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The effect of liquid organic fertilizer (Kascing) on the growth of cayenne pepper (*Capsicum frutescens* L.)

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Abstract

Cayenne pepper is often found in the yard and around the house. Chili is a cultivated plant used as a vegetable crop and can be consumed directly with snacks. The demand for chili increases; meanwhile, the availability of chili fluctuates due to various factors such as; climate and nutrients in the soil (media). The purpose of this study was to determine the effect of liquid organic fertilizer (vermicompost) on the growth of cayenne pepper (*Capsicum frutescens* L.). From September to October 2021, the research was conducted at the Horticultural Plant Laboratory, Faculty of Agriculture, Cokroaminoto University Makassar, and South Sulawesi. The study applied an experimental method with a completely randomized design (CRD). It consists of four treatments and five replications. Thus, there were experimental units. The data were analyzed by analysis of variance (ANOVA) and Tukey's test (HSD). The study found that 1) The average growth is significantly influenced by the higher dose of organic fertilizer on high plant growth, 2) the average plant growth (plant height) differs significantly between treatments, and 3) D, the treatment with a dose of 30 gr/l, is a treatment that is significantly different from other treatments. Thus, the application of organic fertilizer at a dose of 30 gr/l significantly affected the growth of cayenne pepper (*Capsicum frutescens* L.).

Keywords: Chili; Organic fertilizer; Kascing; Growth

1. Introduction

Chili is a plant often found in the yard and around the house. It comes from tropical and subtropical regions, namely the Americas, such as Colombia and South America, and spread to Latin America. The spread of chili throughout the world, including Asia, such as Indonesia, was done by Spanish and Portuguese traders. There are 20 species of chili. Most of them are found in the Americas, but Indonesian generally only knows a few types of chili, such as big chili, curly chili, cayenne pepper, and paprika (Harpenas & Dermawan, 2010). Chili is a cultivated plant used as a vegetable crop (Dalimartha, 2006). Chili is classified as annual or short-lived plants that grow as shrubs (Cahyono, 1998).

Cayenne pepper *(Capsicum frutescens)* is a fruit and plant of the genus Capsicum whose fruit grows upwards. According to Djarwaningsih (2005), cayenne pepper is a 50-150 cm shrub. The root of cayenne pepper is a strong taproot and branches to the side to form fibrous roots. The stems of the cayenne pepper are dark green, hard and woody, round and fine structure, and has many branches. According to Cahyono (1998) states that the stem of the cayenne pepper has a hard and woody structure, dark green, round and fine structure, and has many branches, where the main stem grows upright and strong. Branching is formed after the plant stem reaches a height ranging from 30-45 cm. The branch of the plant is segmented. Each segment is covered with leaves and shoots (branches). Cayenne pepper leaves are oval with pointed ends and flat-leaf edges (not jagged or notched). The leaves are single with a slight horizontal position, have

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pinnate veins, and a single stalk attached to the stem or branch. The flower of the cayenne pepper is a single flower with a star shape. Flowers grow down in the axils of the leaves with a white crown. Flower pollination includes self (self-pollinated crops), but it can also occur crosswise with about 56% success (Cahyono & Tanea, 2005). Cayenne pepper fruit is grown after pollination. Fruits vary in size, shape, colour and taste. The colour of the fruit is green when it is unripe and dark red when it is ripe. Cayenne pepper fruit can be a short round with a pointed tip or conical. The size of the fruit varies according to the type. The small cayenne peppers are around 2 - 2.5 cm long and 5 mm wide. Meanwhile, the bigger ones have a length of up to 3.5 cm and a width of up to 12 mm.

Cayenne pepper is an easy plant to grow in any soil condition. However, according to Fitri et al., (2017) , cayenne pepper can grow well in fertile, loose soil, free from nematodes and bacterial wilt, with a 5.5-6.5 and sufficient water. Furthermore, cayenne pepper can grow well at an altitude of 1-1,500 m above sea level with an air temperature range of 25-320C. Chilli must be planted in the open and not shaded to produce well. The ideal chilli is planted with sunlight intensity between 60%-70%, while the ideal irradiation time for chilli plant growth is 10-12 hours (Alif, 2017). The roots of the cayenne pepper consist of taproots that grow straight to the centre of the earth and fibrous roots that grow to the sides (horizontally). The roots are not deep, so plants can only grow and develop well in loose, porous (easy to absorb water) and fertile soil (Cahyono & Tanea, 2005).

The need for chilli continues to increase along with the growth of Indonesia's population. The need for chilli per capita is currently in the range of 3 kg/capita/year. If Indonesia population is 250 million, then 750,000 tons of chilli are needed annually. According to Siahaan et al., (2016) states that the amount is predicted to be unable to be met by domestic production so that the government do imports. The Ministry of Agriculture released data of national chili production in 2021 is 163,293 tons. The highest demand for chilli is during holy days such as; Ramadhan, Eid, Christmas and New Year. There were fluctuations of chilli production caused by various factors, such as climate anomalies effects in the presence of pests, diseases, and crop failure. Furthermore, the low management of human resources in chilli farming affects the low production of various land management treatments and fertilization.

Fertilization on plants, including cayenne pepper, has an essential role in ensuring the availability of nutrients for plants. One of the fertilizers widely used today to help soil and plant fertility is organic fertilizer (Havlin et al., 1999). Furthermore, Hayati et al., (2012) states the organic fertilizer is also a source of energy and nutrients for microbes. Organic fertilizer in the soil will undergo several overhaul phases by soil microorganisms to become humus. Currently, there are still many chilli farmers who rely on inorganic fertilizers (chemical fertilizers), which can be used to add nitrogen elements in the soil, such as; urea, ammonium sulfate (ZA), and NPK (Foth, 1994). According to (Bahri, 2012) the source of fertilizer affects plant height, leaf width, leaf length, leaf diameter, and lettuce yield. According to (Alviana et al., 2009) found that different fertilizer doses in chilli (Capsicum annum L.) cultivation yielded different yields. It was further stated that the optimization of fertilizer doses in chilli (Capsicum annum L.) cultivation occurred at a nitrogen dose of 237.07 kg/ha, P2O5 108.33 kg/ha, and a K_2O dose of 188.4 kg/ha.

The use of organic fertilizers is significant. Besides its non-destructive nature, the availability of raw materials is relatively abundant and easily absorbed in the soil. As stated (Kaharu, 2021), the advantage of organic fertilizer is that plants more easily absorb the nutrients contained in it. According to (Suwahyono, 2011), organic fertilizer can be made from several types of organic waste, such as; vegetable waste, rice waste, fish waste, chicken, eggshells, and fruit waste (grapes, skins, oranges, apples, etc.) and leaves. These materials are easily obtained since they can be found every day. With the availability of abundant raw materials and easy-to-make by nature, the potential for organic fertilizers is very abundant. Hence, it is essential to know the effect of organic fertilizer on the growth of cayenne pepper (*Capsicum frutescens* L.). Thus, organic fertilizer can replace inorganic fertilizers that farmers have used, and organic fertilizer is expected to reduce chilli production costs.

2. Material and methods

2.1. Time and place

The study was conducted from September to October 2021 at the Horticultural Plant Laboratory, Faculty of Agriculture, Cokroaminoto University Makassar, and South Sulawesi.

2.2. Experimental design

The study used an experimental method with a Completely Randomized Design (CRD). The study involved four treatments and five replications, so there were twenty experimental units. The treatments are detailed as follows:

Table 1 Research experimental design

Items	Treatment			
	A without organic fertilizer/control	**B (organic fertilizer with a concentration of 10 gr/l of water)**	**C (organic fertilizer with a concentration of 20 gr/l of water)**	**D (organic fertilizer with a concentration of 30 gr/l of water)**
1	A1	B1	C1	D1
2	A2	B2	C2	D2
3	A3	B3	C3	D3
4	A4	B4	C4	D4
5	A5	B5	C5	D5

2.3. Research implementation

- Preparation of container. The container is rectangular, made of clear white plastic with a size of 2.5 x 2.5m, the height is 0.5m, and it was prepared before planting.
- Preparation of planting media. The cleaned soil is mixed with sand, and organic fertilizer (vermicompost) with a ratio of each media is 2:1:1. Then, the soil is put into a polybag until it is almost filled around 5 cm from the top surface. The size of polybag is 25 x 40 cm.
- Randomization of planting media. Randomization is intended to obtain equal chances for the results to be achieved. Randomization was done by applying a random sampling with a distance between polybags are 1 x 1 m.
- Seeding. The cayenne pepper seeds are first soaked to prevent the dormancy period before the seeds are planted in polybags. Good seeds are seeds that sink. The seeds are then sown into the space provided. Seeding aims to obtain homogeneity, healthy seeds, and strong roots so that plants can grow well in polybags. Seeds are planted in polybags at two weeks old (14-15 days), with two cayenne peppers planted in each polybag.
- Plant maintenance. Maintenance is done by watering two times a day using a sprayer and giving liquid organic fertilizer every week.
- Preparation of liquid organic fertilizer. The liquid organic fertilizer used in this study is a type of liquid fertilizer made from vermicompost. Vermicompost was chosen since its abundant availability and is widely applied by the farmers.
- The height of the plant growth was measured. These parameters are measured every two weeks until the chilli plants germinate (flower). The measurement is; 1) when the plants are 14 in polybags, 2) when the plants are 28 in polybags, and 3) when the plants are 42 in polybags.

2.4. Data analysis

The data were analyzed to know the effect of the concentration of liquid organic fertilizer on the growth of cayenne pepper. The data were analyzed by analysis of variance (ANOVA). It was continued by using the Tukey test (HSD) if it has an effects on the treatment. According to Ghozali (2009), analysis of variance (ANOVA) is a multivariate analysis technique that distinguishes the mean of more than two data groups by comparing the variances. Furthermore, Yusuf & Daris (2018) states that analysis of variance (ANOVA) is an inferential statistical analysis technique that tests variance. It belongs to the category of parametric statistics (Sudjana, 1996). The 2-way ANOVA is intended to determine whether there is an effect and various criteria tested on the expected results (Furqon, 2009).

3. Results and discussion

3.1. Growth Measurement (Plant Height)

The measurement was done by measuring plant stems from the soil surface to the tip of the stem by using a ruler in Centimeters (cm). The following is the result of measuring plant height (cm).

Table 2 The results of growth measurement in Centimeters (cm)

Days of observation	Treatment	Groups				
		I	II	III	IV	V
T1 (Day - 14)	A	4.0	5.0	4.5	4.2	4.8
	B	6.0	6.5	6.5	6.8	6.5
	C	5.0	5.8	6.0	6.2	6.5
	D	7.0	8.0	8.5	9.0	9.8
T2 (Day - 28)	A	6.0	7.0	6.5	6.2	6.8
	B	7.5	8.5	8.6	9.8	9.5
	C	5.9	6.8	7.0	7.2	7.5
	D	8.2	9.0	9.5	9.0	9.8
T3 (Day - 42)	A	8.2	9.0	10.5	10.5	10.8
	B	10.0	12.5	11.6	12.8	12.5
	C	9.8	10.8	12.0	12.2	11.5
	D	9.5	10.5	11.0	12.0	12.5

Table 2 shows that the average growth of plants that were not given organic fertilizer (control) was shorter in the stem than in cayenne pepper that was given organic fertilizer. The following is the average plant height based on treatment.

Table 3 The results of the plants' height (cm)

Descriptive								
Plants' height (cm)								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A	15	6.9333	2.36301	0.61013	5.6247	8.2419	4.00	10.80
B	15	8.0333	2.58448	0.66731	6.6021	9.4646	5.00	12.50
C	15	8.8733	2.22372	0.57416	7.6419	10.1048	6.00	12.30
D	15	9.7133	1.73076	0.44688	8.7549	10.6718	7.00	12.80
Total	60	8.3883	2.42292	0.31280	7.7624	9.0142	4.00	12.80

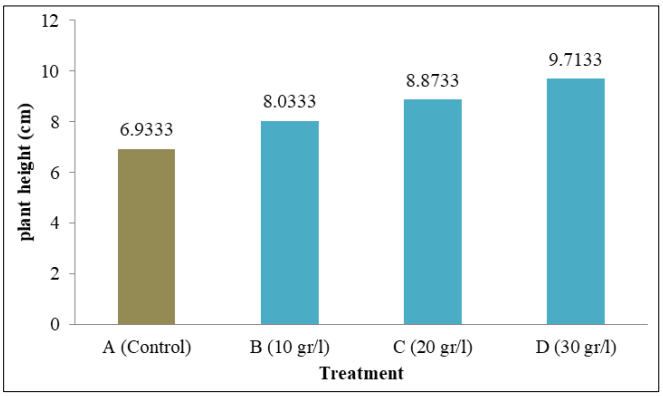

Figure 1 The average result of the cayenne pepper height

Based on the mean plant height measurement, it was found that the cayenne pepper plants that were not treated, such as A (control), had slower growth (6.93 cm) than other treatments. The average plant height of B was 8.03 cm, C was

8.87 cm, and D was 9.71 cm. graphically, it shows that the higher dose of fertilizer gave maximum growth. D was treated for 30 gr/l produced maximum plant height compared to B (10 gr/l) and C (20 gr/l). Graphically the average plant growth is presented as follows:

It can be concluded that higher doses of organic fertilizers provide high plant growth. It may be because of D's higher organic fertilizer treatment (30 gr/l) than other treatments. According to Gardner et al., (1991) state that organic fertilizers affect plant growth because it contains nutrients, such as c-organic, nitrogen (N), phosphorus (P), and potassium (K). According to Schinner et al., (1996), organic matter has an essential role in the soil, especially its effect on soil fertility. It is in line with (Sutedjo, 2010) giving organic fertilizers to plants can increase plant growth and soil fertility, increase nutrient content in the soil and help form green infrastructure in the surrounding environment. The results of research (Salisbury & Ross, 1995) stated that the more shoots that received nutrients, the higher the number of shoots that grew and developed into leaves. The study results (Rizqiani, 2007) also showed an effect of the dose and frequency of liquid organic fertilizer on bean crop yields. The same results were also obtained from the results of research (Adamy, 2012) that there was an effect of organic fertilizer application from various sources of raw materials on the growth of maize (Zea mays L.). Thus, the application of organic fertilizer positively affects plant growth and soil fertility. In order to determine the differences between treatments, an ANOVA analysis was carried out, with the following results:

Table 4 ANOVA analysis result (one way)

ANOVA					
Plant height (cm)					
	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	63.508	3	21.169	4.191	0.010
Within Groups	282.853	56	5.051		
Total	346.362	59			

Based on table 3 above, it was found that the average plant growth (plant height) was significantly different between treatments. In other words, reject H0 and accept H1. It can be seen from the value of Sig. 0.010 is smaller than <0.05, and the F-Statistic value 4.191 is greater than the F-Table 2.190. The results showed that the treatment of organic fertilizer had a significant effect on the growth of cayenne pepper. This is in line with the research results (Campbell et al., 2004) that vermicompost significantly affects the vegetative growth of potato (Solanum tuberosum) plants. According to Kolloa et al., (2016) states that there is an effect of treatment on the growth of tomato plants (Lycopersicum esculentum Mill). The analysis results show that each observation time of 28 DAP and 42 DAP gave the best tomato plant growth and were significantly different from another dose.

Kascing is an organic fertilizer widely developed and used by farmers to replace inorganic fertilizers. Besides, the abundant availability since it is the result of fermented worms or used worm media, and the complex nutrient in it. According to Krishnawati (2003) that vermicompost contains macro and micronutrients. Cassava contains nitrogen (N) 0.63%, phosphorus (P) 0.35%, potassium (K) 0.2%, calcium (Ca) 0.23%, manganese (Mn) 0.003%, magnesium (Mg) 0.26%, copper (Cu) 17, 58%, zinc (Zn) 0.007%, iron (Fe) 0.79%, molybdenum (Mo) 14.48%, organic matter 0.21%, CEC 35.80%, water holding capacity 41.23% and humic acid 13.88%. These elements are the most important elements needed by plants for their growth, including cayenne pepper plants. In addition, according to Lingga (2006) that there are four macronutrients contain in organic fertilizers with various types of inoculums that have respective functions and roles. According to Lin et al., (1993) that a) Nitrogen increases plant growth, increasing protein levels in the plant body, b) Phosphorus stimulates root development so that plants are resistant to drought and accelerating the harvest period, c) Potassium has a function as a catalyst, a constituent and breakdown of carbohydrates, especially in the conversion of proteins and amino acids, and d) Calcium has an important role in the formation and stability of cell walls and the maintenance of membrane structure and permeability, activates several enzymes and regulate many cell responses to stimuli. Vermicompost can also improve soil biological properties. It contains many microbes and plant growth-stimulating hormones, such as 2.75% gibberellins, 1.05% cytokinins, and auxins. A large number of microbes and their high activity can accelerate mineralization or the release of nutrients from worm droppings into forms available to plants (Mambu et al., 2018).

Table 5 ANOVA analysis result (one way)

Plant height (cm)			
Tukey HSD[a]			
Perlakuan	N	Subset for alpha = 0.05	
		1	2
A	15	6.9333	
B	15	8.0333	8.0333
C	15	8.8733	8.8733
D	15		9.7133
Sig.		0.096	0.183

Means for groups in homogeneous subsets are displayed. a. Uses Harmonic Mean Sample Size = 15.000

Based on post hoc analysis data (advanced test), it was found that the average plant growth between A, B and C was equal. In other words, there was no significant difference in growth between the three treatments. The significant difference was D with a dose of 30 g/ltr treatment. Thus, D is a treatment with an optimal dose of organic fertilizer. It happened since the organic fertilizer is a source of organic matter which can not only increase plant growth directly but also increase soil fertility. The treatment of organic fertilizers in higher doses will not cause over-dosage on plants and soil since it does not contain harmful chemicals. According to Mulat (2003) states that the organic fertilizer is more effective and does not damage the environment (soil) because it does not contain chemicals. Furthermore, Kloepper (1993) states that the treatment of vermicompost as organic fertilizer to the soil can improve soil properties such as; improve structure, porosity, permeability, and increase the ability to hold water. Besides that, vermicompost can also improve soil chemical properties such as increasing the ability to absorb cations as a source of macro and micro nutrients and increasing pH in acidic soils. That ordinary organic fertilizers in solid or liquid form can be used to improve the physical, chemical, and biological properties of the soil. Meanwhile, the use of vermicompost is expected to reduce the use of chemical fertilizers and increase the use of organic fertilizers thereby reducing environmental pollution.

4. Conclusion

The results of the study concludes that

- The average growth was strongly influenced by the organic fertilizer. The higher dose of organic fertilizer treatment provides high plant growth,
- The average plant growth (plant height) was significantly different between treatments
- Treatment d with a dose of 30 g/ltr was significantly different from other treatments.

Thus, it can be concluded that the application of organic fertilizer at a dose of 30 g/ltr had a significant effect on the growth of cayenne pepper *(Capsicum frutescens L.).*

Compliance with ethical standards

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