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ENHANCEMENT PHOSPHORUS NUTRIENT UPTAKE AND QUALITY PALM OIL SEEDLING (ELAEIS GUINEENSIS JACQ.) ON MYCORRHIZAL PLANTING MEDIA

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ABSTRACT
Ultisol which is deficient in phosphorus can be used as a planting media for oil palm seedlings with the addition of mycorrhizal fertilizer. This research aims to determine the effect of providing mycorrhizal fertilizer on the growth of oil palm seedlings in ultisol planting media in polybags. The research was carried out at the Experimental Station, Batanghari University. Soil analysis and plant tissue was carried out at the Laboratory of the Agricultural Information Standards Agency for Food Crops, Jambi Province. Analysis of mycorrhizal infection and measurement of plant growth was carried out by the Basic Laboratory of Batanghari University, Jambi. The study used a one-factor completely randomized design. The treatment design is mycorrhizal fertilizer (m) with 4 dose levels as follows: m0= 0 g, m1= 5 g, m2= 10 g, m3= 15 g, and m4= 20 g. The parameters observed were the percentage of root infection, leaf phosphorus content, plant height, stem diameter, plant dry weight, root volume, and soil analysis. The results showed that mycorrhizal fertilizer treatment increased root infection by 700%, phosphorus uptake by 364.45%, plant height by 44.65%, stem diameter by 69.91%, total leaf area by 61.83%, root volume by 365.53%, and total dry weight by 170.21%. Mycorrhizal biofertilizer can be used to increase the growth of oil palm seedlings planted in ultisol media.

KEY WORDS
Mycorrhiza, palm oil, phosphor, plant growth.

Palm oil (*Elaeis guineensis* Jacq.) is plant type yielding palm oil vegetable with objective commercial. Palm oil used as oil cooking, margarine, soap, wax, cosmetics, and industry food others. Together with Malaysia, Indonesia is producer palm oil major in the world (Sitorus, Akoeb, & Sembiring, 2020). Deployment palm oil in Indonesia started from Sumatra to Papua (Sulardi, 2022). Existence palm oil becomes very important for Indonesia, remember area planted already reached 16 million hectares and 4 million worker related straight away and 10 million non-direct worker (Rini & Efriyani, 2017 ; Directorate General of Plantations, 2022)

Palm oil is one of asset plantations that own interest major economic and social issues for public local, especially public of Jambi Province. This matter proven with enhancement wide plantations and production palm oil every the year (Iskandar, Nainggolan and Kernalis, 2018). Table 1 explains that wide land palm oil from 2017 to 2021 continues experience enhancement from 768,022 hectars in 2017 to 1,090,072 hectars in 2021. Production palm oil for five years also experienced the last one enhancement from 1,783,033 tons in 2017 to 3,091,697 tons in 2021. Increase this happen because benefit palm oil and its potential as plant very large exports in economy Jambi Province.

One of method for support continuity industry palm oil, in particular in the field cultivation, providing seeds superior and healthy. For obtain seeds must create supportive conditions growth, including availability necessary macro and micro nutrients. Fertilization is way that can be done for provide macro and micro nutrients. Another method that is also effective is increase ability plant for absorb the nutrients and water it needs. Enhancement ability root in absorb these nutrients and water aimed at retaining the original nutrients no-absorbed become absorbed by the roots plant. Problem bound and unbound nutrients can be absorbed by plants, generally occurs on the ground ultisol.

Table 1 – Land area, palm oil production and Productivity in Jambi Province 2017-2021

Year	Land area (Ha)	Production (Tons)	Productivity (Tons/Ha)
2017	768,022	1,783,033	2,983
2018	1,032,145	2,691,270	3,296
2019	1,034,804	2,884,406	3,518
2020	1,074,600	3,022,600	3,596
2021	1,090,072	3,091,697	3,646

Source: Central Statistics Agency of Jambi Province (2022).

According to Rajmi, Margarettha and Refliaty (2018) and Prasetyo and Suriadikarta, (2014) land ultisol is land on land dry sour who has level low fertility and productivity is one of them is lack phosphorus because phosphorus bound by aluminum. One of method for overcome element bound phosphorus with aluminum is form association between root plants with mycorrhiza.

According to Basri (2018) mycorrhiza is symbiotic fungi with root plant with method colonize skin root plant. Mycorrhizal fungi lots found associate with plants in nature like cocoa, wheat, palm oil, and melon. According to Adetya, Nurhatika, & Muhibuddin (2019) mycorrhizal fungi endophyte is one of type mold owned land great benefits if are inside land, that is repair quality land with increase aggregate soil and colloids, as well increase nutrient and water uptake. Apart from that, hyphae mycorrhiza endophyte increases tolerance plant to dryness, protect root plant from infection soil pathogen, stimulate activity microorganism profitable others, and improve texture and soil structure.

Sastrahidayat (2011) explain that excess main from mycorrhiza is can absorb and collect more nutrients, nitrogen, phosphorus, calcium and potassium fast, as well save it in longer time. Plant can also be mycorrhizal said more stand to drought because of the area rooting growth plant relatively better compared to with plants that don't infected mycorrhiza, and influence other is protected root from pathogen soil, nematodes as well as concentration metal heavy.

Research of Kartika, Salim & Fahrizal (2013) show mycorrhiza 10 and 20 polybag^{-1} on soil ultisol influential real to plant height, stem diameter and leaf area rubber at the moment nursery beginning. Study Idhan & Nursjamsi (2016) show exists interaction between mycorrhiza 7.5 polybag^{-1} and give away fertilizer organic in plants cocoa results continued shoots one year old give influence best in the increase parameters plant height, leaf number, and leaf area index. Research by Suherman, Rahim, & Akib (2012) show that application mycorrhiza with dose 8 polybag^{-1} gives results best for growth height and number of leaf soybean.

Nursery palm oil with planting media land ultisol potential produce seeds that grow no in accordance with standard. The cause is lacking phosphorus nutrients. Phosphorus nutrients will be adsorbed by aluminum so that no available for plant. Sometimes distance roam roots no reach phosphorus nutrient position. For That required agency biological mycorrhiza can help release bound phosphorus nutrients as well as increase power reach out root going to nutrients with help hyphae mycorrhiza. Use mold mycorrhiza this expected can increase rate absorption element necessary phosphorus for growth palm oil seedling.

Seedlings grown in soil with fertility limited need action to plant can independent in absorb nutrient. Inoculate root seedling palm oil with mycorrhiza is one of method for independent seeds in sufficient need nutrients and water.

METHODS OF RESEARCH

Study held in the research extension Batanghari University. Analysis of soil chemistry and plant tissue carried out at the Information and Standardization Center Laboratory

Agriculture (BSIP) Food Crops of Jambi Province. Root infection analysis and measurements of plant growth held ini Basic Laboratory, Batanghari University, Jambi.

The tools used in this research are scale, camera, electric oven, spectrophotometer, leaf area meter, and chemically. Materials used in this study are palm oil seedling 3-month-old Tenera type from Tanjung Katung Village Subdistrict Muaro Sebo Regency Muaro Jambi, fertilizer mycorrhiza, soil ultisol as a planting media and polybag.

The research use completely research design. The treatment is fertilizer mycorrhiza (m) with 4 levels. Fertilizer added in to 3 kg of planting media as follows: m0 = 0 g (control), m1 = 5 g, m2, = 10 g, m3 = 15 g, and m4 = 20 g. Each treatment repeated 4 times, so there is 20 units unit trials, respectively unit test there are 10 palm oil seedling and 8 seedling as sample.

Research area made fence with use paranet 75% to avoid from disturbance animal. Planting media used is soil ultisol taken from experimental station in Pijoan. Soil weighing 3 kg was added to in polybag, next fertilizer mycorrhiza entered to in hole plant in accordance with dose treatment experiments that have been done determined. Seedling used relatively uniform, 3 months old, 20-25 cm high, midrib leaves 3-4, and no attacked pest or disease. Control weed done manually. Seedlings palm oil watered every day.

Observation infection mycorrhiza observed in roots plants, roots plant researched better how many percent mycorrhiza on roots palm oil seedling. Observation carried out in the laboratory at the end study. The method used is coloring root (Kartika, Salim, & Fahrizal, 2013). Before coloring, roots plant host washed moreover formerly until clean from still soil / sand attached. Then Lateral roots are selected, cut and collected. By random taken as much as 5-10% of gathering those lateral roots, then entered in bottle plastic (volume 8 mL) containing 50% alcohol. Roots are inserted in 10% KOH solution soaked for 24 hours, then rinse with water for 5 minutes. If root Still appear colored black soak 1–2 minutes in 10% H2O2 solution. After That root soaked in 2% HCl solution for 24 hours. Furthermore, root entered in staining solution consisting of 100 ml of acid lactate, 100 ml glycerin, 50 ml distilled water, and 0.13 g acid fuchsin, then soaked for 24 hours. Final root soaked Again in destaining solution consisting of 100 ml of acid lactate, 100 ml glycerin, and 50 ml distilled water, soaked for 24 hours and roots Ready observed. Before observation done, especially formerly made preparation root. A total of five pieces in One test. Roots cut with 1 cm long is set above glass object, closed with cover glass, and labeled accordingly treatment. Next preparation the observed under microscope with magnification 10-40 times:

$$\text{Infection percentage } = \frac{\text{number of root infection}}{\text{total root number}} \text{ x } 100\%$$

The degree of infection in the roots classified according to The Institute of Mycorrhizal Research and Development, USDA Forest Service, Athens, Georgia (Setiadi & Setiawan, 2011) as following: 1. Class 1, if infection is 0% – 5%, very low; 2. Class 2, if infection is 6% – 25%, low; 3. Class 3, if infection is 26% – 50%, moderate; 4. Class 4, if infection is 51% – 75%, high; 5. Class 5, if the infection is 76% – 100%, very high.

Test of phosphorus content in plants leave carried out at the BSIP Food Crops Laboratory, Jambi Province. The part that is made test material is leaf plant. Procedure analysis network for phosphor uptake using method Spectrophotometer as explained by (Ritonga & Sukindro, 2012). Furthermore, mark percentage content Phosphorus in leaves (%) is calculated with weight dry seeds plant:

$$\text{P uptake (mg Seedling}^{-1}\text{) = \%P x dry weight seedling (mg)}$$

For measure plant height, lengthen midrib leaf to on with a measuring tape and measure from base stem until end midrib leaf. Measurement plant height done at the end of research (12 weeks after planting).

Stem diameter seeds be measured with use period slide at a height of 2 cm from base seedling. Measuring the diameter done at the end of research (12 weeks after planting).

Root volume weight be measured with method root entered to in glass measure that has been filled with appropriate water dose Then root entered to in glass and look How many increases in the volume of water available. Counting root volume weight done at the end of research (12 weeks after planting).

Shoot root ratio observed at the end study. Plant sample cleaned Then dried in oven at 80°C for 2×24 hours. After That sample entered to in desiccator until the weight is constant. Plant separated part shoot and roots Then weighed.

Observation done simultaneously with shoot root ratio parameters. Shoot dry weight append root dry weight is a total dry weight.

Soil analysis carried out at the BSIP Food Crops Laboratory, Jambi Province. Each samples were obtained pre and post research. Each sample weight is 500 g.

Data were analyzed with Anova. If the test results were significant, continued with the DNMRT test at a 5% significance level to determine the difference in effect between treatments. The SPSS® #24 was used for data processing.

RESULTS AND DISCUSSION

Treatment fertilizer mycorrhiza significantly increasing of root infection, phosphorus uptake, phosphorus content in planting media. Treatment this also affects plant parameters plant heigh, stem diameter, root volume, total leaf area, shoot root ratio, and total dry weight. Association of root seedling palm oil with mycorrhiza make seedling in a way independent capable increase rate absorption phosphorus nutrients and their impact positive on seedling growth.

Mycorrhiza infection in root palm oil seedling show that has happen symbiosis between palm oil seedling with mycorrhiza. Symbiosis this happen because characteristic each other necessary and profitable. Infection rate mycorrhiza on roots palm oil seedling will increase in line with increasing amount dose fertilizer that brings propagules mycorrhiza as in Figure 1.

Figure 1 shows root palm oil seedling infected during treatment fertilizer mycorrhiza. Treatment of m4 taller compared to with treatment other. All treatment fertilizer mycorrhiza cause happens root infection. The highest score obtained in the m4 treatment as 80% infected mycorrhiza and lowest in the m0 treatment.

Giving fertilizer mycorrhiza capable infect root plant palm oil are characterized by their appearance vesicles in hair root plant. This matter in accordance with opinion Jakobsen et al. (2021) that infection mycorrhiza started from formation appressorium on the surface root, then appressorium will penetrate cell root palm oil seedling. After appressorium come in, start grow internal and external hyphae. Hyphae will expand power roam root in absorb nutrients and water. These hyphae too emit enzyme phosphatase that will release bond phosphorus from non-available become available. According to Grünfeld et al. (2022), that infecting mycorrhiza root plant will grow network hyphae external growth with fast and expansive.

Colonization mycorrhiza will expand the absorption area nutrients and water. External hyphae this grows on feathers root and spread evenly distributed in the planting medium. Hyphae external This will get closer hair root with nutrients and water for seedlings have opportunity for absorb more nutrients and water. These nutrients and water will used plant in the process of photosynthesis for produce photosynthate form carbohydrates and sugar for support growth cells and formation new cell.

Increasing percentage infection mycorrhiza in line with enhancement dose fertilizer. This matter can connect with increasing amount spores in planting media. This research use poor soil ultisol element phosphorus and other nutrients. usually, development mycorrhiza will the better in planting media with low nutrient content. It happened infection caused by existence exudate or compound typically produced by roots palm oil seedling and causes development mycorrhiza stimulated. Exudate the contain amino acids required by mycorrhiza for its development.

Infection cause wide surface root will increase so that can absorb more nutrients and water a lot and nutrients and water are not accessible to the roots will be reached by hyphae external. Fulfilled nutrients and water will increase rate photosynthesis seedling marked with increase wide leaves and factors growth other. Excessive photosynthate will stream to roots and utilized by mycorrhiza for its development.

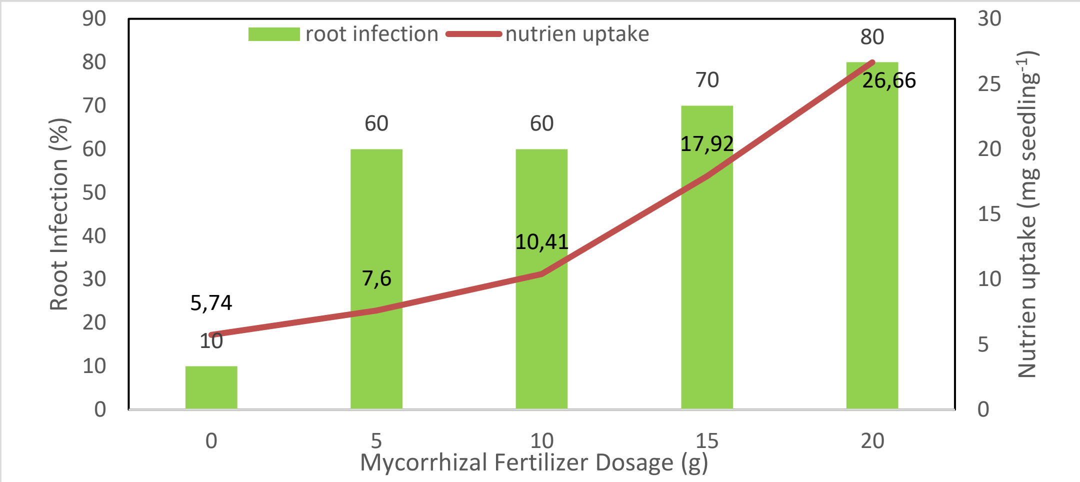

Figure 1 – Percentage root infection and phosphorus uptake palm oil seedling at various dose fertilizer mycorrhiza

The data in Figure 1 shows that on treatment controls are also available infection mycorrhiza as much as 10%. Allegedly mycorrhiza enters in planting media because cleanliness hand moment gives fertilizer mycorrhiza. It could still be a propagule sticks to hands and moments do treatment control then the propagule enters in the media and in associations with root palm oil seedling. Other factors are also possible exists infection during treatment control is characteristic from mycorrhiza fungi. These fungi found in the ground, because level low compatibility so rate infection only 10%.

Phosphorus content in leaves palm oil seedling in treatment fertilizer mycorrhiza m4 taller compared to with other treatments (Figure 1). All treatment fertilizer mycorrhiza cause happens enhancement content phosphorus in leaves from m0 treatment. The highest score obtained in the m4 treatment was 26.66 mg plant $^{-1}$ content phosphorus in the leaves and the lowest in the m0 treatment, namely 57.40 mg plant $^{-1}$ (Figure 1).

The phosphorus uptake in leaves palm oil seedling seen that on every treatment happen enhancement rate phosphorus in leaves matter this happen because exists uptake phosphorus by a given plant mycorrhiza because hyphae external will exudate enzyme phosphatase so that fixed phosphorus will released and dissolved, enter to in roots, transported to leaf through xylem tissue towards leaf plant (Frahat & Shehata, 2021).

External hyphae are very fine so that can enter the pores the smallest and most absorbent soil nutrients and water though the content is very low. Water uptake by hyphae external not only absorb phosphorus nutrients, because absorbs water and dissolves other nutrients such as nitrogen and potassium too absorbed (Jakobsen et al., 2021). Phosphorus nutrient content is presented in Table 2.

Table 2 – Analysis results P_2O_5 content pre and post in planting media

Treatment Dose Mycorrhizal Fertilizer	P_2O_5 content (%)	
	Pre	Post
m $_4$ (20 g)	5.34 SR	10.74 R
m $_3$ (15 g)	5.34 SR	10.28 R
m $_2$ (10 g)	5.34 SR	9.13 SR
m $_1$ (5 g)	5.34 SR	7.82 SR

Description: SR (very low), R (low) (Nganji & Sudarma, 2023).

Analysis of soil chemistry shows that at the post research, occurred enhancement content phosphorus in planting media. The data in Table 2 shows results analysis land for content total soil phosphorus. Phosphorus increases and changes from very low (5.34) at baseline study become low at the end research (7.82-10.74). Giving fertilizer mycorrhiza give enhancement to content phosphorus in planting media, where enhancement dose fertilizer given mycorrhiza, the more content is also high phosphorus in planting media at the post research. This matter happens because network hyphae external from mycorrhiza will expands the area of water and nutrient absorption. Apart from that, size more hyphae fine compared to with root plant possible they for penetrate pores very small (microscopic) soil, so hype can absorb water even in conditions very low ground water content. Plants that form symbiosis with mycorrhiza can also increase absorption of water and phosphorus nutrients through time flow. Absorption high phosphorus is also due to the fact that hyphae fungus emit enzyme capable phosphatase release phosphor from ties specific, so phosphorus nutrients become available for plant (Jakobsen et al., 2021). Phosphorus is not used by plants will be exuded and remains is in the planting medium, so can be measured as enhancement concentration phosphor in that media.

Based on results research and data analysis can concluded that giving fertilizer mycorrhiza in planting media palm oil seedling in polybag deliver influence real to plant height, stem diameter, and leaves area total, root volume, shoot root ratio, and total dry weight as in Tables 3 and 4.

Table 3 – Average plant height, stem diameter, and total leaves area of seedlings palm oil with treatment of various doses of mycorrhizal fertilizer

Treatment Dose Mycorrhizal Fertilizer	Parameter					
	Plant Height (cm)		Steam Diameter (cm)		Total Leaves Area (cm^3)	
m_4 (20 g)	38.56	a	1.92	a	124.94	a
m_3 (15 g)	32.90	b	1.50	b	93.82	a
m_2 (10 g)	30.81	b	1.31	c	85.90	a
m_1 (5 g)	30.73	b	1.21	c	83.80	a
m_0 (0 g)	26.65	c	1.13	c	77.20	b

Description: Numbers followed by the same lower-case letters are not significantly different in the DNMRT follow-up test at the α 5% level.

Of all the parameters observed m4 treatment (20 g) gave average results growth highest at high parameters plants height (38.56 cm), seedling steam diameter (1.92 cm), and root volume (15.13 ml). From the results research, it is known that giving fertilizer mycorrhiza own impact positive to growth plant height palm oil. The taller dose fertilizer given mycorrhiza, increasingly growth is also high tall palm oil seedling.

Significant difference can be seen in high average palm oil seedling between treatment fertilizer biological mycorrhiza m4 with treatment others, namely m3, m2, m1, and m0. Treatments m1, m2, and m3 are not show significant difference between them, however every treatment the different in a way significant compared to with m0 and m4. There is enhancement seedling plant height amounted to 44.69% in the m4 if treatment compared to with m0.

Growth of plant height seen in treatment with dose fertilizer mycorrhiza of 20 grams. This matter indicated fertilizer mycorrhiza effective in support growth palm oil seedling. Amirullah et al. (2021) state that fertilizer infecting mycorrhiza root plant produces network hyphae external growth expand and improve ability root in absorbs water and nutrients primarily phosphate. According to Grünfeld et al. (2022), high absorption of water and nutrients by plants increase growth plants, which are also visible in this study through growth more height large in the m4 treatment.

Mycorrhiza also plays a role in stimulate formation hormones growth plants, like cytokinin and auxins. Hormone cytokinin and auxins influence division and elongation cells, which in turn cause enhancement plant height. When plants dismantled, visible that a number of roots has penetrate the planting medium, which is possibly caused by giving fertilizer mycorrhiza accelerating growth and spread root, as well increase absorption nutrients available in the section under the planting medium.

Table 2 shows that the average diameter of the stem palm oil seedling in different m4 treatments in a way significant with treatment others, namely m3, m2, m1, and m0. Stem diameter palm oil seedling reach mark the highest was in the m4 treatment, namely 1.92 cm, while the lowest recorded in the m0 treatment with a diameter of 1.13 cm. There is enhancement significant amounting to 70.79% of the stem diameter palm oil seedling in the m4 treatment if compared to with m0 treatment. This matter because availability element phosphor in fertilizer mycorrhiza role important in the solving process carbohydrates (respiration) become adenosine diphosphate and adenosine triphosphate for fulfil need energy. In addition elements phosphorus also plays a role in division cell through role nucleoprotein in the cell nucleus, which can speed up growth in stem diameter (Bhantana et al., 2021).

Observation result total leaves area shows that between treatment mycorrhiza different non-real between one with others, however different with treatment control. Leaf area palm oil seedling increase fast with start from m1 treatment. Treatment 5 grams (m1) of fertilizer mycorrhiza capable give level percentage infection root by 60%. Enhancement mark infection root This followed by an increase mark wide total leaf. Enhancement mark wide this total leaves started from enhancement ability root in absorbing nutrients and water. These nutrients and water transported to leaves and becomes material in activity photosynthesis.

When reviewed further, increasing amount leaf will increase ability plant in catch energy solar and fixes $CO_{2.}$ With increase wide leaf so carbohydrates produced will increase. According to Slewinski & Braun (2010) the carbohydrates produced will be transferred to nearby parts. In this way, nutrients and water can be added increase activity final photosynthesis will can add wide leaf.

According to Kannan et al. (2019) wide leaves are very important for determine heavy dry extinct plants, and often stated as mark main in calculation component grow other. Added by Parker et al. (2020) that the more increasing wide leaf planting, then rate hoarding material dry form carbohydrate the more increase. This process will increase plant dry weight. Enhancement rate photosynthesis will increase plant growth as shown in the parameters of root volume, shoot root ratio, and total dry weight (Table 4).

Table 4 – Average root volume, shoot root ratio, and total dry weight the palm oil seedling with treatment of various doses of mycorrhizal fertilizer

Treatment Dose Mycorrhizal Fertilizer	Parameter					
	Root Volume (mm^3)		Shoot Root Ratio		Total Dry Weight (g)	
m_4 (20 g)	15.13	a	2.70	a	8.62	a
m_3 (15 g)	11.25	b	2.44	a	6.18	b
m_2 (10 g)	7.63	c	2.72	a	4.34	c
m_1 (5 g)	2.5	d	2.33	a	3.62	d
m_0 (0 g)	3.25	d	3.6	b	3.19	d

Description: Numbers followed by the same lower-case letters are not significantly different in the DNMRT follow-up test at the α 5% level.

Average root volume palm oil seedling in different m4 treatments in a way significant with treatment others, namely m3, m2, m1, and m0 (Table 3). Root volume highest recorded in the m4 treatment, namely 15.13 ml, while the lowest is m1 treatment with root volume of 2.50 ml. There is increase in root volume palm oil seedling significant amounted to 388.61% in the m4 if treatment compared to with m0 treatment.

Root volume parameter, this occurs enhancement in every treatment. Giving fertilizer mycorrhiza help development system rooting as results from symbiosis mutualism between fungi and roots plant. Symbiosis this involve giving photosynthesis (carbohydrate) by plants, while plant accept addition nutrition phosphorus, which in turn increase structure land and capabilities system rooting for absorb nutrients with more good (Hartatie & Donianto, 2021). Colonization mycorrhiza on roots plant can expand the absorption area root through hyphae external growth through hair root. Interacting hyphae with plant host help get closer nutrients from the rhizosphere zone in plants host, speed up growth and development plant in a way whole. With so, increasingly tall dose given mycorrhiza, increasingly faster and more big growth root plant (Amirullah et al., 2021).

Shoot root ratio decrease in line with treatment fertilizer mycorrhiza. Between treatments fertilizer biological show, no difference real but different real with control. Decline ratio header root in line with increasing root volume. Treatment mycorrhiza also has an effect to heavy dry root because infected plants mycorrhiza tend has volume and length more roots big, so along with enhancement dose mycorrhiza, severe dry roots also increase in a way significant.

On total dry weight parameters, gifts treatment fertilizer biological mycorrhiza has proven increase growth plant. The high dry weight in the m4 treatment was initiated with fact that, on treatment this obtained mark highest for plant high, stem diameter, total leaf area, and root volume. Dry weight is amounting photosynthesis net income utilized by palm oil seedling in support its growth. The taller dry weight, increasingly good growth seedling.

Mycorrhiza contributes to growth plant through enhancement uptake available phosphorus in symbiosis between root plants and mycorrhiza, which in turn increase plant dry weight in each treatment. Findings this consistent with results study (Amirullah et al., 2021), which indicates that application fertilizer mycorrhiza with a dose of 30 g polybag^{-1} is significant increase fresh leaf weight, weight dry shoot, weight dry root, and total weight plant certain in a way significant. Therefore that, you can conclude that treatment fertilizer mycorrhiza effective in increase absorption of water and nutrients by plants, which ultimately increase total dry weight.

Dry weight plant is the sum of the results of the dry weight of roots, stems and leaves. The plant's dry weight is related to the amount of leaf area obtained, which reflects the plant's greater ability to photosynthesize. The extent of a plant's ability to photosynthesize will reflect the extent of the accumulation of dry material formed and subsequently result in the plant's dry weight increasing.

CONCLUSION

Based on results, can concluded that giving fertilizer mycorrhiza will increase rate infection root by 700% by fungi mycorrhiza and increase rate uptake phosphorus by root plant amounting by 364.45%. Enhancement rate infection root association mycorrhiza on palm oil seedlings will increase phosphorus nutrient uptake shown with increasing plant height by 44.65%, stem diameter by 69.91%, total leaves area by 61.83%, root volume by 365.53%, and total dry weight by 170.21%.

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