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THE EFFECT OF DIFFERENT DOSES OF BANANA PEEL LIQUID ORGANIC FERTILIZER ON THE GROWTH AND PRODUCTIVITY OF DENDEK POEK (*Corchorus aestuans*)

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Abstract

Corchorus aestuans has the potential as an animal feed ingredient whose production can be improved by fertilization using banana peel liquid organic fertilizer. The purpose of this study was to determine the effect of various doses of Banana Peel Liquid Organic Fertilizer on the growth and productivity of *Corchorus aestuans* with parameters including: plant height, number of leaves, fresh weight, dry weight, leaf-stem ratio, and root-shoot ratio. The Completely Randomized Design method was used with five doses of organic fertilizer per polybag treatment, namely P1 = 0 ml, P2 = 100 ml, P3 = 200 ml, P4 = 300 ml, and P5 = 400 ml. Research was conducted from 21 March to 30 May at the Faculty of Animal Husbandry, Universitas Padjadjaran. Each treatment was repeated four times, resulting in twenty experimental materials. The researcher conducted Duncan's Multiple Range Test (DMRT) after analyzing the research data for variance. The results showed fresh weight was significantly affected by banana peel liquid organic fertilizer ($P < 0.05$). Still, the plant height, number of leaves, dry weight, stem leaf ratio, and shoot root ratio were not significantly affected ($P > 0.05$). The 100 ml dose was found to be the most effective in increasing the fresh weight of *Corchorus aestuans*.

Keywords: *Corchorus aestuans*, Banana peel liquid organic fertilizer, Growth, Production

PENGARUH PEMBERIAN BERBAGAI DOSIS PUPUK ORGANIK CAIR KULIT PISANG TERHADAP PERTUMBUHAN DAN PRODUKSI TANAMAN DENGDEK POEK (Corchorus aestuans)

Abstrak

Tanaman Corchorus aestuans mempunyai potensi sebagai pakan ternak. Pemberian Pupuk Organik Cair kulit pisang merupakan upaya dalam meningkatkan produktivitas tanaman ini. Tujuan dari penelitian ini untuk mengetahui pengaruh berbagai dosis POC kulit pisang terhadap pertumbuhan dan produktivitas tanaman Corchorus aestuans dengan parameter tinggi tanaman, jumlah daun, berat segar, berat kering, rasio daun batang, dan nisbah pupus akar. Metode Rancangan Acak Lengkap digunakan dengan lima perlakuan yaitu P_1 = 0 ml POC per polybag, P_2 = 100 ml POC per polybag, P_3 = 200 ml POC per polybag, P_4 = 300 ml per polybag, P_5 = 400 ml per polybag telah diuji pada tanggal 21 Maret hingga 30 Mei di Fakultas Peternakan, Universitas Padjadjaran. Setiap perlakuan diulang sebanyak empat kali, menghasilkan dua puluh bahan percobaan. Setelah data penelitian dianalisis ragam, dilakukan uji Duncan Multiple Range Test (DMRT). Hasil penelitian menunjukkan bahwa berat segar dipengaruhi secara signifikan oleh POC kulit pisang ($P < 0,05$), namun tinggi tanaman, jumlah daun, berat kering, rasio daun batang, dan nisbah pupus akar tidak terpengaruh secara signifikan ($P > 0,05$). Dosis 100 ml merupakan dosis yang paling efektif (P_2) terhadap berat segar Corchorus aestuans.

***Kata kunci** : Corchorus aestuans, POC kulit pisang, Pertumbuhan, Produksi*

INTRODUCTION

In Indonesia, agricultural waste is still underutilized by the community as it is often considered to have no economic value, such as banana peels. According to Yulianty *et al*. (2022), banana peel Liquid Organic Fertilizer contains macro elements such as C, N, P, and K, each of which plays a role in the growth and development of fruits and stems. Additionally, banana peel waste contains microelements such as Ca, Mg, Na, and Zn, which are essential for promoting optimal plant growth, ultimately

leading to increased production levels. Banana peel contains 3.63% crude protein, 2.52% crude fat, 18.17% crude fiber, 7.8% calcium, and 2.06% phosphorus (Muda, *et al., 2022*). Banana peel is rich in essential nutrients, including potassium, phosphorus, calcium, and magnesium, which are vital for plant growth and have several health benefits.

Organic fertilizer is produced from organic waste materials such as animal manure, waste, plant residues, sawdust, and activated sludge, that has undergone a processing procedure. It may be in solid or liquid form, and can be enriched with mineral substances and/or beneficial microorganisms to improve soil nutrient content and organic matter, as well as to enhance the physical, chemical, and biological properties of the soil (Minister of Agriculture Regulation No. 70/Permentan/SR.140/10/2011). The fertilizer quality is dependent on the processes or treatments applied (Yulipriyanto, 2010).

Based on the production process, organic fertilizers can be classified as either liquid or solid fertilizers. Liquid organic fertilizer is a solution containing one or more essential elements for plant growth that are easily soluble (Leovini, 2012). Compared to solid fertilizers, liquid organic fertilizers can address nutrient deficiencies more rapidly due to their liquid form, which allows for easier absorption by both soil and plants (Putra and Ratnawati, 2019). Liquid organic fertilizer can enhance the growth of forage plants, such as *Corchorus aestuans*.

C. aestuans, commonly known as *Dengdek Poek* by the local community, is a plant used as livestock feed due to its essential nutrients for animals, including protein, vitamins, and minerals. According to Al-Snafi (2016), phytochemical studies of various extracts from the leaves of *C. aestuans* have revealed the presence of compounds such as phenolics, flavonoids, glycosides, carbohydrates, proteins, amino acids, fatty acids, saponins, phytosterols, triterpenoids, and tannins. Nutritional analysis of *C. aestuans* indicates that the leaves contain 3.7% protein, 76.33 mg/kg beta-carotene, 184.07 mg/kg iron, and 4000 mg/kg potassium. The seeds contain 22.6% protein and 8.3-12.8% oil content (Al-Snafi, 2016).

The growth and productivity of *C. aestuans* can be evaluated using various measures, including plant height, number of leaves, fresh weight, dry weight, leaf-to-stem ratio, and root shoot ratio. Adding banana peel liquid organic fertilizer to *C. aestuans* can improve various aspects of its growth, both in terms of quantity and quality. However, its effectiveness depends greatly on the dosage applied and the environmental conditions in which the plants are grown. By researching the effects of liquid organic fertilizer obtained from banana peels, this study aims to determine the ideal dosage for developing and yielding *Dengdek Poek* (*C. aestuans*) plants.

RESEARCH METHODS

This study used the Completely Randomized Design (CRD) method with five dose treatments: P1 = 0 ml of liquid organic fertilizer per polybag, P2 = 100 ml of liquid organic fertilizer per polybag, P3 = 200 ml of liquid organic fertilizer per polybag, P4 = 300 ml of liquid organic fertilizer per polybag, P5 = 400 ml of liquid organic fertilizer per polybag. Twenty experimental units were generated from four repetitions for each treatment. The observed parameters included plant height, number of leaves, fresh weight, dry weight, leaf-to-stem ratio, and root-shoot ratio. The research was conducted at the Faculty of Animal Husbandry and the Soil Chemistry and Plant Nutrition Laboratory, Faculty of Agriculture, Universitas Padjadjaran.

Seed Preparation

The seeds were first extracted from the pods, and then both the seeds and pods were weighed separately. Next, the seeds were selected and soaked in coconut water for 24 hours to break dormancy. After soaking, the seeds were prepared for planting. At 90 days after planting (DAP), seedlings of *C. aestuans* that had reached a height of approximately 5-8 cm were selected for further use in the study.

Preparation of Planning Media

First, the soil was evenly mixed using a shovel and then placed into polybags. The weight of the soil in each polybag was measured to ensure it reached 10 kg. Afterwards, the polybags filled with soil were labelled and arranged according to the predetermined layout.

Initial Planting and Acclimatization Period

Once the *C. aestuans* seedlings had germinated, individual transplanting was carried out into the planting media (tray). The seedlings were allowed to grow for approximately 3 months to ensure uniform development. After this period, twenty relatively uniform seedlings were selected to begin the treatment.

Fertilization

Fertilization was performed after achieving seedling uniformity, using five treatment doses of liquid organic fertilizer per polybag (P1 = 0 ml, P2 = 100 ml, P3 = 200 ml, P4 = 300 ml, P5 = 400 ml), with a 50% dilution (1:1 ratio) of banana peel liquid organic fertilizer and water. The banana peel liquid organic fertilizer was applied by watering it onto the soil. Fertilization was performed five times at the following intervals: 15, 22, 29, 43, and 50 days after transplanting (DAT) the seedlings into the polybags.

Plant Maintenance

The plants were watered once a day in the morning or evening, and weeded once a week. If pests were found on the plants, such as *Phenacoccus manihoti*, organic pesticides are sprayed according to the recommended dosage, like two times a week. Replanting was performed twice during the planting period, before the plants reached one week of age after transplanting.

Harvesting

The fresh leaves and stems were harvested 8 weeks after the initial planting as samples. The stems of of the *C. aestuans* plants were cut 5 cm above the soil surface.

Method for Making Banana Peel Liquid Organic Fertilizer

The procedure for preparing liquid organic fertilizer from banana peels, according to Rambitan and Sari (2013), was as follows: First, 10 kg of banana peels were chopped into small pieces and blended with 10 litres of water until smooth. The blended mixture was then transferred into a plastic drum, and then added with 250 ml of EM4 and 250 ml of molasses. The mixture was stirred thoroughly until homogeneous. The drum was then covered, and left to ferment for two weeks. Finally, the physical characteristics of the fertilizer, including color, aroma, texture, and consistency, were observed.

RESULT AND DISCUSSION

The following table shows the results of the analysis of banana peel liquid organic fertilizer conducted at the Soil Chemistry and Plant Nutrition Laboratory. Based on the Minister of Agriculture Regulation (2019), the standard liquid organic fertilizer has a minimum organic carbon content of 10%, and the levels of macro-nutrients such as N, P_2O_5, and K_2O should range from 2% to 6%. The data shows that the pH, organic carbon, and N, P_2O_5, and K_2O levels in this study were below the minimum quality standards. Although the quality of this study's banana peel liquid organic fertilizer did not fully meet the standards, its potential benefits justify its continued use.

The banana peel liquid organic fertilizer contains essential nutrients that are beneficial for plant growth. Adjustments or improvements to the production process can further optimize its quality.

Table 1. Analysis Results of Banana Peel Liquid Organic Fertilizer

No	Parameter	Unit	Results
1	C-Organik	%	2,10
2	C/N	-	7,50
3	pH	-	6,28
	Macro:		
1	N	%	0,28
2	P_2O_5	%	0,03
3	K_2O	%	0,25

Source: Soil Chemistry and Plant Nutrition Laboratory (2024)

Table 2. Average Plant Height, Number of Leaves, Fresh Weight, Dry Weight, Leaf-to-Stem Ratio, and Root Shoot Ratio of *C. aestuans.*

Parameter	P1 (0 ml)	P2 (100 ml)	P3 (200 ml)	P4(300 ml)	P5 (400 ml)
Plant Height (cm)	37,33 ± 8,61^{ns}	45,00 ± 9,09	29,23 ± 9,02	31,60 ± 5,92	38,05 ± 3,98
Number of Leaves	171,75 ± 54,27^{ns}	206,50 ± 71,75	138,00 ± 54,08	161,75 ± 30,09	146,50 ± 36,09
Fresh Weight (g)	41,36 ± 6,99^{ab}	52,07 ± 5,74^{a}	28,84 ± 14,29^{b}	34,58 ± 6,46^{b}	33,34 ± 5,59^{b}
Dry Weight (g)	7,16 ± 1,07^{ns}	8,55 ± 1,45	5,75 ± 3,25	6,10 ± 1,52	6,28 ± 1,43
Leaf to Stem Ratio	1,03 ± 0,10^{ns}	1,18 ± 0,12	1,13 ± 0,53	1,13 ± 0,22	0,96 ± 0,05
Root Shoot Ratio	2,33 ± 0,51^{ns}	2,52 ± 0,57	3,27 ± 0,77	2,97 ± 0,43	2,99 ± 0,72

Note: Numbers in the column followed by the same letter are not significantly different at the 0.05 level of Duncan's multiple range test. ns = *non-significant*

Additionally, using natural materials such as banana peels is environmentally sustainable and cost-effective, making it a valuable alternative for promoting sustainable agricultural practices. There were no significant differences (P > 0.05) in the effects of banana peel liquid organic fertilizer on plant height, number of leaves, dry weight, leaf-to-stem ratio, and root shoot ratio. However, there was a significant difference (P < 0.05) in fresh weight. The research results for plant height, number of leaves, fresh weight, dry weight, leaf-to-stem ratio, and root shoot ratio are shown in Table 2.

Plant Height

The low levels of N, P, and K—0.28% N, 0.03% P, and 0.25% K—in the banana peel liquid organic fertilizer indicate a lack of significant effect on the height of *C. aestuans* plants. Nutrients must be provided in the right amounts and balanced according to the plants' requirements to ensure healthy and optimal growth.

There is a direct correlation between macro-nutrients like Nitrogen and plant height growth. The availability of nitrogen (N) stimulates vegetative growth, particularly the development of green leaves essential for photosynthesis, enhances leaf formation and growth, ensures the smooth functioning of metabolic processes, and influences the growth of various plant organs, including leaves, stems, and roots (Lingga and Marsono, 2013). Nitrogen is a vital macronutrient that plays a crucial role in the growth and development of plants. It is the most abundant nutrient required for forming vegetative plant parts, such as the increase in plant height, which results from cellular processes like elongation and cell division (Nur, 2019).

Furthermore, Hidayat et al. (2014) emphasize that plant height growth is influenced by cell division and elongation, particularly at the apex of the plant. Foliar application is a technique that involves the direct application of liquid fertilizers onto the leaves of plants. This method allows plants to absorb essential nutrients through their stomata and epidermis. Known as foliar spraying, this approach involves applying a fertilizer solution to the plant's foliage (Basavaraj & Chetan, 2016).

Number Of Leaves

The quantity of *Corchorus aestuans* leaves was not significantly affected by the banana peel liquid organic fertilizer doses. The plants did not absorb sufficient nutrients, resulting in suboptimal leaf development. Suboptimal doses of liquid organic fertilizers may result in inadequate plant growth due to Nitrogen (N) deficiency, which in turn can limit the effective utilization of Phosphorus (P) (Farida and Daryono, 2016). Dwi et al. (2006) further suggest that while fertilizer application rates influence nutrient content, an increase in fertilizer dose does not necessarily correlate with improved plant yield, as there is a maximum threshold for nutrient absorption by plants. According to Nyakpa and Adnan et al. (2013), the formation of leaves is closely linked to the availability of essential nutrients such as nitrogen (N) and phosphorus (P). The low N (0.28%) and P (0.03%) concentrations in banana peel liquid organic fertilizer did not significantly influence leaf number.

Illustration 1. Yellowing Leaves of *Corchorus aestuans*

Nitrogen deficiency induces chlorosis, while phosphorus deficiency results in stunted growth (Salisbury and Ross, 1995). Additionally, Sitompul and Guritno (1995) highlight that adequate Nitrogen availability promotes broader leaf development, as it plays a critical role in the photosynthetic process.

Fresh Weight

The fresh weight of *Corchorus aestuans* plants shows a significant difference with the application of banana peel liquid organic fertilizer. The P1 treatment yielded the highest fresh weight which indicate that 100 ml is the optimal dose for promoting *C. aestuans*'s growth. According to Murbandono (2008), the availability of sufficient nutrients ensures optimal plant production. In line with this, Dwijoseputro (1988) and Maretik et al. (2023) state that when nutrients are sufficiently available, the photosynthesis process can proceed efficiently, enabling the translocation of nutrients throughout the plant. This ultimately leads to an increase in the fresh weight of the plant.

Salisbury and Ross (1995) state that the fresh weight of plants can indicate plant metabolic activity and the water content in tissues, while nutrient levels and metabolic products also affect the plant's fresh weight. Fresh weight indicates how much water and nutrients the roots absorb, with factors including leaf area, number of leaves, and plant height influencing it (Haryadi, 2015). Plants require both water and nutrients for growth, and the amount of water significantly impacts fresh weight.

Dry Weight

The plants' dry weight was not significantly affected by all treatments, because the nutrient content in banana peel liquid organic fertilizer did not meet the plant's nutritional needs according to the national standards (SNI), such as low nitrogen content. Lakitan (2015) explains that nutrient availability impacts the dry weight of plants. The dry weight of plants consists of the stem and leaf parts of the plant in their dry state, and is used to measure the level of plant production. Plant biomass in the form of dry plant material manifests all the processes and events that occur during plant growth (Sitompul and Guritno, 1995). More dry weight is produced when the roots absorb more nutrients effectively.

Fresh and dry weight are important indicators of plant growth that measure different aspects. Fresh weight reflects the plant's total mass, including water content, which can fluctuate based on environmental conditions. Dry weight, however, represents the plant's actual biomass after removing the water, providing a more stable measure of growth. While fresh weight shows how much the plant has grown in terms of size and hydration, dry weight is a better indicator of overall productivity because it reflects the plant's ability to accumulate organic matter over time.

Djumali and Lestari (2006) assert that fiber production is largely determined by vegetative growth. Improved vegetative growth results in a greater plant fresh weight. Fresh weight reflects the accumulation of photosynthates in the form of plant biomass and water content in the stems and leaves. As the fresh weight of the plant increases, both the

stem weight and the dry weight of the plant's fiber also increase. Hartati and Budi (1991) further state that the dry weight of plant fibers increases with enhanced growth of the plant's vegetative components.

Leaf-to-Stem Ratio

The leaf-to-stem ratio was not significantly influenced by banana peel liquid organic fertilizer because balanced and adequate nutrient levels are required for optimal plant growth. A high leaf-to-stem ratio indicates more leaves relative to stems, which improves plant quality. Fertilizers, especially those containing nitrogen (N), phosphorus (P), and potassium (K), are crucial for promoting vegetative growth. Nitrogen, in particular, has been shown to increase leaf size and surface area by encouraging the expansion of plant tissues. Wahyudi (2010) notes that nitrogen has a significant impact on leaf growth, resulting in larger leaves, higher chlorophyll levels, and improved plant quality.

According to Ye-Shenglan et al. 2020, the leaf is a crucial part of plants, as it produces carbohydrates through the combination of water and carbon dioxide in a process known as photosynthesis. The application of organic fertilizers has been shown to significantly influence the net photosynthetic rate and stomatal conductance in various plants, including pear jujube. Another study reported that the use of manure and liquid organic fertilizers significantly affected leaf growth and plant height (Sumerta et al., 2017). Hgaza et al. 2009 highlighted that leaf characteristics, such as leaf length, width, and color, are indicators of plant growth quality, as the overall photosynthetic rate of a plant depends on the photosynthesis of individual leaves. Therefore, ensuring an adequate supply of nitrogen and other essential nutrients during leaf growth and development is crucial.This ultimately benefits the plant by increasing growth rates and yielding higher productivity. A high leaf-to-stem ratio significantly affects forage nutritional content, with higher quality nutrition associated with a higher leaf-to-stem ratio.

Shoot-To-Root Ratio

The shoot-to-root ratio and the dry weight of the shoot are interrelated. The shoot-to-root ratio increases when the shoot's dry weight is higher and decreases when the roots' dry weight is higher. In this study, shoot-to-root ratios above one were observed. According to Nurmala *et al*. (2017), a shoot-to-root ratio greater than one indicates that the shoot absorbs more nitrogen compared to the roots, promoting shoot development. Nurmala and Irwan (2007) suggest that an optimal ratio for plants is three.

A shoot-to-root ratio greater than three is likely influenced by fertilization and plant genetics. However, the increase in shoot weight is generally greater than the increase in root weight. Fertilization enhances plant growth, allowing the shoot to gain more weight than the roots. Phosphorus is a key element influencing root development, as it promotes root growth, which affects the development of above-ground components. The application of fertilizer improves growth, resulting in a higher shoot weight, followed by an increase in root weight.

CONCLUSION

The dose of banana peel liquid organic fertilizer influences fresh weight, but it does not affect the plant's height, number of leaves, dry weight, leaf-to-stem ratio, or shoot root ratio. The treatment that had the most significant impact on fresh weight in *C. aestuans* was P1, with 100 ml of banana peel liquid organic fertilizer.

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