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Growth Responses of Sacha Inchi (*Plukenetia volubilis* L.) to Eco-Enzyme and Arbuscular Mychorriza Treatments on Inceptisol

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ABSTRACT

The sacha inchi plant (*Plukenetia volubilis* L.) produces seeds with high protein content that are beneficial for human health. The planting of sacha inchi on sub-optimal land, such as inceptisol soil, requires eco-enzyme, an organic fertilizer made from environmentally friendly fermented fruit waste. In addition, the use of biological agents, such as arbuscular mycorrhiza, can increase the plant's ability to absorb macronutrients, such as potassium and phosphorus, from the soil. This study aims to determine the effect of eco-enzyme and mycorrhiza treatments on the growth of sacha inchi plants on inceptisol. A two-factor group randomized design with nine treatments and three replications was employed. The first factor was the concentration of eco-enzyme (0 ml/l, 22.5 ml/l, and 30 ml/l). The second factor was the dose of mycofer (substance containing mycorrhizal spores) (0 g/plant, 30 g/plant, and 40 g/plant). Parameters measured were plant height, number of leaves, root length, root fresh weight, root dry weight, and mycorrhizal infection. The results show that the application of eco-enzyme was able to increase the height of sacha inchi plants in the vegetative phase at 10 and 20 days after planting (DAP) and increase the number of leaves at 30 and 40 DAP. Single application of 40 g/plant of mycofer was able to increase the vegetative growth of sacha inchi on inceptisol. The optimum amount to increase the growth rate of sacha inchi plants was reached through the combination of eco-enzyme at a concentration of 22.5 ml/l and mycofer at a dose of 40 g/plant.

1. Introduction

Sacha inchi (*Plukenetia volubilis* L.), also known as Inca peanut or sacha peanut, is a perennial plant native to Peru (Hidalgo et al., 2019). This plant is a vine that belongs to the Euphorbiaceae family (Nisa et al., 2017). It is also a woody vine that produces seeds with high content of protein (27–30%) and oil (40–60%), exceeding the quality characteristics of available oils used for human consumption worldwide (Cai et al., 2013).

The seeds of sacha inchi plant contains oil, which is an unsaturated fatty acid rich in omega-3 content, higher than other plants. According to Pazmiño (2013), the fatty acid content of sacha inchi is quite high compared to that of other vegetable oil-producing plants, with particularly the content of unsaturated fatty acids, such as omega-3, is 48.61%. Other vegetable oil-producing crops, such as soybean, corn, and sunflower, have lower omega-3 content than sacha inchi. According to Hamaker et al. (1992), sacha inchi contains many nutrients that are very beneficial to the body, including omega-3 (45.2%), omega-6 (36.8%), omega-9 (9.6%), and saturated fat (7.7%).

Planting sacha inchi on sub-optimal land, such as inceptisol soil in West Reuleut Village, North Aceh Regency, Aceh Province, requires the addition of organic fertilizers, such as eco-enzyme. This fertilizer contains enzymes that can increase the population of soil microorganisms so as to improve soil characteristics that bring a positive impact on plant growth. This is necessary due to the low nutrient levels contained in inceptisol. According to Siswanto & Widowati (2018), the fertility of inceptisol soil is considered low due to its low content of soil organic matter, soil acidity, and several macroelements.

An alternative that can be conducted to overcome nutrient deficiency, especially in inceptisol soil, is by adding organic fertilizer known as eco-enzyme. Eco-enzyme is a solution of complex organic substances produced from the eco-fermentation process of organic waste, sugar, and water for 3–6 months. Eco-enzyme contains macroelements, such as potassium (K) at 203 mg/l and phosphorus (P) at 21.79 mg/l (Yuliandewi et al., 2018) so that it is good for fertilizing the soil and providing nutrients for plant.

According to Jaya et al. (2021), eco-enzyme with a concentration of 22.5 ml/l had a significant effect on the yield of fresh weight of bulbs per clump of shallot plants. Besides, eco-enzyme fertilizer provides a number of benefits, such as increasing soil fertility, accelerating plant growth, stimulating plant hormones, and improving the quality of fruits, vegetables, and other crop yields.

In addition, efforts to overcome nutrient limitations can utilize a specific type of fungus, such as mycorrhiza, which can increase nutrient availability and overcome low soil acidity and dry land types. The application of mycorrhizae on inceptisol soil as sub-optimal land that is classified as dry land and often experiences nutrient deficiencies is needed in increasing the land productivity in order to make it suitable for plant cultivation.

Arbuscular mycorrhiza is a form of mutual symbiosis between fungi and the plant root system. The mycorrhizae play a significant role to help the absorption of plant nutrients, increase plant growth, and improve the plant yields. Conversely, fungi obtain their energy by assimilating with plants (Suharno & Sancayaningsih, 2013). According to Sufardi (2012), in the presence of mycorrhiza, the rate of nutrient absorption by plant roots increases almost four times compared to that of normal roots, and the area of root absorption can increase up to 80 times. Besides, Marwani et al. (2013) stated that the use of 30 g/plant of mycorrhiza in jatropha plant had a significant effect on plant height and stem diameter. In addition, the application of mycorrhiza can also increase the uptake of N, P, K, Mg and Ca elements, as well as the oil content of sacha inchi peanut.

Based on the aforementioned background, this study was conducted to investigate the growth response of sacha inchi plants (*Plukenetia volubilis* L.) to the application of eco-enzyme and arbuscular mycorrhiza on inceptisol.

2. Methods

2.1 Time and location

This research was conducted on April–August 2022 in West Reuleut Village, Muara Batu Subdistrict, North Aceh Regency and the Laboratory of the Faculty of Agriculture, Malikussaleh University.

2.2 Materials and tools

The materials used in this study were sacha inchi plant seeds, top soil, water, shallots, cow manure, NPK fertilizer, firewood husk, rice husk, crushed wood pulp, sand, eco-enzyme, mycofer (substance containing mycorrhizal spores) with 99 spores/100 g mycofer containing spores from the species of *Glomus claroideum*, *Acaulospora rogusa*, *Acaulospora colosica*, *Glomus fasciculatum*, *Glomus mosseae*, and *Glomus etunicatum*, distilled water, 10% of potassium hydroxide, 2% of hydrochloric acid, and 0.02% of methylene blue.

The tools used in this study were egg gutters (seeding containers), hoes, watering can, meters, caliper, 80% of paranet, scissors, ovens, digital scales, ordinary scales, machetes, envelopes, plastic bags, 2 m of stakes, name plates, label paper, notebooks, cameras, and stationery.

2.3 Research design

This study used a factorial randomized group design with two treatment factors. The first factor was eco-enzyme (E), which was made in three concentrations, namely E0 (0 ml/l), E1 (22.5 ml/l), and E2 (30 ml/l). The second factor was mycofer (M), which was made in three doses, namely M0 (0 g/plant), M1 (30 g/plant), and M2 (40 g/plant). There were nine treatment combinations with three replications so that the total amount of samples were 162 plants.

The implementation consisted of the following steps: making the eco-enzyme, sowing the seeds, preparing the land, tillage, making the beds, installing the stakes, planting, applying the mycofer and eco-enzyme, and maintaining the plants. Parameters observed were plant height, number of leaves, root length, root fresh weight, root dry weight, and mycorrhizal infection. Statistical analysis using Duncan Multiple Range Test (DMRT) at the 5% level was then performed to figure out whether there were significant differences among the treatment results.

3. Results and discussion

3.1 Plant height

The single application of eco-enzyme has resulted in a very significant effect only at the plant age of 10 and 20 Days After Planting (DAP). E1 treatment produced the highest average plant height, namely 66.14 cm, which is significantly different from that of E0 (control). On the other hand, the single application of mycofer has resulted in a very significant effect on plant height at all ages, namely 10, 20, 30, 40, 50, and 60 DAP. The application of 40 g/plant of mycofer (M2 treatment) produced the highest average plant height, namely 284.44 cm (Table 1).

Table 1. Height of sacha inchi plants due to eco-enzyme and mycofer treatments.

Treatment	Plant Height (cm)					
	10 DAP	20 DAP	30 DAP	40 DAP	50 DAP	60 DAP
Eco-enzyme (E)						
E0 (0 ml/l)	45.48 b	49.31 b	70.04 a	113.80 a	177.74 a	224,15 a
E1 (22.5 ml/l)	61.64 a	66.14 a	80.57 a	128.43 a	207.54 a	274.00 a
E2 (30 ml/l)	57.90 a	63.25a	85.30 a	127.27 a	197.50 a	263.63 a
Mycofer (M)						
M0 (0 g/plant)	43.40 b	47.00 b	59.65 b	9165 b	151.28 b	203.67 b

M1 (30 g/plant)	56.59 a	61.17 a	80.07 a	132.33 a	197.56 a	268.67 a
M2 (40 g/plant)	65.04 a	70.53 a	96.18 a	145.51 a	233.94 a	284.44 a

Description: Numbers followed by the same letter in the same column indicate no significant difference based on the results of DMRT test at the 5% level.

3.2 Number of leaves

There was a significant interaction between eco-enzyme concentration and mycofer dose on the number of leaves at the plant age of 40 DAP. The highest average number of leaves, namely 61.00 strands, was resulted by E1M2 treatment interaction (22.5 ml/l of eco-enzyme + 40 g/plant of mycofer), while the lowest average number of leaves, namely 14.22 strands, was resulted by E0M0 treatment interaction (0 ml/l of eco-enzyme + 0 g/plant of mycofer) (Table 2).

The single application of eco-enzyme resulted in a significant effect at the plant age of 30 and 40 DAP. E1 treatment produced the highest average number of leaves, namely 32.85 and 50.81 strands (30 and 40 DAP, respectively), which is significantly different from E0 (control) with the average number of leaves of 24.37 and 39.37 strands. On the other hand, the single application of mycofer has resulted in a significant to very significant effect on the number of leaves at the plant age of 10, 20, 30, 40, and 50 DAP. M2 treatment produced the highest average number of leaves, namely 84.07 strands, which is significantly different from M0 (control) with the average number of leaves of 54.29 strands (Table 3).

Table 2. Interaction effect of eco-enzyme and mycofer treatments on the number of sacha inchi leaves at 40 DAP.

Eco-enzyme	**Mycofer**		
	M_0 (0 g/plant)	M_1 (30 g/plant)	M_2 (40 g/plant)
E_0	14.22 (3.80) c	44.66 (6.70) b	59.22 (7.72) a
(0 ml/l)	B	A	A
E_1	43.22 (6.60) bc	48.22 (6.97) b	61.00 (7.75) a
(22.5 ml/l)	A	A	A
E_2	47.11 (6.86) b	41.66 (6.46) c	57.67 (7.61) a
(30 ml/)	A	B	A

Description: Numbers followed by the same letter in the same column indicate no significant difference based on the results of DMRT at the 5% level. Numbers in parentheses are the result of $\sqrt{(x + 2)}$ transformation.

Table 3. Number of leaves of sacha inchi plants due to eco-enzyme and mycorrhiza treatments.

Treatment	**Number of Leaves (Sheet)**					
	10 DAP	20 DAP	30 DAP	40 DAP	50 DAP	60 DAP
Eco-enzyme (E)						
E0 (0 ml/l)	9.29 (3.07) a	13.70 (3.98) a	24.37 (4.82) b	39.37 (6.07) b	60.25 (7.96) a	79.00 (8.49) a
E1 (22.5 ml/l)	9.66 (3.16) a	17.37 (4.18) a	32.85 (5.73) a	50.81 (7.10) a	71.29 (8.38) a	91.70 (9.50) a
E2 (30 ml/l)	10.44 (3.27) a	17.18 (4.18) a	31.59 (5.63) a	48.81 (6.98) a	74.18 (8.54) a	92.67 (9.53) a
Mycofer (M)						
M0 (0 g/plant)	7.74 (2.82) b	12.26 (3.50) b	23.07 (4.71) b	34.85 (5.75) c	54.29 (7.34) b	72.82 (8.78) a
M1 (30 g/plant)	10.96 (3.35) a	16.18 (4.06) a	30.03 (5.49) a	44.85 (6.71) b	67.37 (8.14) ab	84.33 (9.09) a

M2 (40 g/plant)	10.70 (3.32) a	19.81 (4.47) a	35.70 (5.98) a	59.29 (7.69) a	84.07 (9.13) a	106.22 (9.95) a

Description: Numbers followed by the same letter in the same column indicate no significant difference based on the results of DMRT at the 5% level. Numbers in parentheses are the result of √ (x + 2) transformation.

3.3 Root length

There was a significant interaction between eco-enzyme concentration and mycofer dose on root length parameter. The highest average root length, namely 58.39 cm, was resulted by E1M2 treatment interaction, while the lowest average root length, namely 31.64 cm, was resulted by E0M0 treatment interaction (Table 4).

The single application of eco-enzyme has not resulted in a significant effect on root length parameter. E2 treatment produced the highest average root length, namely 51.55 cm, while E0 (control) produced the lowest average root length, namely 26.25 cm. On the other hand, the single application of mycorrhiza dose has resulted in a significant effect on root length. Mycofer application of 40 gr/plant produced the highest average root length, namely 55.30 cm, which is significantly different from M0 (control) with the average root length of 44.16 cm (Table 7).

Table 4. Interaction effect of eco-enzyme and mycofer treatments on root length of sacha inchi plants.

Eco-enzyme	Mycofer		
	M_0 (0 g/plant)	M_1 (30 g/plant)	M_2 (40 g/plant)
E_0 (0 ml/l)	31.64 (5.64) b C	53.22 (7.32) a A	53.90 (7.37) a B
E_1 (22.5 ml/l)	46.05 (6.80) b B	45.12 (6.75) b B	58.39 (7.66) a A
E_2 (30 ml/l)	54.79 (7.40) a A	46.25 (6.82) b B	53.62 (7.35) a B

Description: Numbers followed by the same letter in the same column and row indicate no significant effect based on the results of DMRT at the 5% level.

3.4 Root fresh weight

There was a significant interaction between eco-enzyme concentration and mycofer dose on root fresh weight parameter. The highest average root fresh weight, namely 44.52 g, was resulted by E0M2 treatment interaction, while the lowest average root fresh weight, namely 7.47 g, was resulted by E0M0 treatment interaction (Table 5).

The single application of eco-enzyme has not resulted in a significant effect on root fresh weight parameter. E2 treatment produced the highest average root fresh weight, namely 35.24 g, while E1 treatment produced an lowest average root fresh weight, namely 29.61 g. On the other hand, the single application of mycofer has resulted in a significant effect on root fresh weight. M2 treatment produced the highest average root fresh weight, namely 39.56 g, which is significantly different from M0 (control) with the average root fresh weight of 20.63 g (Table 7).

Table 5. Interaction effect of eco-enzyme and mycofer treatments on root fresh weight of sacha inchi plants.

Eco-enzyme	Mycofer		
	M_0 (0 gr/plant)	M_1 (30 gr/plant)	M_2 (40 gr/plant)
E_0	7.47 (2.74) c	36.84 (6.08) b	44.52 (6.69) a

(0 ml/l)	B	A	A
E_1	26.84 (5.22) b	23.59 (4.90) b	34.99 (5.93) a
(22.5 ml/l)	A	B	B
E_2	(27.57) 5.24 b	38.97 (6.27) a	39.16 (6.28) a
(30 ml/l)	A	A	AB

Description: Numbers followed by the same letter in the same column and row indicate no significant effect based on the results of DMRT at the 5% level.

3.5 Root dry weight

There was a significant interaction between eco-enzyme concentration and mycofer dose on root dry weight parameter. The highest average root dry weight, namely 11.96 gr, was resulted by E0M2 treatment interaction, while the lowest average root dry weight, namely 2.06 gr, was resulted by E0M0 treatment interaction (Table 6).

Table 6. Interaction of eco-enzyme concentration and micofer dosage on root dry weight variables.

Eco-enzyme	Mikofer		
	M_0 (0 g/tanaman)	M_1 (30 g/tanaman)	M_2 (40 g/tanaman)
E_0	2.06 (1.56) c	9.56 (3.15) b	11.96 (3.52) a
(0 ml/l)	B	A	A
E_1	7.70 (2.86) b	7.08 (2.75) b	10.94 (3.34) a
(22,5 ml/l)	A	B	B
E_2	7.68 (2.82) b	9.34 (3.12) a	6.97 (2.72) b
(30 ml/l)	A	A	C

Description: Numbers followed by the same letter in the same column indicate no significant difference based on the results of DMRT at the 5% level. Numbers in parentheses are the result of $\sqrt{\ }$ (x + 2) transformation.

The single application of eco-enzyme has not resulted in a significant effect on root dry weight parameter. The E1 treatment produced the best average root dry weight, namely 8.57 g, while E0 (control) produced the average root dry weight of 7.86 g. On the other hand, the single application of mycofer has resulted in a significant effect on root dry weight. M2 treatment produced the highest average root dry weight, namely 9.96 g, which is significantly different from M0 (control) with the average root dry weight of 5.81 g (Table 7).

3.6 Mycorrhizal infection

The single application of eco-enzyme has not resulted in a significant effect on mycorrhizal infection parameter. E1 treatment produced the highest average mycorrhizal infection, namely 50.00%, while E0 (control) produced the lowest average mycorrhizal infection, namely 45.55%. On the other hand, the single application of mycofer has resulted in a significant effect on mycorrhizal infection. M2 treatment produced the highest average mycorrhizal infection, namely 64.44%, which is significantly different from M0 (control) with the average mycorrizal infection of 18.88% (Table 7).

Table 7. Root length, root fresh weight, root dry weight, and mycorrhizal infection in sacha inchi plants due to eco-enzyme and mycofer treatments.

Treatment	Root Length (cm)	Root Fresh Weight (g)	Root Dry Weight (g)	Mycorrhizal Infection (%)
Eco-enzyme (E)				
E0 (0 ml/l)	26.25 (6.76) a	29.61 (5.35) a	7.86 (2.74) a	45.55 a
E1 (22.5 ml/l)	49.85 (6.99) a	28.47 (5.17) a	8.57 (2.98) a	50.00 a
E2 (30 ml/l)	51.55 (7.03) a	35.24 (5.93) a	7.99 (2.89) a	47.77 a
Mycofer (M)				
M0 (0 g/plant)	44.16 (6.68) b	20.63 (4.40) b	5.81 (2.41) b	18.88 b

M1 (30 g/plant)	48.19 (6.87) ab	33.13 (5.75) a	8.66 (3.01) a	60.00 a
M2 (40 g/plant)	55.30 (7.23) a	39.56 (6.30) a	9.96 (3.19) a	64.44 a

Description: Numbers followed by the same letter in the same column indicate no significant difference based on the results of DMRT at the 5% level. Numbers in parentheses are the result of √ (x + 2) transformation.

The application of 22.5 ml/l of eco-enzyme has affected the height of sacha inchi plants. This occurs probably because eco-enzyme contains two essential macroelements, namely potassium (K) and phosphorus (P). Yuliandewi et al. (2018) stated that eco-enzyme contains around 203 mg/l of K element and 21.79 mg/l of P element. K element functions to increase the rate of photosynthesis so that it plays a role to increase the photosynthate content in plants (Rahmawan et al., 2019). Besides, according to Nurhayati (2021), K element is essential in photosynthesis as it is involved in several important processes, such as ATP synthesis, production and activity of photosynthetic enzymes (such as RuBP carboxylase), absorption of CO_2 through the mouth of the leaf, and maintenance of electrical balance during photophosphorylation in the chloroplast. Meanwhile, Safrizal (2014) stated that P element in eco-enzyme plays an important role in photosynthetic activity as a precusor that provides carbohydrate content as an energy source for plant growth and development.

The application of eco-enzyme has significantly increased the number of leaves. This is thought to be due to the reason that growth of the number of leaves is one of the most obvious parts of plant vegetative growth, in which macroelements such as N, P, and K play a very important role at this phase, especially P and K elements that function in the process of differentiation, division, and enlargement of plant cells (Yoga, 2022). By meeting the needs of the necessary macronutrients, plant growth occurs more optimally.

Mycorrhizal treatment has exhibited a very significant effect at all observed plant ages, both on the parameters of plant height and number of leaves. This is due to the colonization of mycorrhizal hyphae in plant roots, which plays a role to increase the availability and absorption of nutrients, especially the P element needed, both in the vegetative and generative growth phases. This is aligned with the explanation of Bussa et al. (2019), that the main function of hyphae in mycorrhizal fungi is to increase the absorption of P element in the soil. This condition allows plant roots to more optimally absorb P element in the soil because roots infected by mycorrhizal hyphae secrete phosphatase enzymes, which are able to release P element from several specific bonds, thus allowing this element to be available in sufficient quantities for plants (Basri, 2018). The optimally absorbed P element can adequately support plant's growth and development.

The application of 22.5 ml/l of eco-enzyme and 40 g/plant of mycofer was able to produce the highest root length of sacha inchi plants, namely 53.90 cm, while the root length resulted without eco-enzyme and mycorrhiza application was only 31.64 cm. Mycorrhizal hyphae that infect the root system of sacha inchi will expand hyphal colonization so that the infected plants will be able to increase their capacity to absorb nutrients and water. The combination between nutrients and enzymes contained in eco-enzyme and mycorrhizal hyphae that colonize the root system has resulted in a wider root zone and higher availability of nutrients, especially P element. This supports the acceleration of growth and root length increase in sacha inchi plants. As stated by Rosnina et al. (2021), colonization of mycorrhizal hyphae in the root zone can expand the reach of roots in obtaining nutrients from the soil so as to increase the absorption of macronutrients, especially P element, and several necessary micro nutrients. The extent of the root zone directly correlates with the length of the roots of sacha inchi plants, where the extensive root zone will cause the roots of sacha inchi plants to also have a long size due to the infection of mycorrhizal hyphae.

The application of mycorrhizae in this study has a very significant effect on root fresh weight. This is thought to be due to the reason that roots infected with mycorrhizae can absorb water even in water stress conditions so that it is still sufficient to support the photosynthesis process. In addition, mycorrhizae can also help in optimally providing nutrients, such as N, P, and K, in the soil. This is in line with the statement of Idris et al. (2018), that the high fresh weight of roots is likely due to the high content of nutrients and the content of N, P, and K elements in the dose of planting media composition. In addition, mycorrhizal infection of sacha inchi plants causes the expansion of the root zone in plant roots. The expanded root zone results in greater root weight and size as well, compared to roots that are not infected with mycorrhizae.

Similarly to that of root fresh weight, mycorrhizae application also has a very significant effect on root dry weight; this is indicated by the high root dry weight produced. The presence of mycorrhizae increases the availability of adequate nutrients in improving metabolic processes that affect the vegetative growth phase of sacha inchi plants. Idris et al. (2018) stated that the optimal metabolic processes and high cell activity will increase root biomass and in turn increases root dry weight.

Application of mycorrhiza on sub-optimal land, such as inceptisol in West Reuleut area, has showed a very significant effect on the infection of mycorrhizal hyphae in the root system of sacha inchi plants. In addition to absorbing nutrients, mycorrhizal infection can increase the availability and absorption of plant nutrients cultivated on dry or sub-optimal land, such as inceptisol in West Reuleut area. This is in line with a study by Rosnina et al. (2021), which stated that the presence of mycorrhiza can expand the root zone of infected plants so that these plants can absorb nutrients more optimally, especially the P element, which is much needed for plant growth. Increasing the P uptake process optimally can increase plant metabolic processes, such as the rate of photosynthesis, respiration, transfer, energy storage, and cell division. Therefore, this makes plant proliferation can occur more optimally (Dahlia & Setiono, 2020).

The interaction of eco-enzyme concentration and mycofer dose had a very significant effect on the parameters of plant fresh weight and plant dry weight. In addition, the concentration of eco-enzyme significantly affected the parameters of leaves number at 40 DAP, stem diameter at 20 and 40 DAP, and root length. Presumably, this is because the eco-enzyme applied to the soil synergizes with mycorrhiza so as to increase the availability of P and K elements to facilitate the optimal growth of sacha inchi plants. The P and K elements contained in the eco-enzyme are absorbed by the external hyphae of sacha inchi plant roots that are colonized by mycorrhizal fungi to be used in the metabolic process in order to increase the number of leaves, root length, root fresh weight, and root dry weight. The results obtained prove that eco-enzyme acts as a provider of P and K elements and mycorrhiza acts as a fungus that elevates the roots' performance in nutrient and water absorption.

Essential macronutrients (N, P, and K) are necessary for supporting plant growth process. The eco-enzyme solution contains two essential macroelements, namely potassium (K) at 203 mg/l and phosphorus (P) at 21.79 mg/l (Yuliandewi et al., 2018). The amount of nutrients contained in eco-enzyme can optimize the uptake of nutrients needed by sacha inchi plants. The application of arbuscular mycorrhizae, especially on sub-optimal land such as inceptisol soil, has proven to be more effective in increasing plant growth rates. Arbuscular mycorrhizal fungi can increase the ability of plants to take up nutrients (N, K, Mg, Ca, O, H, C, and S), especially the P element (Zuroidah, 2011).

4. Conclusions

The following conclusions can be drawn from the results of this study. The application of 22.5 ml/l of eco-enzyme on inceptisol soil can increase the height, number of leaves, and root weight of sacha inchi plants. The single application of 40 g/plant of mycofer is the best dose for increasing plant vegetative growth in almost all parameters observed. The optimum results in the parameters of number of leaves, root fresh weight, and root dry weight at the plant age of 40 DAP were obtained through the treatment interaction of 22.5 ml of eco-enzyme + 40 g/plant of mycofer.

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