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THE EFFECTIVITY OF EM4 MADE FROM BACTERIA *Bacillus* sp. FOR COMPOSTING HOUSEHOLD WASTE AND ON THE GROWTH OF CAYENNE PEPPER PLANT (*Capsicum frutescens* L)

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ABSTRACT

This study aims to determine the influence of differences in EM4 dosage made from *Bacillus* sp. and cow dung against composting household waste, to find the best dose to speed up household waste composting, and to test the resulting compost on the growth of cayenne pepper plants (*Capsicum frutescens* L). This is a 2-stage experiment. The first stage is the effectiveness of composting using a Completely Randomized Factorial design, and the second stage is a biological test by looking at the growth of chili plant seeds using a Completely Randomized Design. The object of this research is household waste that has not undergone decomposition, incubated in the same tub with 4 different dosage levels (0%, 5%, 10%, and 15%), and 3 different treatments with cow dung (1:2 and 1:4). Each treatment was repeated 3 times. This treatment lasted 41 days, followed by the second stage, where the resulting compost was used for cayenne pepper. Each treatment was carried out 5 times over 15 days with 4 observations. The parameters observed were the physical results of the compost (color, odor, and structure), temperature, composting pH, plant height, number of leaves, wet weight, and dry weight of cayenne pepper plants. Data were analyzed descriptively in stages one and two using One-way ANOVA, then continued with the Duncan Multiple Range Test (DMRT). The results showed that using EM4 made from *Bacillus* sp. mixed with cow dung affects the quality of the composting results. The optimal concentration for making household waste fertilizer is 10%. Household waste fertilizer significantly affects the growth of cayenne pepper plants, as seen from all observation parameters, namely plant height, number of leaves, fresh weight, and dry weight.

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1. INTRODUCTION

The current problem in Indonesia regarding household waste is the lack of handling of household waste, which causes the amount of waste in Indonesia to increase. Waste t results from a production process, both industrial and domestic (household). The increase in the amount of household waste produced in Indonesia is expected to increase 5 times by 2021. This piling up of domestic waste, both liquid waste and solid waste, is an environmental problem because the quantity and level of danger are detrimental to health. Waste can also be a limiting factor because it contains heavy metals, toxic organic compounds, and pathogens. Composting can reduce the influence of toxic organic compounds and pathogens on the environment (Yuwono, 2006).

Several efforts to handle this waste have been made but have not yet found the right technique that can be applied to local communities. The desired technique is, of course, one that is low cost with maximum waste processing results with useful efficiency. At this time, where land is increasingly limited, household waste management using microorganisms is an alternative that can be developed. According to Antonius (2007) *Bacillus subtilis*, *Bacillus polymyxa*, and *Bacillus firmus* have been identified as being able to dissolve insoluble forms of P into forms available to plants. Several phosphate compounds that microbes can dissolve are FePO4, Ca3(PO4), AlPO4, glycerophosphate, lecithin, and bone meal. The function of P in plants is the second most important essential element after nitrogen, namely in the processes of photosynthesis, respiration, nutrient transfer, energy storage, cell division, and enlargement, as well as other processes in plants.

Composting or decomposition is the biological breakdown and stabilization of organic materials at high temperatures, with the final result being materials that are good for use in the soil without harming the environment (Prihandarini, 2004 in Agustina, 2007). In other words, the original physical changes into a new physical. This change occurs because of the activities of microorganisms to fulfill their living needs. The decomposition process starts from the destruction process carried out by small insects on plants and the remaining dead organic material into smaller sizes, then continues with the biological process carried out by bacteria and fungi to decompose organic particles. The decomposition process by bacteria and fungi as decomposers is assisted by enzymes that can break down organic materials such as proteins, carbohydrates, and others.

According to Sunarto (2003), the speed of the decomposition process is generally influenced by environmental factors, which can influence the growth of decomposers. These factors include climate factors such as rainfall, humidity, light intensity, air temperature around the composting area, and environmental conditions where organisms grow, such as temperature, water, pH, water salinity, oxygen content, organic nutrient content, and others. In the decomposition process, all physical, chemical, and biological factors interact with each other.

The level of maturity (degree of humification) and stability of the compost (related to microbial activity) determine the compost quality as indicated by various changes in the compost substrate's physical, chemical, and biological properties. In immature compost, the decomposition process of organic material is still ongoing which can create an anaerobic atmosphere in the root environment (oxygen use by microbes) and N deficiency (immobilization of N by microbes), thereby inhibiting plant growth. Incomplete composting often produces phytotoxin compounds such as phenolics which in many cases inhibit the growth of plant seeds (Sulistyorini, 2005) or become a transient site for pathogenic microbes. To avoid this, socialization about appropriate compost-making techniques and using appropriate decomposer microbes must be continuously pursued as a strategic step in improving compost quality. Apart from that, the ease of making compost and the application of decomposer microbes at a relatively low cost cannot be ignored as determining factors for farmers to use decomposer microbes.

2. RESEARCH METHODS

2.1 Types of research

This research is a two-stage experimental study, the first stage is the effect of adding EM4 made from *Bacillus* sp. bacteria. and cow dung in the household waste composting process. The second stage is a biological test of the resulting compost using cayenne pepper (*Capsicum frustescens L*).

2.2 Time and Place of Research

This research was conducted from January to March 2021 in Kadiluwih Hamlet RT 003/ RW 003, Kadiluwih Village, Salam District, Magelang Regency, and at the Biology Laboratory, Faculty of Mathematics and Natural Sciences, Yogyakarta State University.

2.3 Research Target/Subject

This study used cow dung and household waste in ratios of 1:2, 1:4, and control. Each treatment was carried out in three repetitions (Table 1).

2.4 Procedure

2.4.1 Stage I Experiment

In the first stage, the research design was prepared using Complete Random Factorial which had 2 factors. The first was the provision of varying dose levels when adding EM4 made from *Bacillus* sp.; the second factor was the ratio of cow dung to household waste. The research was carried out in 3 replications, so there were 36 treatment combinations.

Table 1. Combination of Household Waste Composting Treatment

EM4 Dosage	Comparison of doses of cow dung: household waste (kg)		
	Control (S1)	1:2 (S2)	1:4 (S3)
EM4 0% (E1)	E1S1 (P1)	E1S2 (P2)	E1S3 (P3)
EM4 5% (E2)	E2S1 (P4)	E2S2 (P5)	E2S3 (P6)
EM4 10% (E3)	E3S1 (P7)	E3S2 (P8)	E3S3 (P9)
EM4 15 % (E4)	E4S1 (P10)	E4S2 (P11)	E4S3 (P12)

2.4.1.1 Characterization of Household Waste

This stage was carried out to determine the type and number of additional materials needed in the composting process. Determining the characteristics of household organic waste was carried out by collecting household waste, sorting it based on the type of waste (vegetable scraps and fruit), and measuring the proportion of each type. Large parts, such as plant stems, leaves, and vegetables, were cut to approximately 5 cm so that the decomposition takes place completely. The composition used for the decomposition process of household waste consisted of vegetable residues such as cabbage, mustard greens, onion skins, garlic skins, carrot skins, and potatoes. Also, the remaining skins and seeds from melons, bananas, apples, watermelon, and grapes remain.

2.4.1.2 Combination Preparations Used in Composting Household Waste

Household waste that had been sorted was then weighed according to the portion determined for each treatment. For each treatment, the ratio used was 60% for vegetable waste and 40% for fruit waste. Semi-dried cow dung was weighed according to the portion for each treatment. Make a bioactivator solution by dissolving EM4 from *Bacillus* sp bacteria by adding 100 ml water and 100 ml molasses to each pot. Adding molasses increases the nutrition of the microbes in EM4 so that they multiply quickly and can break down the material quickly. EM4 solutions were made in 4 variations: 0%, 5%, 10%, and 15%. Each treatment was estimated to consume 2kg of the mixture (EM4 + Waste).

2.4.1.3 Treatment with the addition of EM4 made from *Bacillus* sp. in the Composting Process

Preparation for the composter tub will be used to make holes in several parts of the bucket and divide it with plywood so that one treatment does not mix with another. At this stage, the prepared household waste and cow dung were put into the composter tank, and then EM4 liquid was added according to the size of each treatment and sprayed evenly. Then, the composter was closed tightly using cardboard, and a wedge was provided so the leachate could come out of the hole made in the composter tank.

There are 4 different dose-level treatments when adding EM4 liquid, with a comparison of the amount of cow dung and waste in 3 variations and 3 replications each (36 treatment tanks). The fermentation was for 40 days, stirring every 3 days. Composting was stopped when the compost looked mature, with parameters that can be seen from color, texture, odor, compost temperature, and pH.

2.4.1.4 Observation of the Composting Process

Compost observations were carried out every 3 days, measuring temperature and pH and stirring the fermented compost. In addition to temperature and pH, odor, texture, and color parameters were observed in the final product.

2.4.2 Stage II Experiment

In the second stage, there is a biological test of the resulting compost using cayenne pepper plant growth indicators (*Capsicum frustescens L*). The chili plants used in this stage were 3 weeks old plants. The research design was prepared according to a Completely Randomized Design of 12 treatments with 5 repetitions, so there were 60 samples. The ratio between soil and household waste fertilizer is 2:1. All planting media materials were mixed evenly, and the pH was measured using a soil tester. The seeds were sowed in polybags filled with soil and household waste fertilizer with 5 repetitions of each treatment. The plants were watered every morning. Measurements include environmental factors (temperature and intensity), number of leaves (strands), and plant height (cm) every 5 days for 15 days.

Fresh and dry weight measurements were carried out by cleaning the plant from all media, dipping it in water, and then weighing it using an analytical scale to obtain the fresh weight of the plant. After obtaining the fresh weight of the plants, the plants were placed in an oven for 48 hours at a temperature of 80°C. After the plants were dried, they were weighed again using an analytical scale to obtain the dry weight of the plant (grams).

2.5 Data analysis technique

Data analysis was carried out using the Exel program, which was analyzed descriptively regarding the effect of variations in the concentration of EM4 made from *Bacillus* sp bacteria and the ratio of cow dung to household waste. Quantitative data analysis in the second stage of the experiment was analyzed using ANOVA for number of leaves, plant height, fresh weight, and dry weight of chili plants. The results of the ANOVA test that are significantly different are followed by the DMRT test (Duncan Multiple Range Test) with a significance level of 5%.

3. RESULTS AND DISCUSSION

3.1 The Effect of Adding a Treatment Combination (EM4 Dose Made from Bacillus sp. and Cow Dung)

3.1.1 Physical Measurement Results (Color, Odor, and Structure of Household Waste Compost)

Changes in color, odor, and structure of compost resulting from the decomposition process of household waste with the addition of EM4 made from *Bacillus* sp bacteria. and cow dung are presented in Table 1. Composting products made from household waste are declared safe for use when the household waste has been completely composted. One indication can be seen from the maturity of the compost which includes physical characteristics (smell, color, and texture that resembles soil, weight loss reaching 60%, neutral pH, stable temperature), changes in nutrient content, and low levels of phytotoxicity (Endah Sulistyawati, et al., 2008). Based on the results of Table 1, it can be seen that the characteristics of the results of composting household waste are different for each treatment given.

Table 1. Physical Properties of Compost Results from EM4 Treatment Made from Bacteria*Bacillus sp. and Cow Manure*

No	Treatment	Repeat	Color	Odor	Structure
1	P1	U1	Light brown	Odorless	Still in the shape of a fruit peel
		U2	Light brown	Odorless	
		U3	Light brown	Odorless	
2	P2	U1	Dark brown	Odorless	Agglomerate
		U2	Dark brown	Odorless	Agglomerate
		U3	Dark brown	Odorless	Agglomerate
3	P3	U1	Blackish-brown	Odorless	Agglomerate
		U2	Blackish-brown	Odorless	Agglomerate
		U3	Blackish-brown	Odorless	Agglomerate
4	P4	U1	Pale yellow	Odorless	Still in the shape of a fruit peel
		U2	Pale yellow	Odorless	
		U3	Pale yellow	Odorless	
5	P5	U1	Dark brown	Odorless	Crumbs
		U2	Dark brown	Odorless	Crumbs
		U3	Dark brown	Odorless	Crumbs
6	P6	U1	Yellowish brown	Odorless	Crumbs
		U2	Yellowish brown	Odorless	Crumbs
		U3	Yellowish brown	Odorless	Crumbs
7	P7	U1	Blackish-brown	Odorless	Slightly sticky
		U2	Blackish-brown	Odorless	Slightly sticky
		U3	Blackish-brown	Odorless	Slightly sticky
8	P8	U1	Fresh chocolate	Odorless	Crumbs
		U2	Fresh chocolate	Odorless	Crumbs
		U3	Fresh chocolate	Odorless	Crumbs

No	Treatment	Repeat	Color	Odor	Structure
9	P9	U1	Blackish-brown	Odorless	Crumbs
		U2	Blackish-brown	Odorless	Crumbs
		U3	Blackish-brown	Odorless	Crumbs
10	P10	U1	Brownish black	Odor +	Sticky and still in the form of vegetables
		U2	Brownish black	Odor +	
		U3	Brownish black	Odor +	
11	P11	U1	Brownish black	Odor ++	Sticky
		U2	Brownish black	Odor ++	Sticky
		U3	Brownish black	Odor ++	Sticky
12	P12	U1	Brownish black	Odor ++	Sticky
		U2	Brownish black	Odor ++	Sticky
		U3	Brownish black	Odor ++	Sticky

In Table 1, the color produced in the treatment without adding EM4 and cow dung (treatments P1 and P4), tends to be pale. This is influenced by the lack of microorganisms that break down household waste in the composting process, thereby slowing down the decomposition process. The resulting color tends to remain the same as the initial form, whereas, in the combination treatment with the addition of EM4 and the addition of cow dung, the compost produces a dark brown to blackish color like soil, which indicates that the compost is mature.

The measurements on 4 samples showed that the compost with the addition of EM4 was black. The composting process also creates an odor. The smell appeared after the temperature increased on the 3rd day of observation. The smell begins to disappear when the temperature begins to decrease. From the data above, it can be seen that the final results of composting in treatments P1-P9 have odorless characteristics. This indicates that the compost is completely dry and contains little water, whereas, for the high-dose treatment, EM4 with a content of 15% was given (P10, P11, and P12). The final result obtained is that the compost still smells and is sticky. This is not by the theory that the higher the dose of EM4, the faster the decomposition process will result in the compost maturation being faster. However, as seen from the results of this research, treatment with the addition of 15% EM4 is ineffective and slows down the decomposition process with a marked strong odor in the results. the end and the resulting structure is sticky or wet.

Based on Table 1, it can be compared that the results that are closer to SNI are P9 treatment (EM4 dose 10% with a dose ratio of cow dung and household waste 1:4). The final physical result of household waste compost obtained from P9 treatment is blackish brown, odorless, and has a crumbly texture like soil. This is according to the compost quality standards in SNI 19-7030-2004:6, which state that good compost is physically blackish and smells like earth.

3.1.2. Environmental Conditions During the Household Waste Composting Process

3.1.2.1 Temperature

Temperature is an important factor in the composting process. One of the final results of composting is heat produced from the activity of microorganisms. Temperatures that are too high will cause microorganisms to die. However, if the temperature is relatively low, then the microorganisms will not be able to work fully in decomposition. The results of temperature measurements during the 41 days of composting are presented in Figure 1.

As seen from Figure 1, the temperature increased on the 3rd day after treatment. This is influenced by the additional dose of EM4 and cow dung, which triggers the multiplication of microorganisms. On the 3rd day of P8 treatment (EM4 dose 10% with a dose ratio of cow dung and household waste 1:2), the average temperature value was highest compared to the other treatments, namely 36.1°C. The lowest temperature value was obtained in P1 (0% EM4 dose without adding cow dung or control for the second factor) at 31.6°C. During day-to-day observations, the temperature decreased and began to remain constant on the 25th to 27th day, then on the 30th day the composting temperature increased and began to fall until the end of composting. Temperature is one of the factors that influence the rate of composting because each decomposing microorganism has an optimum temperature in its activities. According to Djuarnani et al. (2005), microorganisms that live at low temperatures (10°C-45°C) are mesophilic microorganisms and microorganisms that live at high temperatures (45°C- 65°C) are thermophilic microorganisms. The best composting temperature is 10°C- 45°C.

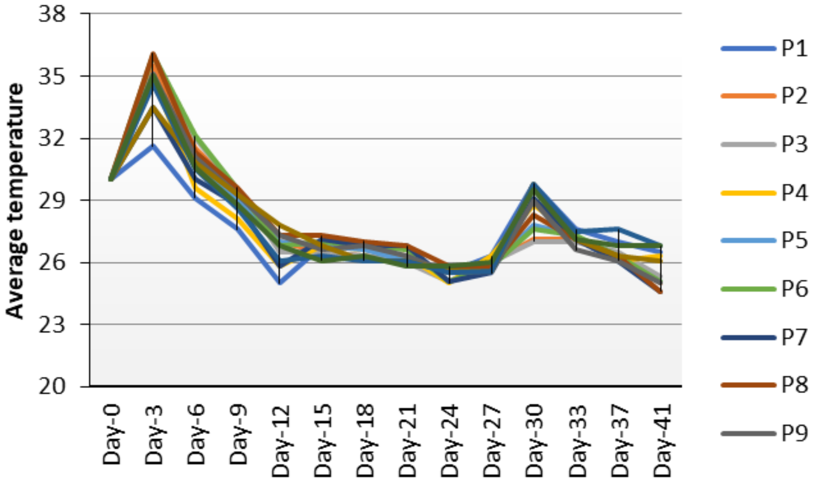

Figure 1. Graph of Average Temperature During Composting Household Waste using EM4 Made from *Bacillus* sp. and Cow Manure.

The increase between temperature and oxygen consumption has a straight proportional relationship. The higher the temperature, the more oxygen consumption there will be and the faster the decomposition process. The high oxygen consumed will produce CO_2 from microbial metabolism, so organic matter decomposes more quickly. Temperature increases can occur quickly in a compost pile. Temperatures ranging between 30°C- 60°C showed rapid composting activity. When the temperature is high, from 60 °C, it will kill some microbes, and only thermophilic microbes will survive. High temperatures also kill plant pathogenic microbes and weed seeds (Yulianto, 2009).

The final result of calculating the average temperature when composting household waste with the addition of EM4 made from *Bacillus* sp bacteria and cow dung is starting to stabilize, marked by the temperature starting to approach ground temperature and no significant fluctuations occurring, around 24°C- 27°C. This matter has met the standards for mature compost according to SNI 19-7030-2004, namely <30ºC.

3.1.2.2 Degree of Acidity (pH)

The acidity or pH in the compost pile also affects the activity of microorganisms. During composting, pH measurements in compost piles are carried out every 3 days. The results of pH measurements are presented in Figure 2.

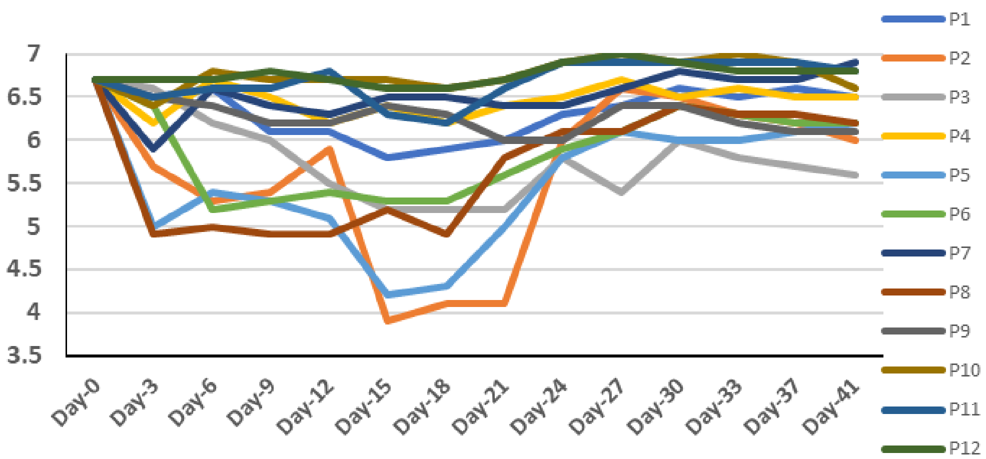

Figure 2. Graph of Average pH During Composting Household Waste Using EM4 Made from Bacteria*Bacillus sp. and Cow Manure*

At the start of composting, after all the materials have been mixed, they are then incubated, and seen from Figure 2, the results of the average pH value in the various treatments on the 3rd day of composting pH begins to decrease or become sour. This is caused by simple organic acids produced from the initial breakdown of materials. The pH of the pile material will return to near alkaline after a few days as the material proteins are broken down and ammonia is released. Acidity that is too high in the early stages will hinder the activity of microorganisms in degrading organic materials.

Based on Figure 2, for all treatments, pH during the decomposition process experiences different changes from one treatment to another. This is due to differences in the dosage of EM4 made from *Bacillus* sp which causes differences in their ability to decompose household waste. The pH value during the composting period greatly influences the growth of decomposing microorganisms. During the composting process, the pH of the compost decreased until the 27th day, when the lowest average value was obtained in the P3 treatment (EM4 dose 0% with a dose ratio of cow dung and household waste 1:4). Theory states that the addition of EM4 affects the pH obtained during the composting process, which illustrates that microbes continue to break down organic materials into organic acids and then into ammonia which increases the pH value significantly. This is also thought to be due to the dominance of mesophilic microbes at the beginning of composting (it has been proven that the initial temperature achieved with the activator is higher than the initial temperature without the activator), which creates a high pH starter at the initial stage of composting.

In the final results of pH measurements, only compost treated with P7, P11, and P12 met the pH requirements for mature compost as required by SNI 19-7030-2004 with an average pH value of P7 of 6.9, P11 and P12 of 6.8. According to the 2004 Indonesian National Standard, the minimum pH value is 6.8 and the maximum is 7.49.

3.2 Test of Compost Results on the Growth of Cayenne Pepper Plants

3.2.1 The Effect of Household Waste Compost on the Increase in Height of Cayenne Pepper Plants

Figure 3 displays the results of measuring the height increase of cayenne pepper plants (Capsicum frutescent L).

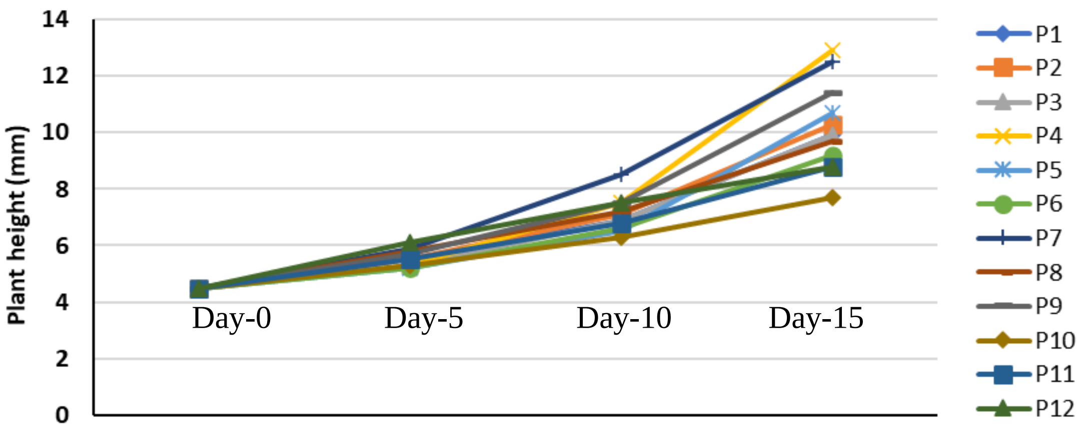

Figure 3. Average graph of the influence of household waste compost on the increase in height of cayenne pepper plants (*Capsicum frutescent L)*

Figure 3 shows the increase in height of cayenne pepper plants with the highest in the treatment (5% EM4 dose without the addition of cow dung or control for the second factor), then P7 (10% EM4 dose without the addition of cow dung or control for the second factor). This shows that in treatments P4 and P7 household waste compost can supply nitrogen in the amount needed for the growth and development of cayenne pepper plants. A plants' need for nitrogen is higher than for other nutrients. The results obtained are in accordance with Dwdjosaputro 1990 in Erawan et al. (2013), that N functions in plant vegetative growth. Nitrogen is an essential nutrient for cell division and elongation so N is a constituent of protoplasm which is found in many tissues such as growing points.

However, when compared with the physical results of the compost in treatment P4, it shows that the compost still has the texture of seeds and fruit skin with a pale yellow color and no smell, which indicates that the quality of the compost is not good. The incompatibility of the results obtained by comparing the quality of the compost and its ability to supply the growth of cayenne pepper plants could be caused by the type of test plant in the P4 treatment whose metabolism in absorbing nutrients was better than the ability of plants with other treatment applications. Environmental factors such as light intensity and plant distance also influence plant growth. Cayenne pepper plants require open land to receive sunlight from morning to evening. Apart from that, this plant likes soil with a smooth drainage system, especially during the rainy season. According to Sitompul and Bambang (1995), plants that receive less light will have a smaller number of cells with a higher habitus than plants that receive much light.

This difference could also be caused by the weakness of this research, which only used physical standards and did not use chemical test results or laboratory tests, which could produce more accurate results regarding the nutritional content of the resulting compost. Data from the One-Way ANOVA test on the increase in height of cayenne pepper plants is presented in Table 2.

Table 2. One-Way ANOVA Test Results of the Effect of Household Waste Compost on the Height of Cayenne Pepper Plants

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Compost	130.968	11	11.906	4.728	.000
Error	120.876	48	2.518		
Amount	251.844	59			

Table 2 above shows the real influence of adding compost made from household waste on the increase in height of cayenne pepper plants. This significance value is smaller than 0.05, which means the compost is produced from household waste with the addition of EM4 made from *Bacillus* sp bacteria and cow dung, which significantly influence the height of cayenne pepper plants. The Duncan Multiple Range Test (DMRT) was conducted to determine the average differences between treatments.

Table 3. DMRT Results on the Effect of Household Waste Compost on Cayenne Pepper Plant Height

Treatment Combination	**N**	**Alpha value = 0.05**				
		1	2	3	4	5
P10	5	3.160				
P11	5	4.260	4.260			
P12	5	4.300	4.300			
P6	5	4.700	4.700	4.700		
P8	5	5.160	5.160	5.160		
P1	5	5.400	5.400	5.400		
P3	5	5.400	5.400	5.400		
P2	5		5.800	5.800		
P5	5		6.200	6.200	6.200	
P9	5			6.900	6.900	6.900
P7	5				8.000	8.000
P4	5					8.400
Sig.		.057	.104	.062	.096	.165

The results of Duncan's further test, with a limit of 5%, showed that the height of the cayenne pepper plants increased (Capsicum frustescens L), and there were differences between treatments. The differences between treatments are caused by different doses and combinations in making household waste compost, which will cause differences in the nutritional content of each planting medium, increasing the height of each cayenne pepper plant. (*Capsicum frutescent L*)different.

3.2.2 The Effect of Household Waste Compost on the Number of Leaves of Cayenne Pepper Plants(*Capsicum frutescent L*)

Figure 4 displays the results of measuring the number of leaves of cayenne pepper plants (Capsicum frutescent L).

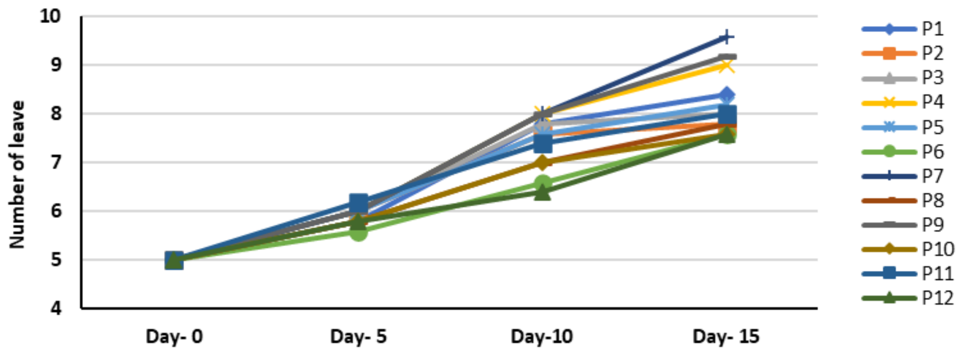

Figure 4. Average Effect of Household Waste Compost on the Number of Leaves of Cayenne Pepper Plants

In Figure 4, treatments P4, P7, and P9 have values that tend to be higher compared to other treatments. The increase in the number of leaves is closely related to the high number obtained in the above parameter measurements. This is because this treatment can supply the nitrogen element in the amount needed for the growth and development process of cayenne pepper plants because the nitrogen nutrient plays a very important role in plant vegetative growth, for example, plant height and the number of leaves of cayenne pepper plants. According to Harjadi (1996), the number of leaves is related to the height of the plant, where the taller the plant, the more leaves it forms because the leaves grow from the nodes.

Table 4 shows a significance value of 0.026 ($P<0.05$). To determine the average differences between treatments, the Duncan Multiple Range Test (DMRT) was carried out at a level of 5%.

Table 4. One-Way ANOVA Test Results of the Effect of Household Waste Compost on the Number of Leaves of Cayenne Pepper Plants

	Sum of Squares	df	Square Mean	F	Sig.
Compost	25,533	11	2,321	2,265	,026
Error	49,200	48	1,025		
Amount	74,733	59			

Table 5 shows that the increase in the number of leaves on cayenne pepper plants with treatment P6 was significantly different from treatments P9 and P7, and treatment P10 was significantly different from treatments P9 and P7. Treatment P12 was significantly different from treatments P9 and P7, and treatments P2, P8, P3, and P11 were significantly different from treatment P7.

3.2.3 Effect of Household Waste Compost on Fresh Weight of Cayenne Pepper Plants

The results of measuring the average fresh and dry weight of cayenne pepper plants are shown in Figure 5. Based on Figure 5, it can be seen that the results of measuring the average wet weight of cayenne pepper plants were highest in treatment P4 (5% EM4 dose without the addition of cow dung or control for the second factor) with a weight of 3.114 gr. The lowest wet weight was obtained in the P10 treatment (15% EM4 dose without the addition of cow dung or control for the second factor) of 1.868 gr. Parameters of fresh weight of cayenne pepper plants reflect the weight of the plant by including the water contained in it.

Table 5. DMRT Further Test Results on the Effect of Household Waste Compost on the Number of Leaves of Cayenne Pepper Plants

Treatment Combination	N	Alpha value = 0.05		
		1	2	3
P6	5	2.6		
P10	5	2.6		
P12	5	2.6		
P2	5	2.8	2.8	
P8	5	2.8	2.8	
P3	5	3	3	
P11	5	3	3	
P5	5	3.2	3.2	3.2
P1	5	3.4	3.4	3.4
P4	5	4	4	4
P9	5		4.2	4.2
P7	5			4.6
Sig.		.070	.066	.055

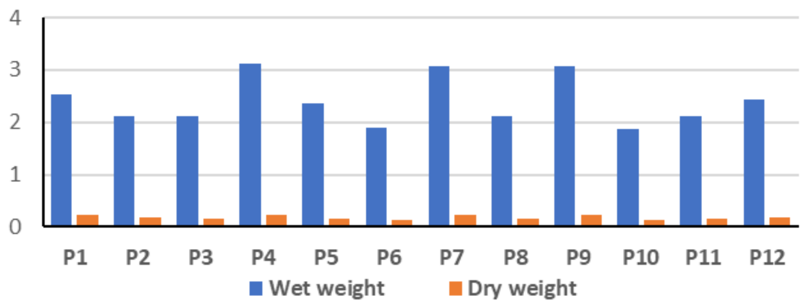

Figure 5. Graph of the Average Effect of Household Waste Compost on the Wet & Dry Weight of Cayenne Pepper Plants

According to Salisbury and Ross (1995), plant fresh weight can indicate plant metabolic activity and the value of total plant fresh weight is influenced by tissue water content, nutrients, and metabolic results. The growing tissue in the body of the cayenne pepper will increase the weight of the cayenne pepper plant. An adequate supply of nutrients influences the development of plant tissue.

Based on Figure 5, the results of measuring the average dry weight of cayenne pepper plants were highest in treatment P1 (0% EM4 dose without the addition of cow dung or control for the second factor), with a weight of 0.235 gr, while the lowest dry weight was obtained in the P6 treatment(EM4 dose 5% with a dose ratio of cow dung and household waste 1:4), reaching 0.131 gr.

Dry weight data shows the net weight of the plant after the water content has been deposited or evaporated after drying. The main components of the dry matter left behind are polysaccharides, lignin in the cell walls, and cytoplasmic components such as proteins, lipids, amino acids, and organic acids (Salisbury, 1995). Analysis of the fresh weight of cayenne pepper plants aged 15 HST is presented in Table 6.

Table 6. One-Way ANOVA Test Results of the Effect of Household Waste Compost on the Wet Weight of Cayenne Pepper Plants

	Sum of Squares	df	Mean square	F	Sig.
Compost	11,406	11	1,037	3,689	,001
Error	13,493	48	,281		
Amount	24,899	59			

Based on the results of Table 6 above, it can be seen that the significance value of the wet weight of cayenne pepper plants of 0.001 is smaller than the determination α = 0.05. Based on the results of the one-way ANOVA test in Table 6, it show that there is a significant difference between the treatment on the fresh weight of cayenne pepper plants. To determine the average differences between treatments, the Duncan Multiple Range Test (DMRT) was carried out at a level of 5%.

The results of the Duncan test with a level of 5% in Table 7 above show that the fresh weight of cayenne pepper plants with treatments P10, P6, P11, P3, P2, and P8 were significantly different from treatments P9, P7, and P4. Treatment P5 was significantly different from P4. Treatments P12, P1, P9, and P7 significantly differed from treatment P4.

Table 7. DMRT Further Test Results on the Effect of Household Waste Compost on the Fresh Weight of Cayenne Pepper Plants

Treatment Combination	**N**	**Alpha value = 0.05**		
		1	**2**	**3**
P10	5	1.8678		
P6	5	1.8898		
P11	5	2.1058		
P3	5	2.1136		
P2	5	2.1174		
P8	5	2.128		
P5	5	2.3512	2.3512	
P12	5	2.4276	2.4276	2.4276
P1	5	2.5206	2.5206	2.5206
P9	5		3.0656	3.0656
P7	5		3.0674	3.0674
P4	5			3.1136
	Sig.	,104	,061	,073

Based on Table 8, it can be seen that the significance value of the dry weight of cayenne pepper plants of 0.000 is smaller than the determination α = 0.05. The results of the one-way ANOVA test in Table 8 show that the treatment has a real influence on the dry weight of cayenne pepper plants.

Table 8. Results of Dry Weight Analysis of Cayenne Pepper Plants

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Compost	,079	11	,007	4,963	,000
Error	,070	48	,001		
Amount	,149	59			

The results of the Duncan further test with a level of 5% in Table 9 show that the dry weight of cayenne pepper plants with treatments P6, P10, P11, P8, P3, P5, P12, and P2 were significantly different from treatments P7, P4, P9, and P1.

4. CONCLUSIONS

Based on research data and discussion, it can be concluded that (1) the use of EM4 made from *Bacillus* sp. mixed with cow dung affects the quality of the composting results, (2) the combination of EM4 concentration treatment made from *Bacillus* sp. and the most optimal addition of cow dung in making household waste fertilizer is the P9 treatment (EM4 dose 10% with a dose ratio of cow dung and household waste 1:4)seen from the physical properties of the compost, it is closest to SNI. (3) Household waste fertilizer significantly affects the growth of cayenne pepper plants (*Capsicum frustescens L*), as seen from all observation parameters, namely plant height, number of leaves, fresh weight, and dry weight. The P4 treatment (5% EM4 dose without adding cow dung or control for the second factor) gave better training results for plant height and fresh weight. In comparison, the P7 treatment (10% EM4 dose without adding cow dung or control for the second factor) gives relatively better results for the number of leaves and plant dry weight.

Table 9. DMRT Test on the Effect of Household Waste Compost on Dry Weight of Cayenne Pepper Plants

Treatment Combination	N	Alpha value = 0.05	
		1	2
P6	5	,13120	
P10	5	,13940	
P11	5	,14740	
P8	5	,16640	
P3	5	,16660	
P5	5	,16700	
P12	5	,17120	
P2	5	,17420	
P7	5		,22520
P4	5		,22720
P9	5		,23380
P1	5		,23460
Sig.		,133	,727

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