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ORIGINAL RESEARCH

Comparing compost and vermicompost produced from market organic waste

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Abstract

Purpose This study was to obtain suitable methods and the combination of market organic waste to make better organic fertilizer.

Method The data were obtained experimentally in the decomposer room. The experimental design was a completely randomized design. The market organic waste consisted of comparing cabbage, banana peduncle, pineapple, added rice straw, and cow manure as bedding. The study used 12 treatments with three replicates. 4 treatments for composting methods (without earthworm) and 8 for vermicomposting (4 treatments using *Lumbricus rubellus* and 4 treatments using *Eudrillus eugeniae*). The compost and vermicompost characteristics variables were final weight, reduction, color, texture, and smell. The variables for chemical properties were pH, C-organic, Total Nitrogen, Total Phosphoros, and Total Potassium.

Results Vermicomposting method reduced market organic waste higher than compost 48.67 to 58%. Vermicompost is black like soil and more crumble. C-organic, pH, total Nitrogen, total Phosphorous and total Potassium following quality of SNI 19-7030-2004. The results show the compost with the combination of cabbage and banana peduncle combination (C-T1) had better values on total N (1.95%) and Total K (4.96%). Vermicompost with the combination of banana peduncle and pineapple with *Eudrillus eugeniae* (E-T3) had better average values on total P (0.43%). The combination of market organic waste used to produce organic fertilizers can be made on a small or larger scale.

Conclusion Vermicomposting is an effective strategy to reduce market organic waste. Composting with T1 combination (C-T1) and vermicomposting T3 combination (E-T3) had better value and was recommended for the following research stage.

Keywords Compost, Vermicompost, *Eudrillus eugeniae*, *Lumbricus rubellus*, Market organic waste

Introduction

Composting is an ancient technique in India. This technique is a viable strategy for bioconverting agricultural waste into high-quality organic fertilizers, and its utilization has been proven to be efficient in several places (Sarkar et al. 2017; Rajkhowa et al. 2019). The market is one of the major sources of agricultural organic waste. The amount of waste source is related to the human population, which

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causes an increase in the use of natural resources (Dolat-Abadi 2021). The intensive use of natural resources causes an increase in waste each year (Coulibaly et al. 2018; Setiawan 2020). The rise in waste generally comes from human activities such as agriculture, animal husbandry, and industry. If not handled properly will cause environmental problems in the future (Mehta et al. 2018; Khan et al. 2022).

Waste management commonly carried out today has not solved the existing waste problems (Bartolozzi et al. 2018). Handling of waste is often done by collecting and disposing of it. For this reason, efforts are needed so that waste can be reused for human interests, especially in the agricultural sector (Lupton 2017; Sindhu et al. 2019). The utilization of organic waste is generally difficult due to volume and smell problems. These problems can be solved by converting organic matter into organic fertilizer. To make organic fertilizer from organic matter needs some requirements like organic matter or substrate composition, decomposer, and environment to process into organic fertilizer such as compost and vermicompost (Jara-Samaniego et al. 2017; Saranraj et al. 2018). These soil organic matter can improve soil fertility to support optimal plant growth and production. Based on Syarifinnur et al. (2020) application of compost improve total N (53,85%) and application of vermicompost improve total P (195,59%), available P (466,26%), total K (109,39%), pH (12,32%) and Organic C (42,03%). The use of organic fertilizers is also an alternative to reduce dependence on inorganic fertilizers and is one solution to reduce environmental pollution

The use of compost and vermicompost shows an increase along with public awareness to get a healthy diet. Many studies show that the application of compost and vermicompost has a positive effect on the soil's physical, biological, and chemical condition. (Odlare et al. 2011). The difference in the use of compost and vermicompost lies in the use of earthworms. On vermicomposting, use earthworms as decomposers and compost without the use of earthworms. This process can make organic fertilizers to improve soil quality and increase agricultural production (Ayilara et al. 2020). To determine the quality of organic fertilizer measured using SNI 19-7030-2004. It is a compost specification from the Indonesian government's domestic organic waste. This specification of compost originating from domestic waste contains scope, references, terms and definitions, requirements for chemical, physical and bacterial content that must be achieved from processed domestic organic waste into compost (National Standardization Agency of Indonesia 2004). The purpose of this study was to obtain suitable methods and the combination of organic waste to make better organic fertilizer.

Material and methods

Study Area

The study was conducted in Mataram City, West Nusa Tenggara, located at 08º 40'29.07" South and 116º 05'33.25" East with an altitude of about 50 meters above sea level. Further analysis was carried out in the Laboratory of Soil, Faculty of Agriculture, Brawijaya University, Malang, Indonesia.

Source of earthworms and organic matter

Earthworms were obtained from worm farms in the city of Malang, East Java, Indonesia. The type of earthworm used were the epigeic type (*Eudrillus eugeniae* and *Lumbricus rubellus*). The market waste consists of cabbage, pineapple, and banana peduncle obtained from the Central Market of Mataram, West Nusa Tenggara, Indonesia (Fig. 1). The cabbage, banana peduncle, and pineapple selection are always available in the market and have never been used to make organic fertilizers. The cow manure was obtained from a live-stock farm located near the research location. Rice straw was collected from rice fields at Mataram City, Indonesia. The composted material was analyzed based on Balittanah (2009).

Cabbage Pineapple Banana Peduncle

Fig. 1 Market Organic Waste Used In Research

Experimental setup

The decomposition process uses a combination of Garg and Gupta (2011) and Yadav and Garg (2016). The market waste was reduced to a smaller and uniform size in the composting process. The market's organic waste decomposition container used a decomposition bin that had been lined with sacks (diameter 47.5 cm, depth 15.5 cm). Comparison of market organic waste (cabbage, banana peduncle, and pineapple), cow manure, and rice straw used a ratio of 3: 1: 1. All feed composition mixture eqaully, with cow manure diluted with one litre water, banana peduncle, pine apple, cabbage and rice straw cut uniform about 5-10 cm in size based on the treatment (Table 1). Mixing is intended to improve the quality of organic fertilizer (Handayanto et al. 1997) and the use of one type of organic waste is not good for the growth of earthworms (according to preliminary research). Let approximately seven days to remove gas from cow manure and organic market. After pre-composting for seven days, the decomposition bin was inoculated with earthworms as many as 200 adults each treatment, which was marked by clitellum. Three replicates were set for each treatment (without earthworm, with Lumbricus rubellus and eudrilus eugeniae). Then the decomposition bin was placed in a decomposition rack. Spray the decomposition bin so that the moist and always keep its moist consistency but not soaking wet. Each sample was taken on the 40th day (free from earthworm, cocon and hatchlings). The results of compost and vermicompost were air dried and analyzed for their nutrient content.

Variable and data collection

On day 40, the observation was made for the physical condition of compost and vermicompost at the process (depreciation, final weight, color, texture, and smell). Chemical analysis of compost and vermicompost for Total N was determined by Kjeldahl's method, Total P and Total K using HNO_3-$HClO_4$ digestion, pH measured by the extraction method with distilled water 1:5 (v/v) and Organic C by Walkley-Black's method (Balittanah 2009). The quality of compost and vermicompost used measurement standards based on SNI 19-7030-2004 (National Standardization Agency of Indonesia 2004).

Statistical analysis

One-way ANOVA was used to analyze the significant different value for each parameter ($P < 0.05$) and followed by DMRT (Duncan's Multiple Range Test) to identify the homogeneous treatment.

Table 1 Comparison and combination of organic material treatment compost and vermicompost

No	Treatment	Organic Material Treatment (Kg)	Mixed Ingredients (Kg)	
1.	C-T1	Cabbage (1.5) and banana peduncle (1.5)		
2.	C-T2	Cabbage (1.5) and Pineapple (1.5)		
3.	C-T3	Pineapple (1.5) and banana peduncle (1.5)		
4.	C-T4	Pineapple (1), Cabbage (1), banana peduncle (1)		
5.	L-T1	Cabbage (1.5) and banana peduncle (1.5)		
6.	L-T2	Cabbage (1.5) and Pineapple (1.5)	Cow Manure (1)	Rice Straw (1)
7.	L-T3	Pineapple (1.5) and banana peduncle (1.5)		
8.	L-T4	Pineapple (1), Cabbage (1), banana peduncle (1)		
9.	E-T1	Cabbage (1.5) and Banana Peduncle (1.5)		
10.	E-T2	Cabbage (1.5) and Pineapple (1.5)		
11.	E-T3	Pineapple (1.5) and Banana Peduncle (1.5)		
12.	E-T4	Pineapple (1), Cabbage (1), Banana Peduncle (1)		

Description: C= without earthworms, L= Using the Lumbricus rubellus earthworm, E= Using Eudrillus eugeniae earthworm; T1, T2, T3, and T4= Compost and Vermicompost Mix Treatment; 1.5:1.5:1:1= Organic matter comparison (kg)

Table 2 Characteristics of market organic waste

No.	Parameter	Banana Peduncle	Pineapple	Cabbage	Cow Manure	Rice straw
1.	Moisture Content (%)	91.77	86.83	96.48	85.32	17.47
2.	pH	4.31	5.45	4.84	8.13	7.54
3.	C-organic (%)	55.36	49.16	52.12	42.80	44.50
4.	C:N Ratio	80.30	41.47	38.95	52.84	50.90
5.	Lignin (%)	30.22	8.60	13.10	19.74	6.39
6.	N-Total (%)	0.69	1.17	1.38	0.81	0.89
7.	P-Total (%)	0.58	0.68	2.02	0.37	0.35
8.	K-Total (%)	1.74	2.79	2.05	1.36	1.90

Results and discussion

Characteristics of market organic waste

The chemical properties used in the manufacturing compost and vermicompost are described in Table 2. The result indicates that the characteristics of market organic waste vary.

Physical characteristics of compost and vermicompost

Based on Table 3, the treatment of earthworm presence and combination organic material is significant ($p<0.05$) on the final weight, and the volume of organic matter shrinks. The compost treatment was the highest weight compared to all vermicompost treatments. The compost treatment produced a weight between 2.97 ± 0.12 to 3.1 ± 0.06 kg, and the vermicompost treatment produced a weight between 2.07 ± 0.07 to 2.57 ± 0.05 kg. The average weight of organic matter decreases during the decomposition process due to microbes in compost and vermicompost, which convert organic matter into smaller particles. The volume deprecation of organic matter in compost is 38.00 ± 1.15 to 40.67 ± 2.4%, and the depreciation in worm application treatment is 55.3 ± 1.76% to 58.0 ± 1.15%.

Table 3 Physical characteristics of compost and vermicompost from mixture of market organic waste

No.	Treatment	Initial Weight (kg)	Final Weight (kg)	Depreciation (%)	Colour	Texture	Smell
1.	C-T1	5.00 ± 0.00	2.97 ± 0.12d	40.67 ± 2.40a	B	LC	S
2.	C-T2	5.00 ± 0.00	3.03 ± 0,13d	39.33 ± 2.40a	B	LC	S
3.	C-T3	5.00 ± 0.00	3.10 ± 0,06d	38.00 ± 1.15a	B	LC	S
4.	C-T4	5.00 ± 0.00	3.07 ± 0,18d	38.67 ± 3,53a	B	LC	S
5.	L-T1	5.00 ± 0.00	2.33 ± 0,12abc	53.3 ± 2.40bcd	BB	C	SS
6.	L-T2	5.00 ± 0.00	2.5 ± 0,06bc	50.00 ± 1.15cb	BB	C	SS
7.	L-T3	5.00 ± 0.00	2.57 ± 0,03c	48.67 ± 0.67b	BB	C	SS
8.	L-T4	5.00 ± 0.00	2.37 ± 0,09abc	52.67 ± 1.76bcd	BB	C	SS
9.	E-T1	5.00 ± 0.00	2.07 ± 0,07a	58.67 ± 1.33d	BB	C	SS
10.	E-T2	5.00 ± 0.00	2.33 ± 0,09ab	55.33 ± 1.76cd	BB	C	SS
11.	E-T3	5.00 ± 0.00	2.10 ± 0,06a	58.00 ± 1.15d	BB	C	SS
`	E-T4	5.00 ± 0.00	2.13 ± 0,03a	57.33 ± 0.67d	BB	C	SS

- Each value is the mean ± SE of three replicates. One-way ANOVA for the significant combination difference (*$P < 0.05$*) and numbers followed by the same letter in the same column are not significantly different at α 5% DMRT.
- C = Compost, L= Vermicompost with *Lumbricus Rubellus*, E= Vermicompost with *Eudrillus Eugeniae*
- T1= Cabbage and Banana Peduncle, T2= Cabbage and Pineapple, T3= Pineapple and Banana Peduncle, T4= Pineapple, Cabbage dan Banana Peduncle
- B= Brown, BB= Blackish Brown, LC= Little Crumb, C= Crumb, S= Smooth, SS= Similar soil

The changes in the final weight of the compost and vermicompost indicate the decomposition process inside and outside the earthworm's body. Earthworms and microbes use carbon as a source of energy and nutrients from organic matter to form body cells during the composting process. In this process, anabolic and catabolic reactions release CO2, water, and heat energy, causing the weight of organic matter to decrease (Abdoli et al. 2019). The higher reduction rate in vermicompost occurs due to earthworms and microbes that use organic matter for their growth. In the treatment of *Eudrillus eugeniae* had a lower weight than the treatment of *Lumbricus rubellus*. *Eudrillus eugeniae* is one of the effective composting agents for organic matter in the tropics and has a high rate of decomposition compared to other earthworms and one of the methods of waste degradation through vermicomposting (Nattudurai et al. 2014; Zhi-wei et al. 2019). According to Parmelee et al. (1990), epigeic earthworms eat organic matter according to their body weight per day.

This weight difference is also influenced by the combination of organic matter treatments (Ramnarain et al. 2019). On color observation, vermicompost has a darker color than compost (brown) and smells like soil when compared to compost. This darker color is due to more humic compounds in vermicompost than in compost (Hanc et al. 2019). According to Ahmed et al. (2005), the decomposition process of organic matter by microbes produces and reacts with amino compounds to form humic acid in dark color. This result also indicates different levels of chemical content and types of microbes in fragmenting organic matter in compost and vermicompost to produce organic fertilizers that can be applied to the soil (Nur et al. 2009; Fornes et al. 2012). Observation of the material structure shows that vermicompost results have a higher friability than compost. It shows that the decomposition process in vermicompost runs faster with the help of earthworms and microbes present in the earthworm body and outside the earthworm body, resulting in a more crumbly texture than compost (Wu et al. 2014).

Chemical characteristics of compost and vermicompost

Organic C

Based on the research results (Table 4.), applying a combination of organic matter and the presence of earthworms and without earthworms significantly affected ($p<0.05$) the organic C. The treatment with *Eudrillus Eugenia* (vermicompost) was significantly different in all treatments than without earthworms (compost). Organic-C content was higher in the treatment without earthworms (compost), but with *lumbricus rubellus*, there was no significant difference between the treatment with compost/without earthworms. Compost treatment with organic matter T1 (cabbage and banana peduncle) has organic C value was not significantly different from the application of *Lumbricus rubellus* with organic matter combination T1 (cabbage and banana peduncle), T2 (cabbage and pineapple), and T4 (pineapple, cabbage and banana peduncle) but significantly different with the combination treatment of T3 (banana and pineapple stems).

Vermicompost with *Eudrilus Eugenia* treatment with organic matter combination T3 (banana and pineapple stems) is significantly different from all compost combinations treatments (T1, T2, T3, and T4). Treatment of T3 had the lowest organic C value average (average 19.38 ± 0.16%) and the compost treatment with a combination of T1, T2, T3, and T4 treatments was 26.69 ± 0.41%, 25.05 ± 0.27%, 24.24 ± 0.36%, and 24.99 ± 0.03%, respectively.

The low value of organic C in vermicompost with *Eudrillus Eugenia* compared to all compost treatments because earthworms and microbes use organic C higher to get energy. At the same time, compost is only used by microbes (Esaivani et al. 2015; Kumar et al. 2017). Organic C from organic matter is broken down and decomposed by microbes present in earthworms into compounds used for the growth of earthworms so that the amount of carbon released through earthworm feces becomes less (El-Haddad et al. 2014). Changes in the organic C content produce essential nutrients plants need (Suthar and Gairola 2014).

pH

The analysis of the application of earthworms and the combination of organic matter significantly affected ($p<0.05$) the final pH of compost and vermicompost. Treatments C-T3, C-T4, L-T3, and E-T3 were not significantly different from treatments L-T4, L-T2, and E-T4, but different from L-T1 and C-T1 E-T1, E - T2, and T2. The pH values for all treatments (earthworms and without earthworms) and organic matter (T1, T2, T3, and T4) ranged from 7 (neutral). This pH value indicates that organic fertilizer from market organic waste can be applied in the field because essential nutrients already exist in that pH range. Changing the average pH in each treatment from acid to neutral is thought to be caused by the organic acid formation due to the decomposition and mineralization of organic matter. The raw materials for organic fertilizers are close to neutral to get nutrients available in the soil (Singh et al. 2005).

Table 4 Result of chemical properties analysis of vermicompost and vermicompost from market organic waste

No.	Treatment	Organic C (%)	pH	N (%)	P (%)	K (%)	C:N ratio
1.	C-T1	26.69 ± 0.41ef	7.6 ± 0.00de	1.95 ± 0.07c	0.29 ± 0.04abcd	4.96 ± 0.17e	13.17 ± 0.58c
2.	C-T2	25.05 ± 0.27f	7.7 ± 0.06e	1.63 ± 0.08a	0.19 ± 0.0 a	3.89 ± 0.02d	16.00 ± 0.58d
3.	C-T3	24.24 ± 0.36def	7.17 ± 0.07a	1.77 ± 0.04abc	0.26 ± 0.01abc	2.40 ± 0.09b	14.00 ± 0.58c
4.	C-T4	24.99 ± 0.03ef	7.23 ± 0.07ab	1.59 ± 0.04a	0.24 ± 0.03ab	2.27 ± 0.10ab	15.67 ± 0.33d
5.	L-T1	23.08 ± 0.54cde	7.50 ±0.06cd	1.67 ± 0.04ab	0.34 ± 0.07bcd	2.29 ± 0.19ab	13.00 ± 0.33bc
6.	L-T2	23.90 ± 0.88de	7.37 ± 0.09bc	1.92 ± 0.06c	0.30 ± 0.00abcd	1.93 ± 0.20a	12.33 ± 0.33abc
7.	L-T3	22.68 ± 0.42bcd	7.27 ± 0.07ab	1.95 ± 0.05c	0.40 ± 0.02cde	1.93 ± 0.10a	11.67 ± 0.33ab
8.	L-T4	23.50 ± 1.7cde	7.37 ± 0.03bc	1.85 ± 0.11bc	0.38 ± 0.04cd	1.89 ± 0.03a	12.67 ± 1.20abc
9.	E-T1	22.11 ± 0.77bc	7.63 ± 0.07de	1.67 ± 0.07ab	0.39 ± 0.01cd	2.49 ± 0.28c	13.00 ± 0.58bc
10.	E-T2	21.18 ± 0.42de	7.63 ± 0.07de	1.72 ± 0.01ab	0.32 ± 0.02abcd	2.92 ± 0.06c	12.33 ± 0.33abc
11.	E-T3	19.38 ± 0.16a	7.30 ± 0.06ab	1.77 ± 0.03abc	0.43 ± 0.00e	2.20 ± 0.06ab	11.00 ± 0.00a
12.	E-T4	20.57 ± 0.31ab	7.40 ± 0.06bc	1.66 ± 0.06ab	0.33 ± 0.02bcd	2.23 ± 0.20ab	12.33 ± 0.33abc
SNI 19-7030-2004		Min: 9.8 Max: 32	Min: 6.80 Max: 7.49	Min: 0.4 Max: -	Min : 0.1 Max: -	Min: 0.2 Max: -	Min: 10 Max: 20

- Each value is the mean ± SE of three replicates. One-way ANOVA for the significant combination difference (*P < 0.05*) and numbers followed by the same letter in the same column are not significantly different at α 5% DMRT.
- **C** = Compost, **L**= Vermicompost with *Lumbricus Rubellus*, **E**= Vermicompost With *Eudrilus Eugeniae*
- **T1**= Cabbage and Banana Peduncle, **T2**= Cabbage and Pineapple, **T3**= Pineapple and Banana Peduncle, **T4**= Pineapple, Cabbage dan Banana Peduncle

Total N

The analysis of the application of earthworms and without earthworms significantly affected (p<0.05) the total N of compost and vermicompost. T1 compost treatment was significantly different from the T2 and T4 compost treatment, with a total N value of T1 of 1.95 ± 0.07%, while T2 and T3 of 1.63 ± 0.08% and

1.59 ± 0.04%, respectively. The high value of total N in the C-T1 treatment compared to other treatments is influencing the quality of the combination of organic matter, which has high N content and low N content, where the cabbage content has the highest total N value and banana stems have a low N value (Handayanto et al. 1994). The E-T4 compost treatment was significantly different from vermicompost treatment (L-T2 and L-T3) but not significantly different from the E-T4, E-T1, L-T1, E-T2, and E-T3. The total nitrogen value that was significantly different between compost and vermicompost in the T1 treatment was thought to be due to higher nitrogen consumption in *Lumbricus rubellus* and *Eudrilus eugeniae*, which is used as a protein source for metabolism cause the lower value of nitrogen (Fernández-gómez et al. 2010).

Total P

The study results showed that the application of earthworms and without earthworms significantly affected ($p<0.05$) the final total P of compost and vermicompost. All compost treatments (T1, T2, T3, and T4) are significantly different from the E-T4 treatments. The P total value in E-T4 had the highest value compared to the treatment without earthworms at 0.43 ± 0.00%. The L-T3 treatment differed significantly from the three compost treatments, namely T2, T3, and T4, while T1 was not significantly different. The higher P total value in the E-T3 treatment compared to all compost treatments was thought to be influenced by the P mobilization process by microbes originating from the enzymatic activity of earthworms (Saikrithika et al. 2014; Ghosh et al. 2018).

Total K

The analysis of the application of earthworms and without earthworms had a significantly affected ($p<0.05$) on the total K of compost and vermicompost. Further test results showed that the compost treatment C-T1 was not significantly different from the compost treatment C-T2, C-T3, and C-T4 but significantly different from all vermicompost treatments except for the E-T3 treatment. The C-T1 compost treatment had the highest value compared to other treatments at 4.96 ± 0.17%, and the earthworm treatment had a total K content ranging from 1.89 ± 0.03 to 2.92 ± 0.06%. The low value of K total in the treatment of earthworms (vermicompost) is thought of by reducing K content during the vermicomposting process used to grow earthworms and microbes (Garg et al. 2006). Another cause of the low value of K content is the leaching process of nutrients, especially the K content, which is more easily washed out in vermicompost than in compost (Singh et al. 2013).

C/N Ratio

The analysis of the application of earthworms and combination organic matter significantly affected ($p<0.05$) the C/N ratio of compost and vermicompost. The value of the C/N ratio is one of the methods used to determine the maturity level of organic fertilizers before being applied to the soil (Suthar 2009) and an important factor in determining the growth and reproduction of vermicomposted earthworms due to the decrease in organic carbon and the increase in nitrogen in the final product (Chauhan and Singh 2013). The treatment without earthworms was significantly different from the E-T3 treatment but not significantly different from the other vermicompost treatments. In the treatment compost (without earthworm), the highest average value was shown in the C-T2 treatment with 16 ± 0.58. The lowest value was treating the earthworm *Eudrilus eugeniae* in the E-T3 treatment of 11 ± 0.00.

Changes in the C/N ratio during the composting process are caused by carbon as an energy source for microbial growth and then released into CO_2. At the same time, microbes use nitrogen to carry out protein synthesis and the formation of microbial body components (Deka et al. 2011). This process causes the carbon and nitrogen content to decrease and directly makes the C/N ratio low (Khwairakpam and Bhargava 2009). Based on the quality standard, the C/N ratio appropriate with SNI 19-7030-2004 or the C/N ratio suitable for organic fertilizer is 10-20.

Conclusion

Based on the Organic C (%), Total N (%), Total P (%), Total K (%), pH, and C/N ratio, the compost and vermicompost were results following the quality standards of SNI 19-7030-2004. The results show that compost with cabbage and banana peduncle combination had better values on total N (1.95 ± 0.07%) and Total K (4.96 ± 0.17%). The vermicompost (banana peduncle and pineapple combination) with *Eudrilus eugeniae* had better average values on the total P (0.43 ± 0.00%) and C/N ratio (11.00 ± 0.00). The average physical characteristics of vermicompost are black like soil and more crumble than compost. These compost and vermicompost are recommended for use in the following research stage. Based on the research carried out, it can be seen that the different combinations of organic matter affect the nutrient content of organic fertilizers. The combination of market organic waste used to produce organic fertilizers (compost and vermicompost) can be made on a small or larger scale and used on agricultural land.

Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest associated with this study.

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