[MICoMS] Editorial Decision on Paper

Kotak Masuk ×

Rizka Mulyawan <ocs@unimal.ac.id>
kepada saya ▾

Rab, 30 Nov 2022, 09.29

Inggris ▾ > Indonesia ▾ Terjemahkan pesan — Nonaktifkan untuk: Inggris ×

ROSNINA A.G/000-00028413-6364 Rosnina A.G A.G:

Congratulations, your submission The Important Roles of Eco-Mychorizae in The Growth of Sugarcane (Saccharum Officinarum) and Sacha Inchi (Plukenetia Volubilis L.) That Potentially as Raw Material of Biofuel has been accepted for presentation at Malikussaleh International Conference on Multidisciplinary Studies (MICoMS) which is being held 2022-12-01 at Lhokseumawe.

Please follow these link for payment:

1. https://ocs.unimal.ac.id/micoms/micoms3rd/schedConf/registration
2. https://forms.gle/c9wLWQ6LC55sSw8p9

Thank you and looking forward to your participation in this event.
Rizka Mulyawan
Chemical Engineering Department
Engineering Faculty
Universitas Malikussaleh
rmulyawan@unimal.ac.id
micoms2022@unimal.ac.id
Malikussaleh International Conference on Multidisciplinary Studies (MICoMS 2017) Malikussaleh International Conference on Multidisciplinary Studies 2022
https://ocs.unimal.ac.id/micoms/micoms3rd/index

5 dari 6

[MICoMS] Editorial Decision on Paper

Kotak Masuk ×

Sisca Olivia <ocs@unimal.ac.id>
kepada saya ▾

28 Des 2022, 12.49

Inggris ▾ > Indonesia ▾ Terjemahkan pesan — Nonaktifkan untuk: Inggris ×

ROSNINA A.G/000-00028413-6364 Rosnina A.G A.G:

After a careful review of your submission, "The Important Roles of Eco-Mychorizae in The Growth of Sugarcane (Saccharum Officinarum) and Sacha Inchi (Plukenetia Volubilis L.) That Potentially as Raw Material of Biofuel" will be considered for Book of Proceeding Malikussaleh International Conference on Multidisciplinary Studies (MICoMS) if the following revisions are successfully implemented.

The reviewers comments:
- Revisions Required
- Inappropriate manuscript template
- You cannot display data in a two-way table. use one-way tables to compare them as a whole (according to the discussion), or just use lowercase notation, obtained from the software
- It must be in accordance between the introduction, objectives, methods, results and conclusions
- Please use the article template

Please find the attached files.
Thank you and looking forward for your article.

Sisca Olivia
Universitas Malikussaleh
sisca.olivia@unimal.ac.id
micoms2022@unimal.ac.id
Malikussaleh International Conference on Multidisciplinary Studies (MICoMS 2017) Malikussaleh International Conference on Multidisciplinary Studies 2022
https://ocs.unimal.ac.id/micoms/micoms3rd/index

THE IMPORTANT ROLES OF ECO-MYCHORIZAE IN THE GROWTH OF SUGARCANE (*Saccharum officinarum*) AND SACHA INCHI (*Plukenetia volubilis* L.) THAT POTENTIALLY AS RAW MATERIAL of BIOFUEL

Commented [T1]: Eco-Enzyme and Micofer..? see the method

Commented [T2]: ??? see the method

THE IMPORTANT ROLES OF ECO-MYCHORIZAE IN THE GROWTH OF SUGARCANE (*Saccharum officinarum*) AND SACHA INCHI (*Plukenetia volubilis* L.) THAT POTENTIALLY AS RAW MATERIAL of BIOFUEL

Rosnina AG[1]*), Zurrahmi Wirda[2], Khaidir[3], M. Hadid Al Hafizh[4,] A.Salim[5], Nurul Rizka Ananda[6]
[1]Agroecotechnology Study Program, Faculty of Agriculture, Malikussaleh University, North Aceh
*Correspondhing Author : rosnina@unimal.ac.id

ABSTRACT

Recently, many alternative fuels have been developed from plant residues containing cellulose and lignin. This study aims to determine the important role of *eco-enzyme* and mycorrhiza in increasing the growth rate of sugar cane and sacha inchi on marginal land. Both of these types of plants are broadleaf plants with high ligine content so they have the potential to produce biofuels and are tolerant to be cultivated on marginal lands. The application *eco-enzyme* on inceptisols increased the vegetative growth of plants at 10 and 20 HST, and the number of leaves at 30 and 40 HST. Giving mycorrhizae at a dose of 40 g/plant can increase the absorption of some macro nutrients so that it can increase the growth of plant length, number of leaves, root fresh weight, root dry weight and root length of Sacha inchi plants on Inceptisol soil which is classified as marginal land. There was an interaction between the administration of 22.5 ml/l ecoenzyme and 40 g mycorrhiza which affected the number of leaves and root length of sacha inchi 40 HST. The application of eco-enzymes and mycorrhiza to sugarcane nurseries with the bud-chip system accelerated the growth of sugarcane bud-chips, while in untreated inceptisol soils the growth was very slow. At the beginning of growth there was no difference in the growth rate of the seedlings, but plant height at 4 WAP was the highest growth rate when mycorrhizal 7.5 g/plant applied (data not published). Eco-enzymes contain microorganisms that help the process of decomposition, transport of nutrients, and mycorrhizae as biofertilizers that can provide nutrients for plants. Both of these materials do very well in increasing crop yields and marginal land productivity.

Commented [T3]: it must past tense

Commented [T4]: ?

Commented [T5]: not in accordance with the results of research and conclusions

Keywords: *Eco-enzyme*, growth-rate, mycorrhizae,

ABSTRACT

Commented [T6]: check contents...! must be in accordance between the introduction, objectives, methods, results and conclusions

Recently, many alternative fuels have been developed from plant residues containing cellulose and lignin. This study aims to determine the important role of *eco-enzyme* and mycorrhiza in increasing the growth rate of sugar cane and sacha inchi on marginal land. Both of these types of plants are broadleaf plants with high ligine content so they have the potential to produce biofuels and are tolerant to be cultivated on marginal lands. The application *eco-enzyme* on inceptisols increased the vegetative growth of plants at 10 and 20 HST, and the number of leaves at 30 and 40 HST. Giving mycorrhizae at a dose of 40 g/plant can increase the absorption of some macro nutrients so that it can increase the growth of plant length, number of leaves, root fresh weight, root dry weight and root length of Sacha inchi plants on Inceptisol soil which is classified as marginal land. There was an interaction between the administration of 22.5 ml/l ecoenzyme and 40 g mycorrhiza which affected the number of leaves and root length of sacha inchi 40 HST. The application of eco-enzymes and mycorrhiza to sugarcane nurseries with the bud-chip system accelerated the growth of sugarcane bud-chips, while in untreated inceptisol soils the growth was very slow. At the beginning of growth there was no difference in the growth rate of the seedlings, but plant height at 4 WAP was the highest growth rate when mycorrhizal 7.5 g/plant applied (data not published). Eco-enzymes contain microorganisms that help the process of decomposition, transport of nutrients, and mycorrhizae as biofertilizers that can provide nutrients for plants. Both of these materials do very well in increasing crop yields and marginal land productivity.

Keywords: *Eco-enzyme*, growth-rate, mycorrhizae,

PENDAHULUAN

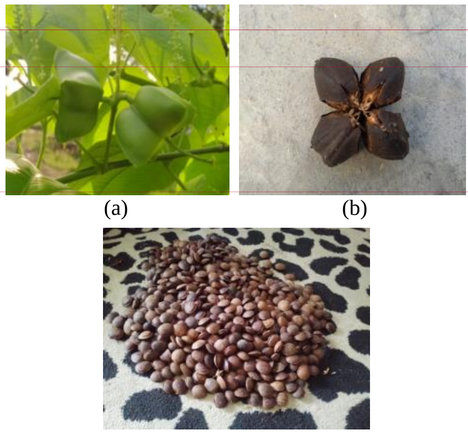
Sugarcane is a broadleaf plant that contains high fiber and lignin. Plant It has a high sucrose content. The high sucrose content causes sugarcane into sugar-producing plants (Rokhman *et al.*, 2014). The rest of processed sugarcane produces waste waste sugarcane which has the potential as a producer of biofuels.

Advances in innovation on planting sugar cane by using a seed called a *bud chips*. These seeds have a lighter mass so as to suppress the weight of the seed 80% and reduce production costs 16.7-20% as well as quickly produce (Djumali *et al.*, 2017). Superiority sugarcane seeds *bud chips* are at the time of *bud chips* transferred to the field, sugar cane is able to form tillers 10–15 tillers so can improve sugarcane productivity. Processing improvements Sugarcane can emit a lot of waste and requires handling R3 (re-use, reduce and recycle). One of them is by recycling as an ingredient in the manufacture of bioethanol.

Preliminary study of bioethanol production in stages namely; *pretreatment*, hydrolysis, fermentation, distillation. Hydrolysis of bagasse serves as a phase to convert complex sugars into simple sugars and is followed by an aerobic fermentation stage. Biological fermentation assisted by white rot fungi /*white rot fungi* as much as 7.4 g has not been able to produce bioethanol (unblished). The distillation results remain clear in color. It is suspected that the number of rot fungi cannot work optimally in relatively low pH conditions.

Other potential commodities produce waste containing high lignin is the Sacha inchi plant (*Plukenetia volubilis*), sacha beans originating from Peru (Hidalgo *et al.,* 2019), is now being widely cultivated. Plant this is a broad leaf included into the Euphorbiaceae family (Nisa *et al.*, 2017). *Plunetia volubilis* is a woody vine produce seeds with high protein content (27–30%) and oil (40–60%), exceed quality characteristics of the oil consumed in around the world (Cai *et al.*, 2013). Plant specialty Sacha inchi is the content of unsaturated fatty acids which is rich in omega-3 by 48.61%, higher compared to other plants. According to Hamaker et al. (1992), sacha inchi has many nutrients very beneficial for the body because it contains omega 3 45.2%, omega 6 36.8%, omega 9 9.6%, and 7.7% saturated fat.

The sacha-inchi plant is a plant that is not widely known by many people. To get a glimpse of the sacha-inchi plant, you can see some pictures of the sacha inchi plant which is loaded in Figure 1.



(a) (b) (c)

Figure 1. (a) immature sacha inchi fruit, (b) ripe sacha inchi fruit, and (c) sacha inchi plant seeds Courtesy by M. Hadid Al Hafizh

Both sugarcane and sacha inchi are plants that are tolerant to environmental stress on marginal lands such as the Inceptisol. Reuleut soil type which have low productivity. According to Siswanto & Widowati (2018), the low fertility of inceptisols is caused by low soil organic matter content, acidity, and the lack.

Availability of several macro elements in the soil. To improve Inceptisol soil can be done by adding organic matter and biological fertilizers such as the use of *eco*-enzymes and Arbuscular Mycorrhizal Fungi (AMF). *Eco-enzyme* contains the macro elements potassium (K) of 203 mg/l and phosphorus (P) of 21.79 mg/l (Yuliandewi et al., 2018), so that it can improve the characteristics of inceptisol soil.

According to Jaya et al. (2021), *an eco-enzyme* with a concentration of 22.5 ml/liter had a significant effect on the fresh weight of tubers per clump of shallot plants. The content of eco-enzymes besides fertilizing the soil, also facilitates plant growth, stimulates fruiting and improves the quality of fruits and vegetables.

Mycorrhizal is a form of mutualism symbiosis between AMF hyphae and plant root systems, so that it can help the availability and absorption of plant nutrients, and plant yields. According to Sufardi (2012), mycorrhizal colonization expands the root zone up to 80 times, thus increasing the absorption rate of nutrients to four times compared to normal roots.

Marwani *et al.* (2013), stated that the application of mycorrhizal 30 g/plant increased the absorption of elements N, P, K, Mg and Ca so that it

Commented [T7]: ?

Commented [T8]: check contents...! must be in accordance between the introduction, objectives, methods, results and conclusions

Commented [T9]: ? sacha inchi !

Commented [T10]:

Commented [T11]:

significantly affected plant height, stem diameter, and oil content of jatropha curcas.

The use of eco-enzymes and mycorrhizae gave a positive response to the improvement of inceptisol soil characteristics which can be seen in the increase in the vegetative growth rate of sugar cane and sacha inchi.

RESEARCH METHODS

Place and Time

This research was conducted in West Reuleut Village, Muara Batu District, North Aceh District and the Laboratory of the Faculty of Agriculture, Malikussaleh University. This research was conducted from April to August 2022.

Materials and Equipment

The materials used for this research were sacha inchi plant seeds, top soil, water, shallots, cow manure, NPK fertilizer, roasted husks, rice husks, wood pulp which had been crushed, sand, eco-enzyme, micophere (material containing mycorrhizal spores) with 99 spores/100 g micopheres containing spores (*Glomus claroideum, Acaulospora rogusa, Acaulospora colosica, Glomus fasciculatum, Glomus mosseae, dan Glomus etunicatum*), distilled water, *potassium hydroxide* 10% *hydrochloric acid* , and *methylene blue* 0.02%The tools used in this study were agricultural tools, paranet 80%, scissors, oven, digital scales, plastic bags, 2 m markers, and stationery.

Experimental design

Study used a factorial randomized block design with two treatment factors, namely *eco-enzyme* (E) concentration *of eco-enzyme* (E) consisting of 3 levels, namely: E0 (0 ml/l), E1 (22.5 ml/l), E2 (30 ml/l) F and micofer (M) namely: M0 (0 g/plant), M1 (30 g/plant), M2 (40 g/plant). Thus there are 9 treatment combinations with 3 repetitions so there are 9 x 3 = 27 experimental units. Then in each bed there were 6 research plants, so that a total of 27 x 6 = 162 plants was obtained.

The implementation of this research consisted of making *eco-enzymes,* sowing seeds, preparing land, cultivating soil, making beds, installing stakes, planting, applying mikofers, applying fertilizers *eco enzymes,* maintenance. While the parameters observed in this study were Plant Length (cm), Number of Leaves (strands), Root Length (cm), Root Fresh Weight (g), Root Dry Weight (g) and Mycorrhizal Infection (%).

Commented [T12]: variables

RESULTS AND DISCUSSION

Plant length (cm)

The concentration *eco-enzyme* alone showed a very significant effect at the age of 10 and 20 DAP. The concentration of E1 produced the best plant length, which was 66.14 cm, which was significantly different from E0 (control). Single dose of micofer showed a very significant effect at each age on plant length variables, namely at the age of 10, 20, 30, 40, 50, and 60 DAP. The M2 dose produced the best plant length, which was 284.44 cm, which was significantly different from M0 (control) (Table 1).

Table 1. Plant length as a result of *eco-enzyme* concentration and mycorrhizal dose treatment.

Treatments	Plant length (cm)					
	10 HST	20 HST	30 HST	40 HST	50 HST	60 HST
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
Mycorrhizal (M)						
M0 (0 g/plants)	43.40 b	47.00 b	59.65 b	9165 b	151.28 b	203.67 b
M1 (30 g/plants)	56.59 a	61.17 a	80.07 a	132.33 a	197.56 a	268.67 a
M2 (40 g/plants)	65.04 a	70.53 a	96.18 a	145.51 a	233.94 a	284.44 a

Note: The numbers followed by the same letter in the same column are not significantly different according to the DMRT 5% test

Number of Leaves (sheets)

There was a significant interaction between the concentration of *eco enzyme* and the dose of mikofer on the number of leaves aged 40 DAP. The best number of leaves was obtained in the E1M2 treatment interaction (22.5 ml/l *eco-enzyme* + 40 g/microfer plant) with an average number of leaves of 61.00, while the lowest number of leaves was in the E0M0 (0 ml/l *eco -enzyme* + 0 g/micoffer plant) with an average of 14.22 strands (Table 2).

The concentration *of eco-enzyme* alone showed a significant effect at the age of 30 and 40 DAP. The E1 concentration produced the best number of leaves, namely 32.85 and 50.81 leaves, which was significantly different from E0 (control) with an average number of leaves of 24.37 and 39.37 leaves. A single dose of micofer showed a significant to very significant effect on the number of leaves at 10, 20, 30, 40, and 50 DAP. The M2 dose produced the best number of leaves, namely 84.07, which was significantly different from M0 (control) with 54.29 leaves (Table 3).

Commented [T13]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T14]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Pictures of the sacha inchi plant and the leaves of the sacha inchi plant can be seen in Figure 2 below

(a) (b)

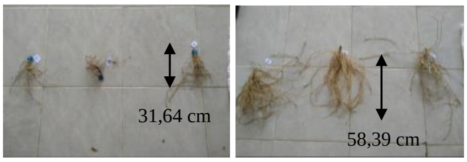
Figure 2. (a) sacha inch plant, (b) sacha inchi plant leaves

Root Length (cm)

There was a significant interaction between the concentration of eco-enzyme and the dose of mikofer on root length variables. The best root length was obtained in the E1M2 treatment interaction with an average root length of 58.39 cm, while the lowest number of leaves was in the E0M0 treatment interaction with an average root length of 31.64 cm (Table 4).

The concentration *eco-enzyme* alone did not show a significant effect on root length variables. E2 concentration produced the best root length, which was 51.55 cm which was significantly different from E0 (control) with an average root length of 26.25 cm. Micofer dose alone showed a significant effect on root length variables. The M2 dose produced the best root length, which was 55.30 cm, which was significantly different from M0 (control) with a root length of 44.16 cm (Table 5).

Pictures of root length due to mycorrhizal colonization and in the absence of mycorrhizal colonization can be seen in Figure 3.



(a) (b)

Figure 3. (a) roots without mycorrhizal colonization, (b) roots with mycorrhizal colonization 40 g/plants mycorrhizal

Fresh Weight of Roots (g)

There was a significant interaction between the concentration of eco-enzyme and the dose of micoferre on the root fresh weight variable. The best root fresh weight was obtained in the E0M2 treatment interaction with an average root fresh weight of 44.52 g, while the lowest fresh weight was in the E0M0 treatment interaction with an average root fresh weight of 7.47 g (Table 6).

The concentration *of eco-enzymes* alone did not show a significant effect on root fresh weight variables. E2 concentration produced the best root fresh weight, namely 35.24 g, which was significantly different from E1 with an average root length of 29.61 g. Mikofer dose alone showed a significant effect on root fresh weight variables. The M2 dose produced the best root fresh weight of 39.56 g which was significantly different from M0 (control) with a root fresh weight of 20.63 g (Table 7).

Root dry weight (g)

There was a significant interaction between the concentration of eco-enzyme and the dose of micofer on the root dry weight variable. The best root dry weight was obtained in the E0M2 treatment interaction with an average root dry weight of 11.96 g, while the lowest fresh weight was in the E0M0 treatment interaction with an average root fresh weight of 2.06 g (Table 6).

The concentration *eco-enzyme* alone did not show a significant effect on root dry weight variables. The concentration of E1 produced the best root fresh weight, which was 8.57 g, which was significantly different from E0 with an average root dry weight of 7.86 g. Mikofer dose alone showed a significant effect on root fresh weight variables. The M2 dose produced the best root dry weight, which was 9.96 g, which was significantly different from M0 (control) with a root fresh weight of 5.81 g (Table 7).

Mycorrhizal Infection (%)

The concentration *of eco-enzyme* alone did not show a significant effect on mycorrhizal infection variables. E1 concentration resulted in the highest mycorrhizal infection with 50.00% infection and the lowest value at E0 with 45.55% infection. A single dose of micofer has shown a significant effect on mycorrhizal colonization in sacha inchi roots (see Fig. 4).

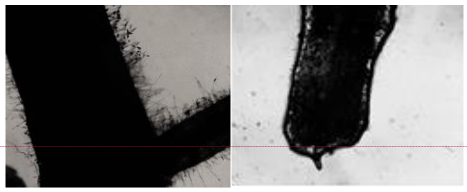


Figure 4. A.Colonization B. No Colonization

Application of AMF 40g/plant resulted in the highest mycorrhizal colonization of 64.44% which was classified as an infection, which was significantly different from M0 (control) with an

Deleted: Courtesy by M. Hadid Al Hafizh

Deleted: ¶

Commented [T19]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T16]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T20]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T17]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Deleted: Courtesi by M. Hadid Al Hafizh¶

Deleted: Courtesi by M. Hadid Al Hafizh¶

Commented [T18]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole infection rate of 18.88% (Table 7).

Table 2. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Variable Number of Leaves 40 DAP.

Eco-enzyme	**Mycorrhizal (M)**		
	M_0 (0 g/tanaman)	M_1 (30 g/tanaman)	M_2 (40 g/tanaman)
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

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T21]: present data in one-way tables or just use lowercase notation, obtained from the software

Commented [T22]: only column???

Table 3. The number of leaves due to the treatment of eco-enzyme concentrations and mycorrhizal doses.

Treatments	**The number of leaves (Sheets)**					
	10 HST	20 HST	30 HST	40 HST	50 HST	60 HST
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
Mycorrhizal (M)						
M0 (0 g/tnm)	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/tnm)	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/tnm)	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

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Table 4. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Root Length Variables.

Eco-enzyme	**Mycorrhizal (M)**		
	M_0 (0 g/tanaman)	M_1 (30 g/tanaman)	M_2 (40 g/tanaman)
E_0	31.64 (5.64) b	53.22 (7.32) a	53.90 (7.37) a
(0 ml/l)	C	A	B
E_1	46.05 (6.80) b	45.12 (6.75) b	58.39 (7.66) a
(22,5 ml/l)	B	B	A
E_2	54.79 (7.40) a	46.25 (6.82) b	53.62 (7.35) a
(30 ml/l)	A	B	B

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T23]: the same comments as Table 2

Commented [T24]:

Table 5. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Root Fresh Weight Variables.

Eco-enzyme	**Mycorrhizal (M)**		
	M_0 (0 g/tanaman)	M_1 (30 g/tanaman)	M_2 (40 g/tanaman)
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

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T25]: the same comments as Table 2

Commented [T26]:

Table 6. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Root Dry Weight Variables.

Commented [T27]: the same comments as Table 2

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

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T28]:

Table 7. Root length, root fresh weight, root dry weight and mycorrhizal infection due to treatment of eco-enzyme concentrations and mycorrhizal doses.

Treatments	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
Mycorrhizal (M)				
M0 (0 g/tnm)	44.16 (6.68) b	20.63 (4.40) b	5.81 (2.41) b	18.88 b
M1 (30 g/tnm)	48.19 (6.87) ab	33.13 (5.75) a	8.66 (3.01) a	60.00 a
M2 (40 g/tnm)	55.30 (7.23) a	39.56 (6.30) a	9.96 (3.19) a	64.44 a

Note: The numbers followed by the same letter in the same column and line are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T29]:

DISCUSSION

Giving mycorrhiza as much as 5 g/plant shows a significant difference in the number of roots in cuttings of patchouli plants (Bancin, 2019). The results of Pratama *et al*. (2019) showed that the treatment of arbuscular mycorrhizal fungi (AMF) 10 g/plant had the best effect on the number of leaves of red bean plants aged 35, 40 and 45 days after planting, leaf area, plant dry weight, number of seeds per plant and seed yield. wet per plot.

Giving *eco-enzyme* 22.5 ml/l affects the length of sacha inchi plants. This is presumably because *eco-enzymes* contain the macro elements potassium (K) and phosphorus (P). Yuliandewi *et al.,* (2018), stated that *eco-enzyme* contains potassium (K) of 203 mg/l and phosphorus (P) of 21.79 mg/l.

Element K functions to increase the rate of photosynthesis so that it can increase the photosynthate content in plants (Rahmawan *et al.,* 2019). According to Nurhayati (2021), element K is essential in photosynthesis because it is involved in ATP synthesis, production in the activity of photosynthetic enzymes (such as RuBP carboxylase), CO2 absorption through the mouth of the leaf, and maintaining electrical balance during photophosphorylation in the chloroplast. *Eco-enzymes* also contain phosphorus, Safrizal (2014), said that phosphorus plays an important role in photosynthetic activity, because it is related to carbohydrate content as a source of energy for plant growth and development.

The increase in the number of leaves in the administration of *eco enzyme* had a significant effect. This is thought to be caused because the growth in the number of leaves is part of vegetative growth, where elements such as N, P, and K have very important roles for plants, such as P and K elements which function in the process of differentiation, division and enlargement of plant cells (Yoga, 2022). So that by fulfilling the needs of the nutrients needed by plants makes plant growth more optimal.

Mycorrhizal treatment showed a very significant effect on all the variables of plant length and number of leaves. This is because in plants infected with mycorrhiza there are hyphae which function as absorbers of nutrients such as phosphorus. This is in line with the explanation of Bussa *et al.,* (2019), that the main function of the hyphae in mycorrhizal fungi is to absorb phosphorus in the soil. Phosphorus in the soil can be absorbed by roots because roots infected by fungal hyphae in mycorrhizae secrete *phosphatase* which are able to release P from specific bonds, making it available to plants (Basri, 2018). The element of phosphorus that is absorbed optimally can result in better plant growth and development.

Root length showed a significant effect due to micopher. The roots of sacha inchi plants with mycophere treatment were longer than those of the control treatment, this was due to the roots infected with mycopheres resulting in a wider root zone. This is in accordance with Rosnina *et al.,* (2021), that the roots of plants infected with mycorrhizae can expand the root zone so that they can reach the presence of nutrients and increase the absorption of macro nutrients, especially P elements and some micro nutrients. Correlation of the width of the root zone corresponds to the length of the roots of the sacha inchi plant, where the wide root zone will cause the roots of the sacha inchi plant to also have a long size due to mycorrhizal colonization.

There was a very significant difference in root fresh weight after being given a micopherer. It is suspected that the roots infected with mycorrhizae can optimally absorb water for photosynthesis and available nutrients such as N, P, K in the soil. This is in line with the statement of Idris *et al.,* (2018), that the high fresh weight of roots is probably due to the nutrient content and N, P, K content at high doses of the planting medium composition. In addition, due to mycoza infection in sacha inchi plants, it causes an expansion of the root zone on plant roots, a wide root zone causes a larger root size and weight compared to roots that are not infected with mycorrhizal.

The root dry weight variable on mycorrhizal administration had a very significant effect, this could happen that the high root dry weight due to mycorrhizal treatment was caused by sufficient nutrient conditions and metabolic activity that occurred in the sacha inchi plant itself. Idris *et al.,* (2018), stated that metabolic processes and high cell activity will increase root biomass and will affect root dry weight.

Administration of mycorrhizal in this study showed a very significant effect on mycorrhizal infection variables. Besides being able to absorb nutrients, mycorrhizal infection can also make the roots become wider. This is in line with the opinion of Rosnina *et al.,* (2021), that the presence of mycorrhiza can expand the root zone of plants that experience mycorrhizal hyphae colonization so that they can absorb nutrients more optimally, especially bound P nutrients to become available to plants. By optimally absorbing element P, the process of photosynthesis, respiration, transfer, energy storage, cell division and enlargement as well as processes in plants can occur optimally (Dahlia and Setiono, 2020).

The interaction between the concentration of *eco-enzyme* and the dose of micoferine had a very significant effect on the variables of plant fresh weight and plant dry weight. In addition, the *eco-enzyme* significant effect on the number of leaves at 40 HST, stem diameter at 20 and 40 HST, and root length.

It is suspected that the important role of microorganisms in *eco-enzymes* accelerates the decomposition of organic matter and the macro-nutrient content of Phosphorus and Potassium in the soil can be absorbed by external hyphae from plant roots which are colonized by mycorrhizal fungi.

Differences in the number of leaves, root length, fresh weight of roots and dry weight of roots from the interaction of *eco-* enzymes and micopheres on control plants proves that the performance of *eco-enzymes* as a provider of P and K elements and mycorrhizae as fungi that make roots perform better in nutrient absorption and water on marginal land experiencing water and nutrient stress proves its existence in increasing the number of leaves, increasing the size of the stem diameter and root length of the sacha inchi plant.

Plants need nutrients in their growth, these nutrients such as macro nutrients N, P, and K. Plants need these nutrients for the process of plant growth. *Eco-enzyme* itself contains the macro elements potassium (K) of 203 mg/l and phosphorus (P) of 21.79 mg/l (Yuliandewi *et al.,* 2018).

With the presence of microorganisms, nutrients and enzymes contained in *eco-* as a result of the eco-fermentation process of fruit waste, it can increase nutrient uptake optimally. The use of biological agents of arbuscular mycorrhizal fungi can increase the ability of plants to take up nutrients (N, K, Mg, Ca, O, H, C, and S), especially phosphorus (Zuroidah, 2011).

Utilization of organic matter and enzymes as well as the presence of mycorrhizal hyphae can increase the suitability of sub-optimal land into productive land which can increase the quantity and quality of production of sugar cane and sacha inchi which can be raw materials in producing renewable energy.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

- Giving *eco-enzyme* 22.5 ml/l is the optimal dose that can increase the growth rate of sacha inchi plants, namely on Inceptisol soils.
- Giving mikofer 40 g/plant increases plant growth rate, number of leaves, stem diameter, root fresh weight, root dry weight, infection and root length.
- There was an interaction on fresh weight of roots and dry weight of roots, number of leaves 40 DAP, and root length in the treatment.

Commented [T30]: non significant? check !

Commented [T31]: the best treatment?

Recommendation

- The use *of eco-enzymes* in the future must be adjusted to the type of plant and soil used, so that the provision of *eco-enzymes* can affect plant growth and development.
- The use of micofer is recommended to use a dose of 40 g/plant to increase growth in almost all observed variables.

ACKNOWLEDGEMENT

The authors would like to thank Malikussaleh University for grant No 11/UN45.3.8/HK.02.03/2022
Proyek Advanced Knowledge and Skills for Sustainable Growth Project in Indonesia-Asian Development Bank (AKSI-ADB) Universitas Malikussaleh 2022.

REFERENCES

Ahmad, F., Fathurrahman, & Bahrudin. 2016. The Effect of Media and Fertilization Intervals on the Growth of Clove Vigor (*Syzygum aromaticum* L.) *e-Jurnal Mitra Sains*, 4(4), 36-47.

Basri, AHH 2018. Study of the Role of Mycorrhiza in Agriculture. *Agrica Extensiona, 12*(2), 74-78.

Bussa, LO, Putra, NLS, and Hanum, F. 2019. Effect of Mycorrhizal Application Time on Growth and Yield of Cucumber (*Cucumis sativus* L.) Variety Harmony. *Agrimeta*, 9(17), 36-40.

Cai, Z., Jiao, D., Lei, Y., Xiang, M., & Li, W. 2013. Growth and Yield Responses of *Plukenetia volubilis* L. Plants to Planting Density. *The Journal of Horticultural Science and Biotechnology, 88*(4), 421-426.

Dahlia, I., and Setiono. 2020. Effect of Dolomite + Sp-36 Combination with Different Doses on Growth and Yield of Soybean (*Glycine max* L. Merrill) in Ultisol. *Journal of Agro Science*, 5(1), 1-9.

Hamaker, B., Valles, C., Gilman, R., Hardmeier, R., Clark, D., Garcia, H., Valdivia, R. 1992. Amino acid and fatty acid profiles of the Inca peanut (*Plukenetia volubilis*) . *Cereal Chem, 69*(4), 461- 463.

Hidalgo, LER, Rogel, CJV, Berneo SMB 2019. Caracterización Del Aceite De La Semilla De Sacha Inchi (*Plukenetia volubilis*) Del Cantón San Vicente, Manabí, Ecuador, Obtenida Mediante Procesos No Termicos De Extrusion. *LA GRANJA: Revista de Ciencias de la Vida 30*(2): 77-87.

Idris, Rahayu, E. & Firmansyah, E. 2018. Effect of Planting Media Composition and Water Volume on Oil Palm Seedling Growth in Main-Nursery. *Agromast*. 3(2), 1-24.

Jaya, ER, Situmeang, YP, & Andriani, AASPR 2021. Effect of Biochar from Urban Waste and Eco-enzymes on Growth and Yield of Shallots (*Allium ascalonicum*, L). *SEAS (Sustainable Environment Agricultural Science), 5*(2), 105-113.

Nisa, K., Wijayanti, R., & Muliawati, ES 2017. Arthropod Diversity in Sacha Inchi in Dry Land. *Journal of Sustainable Agriculture, 32*(2), 132-141.
Nisa, K., Wijayanti, R., & Muliawati, ES 2017. Arthropod Diversity in Sacha Inchi in Dry Land. *Journal of Sustainable Agriculture, 32*(2), 132-141.

Nurhayati, DR 2021. *Introduction to Plant Nutrition*. Surakarta. Unisri Press.

Pazmiño, LLB 2013. *Elaboración de una barra energética a base de Sacha Inchi (Plukenetia volubilis) como fuente de omega 3 y 6* (Unpublished thesis). Quito: Universidad San Francisco de Quito.

Rahmawan, IS, Arifin, AZ, and Sulistyawati. 2019. The Effect of Potassium (K) Fertilization on the Growth and Yield of Cabbage (*Brassica oleraceae* var. capitata, L.). *Journal of Agrotechnology Merdeka Pasuruan*, 3(1), 17-23.

Rosnina, AG, Syafani, A., Supraja, A., Ardiyanti, B. 2021. Effects of the Combination of Biochar and Mycorrhiza on the Growth of Purple Pulut Corn (*Zea mays* L. var ceratina Kulesh) in Inceptisol Reuleut soil. *Agriprima,* 5(1), 34-40.

Safrizal. 2014. Effect of Phosphorus Nutrient on Tissue Phosphorus Nutrient Status, Production and Quality of Mangosteen Fruit (*Garcinia mangostana* L.). *J. Floratek* 9, 22 – 28.

Siswanto, B., & Widowati. 2018. The Effect of Seaweed Agar-Agar Industrial Waste on Soil Chemical Properties and Corn Plant Growth in Inceptisols, Pandaan Pasuruan District. *Buana Science,* 18 (1), 57-66.

Sufardi. 2012. *Introduction to Plant Nutrition*. Banda Aceh. Shia Kuala University Press.

Suharno, & Sancayaningsih, RP 2013. Arbuscular Mycorrhizal Fungi: Potential of Heavy Metal Mycorizoremediation Technology in Mining Land Rehabilitation. *Biotechnology,* 10(1), 37-48.

Yoga, AP 2022. The*Influence of Eco-Enzyme and Vermicompost on the Growth and Yield of Celery* (*Apium graveolens* L.). Thesis (unpublished). Pekanbaru. Riau Islamic University.

Yuliandewi, NW, Sukerta, IM, Wiswasta, IGN. A. 2018. Utilization of Organic Garbage as "Eco Garbage Enzyme" for Lettuce Plant Growth (*Lactuca sativa* L.). *International Journal of Science and Research (IJSR), 7*(2), 1521-1525.

Zuroidah, IR, 2011. *Effect of Arbuscular*

Commented [T32]: see manuscript template

Mycorrhizal Fungi (CMA) on Leaf Anatomical Characteristics and Levels of Koro Sword Bean Plants (*Canavalia ensiformis* L.). Biology Study Program, Faculty of Science and Biology. Surabaya. Airlangga University.

PAPER NAME

1070-1902-1-RV.doc

WORD COUNT	CHARACTER COUNT
5450 Words	27836 Characters
PAGE COUNT	FILE SIZE
8 Pages	5.9MB
SUBMISSION DATE	REPORT DATE
Dec 27, 2022 3:17 PM GMT+7	Dec 27, 2022 3:18 PM GMT+7

14% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 12% Internet database
- 4% Publications database
- Crossref database
- Crossref Posted Content database
- 8% Submitted Works database

Excluded from Similarity Report

- Bibliographic material
- Quoted material
- Cited material
- Small Matches (Less then 8 words)

THE IMPORTANT ROLES OF ECO-MYCHORIZAE IN THE GROWTH OF SUGARCANE (*Saccharum officinarum*) AND SACHA INCHI (*Plukenetia volubilis* L.) THAT POTENTIALLY AS RAW MATERIAL of BIOFUEL

THE IMPORTANT ROLES OF ECO-MYCHORIZAE IN THE GROWTH OF SUGARCANE (*Saccharum officinarum*) AND SACHA INCHI (*Plukenetia volubilis* L.) THAT POTENTIALLY AS RAW MATERIAL of BIOFUEL

Rosnina AG[1]*), Zurrahmi Wirda[2], Khaidir[3], M. Hadid Al Hafizh[4], A.Salim[5], Nurul Rizka Ananda[6]
[1]Agroecotechnology Study Program, Faculty of Agriculture, Malikussaleh University, North Aceh
*Correspondhing Author : rosnina@unimal.ac.id

ABSTRACT

Recently, many alternative fuels have been developed from plant residues containing cellulose and lignin. This study aims to determine the important role of *eco-enzyme* and mycorrhiza in increasing the growth rate of sugar cane and sacha inchi on marginal land. Both of these types of plants are broadleaf plants with high ligine content so they have the potential to produce biofuels and are tolerant to be cultivated on marginal lands. The application *eco-enzyme* on inceptisols increased the vegetative growth of plants at 10 and 20 HST, and the number of leaves at 30 and 40 HST. Giving mycorrhizae at a dose of 40 g/plant can increase the absorption of some macro nutrients so that it can increase the growth of plant length, number of leaves, root fresh weight, root dry weight and root length of Sacha inchi plants on Inceptisol soil which is classified as marginal land. There was an interaction between the administration of 22.5 ml/l ecoenzyme and 40 g mycorrhiza which affected the number of leaves and root length of sacha inchi 40 HST. The application of eco-enzymes and mycorrhiza to sugarcane nurseries with the bud-chip system accelerated the growth of sugarcane bud-chips, while in untreated inceptisol soils the growth was very slow. At the beginning of growth there was no difference in the growth rate of the seedlings, but plant height at 4 WAP was the highest growth rate when mycorrhizal 7.5 g/plant applied (data not published). Eco-enzymes contain microorganisms that help the process of decomposition, transport of nutrients, and mycorrhizae as biofertilizers that can provide nutrients for plants. Both of these materials do very well in increasing crop yields and marginal land productivity.

Keywords: *Eco-enzyme*, growth-rate, mycorrhizae,

ABSTRACT

Recently, many alternative fuels have been developed from plant residues containing cellulose and lignin. This study aims to determine the important role of *eco-enzyme* and mycorrhiza in increasing the growth rate of sugar cane and sacha inchi on marginal land. Both of these types of plants are broadleaf plants with high ligine content so they have the potential to produce biofuels and are tolerant to be cultivated on marginal lands. The application *eco-enzyme* on inceptisols increased the vegetative growth of plants at 10 and 20 HST, and the number of leaves at 30 and 40 HST. Giving mycorrhizae at a dose of 40 g/plant can increase the absorption of some macro nutrients so that it can increase the growth of plant length, number of leaves, root fresh weight, root dry weight and root length of Sacha inchi plants on Inceptisol soil which is classified as marginal land. There was an interaction between the administration of 22.5 ml/l ecoenzyme and 40 g mycorrhiza which affected the number of leaves and root length of sacha inchi 40 HST. The application of eco-enzymes and mycorrhiza to sugarcane nurseries with the bud-chip system accelerated the growth of sugarcane bud-chips, while in untreated inceptisol soils the growth was very slow. At the beginning of growth there was no difference in the growth rate of the seedlings, but plant height at 4 WAP was the highest growth rate when mycorrhizal 7.5 g/plant applied (data not published). Eco-enzymes contain microorganisms that help the process of decomposition, transport of nutrients, and mycorrhizae as biofertilizers that can provide nutrients for plants. Both of these materials do very well in increasing crop yields and marginal land productivity.

Keywords: *Eco-enzyme*, growth-rate, mycorrhizae,

Commented [T1]: Eco-Enzyme and Micofer..? see the method

Commented [T2]: ??? see the method

Commented [T3]: it must past tense

Commented [T4]: ?

Commented [T5]: not in accordance with the results of research and conclusions

Commented [T6]: check contents...! must be in accordance between the introduction, objectives, methods, results and conclusions

PENDAHULUAN

Sugarcane is a broadleaf plant that contains high fiber and lignin. Plant It has a high sucrose content. The high sucrose content causes sugarcane into sugar-producing plants (Rokhman *et al.*, 2014). The rest of processed sugarcane produces waste waste sugarcane which has the potential as a producer of biofuels.

Advances in innovation on planting sugar cane by using a seed called a *bud chips*. These seeds have a lighter mass so as to suppress the weight of the seed 80% and reduce production costs 16.7-20% as well as quickly produce (Djumali *et al.*, 2017). Superiority sugarcane seeds *bud chips* are at the time of *bud chips* transferred to the field, sugar cane is able to form tillers 10–15 tillers so can improve sugarcane productivity. Processing improvements Sugarcane can emit a lot of waste and requires handling R3 (re-use, reduce and recycle). One of them is by recycling as an ingredient in the manufacture of bioethanol.

Preliminary study of bioethanol production in stages namely; *pretreatment*, hydrolysis, fermentation, distillation. Hydrolysis of bagasse serves as a phase to convert complex sugars into simple sugars and is followed by an aerobic fermentation stage. Biological fermentation assisted by white rot fungi /*white rot fungi* as much as 7.4 g has not been able to produce bioethanol (unblished). The distillation results remain clear in color. It is suspected that the number of rot fungi cannot work optimally in relatively low pH conditions.

Other potential commodities produce waste containing high lignin is the Sacha inchi plant (*Plukenetia volubilis*), sacha beans originating from Peru (Hidalgo *et al.,* 2019), is now being widely cultivated. Plant this is a broad leaf included into the Euphorbiaceae family (Nisa *et al.*, 2017). *Plunetia volubilis* is a woody vine produce seeds with high protein content (27–30%) and oil (40–60%), exceed quality characteristics of the oil consumed in around the world (Cai *et al.*, 2013). Plant specialty Sacha inchi is the content of unsaturated fatty acids which is rich in omega-3 by 48.61%, higher compared to other plants. According to Hamaker et al. (1992), sacha inchi has many nutrients very beneficial for the body because it contains omega 3 45.2%, omega 6 36.8%, omega 9 9.6%, and 7.7% saturated fat.

The sacha-inchi plant is a plant that is not widely known by many people. To get a glimpse of the sacha-inchi plant, you can see some pictures of the sacha inchi plant which is loaded in Figure 1.

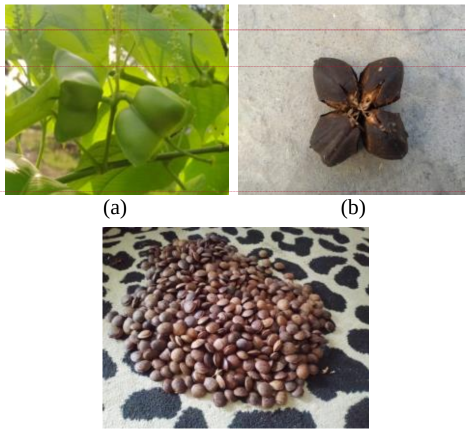


Figure 1. (a) immature sacha inchi fruit, (b) ripe sacha inchi fruit, and (c) sacha inchi plant seeds Courtesy by M. Hadid Al Hafizh

Both sugarcane and sacha inchi are plants that are tolerant to environmental stress on marginal lands such as the Inceptisol. Reuleut soil type which have low productivity. According to Siswanto & Widowati (2018), the low fertility of inceptisols is caused by low soil organic matter content, acidity, and the lack.

Availability of several macro elements in the soil. To improve Inceptisol soil can be done by adding organic matter and biological fertilizers such as the use of *eco*-enzymes and Arbuscular Mycorrhizal Fungi (AMF). *Eco-enzyme* contains the macro elements potassium (K) of 203 mg/l and phosphorus (P) of 21.79 mg/l (Yuliandewi et al., 2018), so that it can improve the characteristics of inceptisol soil.

According to Jaya et al. (2021), *an eco-enzyme* with a concentration of 22.5 ml/liter had a significant effect on the fresh weight of tubers per clump of shallot plants. The content of eco-enzymes besides fertilizing the soil, also facilitates plant growth, stimulates fruiting and improves the quality of fruits and vegetables.

Mycorrhizal is a form of mutualism symbiosis between AMF hyphae and plant root systems, so that it can help the availability and absorption of plant nutrients, and plant yields. According to Sufardi (2012), mycorrhizal colonization expands the root zone up to 80 times, thus increasing the absorption rate of nutrients to four times compared to normal roots.

Marwani *et al.* (2013), stated that the application of mycorrhizal 30 g/plant increased the absorption of elements N, P, K, Mg and Ca so that it

Commented [T7]: ?

Commented [T8]: check contents...! must be in accordance between the introduction, objectives, methods, results and conclusions

Commented [T9]: ? sacha inchi !

Commented [T10]:

Commented [T11]:

significantly affected plant height, stem diameter, and oil content of jatropha curcas.

The use of eco-enzymes and mycorrhizae gave a positive response to the improvement of inceptisol soil characteristics which can be seen in the increase in the vegetative growth rate of sugar cane and sacha inchi.

RESEARCH METHODS

Place and Time

This research was conducted in West Reuleut Village, Muara Batu District, North Aceh District and the Laboratory of the Faculty of Agriculture, Malikussaleh University. This research was conducted from April to August 2022.

Materials and Equipment

The materials used for this research were sacha inchi plant seeds, top soil, water, shallots, cow manure, NPK fertilizer, roasted husks, rice husks, wood pulp which had been crushed, sand, eco-enzyme, micophere (material containing mycorrhizal spores) with 99 spores/100 g micopheres containing spores (*Glomus claroideum, Acaulospora rogusa, Acaulospora colosica, Glomus fasciculatum, Glomus mosseae, dan Glomus etunicatum*), distilled water, *potassium hydroxide* 10% *hydrochloric acid* , and *methylene blue* 0.02%The tools used in this study were agricultural tools, paranet 80%, scissors, oven, digital scales, plastic bags, 2 m markers, and stationery.

Experimental design

This study used a factorial randomized block design with two treatment factors, namely *eco-enzyme* (E) concentration *of eco-enzyme* (E) consisting of 3 levels, namely: E0 (0 ml/l), E1 (22.5 ml/l), E2 (30 ml/l) F and micofer (M) namely M0 (0 g/plant), M1 (30 g/plant), M2 (40 g/plant). Thus there are 9 treatment combinations with 3 repetitions so there are 9 x 3 = 27 experimental units. Then in each bed there were 6 research plants, so that a total of 27 x 6 = 162 plants was obtained.

The implementation of this research consisted of making *eco-enzymes,* sowing seeds, preparing land, cultivating soil, making beds, installing stakes, planting, applying mikofers, applying fertilizers *eco enzymes,* maintenance. While the parameters observed in this study were Plant Length (cm), Number of Leaves (strands), Root Length (cm), Root Fresh Weight (g), Root Dry Weight (g) and Mycorrhizal Infection (%).

RESULTS AND DISCUSSION

Plant length (cm)

The concentration *eco-enzyme* alone showed a very significant effect at the age of 10 and 20 DAP. The concentration of E1 produced the best plant length, which was 66.14 cm, which was significantly different from E0 (control). Single dose of micofer showed a very significant effect at each age on plant length variables, namely at the age of 10, 20, 30, 40, 50, and 60 DAP. The M2 dose produced the best plant length, which was 284.44 cm, which was significantly different from M0 (control) (Table 1).

Table 1. Plant length as a result of *eco-enzyme* concentration and mycorrhizal dose treatment.

Treatments	Plant length (cm)					
	10 HST	20 HST	30 HST	40 HST	50 HST	60 HST
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
Mycorrhizal (M)						
M0 (0 g/plants)	43.40 b	47.00 b	59.65 b	9165 b	151.28 b	203.67 b
M1 (30 g/plants)	56.59 a	61.17 a	80.07 a	132.33 a	197.56 a	268.6[illegible]
M2 (40 g/plants)	65.04 a	70.53 a	96.18 a	145.51 a	233.94 a	284.4[illegible]

Note: The numbers followed by the same letter in the same column are not significantly different according to the DMRT 5% test

Number of Leaves (sheets)

There was a significant interaction between the concentration of *eco enzyme* and the dose of mikofer on the number of leaves aged 40 DAP. The best number of leaves was obtained in the E1M2 treatment interaction (22.5 ml/l *eco-enzyme* + 40 g/microfer plant) with an average number of leaves of 61.00, while the lowest number of leaves was in the E0M0 (0 ml/l *eco -enzyme* + 0 g/micoffer plant) with an average of 14.22 strands (Table 2).

The concentration *of eco-enzyme* alone showed a significant effect at the age of 30 and 40 DAP. The E1 concentration produced the best number of leaves, namely 32.85 and 50.81 leaves, which was significantly different from E0 (control) with an average number of leaves of 24.37 and 39.37 leaves. A single dose of micofer showed a significant to very significant effect on the number of leaves at 10, 20, 30, 40, and 50 DAP. The M2 dose produced the best number of leaves, namely 84.07, which was significantly different from M0 (control) with 54.29 leaves (Table 3).

Commented [T12]: variables

Commented [T[illegible]]: if you want to compare all treatments, you cannot display the[illegible] a two-way table. use one-way tables to compare them as a whole

Commented [T[illegible]]: if you want to compare all treatments, you cannot display the[illegible] a two-way table. use one-way tables to compare them as a whole

Pictures of the sacha inchi plant and the leaves of the sacha inchi plant can be seen in Figure 2 below

(a) (b)

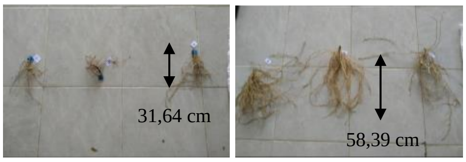
Figure 2. (a) sacha inch plant, (b) sacha inchi plant leaves

~~Courtesy by M. Hadid Al Hafizh~~

There was a significant interaction between the concentration of eco-enzyme and the dose of mikofer on root length variables. The best root length was obtained in the E1M2 treatment interaction with an average root length of 58.39 cm, while the lowest number of leaves was in the E0M0 treatment interaction with an average root length of 31.64 cm (Table 4).

The concentration *eco-enzyme* alone did not show a significant effect on root length variables. E2 concentration produced the best root length, which was 51.55 cm which was significantly different from E0 (control) with an average root length of 26.25 cm. Micofer dose alone showed a significant effect on root length variables. The M2 dose produced the best root length, which was 55.30 cm, which was significantly different from M0 (control) with a root length of 44.16 cm (Table 5).

Pictures of root length due to mycorrhizal colonization and in the absence of mycorrhizal colonization can be seen in Figure 3.



(a) (b)

Figure 3. (a) roots without mycorrhizal colonization, (b) roots with mycorrhizal colonization 40 g/plants mycorrhizal

~~Courtesi by M. Hadid Al Hafizh~~

There was a significant interaction between the concentration of eco-enzyme and the dose of micoferre on the root fresh weight variable. The best root fresh weight was obtained in the E0M2 treatment interaction with an average root fresh weight of 44.52 g, while the lowest fresh weight was in the E0M0 treatment interaction with an average root fresh weight of 7.47 g (Table 6).

The concentration *of eco-enzymes* alone did not show a significant effect on root fresh weight variables. E2 concentration produced the best root fresh weight, namely 35.24 g, which was significantly different from E1 with an average root length of 29.61 g. Mikofer dose alone showed a significant effect on root fresh weight variables. The M2 dose produced the best root fresh weight of 39.56 g which was significantly different from M0 (control) with a root fresh weight of 20.63 g (Table 7).

Root dry weight (g)

There was a significant interaction between the concentration of eco-enzyme and the dose of micofer on the root dry weight variable. The best root dry weight was obtained in the E0M2 treatment interaction with an average root dry weight of 11.96 g, while the lowest fresh weight was in the E0M0 treatment interaction with an average root fresh weight of 2.06 g (Table 6).

The concentration *eco-enzyme* alone did not show a significant effect on root dry weight variables. The concentration of E1 produced the best root fresh weight, which was 8.57 g, which was significantly different from E0 with an average root dry weight of 7.86 g. Mikofer dose alone showed a significant effect on root fresh weight variables. The M2 dose produced the best root dry weight, which was 9.96 g, which was significantly different from M0 (control) with a root fresh weight of 5.81 g (Table 7).

Mycorrhizal Infection (%)

The concentration *of eco-enzyme* alone did not show a significant effect on mycorrhizal infection variables. E1 concentration resulted in the highest mycorrhizal infection with 50.00% infection and the lowest value at E0 with 45.55% infection. A single dose of micofer has shown a significant effect on mycorrhizal colonization in sacha inchi roots (see Fig. 4).

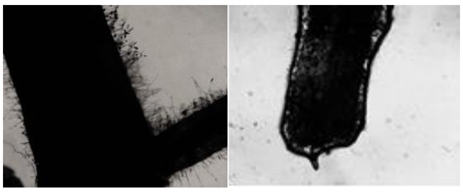


Figure 4. A.Colonization B. No Colonization

~~Courtesi by M. Hadid Al Hafizh~~

Application of AMF 40g/plant resulted in the highest mycorrhizal colonization of 64.44% which was classified as an infection, which was significantly different from M0 (control) with an infection rate of 18.88% (Table 7).

Commented [T15]: this is the research team

Commented [T...]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T...]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T...]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T...]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Commented [T...]: if you want to compare all treatments, you cannot display them in a two-way table. use one-way tables to compare them as a whole

Table 2. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Variable Number of Leaves 40 DAP.

Eco-enzyme	**Mycorrhizal (M)**		
	M_0 (0 g/tanaman)	M_1 (30 g/tanaman)	M_2 (40 g/tanaman)
E_0 (0 ml/l)	14.22 (3.80) c B	44.66 (6.70) b A	59.22 (7.72) a A
E_1 (22,5 ml/l)	43.22 (6.60) bc A	48.22 (6.97) b A	61.00 (7.75) a A
E_2 (30 ml/)	47.11 (6.86) b A	41.66 (6.46) c B	57.67 (7.61) a A

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T21]: present data in one-way tables or just use lowercase notation, obtained from the software

Commented [T22]: only column???

Table 3. The number of leaves due to the treatment of eco-enzyme concentrations and mycorrhizal doses.

Treatments	**The number of leaves (Sheets)**					
	10 HST	20 HST	30 HST	40 HST	50 HST	60 HST
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
Mycorrhizal (M)						
M0 (0 g/tnm)	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/tnm)	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/tnm)	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

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Table 4. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Root Length Variables.

Eco-enzyme	**Mycorrhizal (M)**		
	M_0 (0 g/tanaman)	M_1 (30 g/tanaman)	M_2 (40 g/tanaman)
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

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T23]: the same comments as Table 2

Commented [T24]:

Table 5. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Root Fresh Weight Variables.

Eco-enzyme	**Mycorrhizal (M)**		
	M_0 (0 g/tanaman)	M_1 (30 g/tanaman)	M_2 (40 g/tanaman)
E_0 (0 ml/l)	7.47 (2.74) c B	36.84 (6.08) b A	44.52 (6.69) a A
E_1 (22,5 ml/l)	26.84 (5.22) b A	23.59 (4.90) b B	34.99 (5.93) a B
E_2 (30 ml/l)	(27.57) 5.24 b A	38.97 (6.27) a A	39.16 (6.28) a AB

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T25]: the same comments as Table 2

Commented [T26]:

Table 6. Interaction of Eco-enzyme Concentration and Mycorrhizal Dosage on Root Dry Weight Variables.

Eco-enzyme	**Mycorrhizal (M)**

Commented [T27]: the same comments as Table 2

	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

Note: The numbers followed by the same letter in the same column are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T28]:

Table 7. Root length, root fresh weight, root dry weight and mycorrhizal infection due to treatment of eco-enzyme concentrations and mycorrhizal doses.

Treatments	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
Mycorrhizal (M)				
M0 (0 g/tnm)	44.16 (6.68) b	20.63 (4.40) b	5.81 (2.41) b	18.88 b
M1 (30 g/tnm)	48.19 (6.87) ab	33.13 (5.75) a	8.66 (3.01) a	60.00 a
M2 (40 g/tnm)	55.30 (7.23) a	39.56 (6.30) a	9.96 (3.19) a	64.44 a

Note: The numbers followed by the same letter in the same column and line are not significantly different according to Duncan's multiple range test (UJBD) at the 5% level. The number in brackets is the result of the transformation √ (x + 2).

Commented [T29]:

DISCUSSION

Giving mycorrhiza as much as 5 g/plant shows a significant difference in the number of roots in cuttings of patchouli plants (Bancin, 2019). The results of Pratama *et al*. (2019) showed that the treatment of arbuscular mycorrhizal fungi (AMF) 10 g/plant had the best effect on the number of leaves of red bean plants aged 35, 40 and 45 days after planting, leaf area, plant dry weight, number of seeds per plant and seed yield. wet per plot.

Giving *eco-enzyme* 22.5 ml/l affects the length of sacha inchi plants. This is presumably because *eco-enzymes* contain the macro elements potassium (K) and phosphorus (P). Yuliandewi *et al.,* (2018), stated that *eco-enzyme* contains potassium (K) of 203 mg/l and phosphorus (P) of 21.79 mg/l.

Element K functions to increase the rate of photosynthesis so that it can increase the photosynthate content in plants (Rahmawan *et al.,* 2019). According to Nurhayati (2021), element K is essential in photosynthesis because it is involved in ATP synthesis, production in the activity of photosynthetic enzymes (such as RuBP carboxylase), CO2 absorption through the mouth of the leaf, and maintaining electrical balance during photophosphorylation in the chloroplast. *Eco-enzymes* also contain phosphorus, Safrizal (2014), said that phosphorus plays an important role in photosynthetic activity, because it is related to carbohydrate content as a source of energy for plant growth and development.

The increase in the number of leaves in the administration of *eco enzyme* had a significant effect. This is thought to be caused because the growth in the number of leaves is part of vegetative growth, where elements such as N, P, and K have very important roles for plants, such as P and K elements which function in the process of differentiation, division and enlargement of plant cells (Yoga, 2022). So that by fulfilling the needs of the nutrients needed by plants makes plant growth more optimal.

Mycorrhizal treatment showed a very significant effect on all the variables of plant length and number of leaves. This is because in plants infected with mycorrhiza there are hyphae which function as absorbers of nutrients such as phosphorus. This is in line with the explanation of Bussa *et al.,* (2019), that the main function of the hyphae in mycorrhizal fungi is to absorb phosphorus in the soil. Phosphorus in the soil can be absorbed by roots because roots infected by fungal hyphae in mycorrhizae secrete *phosphatase* which are able to release P from specific bonds, making it available to plants (Basri, 2018). The element of phosphorus that is absorbed optimally can result in better plant growth and development.

Root length showed a significant effect due to micopher. The roots of sacha inchi plants with mycophere treatment were longer than those of the control treatment, this was due to the roots infected with mycopheres resulting in a wider root zone. This is in accordance with Rosnina *et al.,* (2021), that the roots of plants infected with mycorrhizae can expand the root zone so that they can reach the presence of nutrients and increase the absorption of macro nutrients, especially P elements and some micro nutrients. Correlation of the width of the root zone corresponds to the length of the roots of the sacha inchi plant, where the wide root zone will cause the roots of the sacha inchi plant to also have a long size due to mycorrhizal colonization.

There was a very significant difference in root fresh weight after being given a micopherer. It is suspected that the roots infected with mycorrhizae can optimally absorb water for photosynthesis and available nutrients such as N, P, K in the soil. This is in line with the statement of Idris *et al.,* (2018), that the high fresh weight of roots is probably due to the nutrient content and N, P, K content at high doses of the planting medium composition. In addition, due to mycoza infection in sacha inchi plants, it causes an expansion of the root zone on plant roots, a wide root zone causes a larger root size and weight compared to roots that are not infected with mycorrhizal.

The root dry weight variable on mycorrhizal administration had a very significant effect, this could happen that the high root dry weight due to mycorrhizal treatment was caused by sufficient nutrient conditions and metabolic activity that occurred in the sacha inchi plant itself. Idris *et al.,* (2018), stated that metabolic processes and high cell activity will increase root biomass and will affect root dry weight.

Administration of mycorrhizal in this study showed a very significant effect on mycorrhizal infection variables. Besides being able to absorb nutrients, mycorrhizal infection can also make the roots become wider. This is in line with the opinion of Rosnina *et al.,* (2021), that the presence of mycorrhiza can expand the root zone of plants that experience mycorrhizal hyphae colonization so that they can absorb nutrients more optimally, especially bound P nutrients to become available to plants. By optimally absorbing element P, the process of photosynthesis, respiration, transfer, energy storage, cell division and enlargement as well as processes in plants can occur optimally (Dahlia and Setiono, 2020).

The interaction between the concentration of *eco-enzyme* and the dose of micoferine had a very significant effect on the variables of plant fresh weight and plant dry weight. In addition, the *eco-enzyme* significant effect on the number of leaves at 40 HST, stem diameter at 20 and 40 HST, and root length.

It is suspected that the important role of microorganisms in *eco-enzymes* accelerates the decomposition of organic matter and the macro-nutrient content of Phosphorus and Potassium in the soil can be absorbed by external hyphae from plant roots which are colonized by mycorrhizal fungi.

Differences in the number of leaves, root length, fresh weight of roots and dry weight of roots from the interaction of *eco-* enzymes and micopheres on control plants proves that the performance of *eco-enzymes* as a provider of P and K elements and mycorrhizae as fungi that make roots perform better in nutrient absorption and water on marginal land experiencing water and nutrient stress proves its existence in increasing the number of leaves, increasing the size of the stem diameter and root length of the sacha inchi plant.

Plants need nutrients in their growth, these nutrients such as macro nutrients N, P, and K. Plants need these nutrients for the process of plant growth. *Eco-enzyme* itself contains the macro elements potassium (K) of 203 mg/l and phosphorus (P) of 21.79 mg/l (Yuliandewi *et al.,* 2018).

With the presence of microorganisms, nutrients and enzymes contained in *eco-* as a result of the eco-fermentation process of fruit waste, it can increase nutrient uptake optimally. The use of biological agents of arbuscular mycorrhizal fungi can increase the ability of plants to take up nutrients (N, K, Mg, Ca, O, H, C, and S), especially phosphorus (Zuroidah, 2011).

Utilization of organic matter and enzymes as well as the presence of mycorrhizal hyphae can increase the suitability of sub-optimal land into productive land which can increase the quantity and quality of production of sugar cane and sacha inchi which can be raw materials in producing renewable energy.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

- Giving *eco-enzyme* 22.5 ml/l is the optimal dose that can increase the growth rate of sacha inchi plants, namely on Inceptisol soils.
- Giving mikofer 40 g/plant increases plant growth rate, number of leaves, stem diameter, root fresh weight, root dry weight, infection and root length.
- There was an interaction on fresh weight of roots and dry weight of roots, number of leaves 40 DAP, and root length in the treatment.

Recommendation

- The use *of eco-enzymes* in the future must be adjusted to the type of plant and soil used, so that the provision of *eco-enzymes* can affect plant growth and development.
- The use of micofer is recommended to use a dose of 40 g/plant to increase growth in almost all observed variables.

ACKNOWLEDGEMENT

The authors would like to thank Malikussaleh University for grant No 11/UN45.3.8/HK.02.03/2022 Proyek Advanced Knowledge and Skills for Sustainable Growth Project in Indonesia-Asian Development Bank (AKSI-ADB) Universitas Malikussaleh 2022.

Commented [T30]: non significant? check !

Commented [T31]: the best treatment?

REFERENCES

Commented [T32]: see manuscript template

Ahmad, F., Fathurrahman, & Bahrudin. 2016. The Effect of Media and Fertilization Intervals on the Growth of Clove Vigor (*Syzygum aromaticum* L.) *e-Jurnal Mitra Sains*, 4(4), 36-47.

Basri, AHH 2018. Study of the Role of Mycorrhiza in Agriculture. *Agrica Extensiona, 12*(2), 74-78.

Bussa, LO, Putra, NLS, and Hanum, F. 2019. Effect of Mycorrhizal Application Time on Growth and Yield of Cucumber (*Cucumis sativus* L.) Variety Harmony. *Agrimeta*, 9(17), 36-40.

Cai, Z., Jiao, D., Lei, Y., Xiang, M., & Li, W. 2013. Growth and Yield Responses of *Plukenetia volubilis* L. Plants to Planting Density. *The Journal of Horticultural Science and Biotechnology, 88*(4), 421-426.

Dahlia, I., and Setiono. 2020. Effect of Dolomite + Sp-36 Combination with Different Doses on Growth and Yield of Soybean (*Glycine max* L. Merrill) in Ultisol. *Journal of Agro Science*, 5(1), 1-9.

Hamaker, B., Valles, C., Gilman, R., Hardmeier, R., Clark, D., Garcia, H., Valdivia, R. 1992. Amino acid and fatty acid profiles of the Inca peanut (*Plukenetia volubilis*) . *Cereal Chem, 69*(4), 461- 463.

Hidalgo, LER, Rogel, CJV, Berneo SMB 2019. Caracterización Del Aceite De La Semilla De Sacha Inchi (*Plukenetia volubilis*) Del Cantón San Vicente, Manabí, Ecuador, Obtenida Mediante Procesos No Termicos De Extrusion. *LA GRANJA: Revista de Ciencias de la Vida 30*(2): 77-87.

Idris, Rahayu, E. & Firmansyah, E. 2018. Effect of Planting Media Composition and Water Volume on Oil Palm Seedling Growth in Main-Nursery. *Agromast*. 3(2), 1-24.

Jaya, ER, Situmeang, YP, & Andriani, AASPR 2021. Effect of Biochar from Urban Waste and Eco-enzymes on Growth and Yield of Shallots (*Allium ascalonicum*, L). *SEAS (Sustainable Environment Agricultural Science), 5*(2), 105-113.

Nisa, K., Wijayanti, R., & Muliawati, ES 2017. Arthropod Diversity in Sacha Inchi in Dry Land. *Journal of Sustainable Agriculture, 32*(2), 132-141.

Nisa, K., Wijayanti, R., & Muliawati, ES 2017. Arthropod Diversity in Sacha Inchi in Dry Land. *Journal of Sustainable Agriculture, 32*(2), 132-141.

Nurhayati, DR 2021. *Introduction to Plant Nutrition*. Surakarta. Unisri Press.

Pazmiño, LLB 2013. *Elaboración de una barra energética a base de Sacha Inchi (Plukenetia volubilis) como fuente de omega 3 y 6* (Unpublished thesis). Quito: Universidad San Francisco de Quito.

Rahmawan, IS, Arifin, AZ, and Sulistyawati. 2019. The Effect of Potassium (K) Fertilization on the Growth and Yield of Cabbage (*Brassica oleraceae* var. capitata, L.). *Journal of Agrotechnology Merdeka Pasuruan*, 3(1), 17-23.

Rosnina, AG, Syafani, A., Supraja, A., Ardiyanti, B. 2021. Effects of the Combination of Biochar and Mycorrhiza on the Growth of Purple Pulut Corn (*Zea mays* L. var ceratina Kulesh) in Inceptisol Reuleut soil. *Agriprima,* 5(1), 34-40.

Safrizal. 2014. Effect of Phosphorus Nutrient on Tissue Phosphorus Nutrient Status, Production and Quality of Mangosteen Fruit (*Garcinia mangostana* L.). *J. Floratek* 9, 22 – 28.

Siswanto, B., & Widowati. 2018. The Effect of Seaweed Agar-Agar Industrial Waste on Soil Chemical Properties and Corn Plant Growth in Inceptisols, Pandaan Pasuruan District. *Buana Science,* 18 (1), 57-66.

Sufardi. 2012. *Introduction to Plant Nutrition*. Banda Aceh. Shia Kuala University Press.

Suharno, & Sancayaningsih, RP 2013. Arbuscular Mycorrhizal Fungi: Potential of Heavy Metal Mycorizoremediation Technology in Mining Land Rehabilitation. *Biotechnology,* 10(1), 37-48.

Yoga, AP 2022. The*Influence of Eco-Enzyme and Vermicompost on the Growth and Yield of Celery* (*Apium graveolens* L.). Thesis (unpublished). Pekanbaru. Riau Islamic University.

Yuliandewi, NW, Sukerta, IM, Wiswasta, IGN. A. 2018. Utilization of Organic Garbage as “Eco Garbage Enzyme” for Lettuce Plant Growth (*Lactuca sativa* L.). *International Journal of Science and Research (IJSR), 7*(2), 1521-1525.

Zuroidah, IR, 2011. *Effect of Arbuscular Mycorrhizal Fungi (CMA) on Leaf Anatomical Characteristics and Levels of Koro Sword Bean Plants* (*Canavalia ensiformis* L.). Biology Study Program, Faculty of Science and Biology. Surabaya. Airlangga University.

14% Overall Similarity

Top sources found in the following databases:

- 12% Internet database
- 4% Publications database
- Crossref database
- Crossref Posted Content database
- 8% Submitted Works database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	repository.unipa.ac.id	Internet	3%
2	bircu-journal.com	Internet	1%
3	e-journal.janabadra.ac.id	Internet	1%
4	Regis University on 2018-03-02	Submitted works	1%
5	Universitas Warmadewa on 2021-09-19	Submitted works	<1%
6	ejournal.warmadewa.ac.id	Internet	<1%
7	idoc.pub	Internet	<1%
8	jispp.iut.ac.ir	Internet	<1%

9	jurnal.uns.ac.id Internet	<1%
10	faperta.unsoed.ac.id Internet	<1%
11	ijrrjournal.com Internet	<1%
12	miswadipratama.blogspot.com Internet	<1%
13	link.springer.com Internet	<1%
14	Higher Education Commission Pakistan on 2012-04-24 Submitted works	<1%
15	repository.uma.ac.id Internet	<1%
16	dergipark.org.tr Internet	<1%
17	ejournal.gunadarma.ac.id Internet	<1%
18	scholar.unand.ac.id Internet	<1%
19	ejournal.unisbablitar.ac.id Internet	<1%
20	repository.unimal.ac.id Internet	<1%

21	Pontificia Universidad Catolica del Peru on 2021-06-03 Submitted works	<1%
22	moam.info Internet	<1%
23	repository.lppm.unila.ac.id Internet	<1%
24	Higher Education Commission Pakistan on 2011-07-23 Submitted works	<1%
25	University of Rajshahi on 2019-09-29 Submitted works	<1%
26	repositori.usu.ac.id Internet	<1%
27	Universitas Brawijaya on 2022-10-05 Submitted works	<1%
28	core.ac.uk Internet	<1%
29	krishikosh.egranth.ac.in Internet	<1%
30	ejournal.warmadewa.ac.id Internet	<1%
31	Nia Rossiana. "Decreasing Of Lead And Cadmium By Cladosporium an... Crossref	<1%
32	hrcak.srce.hr Internet	<1%

33	media.neliti.com Internet	<1%
34	smujo.id Internet	<1%