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THE EFFECT OF ECO-ENZYMES AND HUSK CHARCOAL ON THE GROWTH OF VANILLA SEEDS

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ABSTRACT

The successful growth and development of the vanilla plant are supported by the availability of soil nutrients that are absorbed by the plant roots. Natural fertilizers derived from plant waste easily decompose in the soil so that they are more quickly absorbed by roots and stored in plant cells. The purpose of this study was to determine the effect of eco-enzymes and husk charcoal on the growth of vanilla seedlings. This study was designed using a complete randomized block design. The first factor was exoenzyme (without eco-enzyme and with exoenzyme 15 ml/plant), namely E0 and E1, the second factor was the husk charcoal dose (0, 5, 10, 15) g/plant, namely P0, P1, P2, P3. Data were analyzed using ANOVA analysis of variance with Duncan's multiple range test (DMRT) with a significant difference of 5%. The results showed that the best vanilla growth was obtained by treating it with 15 ml/polybag eco-enzyme and 15 g/polybag coconut shell charcoal (E1P3). The plant height reaches 79.67 cm, the number of leaves reaches 12.67 strands, and the width reaches 405.42 mm. The fresh weight of the plants reached 71.33 g, the dry weight of the plants reached 28 g, the fresh weight of the roots reached 8.6 g, and the dry weight of the roots reached 1.27 g. Microscopic observation showed that eco enzymes and coconut shell charcoal infected the roots and filled the tissues, then played a role in increasing the growth of the vanilla seedlings.

Key words: eco-enzyme, husk charcoal, vanilla

INTRODUCTION

Vanilla is known as green gold because of its fantastic price, with a value of 1.5 million rupiah per kg of dry vanilla in November 2022. In comparison with other plantation products such as arabica coffee, nutmeg and cocoa, the price of vanilla is much higher at only Rp. 64,160. Rp. 65,000, and Rp. 30,000. It is not surprising that the area of vanilla smallholder plantations has increased from 184 ha in 2020 to 206 ha in 2022, and vanilla production has increased from 23 tons to 24 tons.

Vanilla grows on other plants (epiphytes) and requires sufficient air, loose soil, and nutrients that can be absorbed to grow (Kartikawati & Rosman, 2018). Fertilization during vanilla growth affects the success or failure of cultivation, by adding organic fertilizers that can improve soil quality, stabilize soil aggregates, and support sustainable agriculture (Hayati et al., 2021; Kartikawati & Rosman). Agricultural waste such as eco enzyme and husk charcoal can be processed into organic fertilizers that are environmentally friendly.

Eco-enzyme made from citrus waste is a complex solution (Li et al., 2013). The solution has the benefit of being a sedative and using sugar as a substrate. In addition, this solution also has a fresh aroma and high acidity (Vama & Cherakar, 2020; Mavani et al., 2020). Its function is as a plant fertilizer (Hasanah, 2021) because it contains 203 mg L-1 potassium and 21.79 mg L-1 phosphorus (Hasanah et al., 2022). In addition, this eco enzyme can also be used to solve the problem of stabilizing activated sludge from industrial waste (Arun & Sivashanmugam, 2015). In the Brassica juncea L plant, the effect of this eco enzyme can increase its growth (Lumbanraja et al., 2021). In addition, this eco enzyme also does not have a negative effect on the environment (Vama and Cherekar, 2020).

Agricultural waste from husk charcoal can improve plant fertility as it contains lignin, cellulose, and hemicellulose along with 87-97% ash and silica content, 1% nitrogen, and 2% potassium. Potassium plays a crucial role in the chemical structure, biochemical regulation, and physiological processes of plants, which directly impact their growth and development. Furthermore, the addition of potassium, along with other nutrients, enhances productivity, quality, and resistance against both biotic and abiotic disturbances, especially during periods of drought stress. Recent research by Dizaji et al. (2019) and Imas (2013) states the importance of potassium in plant nutrition. Moreover, the study conducted by Haryuni et al. (2022) found that husk charcoal had a significant effect on the proline content, body height, fresh weight, and dry weight of vanilla plants when faced with the BNR fungus.

The study aimed to find out how eco-enzymes and husk charcoal can affect the growth of vanilla beans. It provided information on how much husk charcoal and eco-enzymes should be used and how they can affect the growth of vanilla seedlings and the appearance of stem parts under a microscope.

METHODS

Preparation of vanilla and soil medium

Preparation of vanilla and soil media using the method from Haryuni et al., 2020.

Preparation of eco-enzym

It takes 3 kg of clean orange peel waste and 10 L of clean water. Put the orange peel waste into a large bucket filled with water and add 1 kg of brown sugar. Let it be stored for 3 months. After 1 and 2 weeks, uncover the bucket for 1 minute and stir well to release any gas that builds up. Before using eco-enzyme, it is important to filter it first.

Preparation of rice husk charcoal

The rice husk charcoal is cleaned of other materials which are mixed together and then collected together and the center is equipped with a tubular chimney to drain the resulting smoke, the section is given a zinc mat so that the fire does not go out and stays clean, the rice husk is burned together with charcoal and paper, the rice husk is Burn it upside down so that everything is exposed to the fire evenly and turns black, leave it for 24 hours until it cools down and is ready to be used as a medium for treating vanilla plants (Haryuni et al., 2022).

Research design

This research was conducted in a greenhouse with a temperature of around 30°C from May to October 2022 at the Department of Agronomy, Faculty of Agriculture, Tunas Pembangunan University, Surakarta, Central Java, Indonesia, using Andosol soil type. This study used a completely randomized group design, with the first factor without eco-enzyme and with eco-enzyme 15 ml/polybag as E0, E1, and the second factor was rice husk charcoal dose treatment (0, 5, 10, 15, 20) g /polybag as P0, P1, P2, P3, P4.

Observation of vanilla bean growth was carried out four weeks after the first treatment of husk charcoal and eco-enzymes, including plant height (measured from the base of the stem to the top of the stem), leaf width, plant fresh weight, plant dry weight, root fresh weight, root dry weight. Furthermore, the dry weight of the leaves and all roots was observed by drying the leaves and roots in an oven at 105°C for 2 hours and continuously at 80°C until constant weight (Huang et al., 2019). Analysis of variance (ANOVA) was performed in this study. If there is a difference between the treatments, then a follow-up test is performed using the Duncan Multiple Range Test (DMRT) at a significance level of 5% (Gomez & Gomez, 1995).

RESULT AND DISCUSSION

Table 1 shows the average effective dose of the effect of husk carbon and eco-enzymes on the growth of vanilla beans analyzed using Duncan's multiple range test (DMRT) at a 5% level in the experimental and control activities.

Table 1. The effect eco enzyme application on hight of plant, wide of life, fresh weight of plant, dry weight of plant, fresh weight of root, dry weight of root on vanilla.

Treatments	Parameters						
	hight of plant (cm)	amount of leaf (sheet)	wide of leaf (mm)	fresh weight of plant (g)	dry weight of plant (g)	fresh weight of root (g)	dry weight of root (g)
Eco enzymes application (E)							
E0	59.67[a]	10.8	323.83[a]	51.73	19.27[a]	5.67[a]	0.86
E1	67.93[b]	11.33	336.74[b]	58.07	23.33[b]	6.87[b]	0.98

Note:
E0= without eco-enzyme, E1= eco-enzyme 15 ml/polybag.
Numbers in the same column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (DMRT) at a 5% level.

Table 1 shows the differences in eco-enzyme treatment on various aspects of plant growth, such as height, leaf width, plant dry weight, and root fresh weight. However, no significant differences were observed in terms of number of leaves, plant fresh weight, and root dry weight.

Eco-enzymes are organic substances that help break down soil nutrients into components that can be used for plant growth. This process occurs through the process of photosynthesis which then causes an increase in the number and size of cells so that the plants become taller, the leaves are wider, the dry weight of the plants is greater, and the weight of the roots is heavier

(Harman et al., 2021; Novianto, 2022). Photosynthesis also plays an important role in increasing the growth rate of plants (Rahmawan et al., 2019). According to Nurhayati (2021), photosynthesis is responsible for ATP synthesis, production of photosynthetic enzymes (eg RuBP carboxylase), absorption of CO2 through leaf stomata, and maintaining electrical balance during the photophosphorylation process in chloroplasts, all of which are influenced by nutrients absorbed by plants. Organic molecules such as proteins, carbohydrates and lipids can be broken down by enzymes such as proteases, amylase and lipases, which are then used for plant metabolism (Arun & Sivashanmugam, 2015).

The use of eco-enzyme chicory orange as much as 15 ml L-1 on the dry weight of Lokananta tubers increased by 20.47% compared to the control on the Sanren variety (Hasanah et al., 2022), with significant effects on root length, stem circumference, and dry weight of lettuce plants (Yuliandewi et al., 2018), supported by research from Novianto (2022) which showed that eco-enzymes increased root length and number of shallots, as well as the growth of Sacha inchi Plukenetia volubilis L (Rosnina et al., 2022) and Turi (Sesbania grandiflora) (Ginting et al., 2021).

Table 2. The effect doses husk charcoal application on hight of plant, wide of leaf, fresh weight of plant, dry weight of plant, fresh weight of root, dry weight of root on vanilla.

Treatments	Parameters						
	hight of plant (cm)	amount of leaf (sheet)	wide of leaf (mm)	fresh weight of plant (g)	dry weight of plant (g)	fresh weight of root (g)	dry weight of root (g)
Eco enzymes application (E)							
P0	57.33	10.67	297.83 ^{a}	43.00 ^{a}	18.50 ^{ab}	5.50 ^{a}	0.65 ^{a}
P1	64.33	10.67	350.88 ^{ab}	52.17 ^{a}	21.83 ^{bc}	5.33 ^{a}	0.84 ^{a}
P2	65.00	10.5	304.08 ^{a}	46.17 ^{a}	18.33 ^{a}	5.00 ^{a}	0.77 ^{a}
P3	68.00	11.83	395.54 ^{bc}	65.50 ^{b}	23.83 ^{c}	7.67 ^{b}	1.14 ^{b}
P4	64.33	11.67	428.12 ^{c}	67.67 ^{b}	24.00 ^{c}	7.83 ^{b}	1.19 ^{b}

Note:
P0= doses of huck charcoal 0g/polybag P1= doses of huck charcoal 0g/polybag, P2= doses of huck charcoal 5g/polybag, P3= doses of huck charcoal 10g/polybag, P3= doses of huck charcoal 15g/polybag, P4= doses of huck charcoal 20g/polybag.
Numbers in the same column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (DMRT) at a 5% level.

Table 2 shows how different doses of husk charcoal affect plant growth. Parameters of leaf width, plant fresh weight, and root dry weight were significantly different at P4, while plant height and number of leaves were not significantly different. The husk charcoal contains potassium, which is an essential macronutrient for plant transport and assimilation. It also plays a role in soil improvement, silica extraction, and supports plant growth in extreme soil conditions and saline soils. The decomposition of husk charcoal affects various factors such as seed germination, root growth, seedling emergence, number of shoots, nutrient availability, and plant productivity. Potassium is very important for wet stem type plants to maintain the balance between the vegetative and reproductive phases.

In that study, it was found that giving rice husk charcoal at a dose of 20g/plant to vanilla seedlings increased leaf area, plant fresh weight, plant dry weight, fresh root weight, and root dry weight (Table 2). Whereas in Lycopersicum esculentum Mill., plant growth requires a dose of 50 g/plant (Kiswondo, 2011). In another study, a dose of 5 g/plant on Lactuca sativa plants increased fresh weight, and the addition of fresh weight also occurred on Arabica coffee and shallot plants (Bismantara et al., 2022; Ngindi et al., 2022). In soybeans, this dose can also increase seed weight (Perdanatika et al., 2018). In addition, in Vigna sinensis L long bean plants, this dose also increased plant height, fresh weight of long bean plants, and fruit weight per plot (Walianggen, 2022).

Table 3. The effect doses husk charcoal and eco-enzym application on hight of plant, amount of leaf, wide of life, fresh weight of plant, dry weight of plant, fresh weight of root, dry weight of root on vanilla

Treatments	Parameters						
	Hight of plant (cm)	Amount of leaf (sheet)	Wide of leaf (mm)	Fresh weight of plant (g)	Dry weight of plant (g)	Fresh weight of root (g)	Dry weight of (g)
Interaction of eco-enzymes and husk charcoal application							
E0P0	55.00	10.67	253.33	40.33	18.33	5.67 ^{bc}	0.61
E0P1	64.67	10.33	325.08	49.33	21.00	6.00 ^{bcd}	0.77
E0P2	61.33	10.67	260.75	46.67	16.33	2.33 ^{a}	0.79
E0P3	56.33	11.00	385.67	59.67	19.67	6.67 ^{bcde}	1.01
E0P4	61.00	11.33	394.33	62.67	21.00	7.67 ^{cde}	1.10
E1P0	59.67	10.67	342.33	45.67	18.67	5.33 ^{b}	0.69
E1P1	64.00	11.00	376.67	55.00	22.67	4.67 ^{b}	0.91
E1P2	68.67	10.33	347.40	45.67	20.33	7.67 ^{cde}	0.75
E1P3	79.67	12.67	405.42	71.33	28.00	8.67 ^{e}	1.27
E1P4	67.67	12.00	461.91	72.67	27.00	8.00 ^{de}	1.29

Note:
P0= doses of huck charcoal 0g/polybag P1= doses of huck charcoal 0g/polybag, P2= doses of huck charcoal 5g/polybag, P3= doses of huck charcoal 10g/polybag, P3= doses of huck charcoal 15g/polybag, P4= doses of huck charcoal 20g/polybag.
E0= without eco-enzyme, E1= eco-enzyme 15 ml/polybag.
Numbers in the same column followed by the same letter are not significantly different according to Duncan's Multiple Range Test (DMRT) at a 5% level.

Table 3 shows that the combination of eco-enzymes and rice husk charcoal did not have a significant effect on plant height, live area, plant fresh weight, plant dry weight, and vanilla root dry weight. However, there was a significant difference in the fresh weight of vanilla tubers. The only significant difference found was in the treatment of fresh root weight. This is because each treatment has a different effect and they do not interact significantly, except for the treatment of fresh root weight which showed a significant effect, indicating an interrelation between the two treatments. When eco-enzymes and husk charcoal enter the plant tissue, they are stored and fill in the gaps in the tissue.

Eco-enzymes contain complex protein chains, hormones, organic acids, enzymes, and mineral salts that accelerate plant biochemical reactions. On the other hand, rice husk charcoal contains potassium, which promotes root growth. Giving eco-enzymes enhances the growth of chili plants, as evidenced by an increase in plant height, stem diameter, leaf width, and greener leaves compared to plants without eco-enzymes.

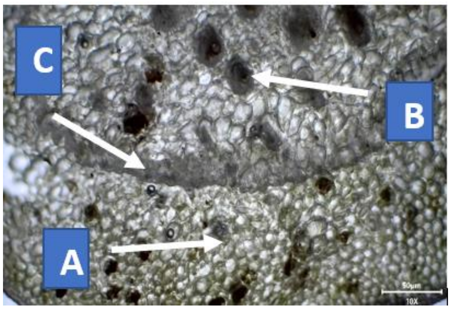

Figure 1. Cross-section of a stem treated with eco-enzyme and rice husk with a magnification of 10x50µm [A: eco-enzymes, B: husk charcoal, C: endodermis]

Figure 1. Vanilla stems filled with ecological enzymes (A) and husk charcoal (B) fill the transport packets at the base of the stem. This shows that the treatment of ecological enzymes and rice husk charcoal enters the plant tissue and is useful and influences plant growth and development (Tables 1, 2, and 3). Ecological enzymes present in vanilla tissue include functional enzymes (amylase, lipase, cacinase, protease, and cellulase), as well as secondary metabolites such as flavonoids, quinones, saponins, alkaloids, and cardio glycosides (Vama and Cherekar, 2020), thereby reducing environmental toxicity. in agriculture and as liquid organic fertilizer (Hamalatha & Visanti, 2020). The husk charcoal in the soil is porous, light, not dirty, and can store air, then enters the plant through the roots to fill the plant tissue (Mishra et al., 2017). Rice husk charcoal functions as a biological fertilizer (Maftuah et al., 2020) and biopesticide (Sala et al., 2020).

CONCLUSION

The effect of eco-enzyme doses had an effect on increasing growth and was significantly different on plant height, leaf width, plant dry weight, and root fresh weight, husk charcoal had an effect and was significantly different on leaf width, plant fresh weight, plant dry weight, root fresh weight, weight dry roots. Meanwhile, the interaction of eco-enzymes and rice husk charcoal had an effect and was significantly different on the fresh weight of the roots 8.6 g (E1P3). Dosing of eco-enzymes had an effect on increasing growth and was very significantly different on plant height, leaf width, plant dry weight, and fresh root weight, husk charcoal had an effect and was significantly different on leaf width, plant fresh weight, plant dry weight, and plant weight. fresh root, fresh weight of root. Meanwhile, the interaction of eco-enzymes and husk charcoal had an effect and was significantly different on fresh root weight of 8.6 g (E1P3).

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