile 2 + soil *in natura*
SF	Synthetic Fertilizer (8N:25P) + soil *in natura*
CT	Control (soil *in natura*)

Synthetic fertilizer in soil 1:100 (w/v); vermicompost and pile compost in 1:10 (w/v)

Biomass accumulation was evaluated at the 22^{nd} manuring day, based on the amount of root and shoot dry mass in each sample (pot). Total dry mass was measured after samples were dried in air circulation oven at 65 °C, for 48 h, until constant weight was reached.

2.5 Statistical analyses

Dry mass values recorded for the evaluated samples were compared among six treatments (manure types) based on analysis of Variance (ANOVA) conducted in *Statistica* software; significant differences were set at $p<0.05$.

3. Results and discussion

Based on the herein analyzed physicochemical parameters, the compost in pile 2 was more mature than that of the control; this pile also presented lower C:N ratio and higher initial mass reduction, which means that passive aeration may have accelerated organic compost degradation due to oxygen supply for microorganism metabolism process, since the treatment was fully aerobic.

Piles' temperature reached the thermophilic stage (>55 °C) in a short period-of-time (1 or 2 days); however, it decreased from the fifth experimental day on until it reached the mesophilic (30 to 45 °C) and maturation stages (25 to 20 °C), as shown in Figure 1 (SÁNCHEZ-MONEDERO et al., 2010; LIM et al., 2016).

The temperature of pile 2 decreased faster than that of pile 1 in the first week; it happened due to heat released through the pipes embedded to enable aeration (Figure 1). However, no treatment reached the temperature necessary to mitigate or kill pathogens (65 °C).

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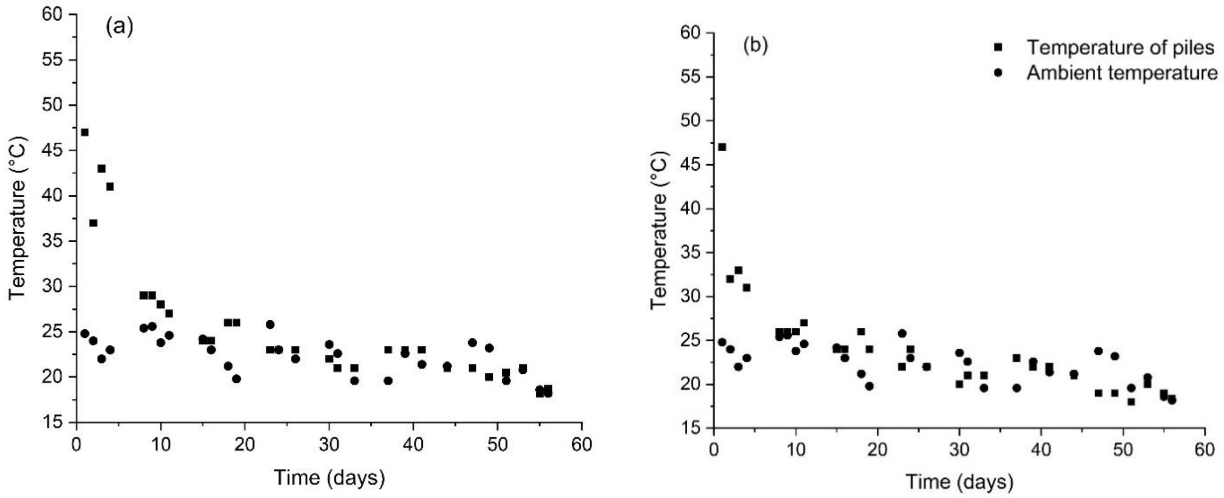

Fig. 1 Temperature variation during the composting process in the pile 1, control (a) and pile 2, passive

The temperature inside the piles is mostly affected by their moisture content and size. In this case, their short size (90 cm high) as directly contributed to dissipate the heat from convection. Similar results were observed by Cotta et al. (2015) and Vich et al. (2017), according to whom small piles enabled heat dissipation and did not reach high temperatures during the composting test.

Both treatments have shown similar moisture contents (60.6% in P1 and 62.1% in P2), which exceeded the value set by the Brazilian Legislation (BRASIL, 2009) (Table 3). Materials got saturated for two experimental weeks (third and fourth analyses) due to rain and lack of roof area. Piles were added with dry grass and subjected to aeration to reduce moisture contents throughout the experiments; however, lower temperature hindered moisture stabilization.

Table 3 Physicochemical parameters during 60 days of composting and some values licensed to Brazilian legislation for use as organic compost

	Pile 1				**Pile 2**			
Period of analyze (days)	**M (%)**	**pH (-)**	**OC (%)**	**C:N (-)**	**M (%)**	**pH (-)**	**OC (%)**	**C:N (-)**
14	51.0	7.01	-	-	51.2	7.02	-	-
21	53.0	7.22	-	-	46.4	7.10	-	
28	63.6	8.64	22.3	16.9	64.2	8.69	22.4	15.2
35	60.4	7.57	-	-	61.1	7.46	-	-
42	51.4	7.64	-	-	62.7	7.74	-	-
50	54.9	7.51	-	-	55.4	7.48	-	-
60	60.6	7.18	17.8	16.1	62.1	7.16	14.8	12.5
Legislation[1]	≤50	≥6	≥15	≤20	≤50	≥6	≥15	≤20

[1]Normative Instruction No 25 of July 23, 2009.

Based on Table 3, pH in P1 and P2 has increased in the second and third experimental weeks; subsequently, it decreased to 7.18 and 7.16 in piles 1 and 2, respectively; these values are considered adequate by the Brazilian legislation (≥6). Materials in the initial composting process produced organic acids that acted as intermediary products in bacterial metabolism. Next, pH in P1 and P2 has increased to values ranging from 8 to 9 due to free ammonium formation and to organic acid and volatile fatty acids decomposition (DIAZ and SAVAGE, 2007; GARCÍA-SANCHEZ et al., 2017); in the end of the composting process, pH tended to neutrality due to humus formation (GAJALAKSHMI and ABBASI, 2008).

Compost maturity was evaluated based on nitrogen and carbon contents in the 30th experimental day and at the end of the experiment (60th day), as shown in Table 3. According to Jiménez and García (1989), C:N ratio and pH value are good final product-maturity indicators. As previously mentioned, pH levels in both treatments reached approximately 7.2; this outcome has indicated compost stability (JIMÉNEZ and GARCÍA, 1989). C:N ratios observed in the current study are in compliance with the Brazilian legislation (≤20), although it does not establish the best value; however, studies have suggested that material stabilization takes place at C:N ratio of 18:1 and at organic compound maturity of approximately 10:1 (KIEHL, 1985; BENITO et al., 2003; SAHA et al., 2010). Both treatments presented C:N ratio lower than 18:1 at the 30th experimental day; however, the C:N ratio in the compost of pile 2 was closer to 10:1 than that of the control in the end of the composting process.

Organic carbon contents in the piles recorded similar results (22%) after 30 composting test days; however, they decreased to 17.8% (in pile 1) and 14.8% (in pile 2) at the end of the process. The organic carbon content in the compost of the control group was in compliance with the Brazilian standard (≥15%), whereas that of pile 2 was close to the standard value.

Piles comprised fast-degradation wastes (cooked food, fruits and vegetables) that were easily metabolized during the mesophilic stage; thus, 60 days were enough for both composts to reach the maturity stage, despite the low temperature and high moisture content observed in the current study.

Overall, both composting treatments conducted at small pilot-scale were capable of treating 145 kg of organic waste; they recorded mass reduction by 53.5% and 67.1% in the control group and passive aeration pile, respectively, as well as produced 57.1 kg of organic compost at the end of the composting process. The aforementioned mass reduction mainly happened due to CO_2 and H_2O release during organic material degradation and waste transformation into stabilized organic matter (FERNANDES and SILVA, 1996; INSAM and BERTOLDI, 2007; QIAN et al., 2014).

3.1 Vermicomposting integration in composted product

The vermicomposting technique enabled improving the compost deriving from precomposting due to increased N, P and OC contents. Both vermicomposts presented similar temperature, which ranged from 20 °C to 35 °C, throughout the experiment (Figure 2) and did not reach the highest temperature set for earthworms (35 °C) (DOMÍNGUEZ, 2004).

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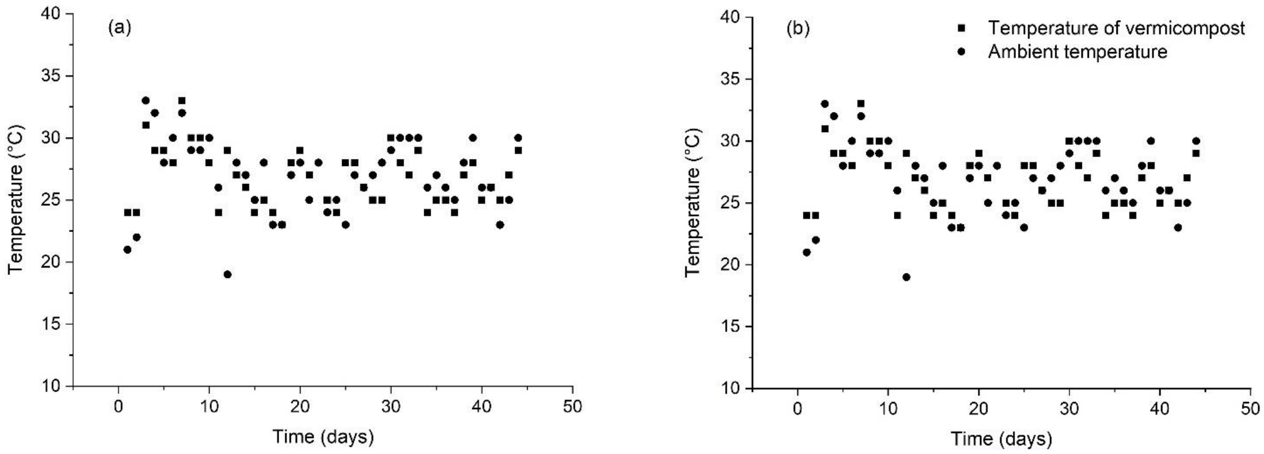

Fig. 2 Temperature variation accordance to degradation time of vermicompost 1 (a) and 2 (b)

The final pH values recorded for vermicomposts 1 (6.60) and 2 (6.77) were in compliance with the minimum pH value set to be used in agriculture (≥6). As shown in Table 4, pH tends to decrease during vermicomposting processes due to CO_2 and organic acid production resulting from microbial metabolism (ELVIRA et al., 1998). Earthworms used in vermicomposting processes often survive in environments whose pH ranges from 5 to 9, which is similar to values observed in the current study (LOURENÇO, 2010; GARG and GUPTA, 2011).

Table 4 Chemical parameters obtained during the vermicomposting process

Period of analyze (days)	Vermicompost 1					Vermicompost 2				
	pH (-)	C:N (-)	N (%)	OC (%)	P_2O_5 (%)	pH (-)	C:N (-)	N (%)	OC (%)	P_2O_5 (%)
0	7.41	13.5	1.27	17.1	0.69	7.00	12.8	1.34	17.1	0.64
15	6.96	12.9	1.40	18.1	0.73	6.81	13.0	1.26	17.4	0.75
30	6.65	10.7	1.72	18.4	1.10	6.57	9.68	1.93	18.7	1.20
45	6.60	10.7	1.73	18.5	1.20	6.77	9.69	1.95	18.9	1.20
Legislation[1]	≥6	≤14	≥0,5	≥15	-	≥6	≤14	≥0.5	≥15	-

[1]Normative Instruction No 25 of July 23, 2009.

With respect to organic compost maturity, there was decreased initial C:N ratio in vermicompost 1 (from 13.5 to 10.7) and 2 (from 12.8 to 9.69), which presented similar values – lower than the Brazilian limit (≤14) – at the end of the decomposition process (BRASIL, 2009). Initial organic carbon content (17.1%) increased to 18.5% and 18.9% in vermicompost 1 and 2, respectively; this parameter has also recorded similar values at the end of the experiment and met the minimum value set to be used as organic compost (≥15).

Both vermicomposts presented increased nitrogen level during the experiment and exceeded the minimum value established for organic fertilizers (≥0.5%). Vermicompost 2 tended to show higher total nitrogen content (1.95%); this outcome has indicated that the material in the

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passive aeration pile was mostly subjected to degradation by earthworms and microorganisms. The activity of nitrogen fixing bacteria and earthworms in vermicomposting processes can enhance nitrogen levels in the final product deriving from organic material mineralization processes (BHAT et al., 2018). Nitrogen is an important plant protein constituent that plays an essential role in plant yield (DOMÍNGUEZ, 2005; SÁNCHEZ et al., 2017; BLOUIN et al., 2019).

Phosphorus levels in the initial substrate were relatively low (VC1: 0.69% and VC2: 0.64%), although they presented equal increase (approximately 60%) in both vermicomposts (VC1 = VC2 = 1.2%) at the end of the vermicomposting process. Phosphorus content increased due to the ability of *E. foetida* to break organic compounds during vermicompost material mineralization (RICHARDSON, 2001). Although the Brazilian legislation does not set the minimum value for phosphorus level, this element is essential to plant growth and contributes to crop improvement, since it normalizes vegetal growth and maturity, as well as participates in photosynthesis processes (YADAV and GARG, 2009; BHAT et al., 2018). Other vermicompost features comprise the potential to transform organic phosphorus into its mineral form, as well as to dissolve insoluble phosphorus (GHOSH et al., 1999; YADAV and GARG, 2009; RAPHAEL and VELMOUROUGANE, 2011; ALIDADI et al., 2016). Phosphorus solubilization is essential to increase bioavailability concentration to plant growth (SÁNCHEZ et al., 2017).

3.2 *Brachiaria* growth evaluation

Data analyzed in the current study did not show significant differences between manure types. It may have happened due to low number of repetitions (three), which led to high standard deviation of the mean in some treatments (Table 5).

Table 5 Biomass accumulation (dry mass on roots, aerial part and total) in *Brachiaria* samples according to manure type

Treatments	Dry mass (media ± standard deviation)		
	Roots (g)	**Aerial Part (g)**	**Total (g)**
CP1	0.11±0.02	0.04±0.03	0.15±0.03
CP2	0.22±0.07	0.14±0.01	0.36±0.07
VC1	0.07±0.02	0.09±0.01	0.15±0.02
VC2	0.03±0.02	0.15±0.04	0.18±0.06
SF	0.36±0.28	0.53±0.46	0.89±0.74
CT	0.08±0.05	0.11±0.01	0.19±0.03

CP1: compost pile 1 (without passive aeration); CP2: compost pile 2 (with passive aeration); VC1: vermicompost pile 1; VC2: vermicompost pile 2; SF: synthetic fertilizer (8N:25P); CT: control (soil *in natura*)

Although data did not present significant difference, *Brachiaria* samples treated with synthetic fertilizer tended to grow more than the ones subjected to other treatments (Table 5). The plant growth period after seedling pruning (22 days) may have not been enough to change soil features and/or provide nutrients deriving from the biofertilizer, since nutrients take more time to act than chemical fertilizers (SÁNCHEZ et al., 2017). Nitrogen and phosphorus immobilization in the compost is another factor capable of contributing to lack of *Brachiaria* growth (BERNAL et al., 1998). Nitrogen immobilization can happen when mineralized species (e.g.: ammonium NH_4^+ and/or nitrate NO_3^-) are absorbed by microorganisms or when they attach to the organic matter in

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the soil. In this case, N is released to the plant after microorganism death (AL-BATAINA et al., 2016; SÁNCHEZ et al., 2017).

Some studies have suggested other vermicompost proportions and action times in crops other than the gramineous ones. Among them, one finds: applying from 0.5 to 0.6 vermicompost g/ soil g to tomato seedlings for 60 days (ZUCCO et al., 2015), 20% vermicompost (w/v) – also to tomato crop – for 32 days (ZALLER, 2007); 25% vermicompost (w/v) to lettuce and onion for 60 days (MORALES-CORTS, 2014) or 20% vermicompost (w/v) to lettuce for 49 days (ALI et al., 2007). Overall, Blouin et al. (2019) have suggested that vermicompost content should correspond to 30–50% of total soil volume to enable proper crop growth.

Plants must have access to different primary macronutrients (N, P and K) and micronutrients such as iron (Fe), boron (B), manganese (Mn), zinc (Zn), cooper (Cu), among others, in order to reach suitable growth (CASTRO et al., 2010). Thus, future studies about *Brachiaria* plants treated with organic compounds should focus on quantifying these micronutrients, since the lack of them can influence plant growth.

4. CONCLUSION

The composting process (with, or without aeration) was efficient in treating 145 kg of organic waste (vegetables, fruits, as well as cooked food and meat leftovers) since it produced approximately 57.1 kg of organic compost in a short period-of-time (60 days). This technic is a sustainable way to properly recycle organic fractions instead of sending them to landfills and shortening their useful life. Thus, it is an interesting alternative to be used in full-scale composting processes aimed at treating organic fractions in Uberaba County, MG, Brazil.

The final product subjected to vermicomposting has shown improved features such as increased organic carbon (from 17.1% to 18.9%), nitrogen (from 1.26% to 1.95%) and phosphorus (from 0.64% to 1.2%) contents.

Organic composts did not show significant differences in dry mass accumulation in *Brachiaria* crops. It is important keeping in mind that both vermicompost and composted products presented several advantages such as increased organic carbon and macronutrient contents essential to plants, as well as that the experimental time may have not been enough to change soil features or release these nutrients. Thus, future studies should be conducted at higher scale, based on different parameters. They could also use other biofertilizer ratios (such as 20% and 50%), longer action time (≥30 days), larger number of sample repetitions (≥5 pots), as well as analyze other chemical and microbiological parameters in the organic compost such as Zn, K, Ca, Cu, Fe, B, Mn and CEC, since they could influence *Brachiaria* growth.

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