

THE IMPACT OF USING A MIXTURE OF ORGANIC FERTILIZERS (COMPOST AND LIQUID ORGANIC) AND PLASTIC MULCH, ON THE DEVELOPMENT OF CAYENNE PEPPER PLANTS

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Abstract. *Husoak Village, Hubikiak District Jayawijaya is one of the regions in Papua province where plants including chili. The cultivation system are extensively and using traditional method depending on soil nutrients. The aim of the research is to see how utilizing a mix of organic fertilizer and mulch affects the growth and development of chili plants. This research was conducted based on a randomized block design consisting of 4 treatments. namely P1 = compost; P2 = compost + liquid organic fertilizer + plastic mulch; P3 = compost +TiO₂+liquid organic fertilizer + plastic mulch; P4= Control (No Treatment). When compared to the control. the results showed that using a mix of organic fertilizer (compost and liquid organic) and mulch had an effect that was not significant. This demonstrates that cayenne pepper plants may still get the nutrients they require from nutrients available in the soil. Fertile land is still classified as cultivated land.*

Keywords: *organik fertilizers; plastic mulch; growth; chili plant*

1. Introduction

One of the most popular horticulture products that people in Indonesia have a high need for is chili. People in Indonesia typically distinguish between two varieties of chili: big chilies and small chilies (cayenne pepper). People in Papua Province frequently plant cayenne pepper, one variety of chili. Although there are many people that grow cayenne pepper, this does not mean that output will constantly rise. Whereas, according to statistics from the Central Statistics Agency and the Directorate General of Horticulture in 2019, the production of chili plants in the province of Papua declined from 2018 to 2019, totaling 6,943 tons in 2018, 4,388 tons in 2019, and 3,436 tons in 2019. The traditional agricultural method, farmers' declining interest, and the Covid-19 epidemic were all factors in the decline.

This decline in chili productivity should not have occurred, because Papua is an area that has large and fertile land, has a cool highland topography, making it suitable for the development of vegetable commodities, including cayenne pepper. The Ministry of Agriculture is further encouraged by this requirement to support the growth of horticulture in Papua as a site for the development of horticultural areas. However, the use of modern agricultural techniques must also support the state of the Papua region. As a result, the transformation of the conventional agricultural system into a modern agricultural system was listed as one of the priority programs

for 2019 by the Head of the Jayapura Regency Food Crops and Horticulture Service. Since natural soil nutrients are the only source of nutrients used in traditional agricultural systems, continuous cultivating activities would reduce soil productivity.

One of the contemporary agricultural practices that can be used in the cayenne pepper production is the use of organic fertilizers and mulch. Application of this method can to increase the growth of chili plants and support sustainable agriculture. Organic fertilizers used in the form of compost and liquid organic fertilizer from local microorganisms (MOL) banana weevil. Compost is very helpful in increasing the ability of the soil to hold water so that it can store groundwater for longer. The availability of water in the soil can prevent the dry layer on the soil.

Therefore, compost is very helpful in maintaining root health and making it easier for plant roots to grow. increased of soil organic matter. soil structure improves and increased of water holding capacity. Improvement of soil physical properties has a positive effect on plant root growth and nutrient absorption [Rozy et al. \(2013\)](#). [Supit et al. \(2016\)](#) stated that compost treatment had a very significant effect on the growth and production of shallots, peanuts, and soybeans. Compost treatment with a dose of 90 t.ha⁻¹ (225 g.pot⁻¹) gave maximum growth and production of shallots, peanuts, and soybeans. Furthermore, [Kurnia et al. \(2019\)](#) reported that tomato plants fertilized with 30 t.ha⁻¹ grass compost gave the same results as using synthetic fertilizers. It was further reported that the application of compost was able to maintain plant productivity ([Vijayakumar et al., 2021](#)).

One of the organic fertilizers that can be used is local microorganism (MOL) from banana weevil. Besides being easy to process, banana weevil is also an agricultural waste that has not been used optimally ([Tuhuteru, 2019](#)). [Budiyani et al. \(2016\)](#) reported that MOL banana weevil contains microorganisms in the form of *Bacillus* sp. *Aeromonas* sp. *Aspergillus nigger*. *Azospirillum*. *Azotobacter* and cellulolytic microbes. The relevant research also reported that liquid organic fertilizer contains microorganisms that are not found in the soil, such as *Azotobacter* sp. *Azospinillum* sp. *Lactobacillus* sp. *Pseudomonas* sp. phosphate solubilizing microbes, and cellulose microbes. [Lepongbulan et al. \(2017\)](#) suggested that the MOL of banana weevil functions as a nutrient addition to plant nutrients and as a biovactor to accelerate fermentation. In addition, the MOL solution contains micro and macro nutrients and also contains bacteria that have the potential to decompose organic matter and at the same time stimulate plant growth ([Hadi, 2019](#)). Microorganisms contained in the banana hump mole play an important role in the decomposition of organic matter. In addition, MOL banana weevil also functions as organic material, also contains NPK nutrients and the hormones auxin, gibberellins and cytokinins which are good for plant growth ([Salma & Purnomo 2015](#)) and can also reduce toxic compounds in the soil ([Liu et al., 2018](#)). The use of banana weevil MOL can accelerate the decomposition process ([Ramon et al.,](#)

2019; Afifah *et al.*, 2019). In order to produce secondary vegetative compost and other organic compost fertilizers, the MOL banana weevil has the potential to be used as a decomposer.

The effect of plastic mulch on plant growth and yield, especially determined by its effect on the balance of light striking the plastic surface used (Darmawan *et al.*, 2014). Almost 33% of the sunlight that hits the surface of the silver plastic mulch is reflected back into the air, so that very useful in the distribution of light that can be utilized by all plants to get light. Thus, the use of plastic mulch can control the microclimate on cultivated land, especially the intensity of sunlight, temperature and soil moisture. This research aims to see the effect of using a combination of organic fertilizers (compost and liquid organic fertilizer) with mulch in increasing the growth and productivity of cayenne pepper plants. The results of this study can be used as a reference or guideline in the pattern of cayenne pepper cultivation, especially for the Husoak Village, Hubikiak District, Jayawijaya, Papua Province.

2. Methods

2.1. Experimental Design

This research was conducted in Husoak Village, Hubikiak District, Jayawijaya, Papua Province, Indonesia and located on the meridian 137°12'-141°00' East Longitude, and 3°2'-5°12' South Latitude. This research was conducted based on a randomized block design consisting of 4 treatments, namely P1 (Compost); P2 (Compost + liquid organic fertilizer + plastic mulch); P3 (compost +TiO₂+liquid organic fertilizer + plastic mulch); and P4 (Control or No Treatment). Each treatment was repeated 3 times.

Nursery cayenne pepper seeds using a plastic tube. Silver plastic mulch (is installed on the beds according to the treatment and perforated according to the size of the planting hole and the spacing used. TiO₂ was sown on the beds (250g/meter). Compost was applied 3 days before planting as much as 500 g/planting hole. The application of liquid organic fertilizer (MOL banana weevil) was carried out 2 weeks after planting by watering, 2 times a week as much as 100 ml/planting hole.

Liquid organic fertilizer or MOL banana weevil creation begins with the banana hump was cleaned and weighed up to 3 kg before being sliced. It was then placed in a bucket and 10 L of rice water was added. Then, 1/2 kg of sugar was added, it was mixed, and it was carefully sealed to begin the 21-day fermentation process. MOL was filtered after 21 days and is now a decomposer.

Compost was made using various secondary vegetation especially weeds, which was collected and chopped to a size of 1-3 cm. In addition, it was weighed up to 50 kilograms before being added along with 20 kg of dry pig manure and 10 kg of combustion ash. Next, a trowel was used to thoroughly combine the three materials. 100 ml L⁻¹ MOL was added to the mixture by

pouring it over the combined compost material. Following that, the composting process was completed by being buried in the earth for 45 days. The completed compost has a crumb-like texture and a blackish brown tint. In addition, the compost had dried and was prepared for the subsequent process.

The parameters tested were physical and chemical properties of the soil, as well as the growth and production parameters of chili plants in the form of plant height, number of leaves, number of branches and number of fruit. Observations of cayenne pepper plant growth were carried out every week until 12 weeks after planting.

2.2. Data Analysis

Analysis of Variance was used to determine the significance of the observed response to each treatment (ANOVA). If the treatment shows substantially different results, the Least Significant Difference (LSD) further test is performed at a confidence level of $\alpha = 0.05$.

3. Results and Discussion

3.1. Physical and chemical properties of the soil

The characteristics of the soil, both physical and chemical qualities of the soil were practically the same, according to the findings of soil analysis on treated and controlled soil, indicating that changes in soil properties were not significantly impacted by the treatment. Both the control and treatment areas had the macro- and micronutrients that chili plants required for growth and development (Table 1).

The macronutrients needed by plants are Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), and Sulfur (S). The results of soil analysis showed that both the control and treated land contained high levels of macronutrients. The high content of C-organic and N-organic, P₂O₅ and K₂O in the research soil samples (control, P1, P2, P3) was caused by mineralization or decomposition of soil organic matter and organic matter derived from sweet potato plant residues and cayenne pepper on the soil (for control soil) as well as from the addition of compost and liquid organic fertilizer (treated soil). This is as described by Gunawan *et al.* (2019) that one of the factors for increasing or improving soil chemical properties and soil fertility status is the use of organic matter. Soil fertility can be further improved by incorporating cover crops that add organic matter to the soil, which leads to improved soil structure and promotes a healthy, fertile soil; by using green manure or growing legumes to fix nitrogen from the air through the process of biological nitrogen fixation; by micro-dose fertilizer applications. Organic farming practices have demonstrated beneficial effects by enhancing soil organic matter content, soil porosity, structural stability, moisture, nutrient availability, biological activity, and soil erosion reduction (Wang *et al.*, 2017). Organic matter in

compost and liquid organic fertilizer is a source of elements C, N, P and K. This is in accordance with result research of [Jamilah & Juniarti \(2017\)](#) that an amendment in soil chemical properties after the application of *C. odorata*, compost achieving optimal fertility for rice crop. Nitrogen and other minerals uptake in rice crop increased due to the increased provision of artificial fertilizers escorted by lowering the dose of *C. odorata* compost. Optimum P availability is at pH 6.5. Below 6.5, P becomes insoluble Al/Fe minerals or absorbs to oxides and clay. Above 6.5, P bonds with Ca to form solid minerals similar to Ca-phosphate fertilizers. Relatedly, Ca-phosphate fertilizers added to acid soils will readily dissolve and release P, but will have limited solubility in alkaline soils ([Miller, 2016](#)).

Table 1. Result of Analysis physical. and chemical soil properties

No.	Component analysis	Result of Analysis			
		P1	P2	P3	Control
Physical soil properties					
1.	Soil structure	-	-	-	Gumpal membulat
2.	Texture	Dusty Clay	Dusty Clay	Dusty Clay	Dusty Clay
Chemical soil properties					
3.	pH	6.22 ⁿ	6.70 ⁿ	6.69 ⁿ	7.21 ⁿ
4.	C (%)	3.10 ^h	3.80 ^h	3.57 ^h	3.51 ^h
5.	N (%)	0.14	0.15	0.16	4.31 ^h
6.	HCl 25% dan olsen/bray				
7.	P ₂ O ₅	40 ^h	30 ^h	37 ^h	43.76 ^h
8.	K ₂ O (mg/100g)	238 ^h	324 ^h	182 ^h	58.35 ^h
9.	Fe (%)	3.61	2.85	3.30	Nd
10.	Mn (%)	0.03	0.03	0.03	Nd
11.	Zn (ppm)	54.48	54.11	56.59	Nd
12.	Cu (ppm)	15.44	16.47	15.68	Nd
13.	Ca (%)	0.58	0.88	0.60	Nd
14.	Mg (%)	0.15	0.17	0.15	Nd
15.	S (%)	0.15	0.17	0.17	nd

Noted: n = netral; h = high; nd = no detection

3.2. Plant Growth

Based on observations on plant height ([Table 2](#)), number of leaves ([Table 3](#)), number of branches ([Table 4](#)) and number of fruit ([Table 5](#)), in general the treatment of compost (P1), compost, liquid organic fertilizer and mulch plastics (P2), as well as composts, liquid organic fertilizers, TiO₂ and plastic mulch (P3) gave no significant effect with no treatment (control). The growth and development OF cayenne pepper plants, whether treated or not, showed no significant difference in performance. This is because the nutritional needs and soil conditions are in accordance with the conditions for growing cayenne pepper plants. It is suspected that the factor that played an important role was the cultivation system that was previously applied to the land.

The results of analysis of variance on chili plant height data showed that in general, the treatment of P1, P2 and P3 did not have a significant effect on cayenne pepper plant height when compared to the control (without treatment), except at plant ages of 4 WAP, 7 WAP, 8 MST, 10 MST and 11 MST. The best treatment that had a significant effect on the growth of chili plant

height was P1.

Table 2. The results of observations of chili plant height.

Treatment	Plant Age (Week after planting)											
	1	2	3	4	5	6	7	8	9	10	11	12
Control	12.13	15.60	19.33	25.03 ^{ab}	30.00	35.13	39.20 ^a	44.97 ^a	49.47	55.20 ^b	63.50 ^b	69.97
P1	12.4	15.93	19.67	26.57 ^a	30.47	34.60	38.83 ^a	44.33 ^a	51.17	60.10 ^a	68.30 ^a	76.13
P2	11.1	14.13	18.75	25.20 ^{ab}	28.90	33.07	36.40 ^{ab}	41.33 ^b	49.33	61.27 ^a	67.80 ^a	77.13
P3	12.73	15.73	19.10	22.67 ^b	27.93	30.97	34.80 ^b	40.30 ^b	49.30	59.13 ^a	68.43 ^a	74.43

Noted: P1 = Compost; P2 = Compost + liquid organic fertilizer + plastic mulch; P3 = compost+TiO₂+liquid organic fertilizer + plastic mulch; numbers followed by different letters are significantly different (LSD= 0.05)

Table 3. The results of observations of the number of leaves of chili plants

Treatment	Plant Age (Week after planting)											
	1	2	3	4	5	6	7	8	9	10	11	12
Control	22.00	36.67 ^a	40.67	53.67	82.33	117.67	145.33	154.00	204.00 ^b	254.00 ^c	295.33 ^c	344.00
P1	19.67	28.00 ^b	32.67	62.00	78.00	110.33	142.00	177.67	211.33 ^b	292.33 ^b	320.67 ^b	358.67
P2	22.33	29.00 ^b	34.33	63.67	83.33	109.00	146.00	192.33	266.00 ^a	320.67 ^a	356.67 ^a	403.33
P3	19.00	39.33 ^a	41.00	64.00	75.67	107.00	152.00	204.33	257.33 ^a	308.00 ^{ab}	344.00 ^a	368.00

Noted: P1 = Compost; P2 = Compost + liquid organic fertilizer + plastic mulch; P3 = compost+TiO₂+liquid organic fertilizer + plastic mulch; numbers followed by different letters are significantly different (LSD= 0.05)

The results of analysis of variance on the number of leaves of chili plants showed that in general, the treatment of P1, P2 and P3 did not have a significant effect on the number of leaves of cayenne pepper plants when compared to the control (without treatment), except at the age of plants 2 WAP, 9 WAP, 10 WAP and 11 WAP. The best treatment that gave a significant effect on the growth of the number of leaves of cayenne pepper plants was P2.

Table 4. The results of observing the number of branches of chili plants

Treatment	Plant Age (Week after planting)								
	4	5	6	7	8	9	10	11	12
Control	2.67	3.67	5.67	7.00	7.33	8.33	8.67	9.00	9.00
P1	2.33	3.00	4.33	5.67	6.67	7.33	8.67	8.67	9.00
P2	3.00	3.33	4.33	6.33	7.33	8.33	8.67	9.33	9.33
P3	2.33	4.33	5.67	6.00	7.33	8.33	9.33	10.00	10.00

Noted: P1 = Compost; P2 = Compost + liquid organic fertilizer + plastic mulch; P3 = compost+TiO₂+liquid organic fertilizer + plastic mulch;

The results of analysis of variance on data on the number of branches of chili plants showed that in general, the treatment of P1, P2 and P3 did not have a significant effect on the number of branches of cayenne pepper plants when compared to the control (without treatment).

Every week, the growth and development of cayenne pepper plants (P1, P2, P3), both those planted on untreated and treated soils (P1, P2, P3), increased. This is because the soil's physical and chemical properties are ideal for cayenne pepper plant growth and development (see [Table 1](#)). This rise happened because the metabolic processes in the plant tissues were working smoothly since the nutrients required, particularly the key elements N, P, and K, were accessible in sufficient

quantities.

Table 5. The results of observing the number of chili plants.

Treatment	Plant Age (Week after planting)			
	9	10	11	12
Control	16.33	28.33	46.67	72.33
P1	16.67	31.33	46.33	82.00
P2	16.33	29.00	45.00	83.33
P3	15.67	28.00	51.67	78.33

Noted: P1 = Compost; P2 = Compost + liquid organic fertilizer + plastic mulch; P3 = compost+TiO₂+liquid organic fertilizer + plastic mulch;

Each of these nutrients has an important function in chili plant growth and development. Phosphate for plants stimulates flowering, fertilization, root growth, seed production, plant cell division, and enlarges cell tissue by transporting energy from metabolism in plants. Potassium facilitates photosynthesis by transferring digested products, enzymes, minerals, and water, as well as enhancing plant resilience to disease. Nitrogen stimulates overall plant development, as well as the synthesis of amino acids and proteins in plants, as well as vegetative growth (green color) such as leaves. Carbon is used as a source of energy. Calcium stimulates cell growth, strengthens and regulates penetrating power, cares for cell walls, and is particularly vital at the root growth stage. All of the macro criteria were met, according to the results. Every week, the plant's height, number of leaves, number of branches, and number of fruits grew.

However, statistical analysis of variance (ANOVA) revealed that there was no significant difference in the treatment given to the growth and development of chili plants compared to the control group. This isn't to say that composts, liquid organic fertilizers, TiO₂, and plastic mulch aren't beneficial to the growth and development of chili plants. Plant height, number of leaves, number of branches, and number of chili plants were all higher in the treated group than in the control group. Plastic mulch can be used to regulate the microclimate around cayenne pepper plants, such as soil temperature and moisture. The result research of [Kamil *et al.* \(2020\)](#) shows that the plastic mulch practice can sustain the availability of nutrients in the soil. Where plastic mulch were significantly high in pH, total N and exchangeable Mg, while organic C was found to be low in a plot with the application of pesticide. Mulching can also stimulate plant height and branching rate. When compared to straw mulch or no mulch, plastic mulch produced the most overall number of fruit ([Ardhona *et al.*, 2013](#)).

4. Conclusions

In chili plantations, a combination of compost, liquid organic fertilizer, and plastic mulch can improve the soil's nutrient status and physical qualities. The growth and development of cayenne pepper plants is aided by this. Statistical testing revealed that there was no significant difference between treatments in terms of encouraging chili plant growth and development. Because the area

is still categorized as fertile land, this is the case. As a result, using simple organic fertilizers to boost the growth and development of chili plants is still sufficient. Liquid organic fertilizer made from MOL banana weevil, whereas compost made from secondary vegetation.

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