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Effect of Pineapple Peel Extracts on Organic Fertilizer Nutrients and Growth of Cayenne Pepper (*Capsicum Annuum*)

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ABSTRAK

Ekstrak kulit nanas dapat digunakan untuk pembuatan pupuk organik karena kandungan karbohidrat, protein, dan gula yang tinggi. Penelitian ini bertujuan untuk mengetahui pengaruh ekstrak kulit nanas terhadap unsur hara pupuk dan pertumbuhan cabai rawit. Penelitian ini menggunakan metode eksperimen dengan Rancangan Acak Kelompok yang terdiri dari tiga kombinasi perlakuan ekstrak nanas. Percobaan dilakukan dalam wadah plastik 5 L selama 15 hari. Hasil penelitian menunjukkan bahwa ekstrak kulit nanas berpengaruh nyata terhadap unsur hara pupuk dan pertumbuhan cabai rawit ($p < 0,05$). Ekstrak sebanyak 2500 mL menghasilkan tinggi tanaman tertinggi dan jumlah daun terbanyak. Ekstrak 2000 mL menghasilkan kalium dan nitrogen yang rendah. Kekurangan kalium dan nitrogen dapat menurunkan tinggi tanaman dan mengubah warna daun.

Kata Kunci:

Cabai rawit, kalium, kulit nanas, pupuk organik

Keywords **:**

Cayenne Pepper, Organic Fertilizer, Pineapple Peel, Potassium

ABSTRACT

Pineapple peel extract can be used for manufacturing organic fertilizer due to its high content of carbohydrates, protein, and sugar. The study aimed to find the effect of pineapple peel extract on fertilizer nutrients and the growth of cayenne pepper. The experiment employed an experimental method with a Randomized Block Design consisting of three combination pineapple extract treatments. The experiment was performed in 5 L of plastic containers for 15 days. The result showed that pineapple peel extract significantly affected fertilizer nutrients and the growth of cayenne pepper ($p < 0.05$). The extract of 2500 mL generated the highest height of the plant and the greatest number of leaves. The extract of 2000 mL produced low potassium and nitrogen. Lack of potassium and nitrogen could reduce plant height and change leaf color.

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INTRODUCTION

Biomass waste comprises rich nutrients and high organic material, which can be put to beneficial use as fertilizer sources (Chew et al., 2019). Organic fertilizers are naturally obtainable mineral resources containing adequate amounts of vital plant nutrients. Organic fertilizer can be derived from animal excrement, plant matter (peanut shells, straw), poultry litter, fish manure,

blood meal and cottonseed meal (Shaji et al., 2021). The function of organic fertilizers affects soil qualities such as soil microbial activity, soil organic material household, soil salt content and soil pH (Möller & Schultheiß, 2015). Moreover, organic fertilizers can increase yield, soil bulk density and essential soil minerals such as nitrogen, phosphorus, potassium, calcium and magnesium (Oyetunde-Usman et al., 2021).

The application of organic fertilizers may not only enhance soil characteristics but may also assist in climate protection by increasing carbon (C) sequestration in soils. Increasing organic material by sequestering C in soils may diminish atmospheric CO_2 emissions and lead to continuing losses in the form of CH_4 and N_2O emissions by affording substrates for microbial activity and microbial oxygen consumption (Zhang et al., 2016). Many studies have revealed that applying organic fertilizers to the soil can enhance microbe communities and increase yield (Ma et al., 2023; Shang et al., 2020; Ye et al., 2022). However, no study has not investigated the combination of pineapple peels and tofu liquid waste in organic fertilizer and its effect on the growth and yield of cayenne pepper.

Pineapple peels have contents of 81.72% water, 17.53% carbohydrates, 4.41% protein and 13.65% reducing sugar (Sutikarini et al., 2023). Pineapple peels can be used as the raw material of organic fertilizer because it has a high content of carbohydrates, sugars, and proteins (Suryani et al., 2022). The previous study who was conducted by Alasa et al., (2021) also reported that adding organic fertilizer from pineapple peels enhanced soil fertility, increase plant yield, and improve growth parameters such as sprouting time, plant height, leaves area and the number of leaves per branch. Tofu liquid waste contains proteins, amino acids, and plentiful nutrients such as N, P, K, Ca, Mg and Fe. Protein will be released as an N compound by microbes. The N compounds will be absorbed by the plant roots (Chaorlina et al., 2021). Fauziah & Idris (2022) show that application of tofu liquid waste significantly affected chlorophyll, height, number of flowers, pod length, and fruit weight of beans. Samah & Candra (2022) also show that organic fertilizer from tofu liquid waste influenced the height, number of leaves and stem diameter of mustard green. Therefore, many studies have revealed the effect of organic fertilizer on plant growth. The study aimed to discover the influence of pineapple peel extract combined with tofu liquid waste on fertilizer nutrients (N, P, and K) and the growth of cayenne pepper (height, number of leaves, and color).

MATERIAL AND METHODS

This research used an experimental method with a Randomized Block Design consisting of three combination pineapple extract treatments with two replications. Each sample (tofu liquid waste) was treated with three variations of pineapple peel extract. Thus, the total of observed samples was six.

Preparation of pineapple peels extracts

2000 gram of pineapple peels were chopped then mashed using a blender. Mashed pineapple peels were strained to collect the pineapple peels extracts then stored in tight-closed bottles.

Preparation bio activator

1500 mL of tofu liquid waste was mixed with pineapple peels extract at different volumes of 1500 mL, 2000 mL, and 2500 mL. 200 mL of Effective Microorganism- 4 (EM-4) was added into the mixture and poured into 5 L of bottles then stirred well.

Production of organic fertilizer

Leaves and vegetable wastes were shredded using vegetable waste shredder. 500 gram of leaves and 1200 gram of vegetable wastes were introduced into 5 L of plastic drum containers then added bio activator and water, and stirred thoroughly. The containers were sealed tightly. The fermentation was carried out for 15 days.

Analysis of fertilizer

The nutrients of fertilizer were analyzed according to the standard methods. The total N content was determined by the Kjeldahl method. The total P and K contents were measured by the perchloric acid digestion method and spectrophotometry procedures (Shang et al., 2020).

Statistical analysis

The significance of the results was performed by analysis of variance (ANOVA) using Microsoft Excel 2019. A p-value less than 0.05 denotes significant influence, while a p-value higher than 0.05 signifies insignificant impact.

RESULTS AND DISCUSSION

Effect of pineapple peels on fertilizer contents

The effect of pineapple peels on fertilizer content was investigated in different volumes of 1500 mL, 2000 mL and 2500 mL. Table 1 presents fertilizer contents at various volumes of pineapple peel extracts.

Table 1. Nutrients of fertilizer at various volumes of pineapple peel extracts

Pineapple peel extracts (mL)	Nutrient content		
	N	P	K
1500	9.395% ± 0.0002	3.645% ± 0.0005	1.710% ± 0.003
2000	9.395% ± 0.0006	3.810% ± 0.0003	1.580% ± 0.004
2500	9.420% ± 0.0001	3.685% ± 0.0011	1.615% ± 0.004

The different volumes of extract provided the highest nutrient of each parameter. 2500 mL of extract obtained the highest N content. The highest P content was obtained by 2000 mL of extracts, while the highest K content was generated by 1500 mL of extracts. As seen in Table 1, volumes of pineapple peel extract affected the nutrient content of fertilizer. Statical analysis proved pineapple peels significantly affected the nutrient content of fertilizer ($p < 0.05$). Ramadhani & Nuraini (2018) reported that pineapple waste increased the availability of N, P, and K.

The total nitrogen contents provided the highest amount among total phosphorus and potassium contents, while the potassium content had the lowest amount. The results are similar to the previous study by Mustapha et al. (2021), where pineapple peel had the lowest potassium amount among nitrogen and phosphorus amount. Nitrogen plays a role in the photosynthesis of plants, and it is a constituent component of protein. Lack of nitrogen can lead to inadequacy in sunlight absorbance by the plant, resulting in a deficiency of nutrient uptake (Hamid et al., 2019).

Hariyanto et al., (2023) stated that nitrogen and phosphorus affected plant growth and yield. They reported that fertilizer containing nitrogen and phosphorus impacted the number of shoots, flowers and fruit sets on the dragon fruits' growth. Pineapple peel extracts generated the lowest potassium nutrient among nitrogen and phosphor, signifying that fruit peels are essential sources of potassium for plant growth (Mustapha et al., 2021).

Effect of pineapple peel extracts on the growth of cayenne peppers

The application of pineapple peel extract was observed towards the growth of cayenne peppers (plant height, number of leaves and color of leaves). Figure 1 shows the growth of cayenne peppers in different volume extracts

Figure 1. Growth of cayenne peppers in different volume extracts: (A) 1500 mL; (B) 2000 mL; (C) 2500 mL

Treatment of 2500 mL extracts had the most significant number of leaves (8 leaves), followed by 1500 mL and 2000 mL with the number of leaves of 6 and 5, respectively. The result showed that pineapple peel extracts significantly affected the number of leaves ($p < 0.05$). This condition may occur due to richer nitrogen owned by 2500 mL of extract. Increase in nitrogen concentration increased number of leaves. Nitrogen is part of the cause of the increasing size of cells and the rate of their fission, which results in a substantial increase in growth characteristics, and the number of leaves is a trait linked to the genotype principally, nevertheless, it is influenced by growth factors, specifically nitrogen fertilizer and its contents (Hashim et al., 2022).

Data on plant heights performs that the treatment of 2000 mL generated a height of 10 cm, while the treatment of 1500 mL as well as the treatment of 2000 mL provided a height plant of 10.2 cm. The results happen since the extract of 2000 mL had the lowest potassium level. A deficiency of potassium reduces plant height and inhibits root and leaf respiration as well as photosynthesis (Fontana et al., 2020). The analysis result verified that pineapple peel extracts provided a significant effect on plant height ($p < 0.05$)

The use of 2500 mL and 1500 mL extracts gave leaves a color of light green, while 2000 mL of extract produced yellowish-green of leaves. Yue et al., (2022) revealed a correlation between a lack of nitrogen and changes in color and shape. The color of the leaves turned yellowish-green, the vein transformed into white, and the shape of the leaves was deformed unevenly. A previous study conducted by Yang et al. (2016) found that potassium deficiency turned cotton leaf color from green to yellow and red. The summary of the height of the plant, the color of the leaves, and the number of leaves can be seen in Table 2.

Table 2. Effect of treatment of extract on the growth of cayenne peppers

Pineapple peel extracts (mL)	Height of plant (cm)	Number of leaves	Color of leaves
1500	10.2	6	Lime green
2000	10	5	Yellowish-green
2500	10.2	8	Lime green

CONCLUSION

The level of pineapple peel extract significantly affects fertilizer nutrients ($p < 0.05$). The treatment of pineapple peel extract substantially influences cayenne pepper's growth, viz the number of leaves, the color of leaves and the height of the plant ($p < 0.05$). Pineapple peel extracts produces higher level of nitrogen compared to potassium and phosphorus. The low potassium level reduces the plant's height, decreases the number of leaves, and changes leaf color.

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