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The Quantity Effect of Earthworms (*Lumbricus Rubellus*) and Urea on The NPK Quality of Coffee Husk Waste Compost

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A R T I C L E   I N F O

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A B S T R A C T

Utilization of coffee husk waste as compost can reduce the use of chemicals in cultivation. The addition of the two materials to compost with various doses of urea and the number of earthworms (Lumbricus rubellus) is expected to help speed up the process of decomposing coffee husk waste into compost and can increase the nutrient content in the compost. Urea and earthworms are used as decomposition materials and enrich the NPK element in the coffee husk waste compost. The result of making organic fertilizer from coffee husk waste compost is in the form of granules. Granulating is done manually to provide innovation in organic fertilizers. The purpose of this study was to determine the best combination of urea and earthworms in improving the NPK nutrient quality of coffee husk waste compost. Research on coffee husk waste compost was carried out at the Green House and Soil Biology Laboratory, Faculty of Agriculture, University of Jember. The method used was a factorial completely randomized design (CRD) with 2 factors, earthworms (Lumbricus rubellus) and urea with 3 levels each. The data obtained were analyzed statistically using Analysis of Variance (ANOVA). If there is a data treatment that shows significantly different results, then the Duncan Multiple Range Test (DMRT) is carried out with a significant level of 5%. The interaction between the number of earthworms (*Lumbricus rubellus*) and the dose of urea in the composting of coffee husk waste has a very significant effect on several variables, namely; Moisture content, Nitrogen, Phosphorus, Potassium, C-Organic, and C/N ratio values, however, did not significantly affect the temperature and PH variables of coffee husk waste compost.

INTRODUCTION

Coffee is a plantation commodity that is currently in great demand by consumers. Coffee plantations in Indonesia are also a contributor to the country's economy. Coffee has a promising economic value in the industrial sector. The development of the coffee industry has quite large prospects on a national and international industrial scale. Indonesia has an area of smallholder coffee plantations that increased from 2015 to 2017. In 2015 the area cultivated by PR (Public Plantation) was 1,183 million hectares, then increased by around 1.34 percent in 2016 to an area of 1,199 million hectares. In 2017 the area of PR (Public Plantation) coffee land increased to 1,205 million hectares (BPS-Indonesia 2017)

Processing of coffee husk waste can be a solution that is applied as a form of draining coffee industry waste. Coffee husk waste is usually thrown away or used as animal feed. Utilization of coffee husk waste into compost can increase plant growth and development. Utilizing coffee husk waste in compost can reduce the use of chemical fertilizers so that it is more environmentally friendly (Hartati et al., 2019). Coffee husks that are hard enough make the waste long enough to decompose into compost. Composting coffee husk waste will take quite a long time if it is not assisted by microorganisms or materials that can speed up the decomposition process. The results of Puslitkoka research showed that the Corganic content of the coffee berry husk was 45.3%, nitrogen content was 2.98%, phosphorus was 0.18% and potassium was 2.26%. In addition, coffee fruit husk also contains elements of Ca, Mg, Mn, Fe, Cu, and Zn.

Earthworms are decomposer organisms that can assist in the composting process of organic matter in the soil. Earthworms are organisms that are easy to get because of their habitat in the soil and are very easy to cultivate. The utilization of urea as a supporting material to accelerate the decomposition process is used as a material that is easy to obtain easily. Apart from earthworms, another supporting material that can be used in the decomposition process is urea. Urea is a material used to speed up the decomposition process as well as a material that can add nutrients to coffee husk waste compost. The addition of these two materials is a material that can increase the composting of coffee husk waste and accelerate the decomposition process of coffee husk waste within a certain time. Composting coffee husk waste with the final result of POG (organic granular fertilizer) is expected to reduce the use of chemical fertilizers or organic fertilizers in bulk form because it can cause plant overdose as a result of the sudden release of nutrients in plants. The use of tapioca starch as an adhesive is expected to be able to obtain the physical quality of POG (organic granule fertilizer) in good and old soil.

Husk waste into compost can increase plant growth and development. Utilizing coffee husk waste in compost can reduce the use of chemical fertilizers so that it is more environmentally friendly (Hartati et al., 2019). Coffee husks that are hard enough make the waste long enough to decompose into compost. Composting coffee husk waste will take quite a long time if it is not assisted by microorganisms or materials that can speed up the decomposition process. The results of Puslitkoka research showed that the Corganic content of the coffee berry husk was 45.3%, nitrogen content was 2.98%, phosphorus was 0.18% and potassium was 2.26%. In addition, coffee fruit husk also contains elements of Ca, Mg, Mn, Fe, Cu, and Zn.

METHODS

Location and Time

The research was conducted from April 1 2022 to June 2022 at a private Greenhouse and the analysis process was carried out by the Soil Fertility Laboratory and Soil Biology Laboratory, Faculty of Agriculture, University of Jember.

Method of Colloecting Data

The main tools used in the research on composting are compost boxes, plastic bags, grinding diesel engines, sieves, knives, buckets, gunny sacks, digital scales, and thermometers. While the tools in the laboratory are glassware, pH meter, oven, incubator, LAF, autoclave, burette, and pipette. The tools used to make granular organic fertilizer are winnowing containers, sprayers, digital balances, and manual flour sieves.

Materials used in the research process The materials used for composting are robusta coffee husk waste, water, earthworms (Lumbricus rubellus), urea, distilled water, and tapioca flour. The weight of the coffee husk waste compost used in each treatment was 3 kg with a dry weight of 2.94 kg.

The study was designed using a completely randomized design (CRD) with two factors, namely factor A is the number of earthworms and factor B is the dose of urea. The total weight of earthworms (Lumbricus rubellus) as a decomposer material is given with 3 levels according to the research of Sutanhaji et al (2019):

A0 :Without earthworms as a control.
A1 : 200 grams of earthworms into 3 kg of coffee husk waste
A2 : 400 grams of earthworms into 3 kg of coffee husk waste

The dose of urea fertilizer given to the sample as a compost enrichment agent accelerates the composting process by 3 levels:

B0 : Addition of 0% urea fertilizer from 3 kg of coffee husk waste.
B1: Addition of 1% urea fertilizer from 3 kg of coffee husk waste.
B2 : Addition of 2% urea fertilizer from 3 kg of coffee husk waste.

Furthermore, the granulation process was carried out manually, using tapioca flour as an adhesive with a dose of 11%. Composting coffee husk waste is preparing tools and materials. Finely chop the coffee husk with a grinding machine. Dry the husk of the coffee and then weigh it to find out the dry weight. Weighing 3 kg of coffee husks up to 27 times the scales. Put the chopped coffee husks into a bucket of 3 kg each. Mix chopped coffee husks with water to make it like mush so worms can eat it easily. Weigh the dose of urea and then proceed by dissolving the urea in clean water with a predetermined dose. Mix the chopped coffee husks and the dissolved urea in the water. Mix the three ingredients and then place them in a closed plastic bag for 15 days. Performing these 9 treatments each had 3 replications. After 15 days, the fermented material is allowed to stand for 15 days. Lining the composting container with burlap sacks so that water can seep in so that the moisture in the media is maintained. Add earthworms to compost according to weight.

The compost treatment was stopped after 45 days the compost material became vermicompost which was characterized by its black color, fine texture, and earthy smell, and the original material is difficult to identify.

Harvesting the compost is continued by separating the worms and compost in the tub. Grind the finished compost using a sieve to get fine and uniform particles. The refined raw materials are then mixed with an adhesive, namely 11% tapioca flour. Mixing adhesive materials in compost in the manufacture of POG with a high percentage will produce POG with high bulk density, durability, and dispersion time of granular organic fertilizer (Utari et al, 2015). The next process is to expose granulated organic fertilizer to direct sunlight to dry.

Observation variable

The research variables analyzed were temperature, texture, color, moisture content, aroma, pH, C-Organic, N-total, P_2O_5, K_2O and C/N ratio.

Compost Chemical Properties Analysis

Chemical analysis was carried out by testing the results of coffee husk waste compost in the laboratory, namely on the variables of compost moisture content, pH (acidity of compost), C-Organic, N-total, P_2O_5, K_2O, and C/N ratio of compost.

1. Determination of Water Content.

Measurement of compost moisture content can be done in the laboratory with an oven. The water in the organic fertilizer sample was evaporated using oven drying. The sample used to measure the water content is using organic fertilizer that has been mashed beforehand. Each sample weighed as much as 10 grams of natural fertilizer and 5 grams of refined fertilizer. The next step is to put it in a closed porcelain cup and bake it at 105 overnight (16 hours).

Water Content (%) = (W – W1) x 100/W

2. pH (Acidity of Compost)

The tools and materials used in measuring the pH of organic compost include shaking bottles, measuring cups, shaking machines, spray flasks, and pH meters. The reagent used a buffer solution of pH 7.0 and pH 4.0. The way to measure the pH of organic fertilizers is by weighing 10.00 g of organic fertilizer that has been mashed, then putting it in a shaken bottle. The next step is adding 50 ml of ion-free water and then shaking it with a shaker for 30 minutes. The soil suspension was measured with a calibrated pH meter using a buffer solution of pH 7.0 and pH 4.0.

3. C-Organik

C-Organic content was analyzed using the Walkey and Black method (Thom and Utomo, 1991). The tools and materials needed in analyzing C-Organic include Analytical balance, 100 ml volume measuring flask, 10 ml scale dispenser / 10 ml measuring pipette, 5 ml volume pipette, Visible Spectrophotometer, H_2SO_4 pa. 98%, BJ 1.84, K_2Cr2O_7 1 N, and a standard solution of 5000 ppm C. The first step is to accurately weigh 0.05 – 0.10 g of the fertilizer sample that has been mashed into a 100 ml volume measuring flask. Add successively 5 ml of 1 N $K_2Cr_2O_7$ solution, shake, and 7 ml of H_2SO_4 pa. 98%, shake again, leave 30 minutes if necessary shake occasionally. For a standard containing 250 ppm C, pipette 5 ml of 5000 ppm C standard solution into a 100 ml volume measuring flask, and add 5 ml of H_2SO_4 and 7 ml of 1 N $K_2Cr_2O_7$ solution by processing as above. Also, work on the blank used as a standard 0 ppm C. Each is diluted with ion-free water and after it cools the volume is adjusted up to the 100 ml mark, shaken back and forth until homogeneous, and leave overnight. The next day it is measured with a spectrophotometer at a wavelength of 561 nm. Measurement of C-Organic with the following formula:

C-organik (%) = ppm kurva x100/ mg sample x 100 ml/1.000 ml x fk

4. N-total

Total nitrogen is the total amount of nitrogen contained in organic fertilizers, which includes the levels of N-organic, N-NH_4, and N-NO_3. The tools used in measuring total N are analytical balance, digestion apparatus (electric heater/Kjeldahl therm block digestor), destination unit/Kjeldahl flask, titrator/burette, dispenser, Erlenmeyer vol. 100 ml, dispensers. The reagent used in the measurement of total N is as follows H_2SO_4 pa. 98%, standard solution H_2SO4 0.05 N Pipette 25 ml standard vitriol H2SO4 1 N in a 500 ml volumetric flask, impregnate to the tera mark with deionized water, 1% boric acid Weigh 10 g boric acid in 1,000 ml deionized water, indicator Conway Weigh 0.15 g BCG + 0.1 g MM in 100 ml 96% ethanol, selenium mixture, 40% NaOH Weigh 40 g NaOH in a 100 ml volumetric flask, compress to the mark with deionized water.

The method of determining organic N and N-NH_4 is first weighing carefully 0.250 g of organic fertilizer sample that has been mashed into the Kjeldahl flask/digester tube. Add 0.25 – 0.50 g of selenium mixture and 3 ml of H2SO4 pa, shake until the mixture is evenly distributed, and leave 2 – 3 hours to be charred. Destructs to perfection with a gradual temperature of 150°C until finally a max temperature of 350°C and a clear liquid is obtained (3 – 3.5 hours). After cooling it is diluted with a little distilled water so it doesn't crystallize. Transfer the solution quantitatively into a 250 ml volume distillation flask, add deionized water to half the volume of the boiling flask and a small number of boiling stones. Prepare a distillate container, namely 10 ml of 1% boric acid in a 100 ml Erlenmeyer volume spiked with 3 drops of Conway indicator. Distillate by adding 20 ml of 40% NaOH. Distillation is complete when the volume of liquid in the Erlenmeyer has reached about 75 ml. The distillate is titrated with 0.05 N H_2SO_4, until the endpoint (the color of the solution changes from green to light pink) = A ml, and the blank is determined = A1 ml.

The first step in the determination of N-NH_4 is to carefully put 1 g of fine sample into the boiling flask of the distillation, add a little boiling stone, 0.5 ml of liquid paraffin, and 100 ml of deionized water. The blank is 100 ml of deionized water plus boiling stones and liquid paraffin. Prepare a distillate container, namely 10 ml of 1% boric acid in a 100 ml Erlenmeyer which is spiked with 3 drops of Conway's indicator. Distill by adding 10 ml of 40% NaOH. Distillation is complete when the volume of liquid in the Erlenmeyer has reached about 75 ml. The distillate is titrated with a standard solution of 0.05 N H_2SO_4, until the endpoint (the color of the solution changes from green to light pink) = B ml, blank = B1 ml. The final step is to determine N-NO3, to determine N-NO_3, namely by using a former determination (N-NH_4) and letting it cool, then adding deionized water (including blank) to the original volume. Prepare a distillate container, namely 10 ml of 1% boric acid in a 100 ml Erlenmeyer which is spiked with 3 drops of Conway's indicator. Distillate by adding 2 g of Devarda Alloy, distillation starts without heating so that the foam does not overflow. After the foam is almost gone, heating starts at a low temperature, after boiling the temperature is raised to normal. Distillation is complete when the volume of liquid in the Erlenmeyer has reached about 75 ml. The distillate is titrated with a standard solution of 0.05 N H2SO4, until the endpoint (the color of the solution changes from green to light pink) = C ml, blank = C1 ml.

Calculation :

N-organik dan N-NH4

N (%) = (A ml – A1 ml) x 0,05 x 14 x 100 / mg example x fk

N-NH_4

N-NH_4 (%) = (B ml – B1 ml) x 0,05 x 14 x 100 / mg example x fk

N-NO_3

N-NO_3 (%) = (C ml – C1 ml) x 0,05 x 14 x 100 / mg example x fk

N-total (%) = N-organik + N-NH4 + N-NO3

5. Phosphor (P)

Phosphor (P) content was analyzed using Kjeldahl. The tools and materials needed to determine potassium levels in compost are; Analytical balance, 50 ml volume Kjeldahl flask, Kjeldahl therm digestor tube and block, 50 ml volume measuring flask, 20 ml volume chemical tube, Vortex mixer, 0 – 10 ml scale dilution / 10 ml volume measuring pipette, 0 – 10 ml scale dispenser / 1 ml volume pipette, visible spectrophotometer, atomic absorption spectrometer, HNO_3 pa 65%, $HClO_4$ pa. 70%, Standard stock solutions of K, Na, Ca, Mg, Fe, Al, Mn, Cu, Zn 1,000 ppm each in deionized water, Standard stock solutions of 500 ppm PO4, 500 ppm S and 100 ppm B in free water ions, 25,000 ppm LaCl3 solution (67 g LaCl3 + 15 ml 25% HCl in 1,000 ml deionized water and mixed series III containing P in the same extract as the sample extract with a concentration of 0; 1; 2; 4; 6; 8; and 10 ppm PO4.

Phosphate determination dye generator reagents, namely: concentrated reagent; 12 g of ammonium heptamolybdate + 0.275 g of potassium antimony tartrate + 140 ml of H2SO4 in 1000 ml of deionized water. Dilute reagent (made when it will be used, cannot be stored); 0.53 g of ascorbic acid + 50 ml of concentrated reagent is made into 500 ml of deionized water. The first step is to weigh 0.5 g of the crushed fertilizer sample into the digestion flask/Kjeldahl flask. Add 5 ml of HNO_3 and 0.5 ml of $HClO_4$, shake and leave overnight. Heat the block digestor starting with a temperature of 100°C, after the yellow steam runs out the temperature is increased to 200 0C. The digestion was terminated when white steam appeared and about 0.5 ml of liquid remained in the flask. Cool and dilute with H_2O and make the volume equal to 50 ml, shake until homogeneous, and leave overnight or filter with W41 filter paper to obtain a clear extract (extract A).Pipette 1 ml of extract B into a chemical tube with a volume of 20 ml (pipetted before measuring K and Na), as well as each series of standard P (standard Mixture III). Add 9 ml of color reagent to each sample and standard series, and shake with a Vortex mixer until homogeneous. Allow 15 – 25 minutes, then measure with a spectrophotometer at a wavelength of 889 nm and record the absorbance value.

P calculation formula:

P content (%) = ppm curve x ml extract/1,000 ml x 100/mg sample x fp x 31/95 x fk

5. Potassium (K)

Potassium (K) content was analyzed using the Kjeldahl method. The tools and materials needed to determine potassium levels in compost are; Analytical balance, 50 ml volume Kjeldahl flask, Kjeldahl therm digestor tube and block, 50 ml volume measuring flask, 20 ml volume chemical tube, Vortex mixer, 0 – 10 ml scale dilator / 10 ml volume measuring pipette, 0 – 10 ml scale dispenser / 1 ml volume pipette, visible spectrophotometer, atomic absorption spectrometer, HNO_3 pa 65%, $HClO_4$ pa. 70%, Standard stock solution of K, Na, Ca, Mg, Fe, Al, Mn, Cu, Zn 1,000 ppm each in deionized water, 500 ppm PO_4 standard stock, 500 ppm S, and 100 ppm B in deionized water, 25,000 ppm LaCl3 solution (67 g LaCl3 + 15 ml 25% HCl in 1,000 ml deionized water and mixed standard I containing K in the same extract with concentrations 0; 2; 4; 8; 12; 16; and 20 ppm K. Carefully weigh 0.5 g of the fertilizer sample that has been mashed into the digestion flask/Kjeldahl flask. Add 5 ml of HNO_3 and 0.5 ml of $HClO_4$, shake and leave overnight. Heat the block digestor starting with a temperature of 100 0C, after the yellow steam runs out the temperature is increased to 200 0C. The digestion was terminated when white steam appeared and about 0.5 ml of liquid remained in the flask. Cool and dilute with H2O and adjust the volume to 50 ml, shake until homogeneous, leave overnight or filter with W41 filter paper to obtain a clear extract (extract A) Pipette 1 ml of extract A into a chemical tube with a volume of 20 ml, add 9 ml of free water ion (can use dilution), shake with Vortex mixer until homogeneous. This extract is the result of 10x dilution (extract B). Measure K and Na in extract B using a flame photometer or SSA with a standard series of mixed I as a comparison, record the emission/absorbance of both standards and samples

The calculation formula for K content:

K content (%) = ppm curve x ml extract/1,000 ml x 100/mg sample x f
x fk

6. C/N ratio

The C/N ratio value is obtained by comparing the total N value and the organic C value in each treatment by dividing the C value by the total N value in the compost

Data Analysis

To determine the effect of the combination of treatments, the data obtained was then carried out with variance analysis. Then if the results obtained are significantly different, then a further test is carried out, namely the Duncan Multiple Range Test (DMRT) with a significance level of 5%.

RESULTS AND DISCUSSIONS

Results of Annova Calculation of Coffee Peel Waste Compost

Table 1. Summary of the results of ANOVA analysis with the DMRT test can be seen in table 1 below

No	Observation Variable	Calculated F Value		
		Interaction (A× B)	Amount of Earthworms (A)	Urea Dose (B)
1	Temprature	1,03ns	151,80**	0,99ns
2	pH	0,75ns	25,15**	16,35**
3	Water Content	11,78**	61,97**	22,15**
4	C-Organik (%)	31,23**	6,94**	18,53**
5	N total (%)	196,83**	1875,57**	157,17**
6	Phospor (%)	23,70**	165,58**	16,08**
7	Potassium (%)	57,74**	76,32**	141,88**
8	C/N rasio	279,73**	325,17**	356,03**

Note: *significantly different, **very significantly different, ns not significantly different

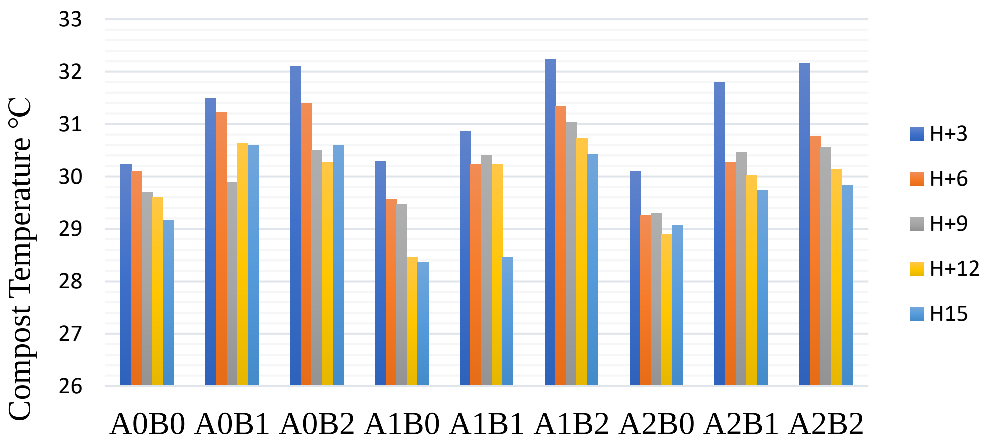

Figure 1. Fermentation temperature of Coffee Husk Waste for 15 days (0-15)

Figure 1 shows the observations during the fermentation process carried out every three days. Figure 1 shows the highest temperature during the fermentation process, namely in the A1B2 H+3 treatment, which is at 32.2°C. The lowest temperature during the fermentation process was on the last day of fermentation in the A1B0 treatment of 28.3°C.

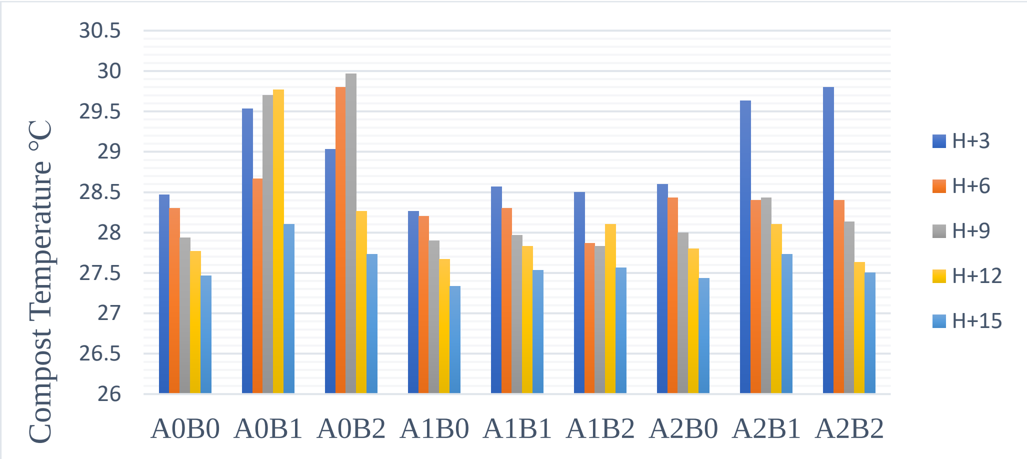

Figure 2. Temperature of open fermentation of Coffee Husk Waste for 15 days (15-30)

The highest temperature during anaerobic composting without earthworms was at H+9 in the A0B2 treatment of 29.9°C and the lowest temperature at D+15 was A1B0 at 27.3°C. The minimum temperature during the 30th day of the decomposition process is due to the compost temperature being more influenced by the ambient air temperature because the decomposition process has been reduced (Dewi et al., 2022).

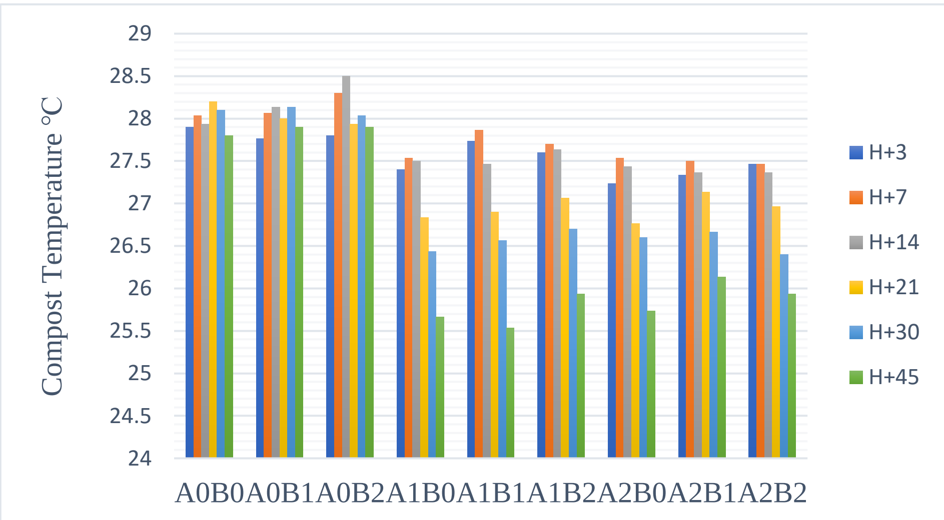

Figure 3. Closed fermentation temperature of Coffee Husk Waste for 15 days (30-75)

Figure 3 shows the highest temperature during the vermicompost process of coffee husk waste, namely the A0B2 treatment at H+7 of 28.5°C, and the lowest temperature obtained during the harvesting process, namely the A1B1 treatment at 25.5°C.

Coffee Peel Waste Compost Smell

The aroma of compost becomes an observation variable because the change in aroma at the beginning of composting and harvesting will be different.

Table 2. Coffee Peel Waste Compost Smell

Day	Coffee Peel Waste Compost Smell
D+7	The stench of rotting urea is like the smell of sewage
D+14	The stench of rotting urea is like the smell of sewage
D+21	The smell of rot and urea is slightly overpowering
D+28	The smell of urea is slightly pungent
D+35	The smell of urea is not overpowering
D+42	Smells like worm excrement quite pungent
D+49	Smells like worm excrement and doesn't sting
D+56	Smells like fresh earth
D+75	Smells like fresh earth

Table 3. Coffee Peel Waste Compost Color

Treatments	Tests		
	I	II	III
A0B0	2/2 10YR (Black Marlin)	2/1 10YR (Dune)	2/1 10YR (Dune)
A0B1	2/2 10YR (Black Marlin)	2/2 10YR (Black Marlin)	2/2 10YR (Black Marlin)
A0B2	2/1 10YR (Dune)	2/2 10YR (Black Marlin)	2/1 10YR (Dune)
A1B0	2/1 10YR (Dune)	2/1 10YR (Dune)	2/1 10YR (Dune)
A1B1	2/2 10YR (Black Marlin)	2/2 10YR (Black Marlin)	2/2 10YR (Black Marlin)
A1B2	2/1 10YR (Dune)	2/1 10YR (Dune)	2/1 10YR (Dune)
A2B0	2/1 10YR (Dune)	2/1 10YR (Dune)	2/1 10YR (Dune)
A2B1	2/2 10YR (Black Marlin)	2/2 10YR (Black Marlin)	2/1 10YR (Dune)
A2B2	2/1 10YR (Dune)	2/1 10YR (Dune)	2/1 10YR (Dune)

Table 4. Coffee Peel Waste Compost Texture

Day	Coffe Peel Waste Compost Texture
D+14	Very rough textured
D+28	Coarse textured
D+42	Somewhat rough textured
D+56	The texture of the crumb is slightly finer like the soil
D+75	Textured fine crumbs like soil

Coffee Peel Waste Compost Color

Coffee Husk Waste Compost has an initial light brown color like harvested rice bran. Observation of the color of coffee husk waste compost was carried out at harvest time using the Munsell Color Chart for Plant Tissues.

Table 3 shows that the color of all the coffee husk waste compost has the same value, which is at number two, but the mature compost has a different chroma. The value on the Munsell Color Chart for Plant Tissues is the value of a color to indicate the brightness of the color that radiates from the compost. Chroma is the degree of strength of color so that the strongest color shows high chroma or vice versa. The change in color to dark indicates that the compost is ripe.

Water content

The water content value based on the analysis of coffee husk waste compost was obtained, namely, the highest value of compost water content was obtained in treatment A1B2 (200 gr earthworms: 2% urea) of 28.46% and the lowest moisture content was obtained in A2B1 treatment (400 gr earthworms: urea 1%) of 7.79%.

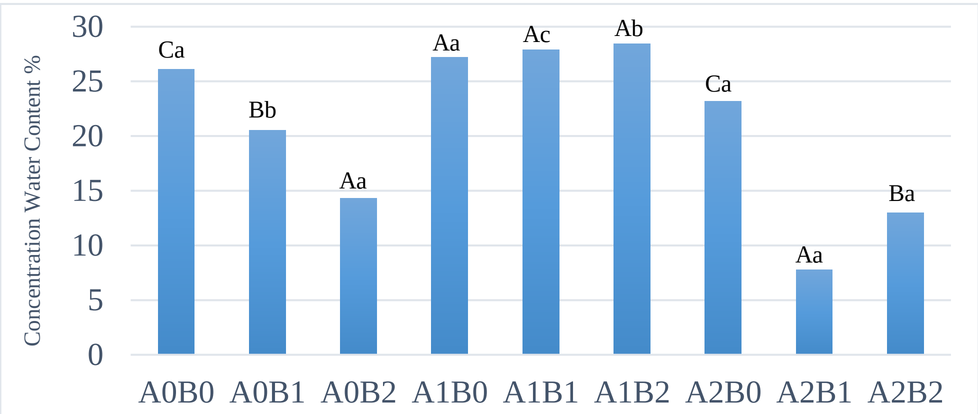

Figure 4. Combination Moisture Content of Coffee Husk Waste Compost Treatment.

Acidity (pH)

The acidity (pH) of the compost is measured at the time of harvesting to determine the acidic or alkaline pH level of theCoffee Husk Waste Compost.

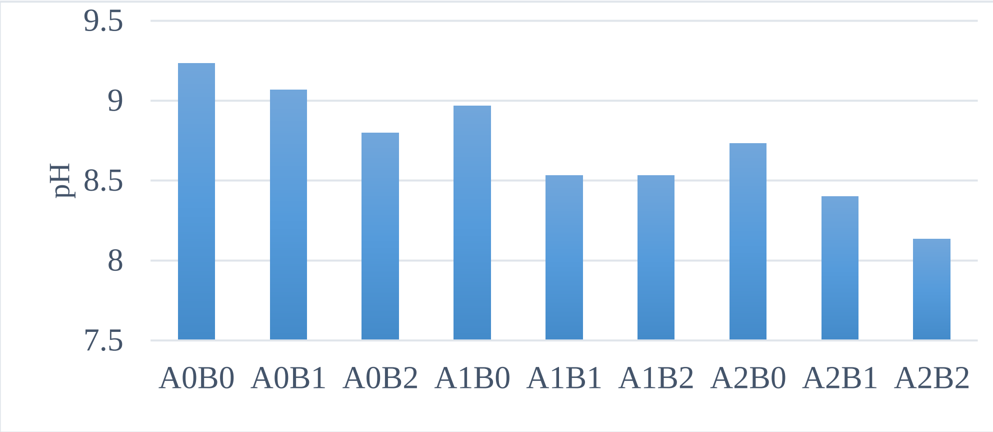

Figure 5. Acidity (pH) of Coffee Husk Waste Compost

Based on Figure 5, the treatment with the highest pH was in the control treatment A0B0 (0 g earthworms: 0 gr urea) of 9.23 and the lowest pH was in the A2B2 treatment (400 g earthworms: 60 gr urea) of 8.13.3.

C-Organic in Coffee Husk Waste Compost

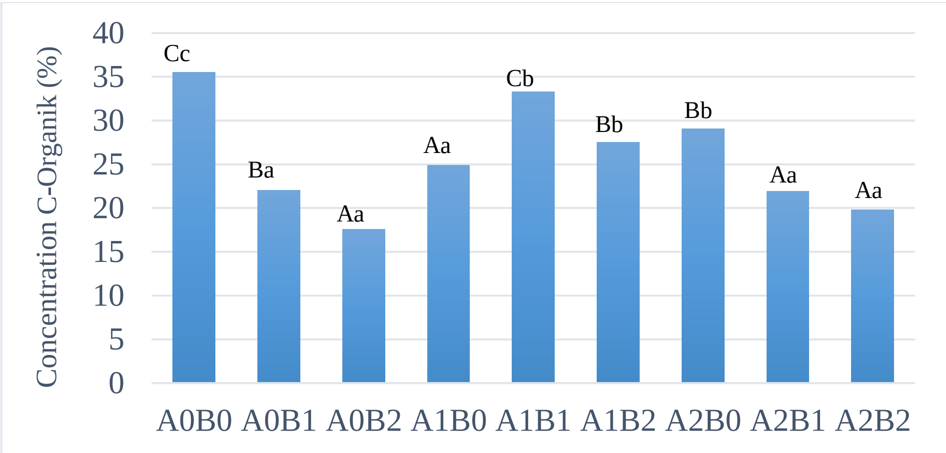

Figure 6. C-Organic in Coffee Husk Waste Compost

Based on figure 6 of the C-Organic analysis showed that the A0B0 treatment had the highest C-Organic among all the treatments, namely 35.52% with the control treatment without the use of earthworms and urea. The lowest C-organic was found in the A0B2 treatment (0 g earthworms: 2% urea) of 17.6%.

Total N content in Coffee Husk Waste Compost

The results of the N analysis showed that the highest total N content was obtained in the A1B2 treatment (200gr earthworms: 2% urea) of 9.07, while the lowest total N content was found in the A0B0 treatment of 4.55, namely the control without the use of earthworms and urea.

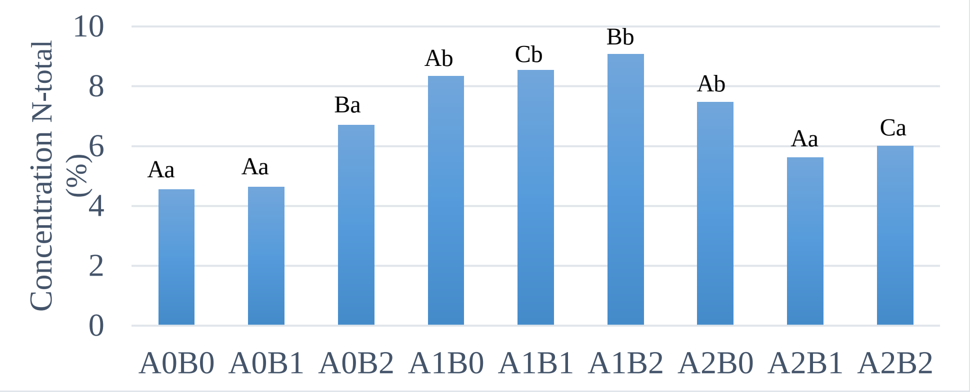

Figure 7. N-Total Concentration Combination Treatment of Coffee Peel Waste Compost

P_2O_5 Content in Coffee Peel Waste Compost

The highest P_2O_5 value was obtained in the A1B2 treatment (200 g earthworms: 1% urea) which was 0.16%, while the highest P_2O_5 value was obtained in the A0B2 treatment (0 g earthworms: 2% urea) which was 0.07%.

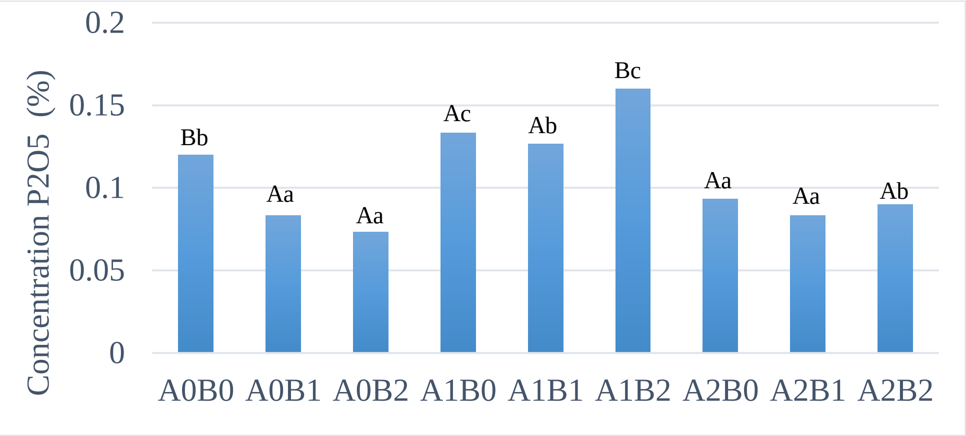

Figure 8. P_2O_5 Concentration Combined Treatment of Coffee Peel Waste Compost

K_2O Value in Coffee Peel Waste Compost

The results of the analysis of the K_2O value in the composting of coffee husk waste showed that there was a difference between the treatments that were not too different. The highest K2O value was obtained in the A1B0 treatment (200gr earthworms: 0% urea) of 0.66%. The lowest K2O value was obtained in the A2B2 treatment (400 g earthworms: 2% urea) which was 0.45%.

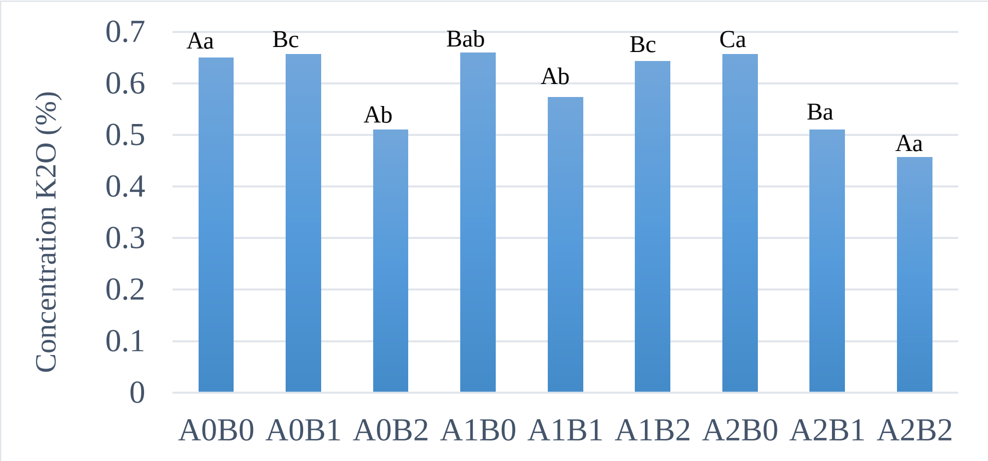

Figure 9. K2O Concentration Combined Treatment of Coffee Peel Waste Compost.

Value of C/N ratio in Coffee Husk Waste Compost

The highest C-Organic value in coffee husk waste compost was obtained in the A0B0 control treatment (0 g earthworms: 0% urea) which was 7.31%. The lowest C/N ratio value of 2.62% was obtained in the A0B2 treatment (0 g earthworms: 2% urea).

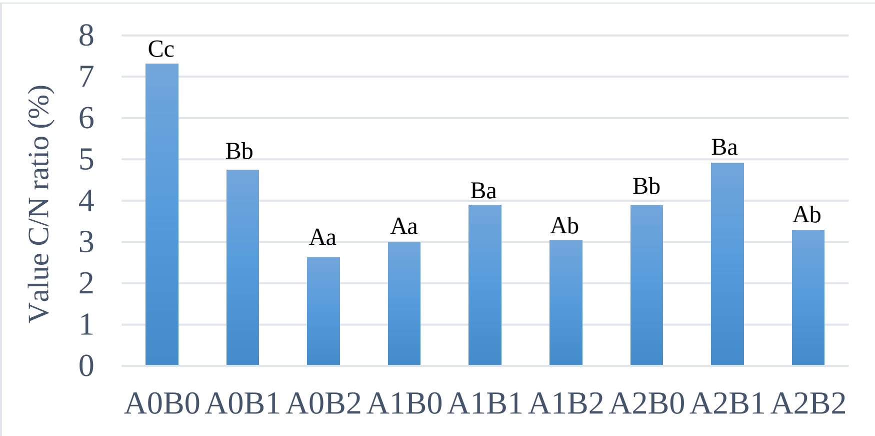

Figure 10. C/N Value of the Combined Treatment Ratio of Coffee Husk Waste Compost

Population Number of Worms

Table 4. Earthworms population

No	Treatments	Early amount of erathworms	End amount of erathworms	Increase/decrease of earthworms
1	A1B0	200 gram	323,3 gram	Increase 61,65%
2	A1B1	200 gram	194 gram	Decrease 3 %
3	A1B2	200 gram	187,6 gram	Decrease 6,2 %
4	A2B0	400 gram	423,6 gram	Increase 5,9 %
5	A2B1	400 gram	354 gram	Decrease 11,5 %
6	A2B2	400 gram	303 gram	Decrease 24,25 %

Based on table 4, the population of earthworms in the treatment without using urea had an increased population compared to the treatment using urea.

DISCUSSION

The temperature decreased during the initial process of observation until the compost harvest. The highest temperature when composting coffee husk waste is 32.2°C and the lowest temperature at harvesting is 25.5°C. According to Suwantatanti (2017), temperatures ranging from 23°C to 45°C are the mesophilic phase during composting. The mesophilic phase in composting is relatively low because the temperature does not exceed 45°C and occurs because the amount of composting waste does not provide enough heat insulation so that only mesophilic bacteria can reproduce. Bacterial activity in decomposing organic matter will cause an increase in temperature when composting coffee husk waste. The high temperature at the beginning of composting occurs due to the decomposition of highly reactive compounds such as sugar, carbohydrates, and fats. The release of energy in the form of heat causes an increase in temperature. (Dewi et al., 2022).

The change in the aroma of the compost is visible from time to time. At the beginning of the composting process, namely during the fermentation process, the smell of the compost is very pungent like a rotten smell, and then becomes an earthy smell indicating that there is a decomposition process in the coffee husk waste compost (Rahmadanti et al., 2019). According to Sujanto et al., (2019) the odor that occurs during decomposition is produced because the anaerobic decomposition process produces smelly ammonia gas (NH_3).

At the beginning of composting, all treatments had the same color, namely light golden brown. Measurements were made at the end of harvesting because when given urea solution in compost fermentation the colors tended to be the same. The color of the compost after being cooked becomes blackish brown like wet soil. Composting organic materials for almost two months has a black color which indicates that the compost is ripe (Hermawansyah 2017).

The texture of coffee husk waste before composting has a very rough texture but slowly the texture changes due to the treatment of earthworms (Lumbricus rubellus) as a waste decomposer. Changes in texture so that it becomes crumbs like soil only changes in the composting of coffee husk waste with the addition of earthworms (Lumbricus rubellus). Earthworms (Lumbricus rubellus) as decomposers of coffee husk waste produce dirt called vermicompost which will later become the final result of composting. Organic materials that have been processed by earthworms will become natural compost known as vermicompost (Liberty et al., 2022)

The varying moisture content is caused by the drying carried out for three days so that the water content is reduced so that it is easy to smooth the research sample material because the original compost has moisture which tends to get wet. The influence of the intensity of sunlight and the placement of the sun will greatly affect the evaporation of the moisture content in the compost. Another effect is that each compost feels dry on top, so water is added so that there is a difference in the water content in the compost. Compost that has a low water content tends to get good air circulation and light when drying the sample material for the study. Ideal compost has a humidity range of 40-60% so that microbes can still move in it. The cause of changes in humidity below the range needed by microbes is that the raw materials are too dry and the compost heap is not covered which causes evaporation (Hermawansyah 2017).

Based on the results of Duncan's test, the interaction between the two factors, namely earthworms and urea in the compost, gave significantly different results to the pH of the coffee husk waste compost. The results showed that treatment using urea had a lower pH compared to not using urea. The decrease in pH in compost by treatment with urea was due to the nitrogen content of urea in the form of ammonia which could turn into nitrate so that it would undergo a nitrification process which increased the production of hydrogen ions which could increase the acidity of the compost (Foth 1995)

The pH value of coffee husk waste compost tends to be alkaline because it has a pH above 7. The increase in pH until the end of composting is caused by microbes that use organic acids which cause the pH to rise. The results of pH observations showed that at the beginning of composting, namely on day 0, the pH increased until the end of composting. This is caused by microbes using organic acids which will cause the pH to rise, then organic acids are used by other types of microbes until the degree of acidity returns to neutral (Maradhy, 2009).

C-Organic content is an important factor determining the quality of minerals in compost. The higher the total C-Organic content, the better the quality of the minerals in the compost. The treatment with the largest C-Organic content was in the composting of coffee husk waste, namely A0B0(0 gr earthworms : 0% urea) of 35.52. The high organic C content is caused by the lack of activity of decomposing microorganisms in the untreated coffee husk waste compost. Composting for 30 days experienced a decrease in C-Organic levels due to the decomposition of carbon by freeing (Sujonto et al., 2017).

The composting treatment of coffee husk waste which had the lowest C-Organic content was A0B2 (0 gr earthworms: 2% urea) of 17.5867. The use of urea as a material to speed up the composting process greatly affects the decrease in C-Organic content in the compost. According to the Large Research and Development Center for Agricultural Land Resources (2006), carbon is a source of energy for growth in microbes, while the element nitrogen in urea is needed by microbes as a protein builder. According to Ayunin et al., (2016) The addition of nitrogen-containing urea fertilizer will reduce the C-Organic content in the compost due to the increased activity of microorganisms. According to Panatagama et al., (2018) composting without earthworm treatment will take quite a long time to compost because it only relies on aerobic bacteria in composting, resulting in lower C-organic gain than composting using earthworms.

The highest N value was in the A1B2 treatment (200gr earthworms: 2% urea) which was 9.07%. Factors that affect the level of total N in compost include the use of compost raw material with coffee husk waste. Another factor is the use of doses of earthworms (Lumbricus rubellus) and urea in the composting of coffee husk waste. According to Muksin and Agustinus (2021) the higher the earthworm population shows a positive correlation with the N element because the higher the earthworm population in the compost, the higher the Nitrogen content in the compost.

The digestive tract of earthworms contains various synergistic consortia of organisms such as protozoa, bacteria, and micro-fungi which are capable of degrading cellulose compounds and contain various enzymes such as lipase, protease, urease, cellulase, amylase, and chitinase (Pathma and Saktivhel, 2012). The urease enzyme plays an important role as a catalyst for the hydrolysis of urea into ammonia and carbamic acid. The activity of the soil urease enzyme was determined by measuring the product of hydrolysis of urea by urease, namely [NH_4^+-N]. The urease enzyme can be used as an indicator to predict the amount of N content in an unavailable form in an environment (Sirko 2000).

The total N content also increased, presumably because of the addition of the urea factor which contains a relatively high nitrogen element in waste composting. High total N levels will accelerate organic matter decomposition (Wijayanti and Budi 2018). Nitrogen comes from three stages of the reaction of amination, ammonification, and nitrification. The amination reaction is a reaction that decomposes proteins found in organic matter into amino acids. The ammonification reaction is a change of amino acids into ammonia (NH_3) and ammonium (NH_4^+) compounds. The final reaction, namely nitrification, is the conversion of ammonia compounds into nitrates involving Nitrosomonas and Nitrosococus bacteria (Indrawan et al., 2016).

While the N value which tends to be low in various treatments can be seen in the figure that the A0B0 treatment (0 g worms : 0% urea) is equal to 4.55%. Treatments that have a low total N-value are treatments that are not given either of these two factors or one of the composting factors has a low N compared to compost that is given earthworms (Lumbricus rubellus) and urea. According to research by Panatagama et al., (2018) composting using earthworms produces a higher N-total than without using earthworms. Vermicompost, which has a high N content, comes from the digestion and mineralization of N organic matter in high concentrations. According to Sofa et al., (2022) the low nitrogen content in compost can be caused by the evaporation of nitrogen in the compost. This evaporation causes loss of nitrogen because nitrogen is easily lost either through washing or evaporation.

The interaction of earthworms (Lumbricus rubellus) and urea has a significant effect on the value of coffee husk waste composting. Phosphorus is very important for plants because it functions as the formation of proteins, fats, and seeds. Phosphorus (P) is an essential macronutrient that is very important for plant growth, but its content in the soil is lower than Nitrogen and Potassium (Abdul Azis 2013).

The highest P_2O_5 value was obtained in the A1B2 treatment (200 gr earthworms: 60 gr urea) which was 0.16%. The value is in line with the N content in the compost, the higher the total R-value, the higher the phosphorus value so it can be seen that the coffee husk waste compost has a high N value in the A1B2 treatment (200 gr earthworms: 60 gr urea) also has a P_2O_5 is also high. The effect of adding nitrogen-containing urea to the composting of coffee husk waste gave an increase in the P_2O_5 value of the coffee husk waste compost. According to Badruzzaman et al., (2016) state the content (P) in the compost is related to the N content in the compost. Phosphorus content increases influenced by nitrogen which multiplies microorganisms to reorganize phosphorus to increase. Phosphorus levels are also affected by the biological activity of the compost, namely earthworms. High levels of phosphorus in compost are caused by earthworm mucus which can increase the P nutrient in the soil (Putra & Nuraini, 2017).

The lowest P_2O_5 value was obtained in the A0B2 treatment (0 g earthworms: 60 g urea) of 0.073%. The treatment with the lowest value was the treatment without earthworms but used 60 gr of urea. The decrease in P-Total levels is because at the end of the decomposition phosphorus is utilized by microorganisms to form protein in their bodies so that phosphorus in the compost is reduced (Murbandono 2000). According to Kaswinarni et al., (2020) Another factor that affects the phosphorus content in compost is the organic matter for composting. The weathering process that occurs in the compost material causes high phosphorus levels so that at the ripening stage of the compost, the microbes will die and the phosphorus levels in the microbes will mix with the compost material, thus increasing the phosphorus levels in the compost.

The results of Duncan's test showed that there was an interaction effect of the number of earthworms (Lumbricus rubellus) and urea on the K_2O value of coffee husk waste compost. The highest K_2O value was obtained in the A1B0 treatment (200gr earthworms: 0% urea) of 0.66%. Based on Panatagama's research (2018) composting organic matter using earthworms (Lumbricus rubellus) has higher potassium levels compared to treatments that do not use earthworms. The activity of microorganisms that decompose organic matter can increase the increase in potassium levels in compost.

The lowest potassium value was found in the A2B2 treatment (400 g earthworms: 2% urea) which was 0.45%. Differences in potassium levels in each treatment can occur due to differences in the speed of microorganisms in the decomposition process of organic matter during fermentation (Bachtiar and Adi 2019). The potassium content in coffee husk waste compost in the A1B0 treatment with 200 grams of earthworms (Lumbricus rubellus) increased the number of earthworms up to 323 grams during harvesting. However, in the A2B2 treatment, there was a decrease in the number of worms with the initial number of worms of 400 grams decreasing to 293 grams. This proves that the quality of vermicompost based on potassium content is also determined by the number of earthworms and composting time (Husain et al., 2015). Potassium has an important role in the process of photosynthesis in the formation of protein and cellulose which functions to strengthen plant stems (Ekawandani and Kusuma, 2018).

The highest C/N ratio of coffee husk waste compost was obtained in the control treatment A0B0 (0 g earthworms : 0% urea) which was 7.31. The lowest C/N ratio value of 2.62 was obtained in the A0B2 treatment (0 g earthworms: 2% urea). The value of the C/N ratio is a comparison between the value of Organic C and total N. The higher the C value and the lower the N value, the higher the C/N ratio will be, but if the C-Organic value is low and the N value is high, the C/N ratio will be low.

Treatment A0B0 (earthworms 0 g: 0% urea) has a C-Organic value of 35.52 and an N value of 4.55, this is inversely proportional to the A0B2 treatment (earthworms 0 gr: urea 2%) which has a C value -Organic 17.58 and a total N value of 6.69. The value of the C/N ratio in the A0B2 treatment was lower because it had quite a high N and lower C-Organic than A0B0. The A0B0 treatment had a relatively low N value. It did not add urea in the decomposition process, whereas the A0B2 treatment had a higher N value because it added 2% urea to the composting process. According to Sujonto et al., (2014) the influence of C-Organic content and N values increases decomposition activity because they are a source of energy and a constituent of cells in microorganisms. The C/N ratio of coffee husk waste at the time before it was decomposed was quite high at 30.4%. The higher the C/N ratio in a material, the longer the decomposition process takes. A decrease in the C/N ratio on coffee husks which tend to be hard indicates a decomposition process.

The increase in the weight of earthworms in the treatment without urea was because the initial temperature of giving the worms to the coffee husk waste compost without urea was lower than the temperature of the coffee husk waste compost with urea so the worms more easily adjusted and adapted to that temperature. Figure 4.2 shows the initial temperature of adding earthworms to coffee husk waste compost that did not use the urea factor, namely the A1B0 treatment at 27.3°C and A2B0 at 27.4°C while the temperature without using urea had an average temperature of 27.8°C. which tends to be hotter, causing the worm population to die or decrease.

According to Chaniago and Yunita (2019), The humidity of the worm media provided greatly affects the survival of earthworms. If the media is too dry, the earthworms will immediately enter the media looking for lower temperatures and may stop eating so that the earthworms die. Conversely, if the feed medium is too moist, it will cause the earthworms to turn pale and then cause the death of the earthworms. In addition, other factors cause a reduction in the population of earthworms in the coffee husk waste compost media, namely the room temperature which tends to fluctuate. Placing the arrangement of containers on wooden racks also makes a difference in the reception of indirect sunlight intensity on the containers. This intensity causes the temperature of the feed medium to rise so that the worms can die.

CONCLUSSION

There is an interaction effect of the number of earthworms (Lumbricus rubellus) and the dose of urea on increasing the NPK content of coffee husk waste compost with the best treatment combination, namely A1B2 by giving 200 grams of earthworms with a dose of 60 grams of urea in coffee husk waste compost, which has a very significant effect on nutrient variable N-total and because it has the best total N-total and P_2O_5 of 9.07% and 0.16%.

Giving the number of earthworms (lumbricus rubellus) of 200 grams to 3 kg of coffee husk waste compost gave the best quality results of coffee husk waste compost, namely in the A1B2 treatment. Giving a dose of 2% urea can reduce the C/N ratio of coffee husk waste compost by 3 kg to 2.62% in the implementation of A0B2.

The combination of treatments for the variables pH, water content, C-Organic, N-total, P_2O_5, K_2O, and C/N ratio according to the stipulation of Regulation of The Minister Of Agriculture No. 01/Kepmentan/No. 261/2019 obtained from a combination of 200 grams of earthworms (Lumbricus rubellus) and 60 grams of urea by composting 3 kg of coffee husk waste compost. Manual granulation process can be carried out on coffee husk waste compost as an organic fertilizer innovation with a more attractive appearance without dust pollution.

REFERENCES

Abdurachman, A.A., U. Haryati., dan I. Juarsah. 2013. Analysis of Phosphorus (P) Content in Mushroom Waste Organic Compost With Tofu Dregs Activator. Jakarta Selatan: *Badan Litbang Pertanian*. 1(1) : 1-14

Bachtiar, B., dan A. H. Ahmad. 2019. Analysis of the Nutrient Content of Johar Cassia siamea Compost With the Addition of an Activator. *Jurnal Biologi Makassar*. 4(1): 68-76.

Ayunin, R. W., W. D. Nugraha., dan G. Samudro. 2016. Effect of Addition of Urea Fertilizer in Aerobic Composting of Organic Waste into Mature and Stable Enriched Compost. *Jurnal Teknik Lingkungan*. 5(2) : 1-16.

Badan Pusat Statistik. (2017). Retrieved from Badan Pusat Statistik Web Site: https://www.bps.go.id/publication/2018/12/20/71e7ada61b13e59be0b1bf80/statistik-kopi-indonesia-2017.html.

Chaniago, N., dan Y. Inriyani. 2019. The Effect of Types of Organic Materials and Composting Process Time on the Quantity and Quality of Vermicompost. *Agricultural Research Journal*. 15(1) : 1-14.

Hartati., N Azmin., Andang, M.E. Hidayatullah. 2019. The Effect of Compost from Coffee Skin Waste (Coffea) on the Growth of Long Bean Plants (Vigna Sinensis L.). *Jurnal Biologi dan Pembelajarannya*. 6(2) : 71-78.

Hermawansyah, Dony. 2017. Analysis of Physical Parameters of Compost Using the Vermicomposting Method on Dry Leaf Waste. *Jurnal Teknik Lingkungan*.1-11.

Husain, D., Sukarsono., dan N. Mahmudati. 2015. Effect of Number of Earthworms Effect of Number of Earthworms (Lumbricus Rubellus) and Composting Time on the NPK Content of Oyster Mushroom Growing Media Waste. *Jurnal Pendidikan Biologi Indonesia*. 1(1) : 1-8.

Indrawan, I. M. O., G. A. B. Widana., dan M. V. Oviantari. 2016. Analysis of N, P, K Content in Compost Fertilizer Production at Jagaraga Landfill, Buleleng. *Jurnal Wahana Matematika dan Sains*. 9(2) : 1-25.

Kaswinarni, F., dan A. A. S. Nugraha. 2020. Levels of Phosphorus, Potassium and Physical Properties of Market Organic Compost Fertilizer with the Addition of EM4 Starter, Cow Manure and Chicken Manure. *Jurnal Ilmiah Multi Sciences*. 12(1) : 1-6

Sofa, N ., G. T. M. Hatta., dan Y. F. Arifin. 2022. Analysis of Compost Based on Organic Waste in the Campus Environment with Em4 Activators, Cow Manure and Poultry Manure in an Effort to Support the Green Campus Movement. *Jurnal Hutan Tropis*. 10(1) : 1-11.

Suwantatanti and W. P, “Pemanfaatan MOL Limbah Sayur pada Proses Pembuatan Kompos,” vol. 40, 2017.

Sunjoto, W.D., T.C. Setiawati., dan S. Winarso. 2014. Increasing the Speed of Decomposition of Coffee Peel Waste with the Addition of Trichoderma Spp as a Decomposer and *Pseudomonas sp* for Phosphate Enrichment. *Jurnal Berkala Ilmiah Pertanian*. 1-7.

Muksin dan A. J. P. Anasaga. 2021. The Relationship of Earthworm Populations to C-Organic and N-Total in Horticulture and Monocculture Cultivation of Coffee Plants in Nduaria Village. *Journal of Sustainable Dryland Agriculture.* 14 (1): 32-46.

Murbandono, L. 2002. Membuat Kompos. Penebar Swadaya. Jakarta.

Pathma, J. and N. Sakthivel. 2012. Microbial Diversity Of Vermicompost Bacteria That Exhibit Useful Agricultural Traits And Waste Management Potential. Springerplus. 1(26): 1-19.

Putra, Bima Purna & Nuraini, Yulia. (2017). Incubation Study of Various Doses of Earthworm Mucus Mucus Fermentation Liquid Fertilizer (Lumbricus Rubellus) Against Phosphorus, C-Organic and pH in Inceptisols. *Jurnal Tanah dan Sumberdaya Lahan*. Vol 4 No 2 : 521-524.

Sirko, A. and R. Brodzik. 2000. Plant ureases: roles and regulations. *Acta Biochimica Polonica*, 47(4):1189-1194.

Wijayanti, R., dan B. Prasetya. 2018. The Effect of Urea Application on the Decomposition Rate of Sugarcane Litter at the Jengkol Sugar Research Center, Kediri Regency. *Jurnal Tanah dan Sumberdaya Lahan*. 5(1) : 793-799.