Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

Effectiveness of Biological Fertilizer of Arbuscular Mycorrhizal in Efforts to Increase the Productivity of The Cayenne Pepper (*Capsicum frutescens* L.) Local of Wamena

[1*]Sumiyati Tuhuteru, [2]Rein Edward Yohanes Rumbiak, [3]Inrianti, [4]Endius Wenda, [5]Rusina Himan, [6]Mariana Lengka

[1,3,4,5,6]Program Study of Agrotechnology, College of Agricultural Sciences of Petra Baliem Wamena, Papua Mountains Province, Indonesia

[2]Program Study of Agribusiness, College of Agricultural Sciences Petra Baliem Wamena, Papua Mountains Province, Indonesia

(Received: 02 September 2023 Revised: 14 October Accepted: 07 November)

KEYWORDS

Arbuscular Mycorrhiza, Biological Fertilizer, Fungi, Local Cayenne Pepper

ABSTRACT:

Cayenne pepper (Capsicum frutescens L.) is a horticultural crop commodity that has high economic value. So, it requires innovations to increase cayenne pepper production, especially due to the need for more quality land, such as dry land in Wamena. The innovation in question includes using biological microorganisms that positively impact plants and the environment, such as arbuscular mycorrhizal fungi (CMA). For this reason, this research aims to analyze the effectiveness of mycorrhizal biological fertilizer in increasing the productivity of local Wamena cayenne pepper plants. The research was conducted from June to September 2023 using a completely randomized design method with 1 factor, namely the dose of mycorrhizal fertilizer (20 g, 50 g, 80 g, and 120 g), repeated six times. Next, the observation data obtained was analyzed using ANOVA, which continued with the DMRT test at a 5% level. The results of the research showed that mycorrhizal treatment had a good impact on increasing the productivity of cayenne pepper plants, seen from plant growth indicators such as plant height, stem diameter, and number of leaves, as well as plant yield indicators seen from the number of fruit per plant, fresh weight of fruit per plant, and also fresh weight. Furthermore, plant dryness is supported by plant physiological processes such as total plant chlorophyll content. The dose of mycorrhizal fertilizer that is effective in increasing the productivity of cayenne pepper plants is a dose of 120 g per plant (P4).

I. INTRODUCTION

Cayenne pepper (*Capsicum frutescens* L.) is a horticultural crop commodity that has high economic value. Indonesian people are one of the largest consumers of chilies in the world. Chilies are one of the important products in Indonesian food, and chilies can even influence the rate of inflation. Therefore, domestic availability of cayenne pepper must continue to be met (Pratiwi et al., 2022). Cayenne pepper is widely used as a kitchen spice, the main ingredient in the sauce industry, chili powder industry, instant noodle industry, and even the pharmaceutical industry (Rochmana & Ngadiani, 2020). Cayenne pepper is also known to contain essential oils which give it a spicy taste and is very popular with Indonesian people. On the other hand, cayenne pepper also has the opportunity to become an export commodity and

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

can increase the income of local farmers in Wamena. The need for chilies increases every year in line with the increase in population and the development of industries that require raw materials for cayenne peppers. The need for cayenne pepper continues to increase, as data from the Central Statistics Agency (BPS) recorded, production of cayenne pepper in Indonesia will be 1.55 million tons in 2022. This number is an increase of 11.5% compared to the previous year which was 1.39 million tons. Papua is one of the suppliers of cayenne pepper with a production of 4,335 tonnes, with the amount of cayenne pepper consumption in Indonesia reaching 569,650 tonnes in 2022, this figure has increased by 7.86% or 41,510 tonnes compared to 2021 and is the highest amount of cayenne pepper consumption in the period of time. Last 5 years (BPS, 2023). This means that demand for cayenne pepper is increasing. So it requires new innovations to increase cayenne pepper production, especially due to the lack of quality land such as dry land in Wamena. Cayenne pepper is an important vegetable crop consumed by most people. Cayenne pepper production is also influenced by the type of variety and low adaptability to growing in different environments (Kamila et al., 2023).

The low productivity of cayenne pepper is influenced by several problems which are influenced by environmental factors, attacks by pest organisms, genetics, low soil fertility, and the cultivation techniques used. High productivity of chili plants is one of the goals of developing chili cultivation (Pratiwi et al., 2022). Increasing the productivity of cayenne pepper plants is carried out to meet increasing consumer demand by making land use more efficient. Apart from that, the low production of cayenne pepper in Wamena is caused by decreasing soil fertility due to farmers' land being classified as marginal, namely dry and sandy loam which cannot be avoided and land management that does not pay attention to sustainability aspects. Therefore, efforts are needed to improve land management that can support the sustainability of crop production. One effort that can be made is the use of soil microorganism inoculum (Herawati et al., 2021).

One cultivation technique that can influence the growth and development of cayenne pepper plants is by involving plant growth-promoting microorganisms such as root fungi or known as Mycorrhiza which are currently widely marketed. The use of soil microorganisms, also known as biological fertilizer, functions to add certain nutrients or facilitate the availability of nutrients in the soil for plants (Herawati et al., 2021). Nutrient provision takes place through symbiotic or non-symbiotic relationships. One of the biofertilizers that is widely used is Arbuscular Mycorrhiza which forms a symbiotic association with plant roots and functions to help absorb P by plants.

Mycorrhiza helps plants absorb water and certain nutrients in the soil which plants use in metabolic processes in their bodies. Furthermore, the results of plant metabolism are used by mycorrhiza as a source of nutrients (Puspitasari & Indradewa, 2018). Arbuscular mycorrhizal fungi have a positive impact on plant growth by stimulating the production of growth hormones, increasing the rate of photosynthesis, increasing the osmotic pressure of cells experiencing salinity and drought stress (Utari & Rachmawati, 2022). Apart from that, mycorrhiza can also be used as a bioindicator to determine environmental quality (Febriyantiningrum et al., 2021).

Dry land is the impact of the drought that has hit Wamena in recent months and is a serious problem for agriculture, because it has a direct and indirect impact on agricultural output and the standard of living of local farmers who depend on the harvest of cultivated cayenne pepper. One of the reasons for this is the lack of soil water content due to the nature of the soil which belongs to the sandy clay loam soil group which has low water retention properties and if drought strikes the soil will dry out and have a hard texture which is known to damage plant roots (Mahanani et al., 2020). Apart from that, it is known that if a plant lacks water it will reduce the turgor pressure in the cells and also have a direct effect on reducing the rate of photosynthesis (Utari & Rachmawati, 2022). If the rate of photosynthesis decreases, plant growth will decrease, which can result in plant death (Latief et al., 2019). Therefore, it is important to carry out this research with the aim of studying the growth and yield response of cayenne pepper plants (*Capsicum frutescens* L) cultivated in dry land to the application of mycorrhiza.

II. RESEARCH MATERIALS AND METHODS

The materials used in this research were local Wamena cayenne pepper (*Capsicum frutescens* L.) seeds from

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

local farmers, 25 x 30 cm polybags, water, cow dung compost and MycoVir stamped arbuscular mycorrhizal fertilizer obtained from an agricultural shop. The main tools used in this research are digital scales, spectrophotometers, measuring rulers, calipers, gembors and writing instruments. This research was carried out in June - September 2023 in a plastic house and Agriculture Laboratory, Faculty of Agriculture, Halu Oleo University, Kendari. The method used in this research was experimental with a non-factorial completely randomized design (CRD). The treatment given was the application of mycorrhizal fertilizer which was the factor tested. The doses given were different, namely the treatment without mycorrhiza which was known as a comparison or as a control plant (P0), 20 g (P1), 50 g (P2), 80 g (P3) and 120 g (P4). Each treatment with 6 repetitions. The analysis is continued with the ANOVA test, which if the research results show a real effect will be continued with the Duncan test at 5% level using the SAS 9.0 program.

Mycorrhizal treatment is given when the plants are 4 WAP (weeks after planting) or when they are moved from the nursery by mixing them directly into the planting medium before being put into each polybag that has been prepared according to the treatment determined by the amount of soil. Furthermore, the variables observed included plant height, stem diameter, number of leaves, number of fruit and fresh weight of fruit per treatment) as well as observing the total chlorophyll content as a physiological parameter of the plant. Plant height and stem diameter were measured when the plants were 6 and 23 WAP, while the number of fruit and fruit weight were carried out at harvest and observations were made of the total fresh and dry weight of the plant to determine the amount of photositate formed.

Chlorophyll levels were measured on the leaves of cayenne pepper plants using a spectrophotometer. The leaves taken are mature leaves found on the first primary branch of each cayenne pepper plant. After that, a 0.1 g sample of cayenne pepper leaves was placed in a mortar with 10 ml of 80% acetone. After the leaves were completely dissolved, they were then filtered using filter paper and collected using a test tube. After that, the solution was put into a cuvette and the chlorophyll content was measured using a UV Vis spectrophotometer at wavelengths of 645 nm and 663 nm (Prastyo & Laily, 2015). Calculation of total chlorophyll levels (mg/L) was carried out using the formula: Total Chlorophyll = 17.3xA645 + 7.18 x A663. Next, the results of calculating the total chlorophyll content from the formula are converted into units of mg/g with the formula: (1/100 x total chlorophyll content)/ 0.1 mg/gram.

After the observations were made, they were then analyzed using ANOVA, where in the Variance Analysis carried out the calculated F was greater than the F table or the probability (sig) < 0.05, then H0 was rejected and H1 was accepted (Utari & Rachmawati, 2022 (Utari & Rachmawati, 2022). Further tests were carried out by comparing the treatment means (post hoc) multiple range test or DMRT (Duncan).

III. RESULTS AND DISCUSSION

The results of observations on plant productivity were viewed from the parameters of plant growth and yield as well as the physiology of cayenne pepper plants. The growth parameters of cayenne pepper plants which are indicators in this research are plant height and plant diameter which were observed when the plants were 6 and 23 WAP. The results of the observations showed significantly different effects between the treatments tested. Plant growth showed a significantly different effect from the P4 treatment (120 g of mycorrhizal fertilizer) with a mean of 80.33 cm at 6 WAP observations and 97.32 cm at 23 WAP observations (Table 1).

TABLE I: Observation Results of Plant Height and Stem Diameter of Cayenne Pepper Plants

Treatment	Plant Height (cm)		Bar Diameter (mm)	
	Week After Planting (MST)			
	6	23	6	23
P0	70.30 [b]	81.70 [b]	4.20 [b]	5.50 [b]
P1	87.66 [a]	90.63 [b]	5.43 [a]	6.10a [a]
P2	80.00 [a]	93.40 [b]	5.21 [a]	6.30 [a]
P3	80.06 [a]	95.35 [a]	4.63 [ab]	6.00 [ab]
P4	80.33 [a]	97.32 [a]	5.74 [a]	6.80 [a]

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

Description: P1 = 20 g mycorrhiza; P2 = 50 g mycorrhiza; P3 = 80 g mycorrhiza; P4 = 120 g mycorrhiza. Numbers followed by different letters indicate the effect of the mycorrhizal fertilizer given.

The results of research on plant height were also followed by observations of the stem diameter of cayenne pepper plants which showed a real influence on observations 6 and 23 WAP by the same treatment, namely, P$ with an average stem diameter produced of 5.74 mm at observations 6 and 6 WAP. 80 mm on observation 23 WAP. The research results obtained showed a real effect on plants with the comparison treatment (P0). This shows that Mycorrhizal biofertilizer has an effect on plant growth. This is thought to be the result of adding mycorrhizal fertilizer to increase nutrient uptake by plants, resulting in better plant growth and yield (Rosita et al., 2017). This also shows that the interaction between mycorrhizal fertilizer and the roots of cayenne pepper plants which are in symbiosis with mycorrhizae can increase the growth and production of cayenne peppers compared to without mycorrhizae (Abror & Mauludin, 2016). It is known that mycorrhizal plants are able to absorb nutrients well for plant development needs such as increasing plant height and plant stem diameter.

Stem diameter is an important parameter for plant growth. This is because tall plants without a large and sturdy stem diameter will increase the risk of the plant falling easily, especially when entering the generative phase (Madusari et al., 2018). This means that the more mycorrhiza given, the larger the plant stem diameter. One of the reasons why the increase in plant height and the diameter of plant stems is because the P element is available in sufficient conditions in the soil. Element P is known to be produced by mycorrhizal fertilizers in symbiosis with plant roots in the form of exudates. This is the same as the use of bacteria that trigger plant growth which also produces root exudates containing P elements which are important for plant growth (Tuhuteru et al., 2018). Because, the inoculant of nitrogen-fixing bacteria and phosphate-solubilizing bacteria has an effect on stem diameter of 0.4 mm (Permatasari & Nurhidayati, 2014) . For this reason, the more mycorrhizal treatment, the more P elements that can be absorbed by the plant.

It is known that phosphorus functions as a component of 1032 several enzymes and proteins, ATP, RNA, DNA and phytin. ATP is a compound involved in various energy transfer reactions in almost all plant metabolic processes, so that the element phosphorus plays a vital role in providing chemical energy involved in the production of heat, light and movement. The response of plants to this element is mainly seen in the root system, general growth, quality and total production (Hanafiah, 2013 cit Supriansyah et al., 2021).

This is in line with the results of previous research which shows that the use of arbuscular mycorrhiza plays a role in forming symbiotic associations in plant roots and helps plants absorb P (Herawati et al., 2021). Phosphorus is considered a key nutrient for plant growth and is necessary to maintain optimal crop production and quality. This element is important for cell division, reproduction and plant metabolism. In addition, its role is related to the acquisition, storage and use of energy (Adetya et al., 2018). Plants with mycorrhizae can absorb P, in quantities several times greater than plants without mycorrhizae, especially on P-poor soils. The working principle of this mycorrhizae is to infect the root system of the host plant, producing intensive hyphae networks so that plants containing mycorrhizae will be able to increase capacity to absorb nutrients (Abror & Mauludin, 2016).

Apart from that, it is also known that the increase in plant height is influenced by the nutrient N which plants need in large quantities or is known as a macro nutrient for plants because its availability affects the biomass between roots and stems. Apart from that, the existence of nutrient uptake factors for plant growth and development is also thought to be caused by the genetic characteristics of the plant. This is in accordance with the statement by Yulina et al., (2021) that plant height is influenced by the genetic characteristics or genotype of the plant and the environmental conditions in which the plant grows. For this reason, it is hoped that further research regarding the genetic characteristics of local Wamena cayenne pepper plants can be carried out. So, it can support any research results that take place in the local area.

The effect of applying mycorrhizal fertilizer can also be seen in the number of leaves and total chlorophyll content of cayenne pepper plants. The results of the research showed that there was a very real effect demonstrated by the P4 treatment

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

with an average number of leaves of 96, 67 with a total plant chlorophyll content of 5.31 mg/L (Table 2).

TABLE II: Observation of the Number of Leaves and Total Chlorophyll Content of Local Wamena Cayenne Pepper Plants

Treatment	Number of Leaves (pieces)	Total Chlorophyll Content (mg/L)
P0	50.74 [c]	2.56 [c]
P1	55.60 [bc]	3.45 [bc]
P2	77.42 [b]	4.67 [ab]
P3	80.22 [a]	5.30 [a]
P4	96.67 [a]	5.75 [a]

Description: P1 = 20 g mycorrhiza; P2 = 50 g mycorrhiza; P3 = 80 g mycorrhiza; P4 = 120 g mycorrhiza. Numbers followed by different letters indicate the effect of the mycorrhizal fertilizer given.

Judging from the large number of leaves, the amount of chlorophyll is also high, as seen in treatment P4 (120 g of mycorrhizal fertilizer). This is supported by the growth of cayenne pepper plants in this treatment which looks good and is an effective dose of mycorrhizal fertilizer. The number of leaves produced shows the plant's ability to photosynthesize more optimally. On the other hand, if a plant photosynthesizes well, it will produce a large number of leaves. According to (Pratiwi & Sega, 2018), the number of leaves on a plant is a manifestation of the results of photosynthesis, because in the vegetative phase the results of photosynthesis are partly allocated to the growth of the number of leaves. This is also supported by Proborini & Yusup, (2017) who stated that plants that actively photosynthesize will have a positive influence on increasing the number of leaves, plant weight, root weight and crown, so that mycorrhizal plants will have the number of leaves and plant weight. higher than non-mycorrhizal plants.

The highest number of leaves formed in the P4 treatment (120 g of mycorrhizal fertilizer) was 96.67 with a total chlorophyll content of 5.75 mg/L and had a significant effect on the comparison treatment (control/P0). This is thought to be due to high nutrient uptake in plants treated with mycorrhizal fertilizer. As stated by Clarah et al., (2017) that high nutrient uptake results in the rate of photosynthesis increasing so that plant growth and development also increases, which means the total amount of chlorophyll is also high. Plant photosynthetic activity is greatly influenced by leaf chlorophyll content, leaf area, amount of leaf chlorophyll and environmental factors (Saragih et al., 2021). Meanwhile, the control treatment (P0) showed the lowest number of leaves and the total chlorophyll content was also low, which is thought to be because the control plants (P0) did not receive a nutritional supply from mycorrhizal fertilizer, thus affecting the chlorophyll content.

Judging from the symbiotic process, the high level of chlorophyll shown by the P4 treatment indicates that the mycorrhizal spores given to the plant roots have entered the plant roots to help the plant in the process of absorbing plant nutrients. This was stated by Herawati et al., (2021) that mycorrhiza is a fungus that is able to enter plant roots to help meet the availability of nutrients for plants.

Apart from that, judging from the ability of leaves as plant organs that function in absorbing sunlight for the photosynthesis process (Zahara & Fuadiyah, 2021), a large number of leaves can maximize light absorption and assimilation. Thus, the plant's ability to carry out photosynthesis runs well because the process of absorbing solar energy is also high. If the number of leaves is large, it is clear that the amount of sun absorption is also high. If so, it will affect the vegetative growth of the plant. So that in the end it will affect the total chlorophyll amount of the plant.

Furthermore, the relationship between the number of leaves and the total chlorophyll of cayenne pepper plants is influenced by the number and size of cells which are triggered by the plant's ability to absorb nutrients to form carbohydrates. The presence of nitrogen elements from plant root exudates due to the symbiotic process of plants with mycorrhizal fungi, is thought to have a function in forming enzymes and chlorophyll molecules. Apart from nitrogen, another nutrient produced as a result of the symbiosis of plant roots with mycorrhiza is potassium which functions as an activator for various protein synthesis and carbohydrate metabolism enzymes. Then, the presence of phosphorus plays an active role in transferring energy in plant cells and

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

magnesium as a constituent of chlorophyll and helps translocate phosphorus in plants.

As a result of increasing chlorophyll, the photosynthate formed will become larger and encourage cell division and cell differentiation which is closely related to the increase in the number and size of plant organs. The results of photosynthesis will be translocated to areas of vegetative use, namely roots, stems and leaves which influence plant growth and development due to the ability of mycorrhiza to absorb P from mineral sources. P is difficult to dissolve because it produces organic acids and phosphatase enzymes. Plants given mycorrhiza can absorb high levels of N and P nutrients, because mycorrhiza will encourage the hyphae on the roots of the host plant to develop (Syamsiah et al., 2014). This is in line with the results of research by Basri, (2018) which states that good adaptation between mycorrhiza and plants shows good growth even in polluted areas and tropical areas. So, the higher the chlorophyll content, the rate of photosynthesis will also increase. Photosynthesis rate and chlorophyll content are growth benchmarks related to plant production (Proklamaningsih et al., 2012).

The high level of chlorophyll produced by plant leaves also has an impact on the plant production achieved. The results of the study showed a real influence on the number of fruits per plant by the P4 treatment (120 g mycorrhiza) on the control treatment with a total of 98.81 fresh fruits with an average fresh fruit weight per plant of 67.97 g (Table 3).

TABLE III: Observation of the fruit number at harvest per sample plant, fresh weight of fruit per sample plant, fresh weight of the plant and dry weight of plant

Treatment	Number of Fruits per Sample Plant (fruit)	Fresh Fruit Weight per Plant (g)	Total Plant Fresh Weight(g)	Total Plant Dry Weight (g)
P0	56.35 [c]	40 .56 [c]	16.43 [c]	8.02 [b]
P1	65.54 [b]	53.74 [b]	18.21 [b]	9.32 [b]
P2	72.76 [b]	48.12 [b]	18.47 [b]	9.33 [b]
P3	85.78 [a]	60.05 [ab]	18.45 [b]	9.54 [b]
P4	98.81 [a]	67.97 [a]	21.78 [a]	10.88 [a]

Description: P1 = 20 g mycorrhiza; P2 = 50 g mycorrhiza; P3 = 80 g mycorrhiza; P4 = 120 g mycorrhizal fertilizer. Numbers followed by different letters indicate the effect of the mycorrhizal fertilizer given.

The impact of providing mycorrhiza is not only visible in the vegetative phase of the plant, but also in the results achieved. This is related to the benefits of mycorrhiza in plants due to increased nutrient uptake, resistance to drought, production of growth hormones and growth regulators, protection from root pathogens and toxic elements (Basri, 2018). Apart from that, it is known to be related to the role of mycorrhiza in initiating the roots of its host plants in terms of absorbing phosphorus (P) and other nutrients such as N, K, Zn, Co, S and Mo from the soil and improving soil conditions both pH and soil organic matter content. due to increased activity of soil microorganisms. This occurs because of the symbiotic association between fungi and plants which colonize the plant root cortex tissue which occurs during the active growth period of the plant (Basri, 2018).

Increased plant production occurs at the root initiation stage of the host plant by releasing bound P so that it is available to the plant. P release occurs as a result of the absorption of P from soil mineral sources which are difficult to dissolve because they produce organic acids and phosphatase enzymes. Plants with mycorrhizae can absorb P in amounts several times greater than plants without mycorrhizae, especially on P-poor soil such as dry soil conditions on marginal land belonging to local Wamena farmers. This is found in various research facts that have been carried out which are thought to be due to the role of mycorrhizal fungi in increasing plant growth as well (Abror & Mauludin, 2016). This affects the amount of production achieved. Apart from that, the working principle of this mycorrhiza is to infect the root system of the host plant, producing an intensive network of hyphae so that plants containing mycorrhiza will be able to increase their capacity to absorb nutrients (Pareira et al., 2019; Lopang, et al., 2020).

This is in accordance with the statement of Rajmi et al., (2018), which states that Arbuscular Mycorrhizal Fungi

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

(AMF) can be used as an alternative in increasing the available P content in the soil, namely mycorrhizal hyphae release the enzyme phosphatase so that P bound in the soil will dissolved and available to plants and plant roots infected with mycorrhiza will cause more root growth, resulting in faster P absorption by plant roots. The increase in yield achieved also affects the fresh and dry weight of the plant.

For this reason, plants with 120 g mycorrhiza treatment (P4) were 17.60 g and showed a real effect from treatment without mycorrhiza (control). This is supported by plant physiological processes, especially the increased photosynthesis process (seen from the total amount of chlorophyll formed) (Afa et al., 2022). Then, as a result of increased plant growth, plant biomass also increases through the absorption of nutrients and this can happen because the symbiotic mechanism of fungi and plant roots supports more optimal plant growth so that there is an increase in the fresh weight of the plant, which means that the provision of mycorrhiza is able to increase the fresh weight of the plant (Rokhminarsi et al., 2022). For example, research results show that mycorrhizae are able to increase plant growth by increasing the absorption of nutrients in the form of N, P, K, Ca, Cu, Mn, and Mg (Saputri et al., 2020) , the absorbed nutrients play a role in cell division, increasing plant growth includes increasing size, volume, biomass and cell number (Saidah et al., 2019).

Furthermore, the addition of plant fresh weight biomass will have an impact on plant dry weight, which in the research results shows a real influence by P4 treatment (120 g mycorrhiza) with an average total plant dry weight of 10.88 g and a significant effect on comparison plants (Control). It is known that the dry weight of a plant is an indicator to determine the amount of water absorbed by the plant and the status of nutrients (Khumaira et al., 2020). It can be said that plants treated with 120 g of mycorrhiza absorb water and nutrients well. Apart from that, Lizawati et al., (2014) stated that the dry weight of plants is an indication of the protein content and other organic materials resulting from photosynthesis which can be deposited after plants whose water content is dried. The greater the dry weight of a plant, the more efficient the photosynthesis process takes place. In other words, it can be said that the high dry weight of plants can be related to the amount of carbohydrates produced in the photosynthesis process that takes place in plants. With the increase in photosynthate formed, the dry weight of plants increases because 90% of plant dry matter comes from photosynthesis, which was later proven by Ngadiani & Andriani, (2022) who tested *Gigaspora sp spores and propagules* . on cayenne pepper plants and affects the total dry weight of the plant. So it is said that it is relevant that the growth rate of cayenne pepper given inoculant is better than without inoculant (control), namely that it can increase dry weight through total weight compared to control.

The high fresh and dry weight of the plant is also influenced by the number of leaves planted, namely the more leaves produced, the greater the chance of producing a high fresh weight and total dry weight of the plant. The real influence of the use of mycorrhiza on increasing the total dry weight of plants is in line with the results of research on the use of mycorrhiza in soybean (Panataria et al., 2022) .

This is supported by Krisdayani et al., (2020) that giving mycorrhiza can increase the dry weight of plants because the activity of endomycorrhizal hyphae in absorbing P nutrients also occurs through the phosphatase enzyme produced by mycorrhiza. Next, usage Mycorrhiza is good for rice seedlings because it can increase plant growth and yield in limited soil water content (Mahmudi et al., 2023). Thus, the provision of mycorrhiza in this research on dry land conditions owned by farmers in Wamena City was able to increase the growth and yield of cayenne pepper plants. Thus, it can be said that measuring total plant biomass by measuring the wet weight and dry weight of the plant is the best parameter to use as a growth indicator.

IV. CONCLUSION

The use of mycorrhizal biological fertilizer is able to increase the productivity of local Wamena cayenne peppers on marginal land conditions, seen from the observed growth and yield of cayenne pepper plants as shown by the P4 treatment (120 g of mycorrhizal fertilizer). Growth shown is height, stem diameter, number of leaves, plant chlorophyll content, fruit number, fresh weight of fruit per plant, as well as fresh and dry weight of the plant. So that the use of mycorrhizal fertilizer even in limited conditions can increase the growth and yield of cayenne pepper plants and can be recommended for future farming systems.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

ACKNOWLEDGEMENT

We would like to express our thanks to the Directorate of Research, Technology, Community Service of the Republic of Indonesia for their budget contribution to this research so that this research can run as intended, and is proven through a research contract signed by the STIPER Petra Baliem Wamena Research and Community Service Institute through the Institute XIV Higher Education Services with No. 1032/LL14/PG.02.00.PL/2023 and between researchers and the STIPER Petra Baliem Wamena Research and Community Service Institute with No. 016.206/LP2M/STIPER-PBW/VII/2023.

REFERENCE

[1] Abror, M., & Mauludin, M. (2016). Effect of Arbuscular Vesicular Mycorrhiza on Phosphate Absorption Efficiency on Growth and Production of Cayenne Pepper (Capsicum frutescens L.). (In Indonesian). *Nabatia*, *12*(1), 56–61. http://ojs.umsida.ac.id/index.php/nabatia/article/view/484

[2] Adetya, V., Nurhatika, S., & Muhibuddin, A. (2018). The Effect of Mycorrhizal Fertilizers on the Growth of Cayenne Pepper (Capsicum frutescens) In Sand Soil. (In Indonesian). *Jurnal Sains Dan Seni ITS*, *7*(2), 2337–3520.

[3] Afa, L., Bahrun, A., Sutariati, G. A. K., & Syarif, A. (2022). The effect of Ameliorant on Growth and Yield of Cayenne pepper (Capsicum frutescens L.). (In Indonesian). *Jurnal Media Pertanian*, *7*(2), 148. https://doi.org/10.33087/jagro.v7i2.167

[4] Basri, A. H. H. (2018). Study of The Role of Mycorrhiza in Agriculture. (In Indonesian). *Agrica Ekstensia*, *12*, 74–78. https://www.polbangtanmedan.ac.id/upload/upload/jurnal/Vol 12-2/11 Arie Mikoriza.pdf

[5] BPS. (2023). *Vegetable Plant Production. Planting Production. (In Indonesia)*. https://www.bps.go.id/indicator/55/61/2/produksi-tanaman-sayuran.html

[6] Clarah, S., Budihastuti, R., & Darmanti, S. (2017). *Pengaruh Pertumbuhan , Ukuran Stomata dan Kandungan Klorofil Cabai Rawit (Capsicum frutescens Linn) Varietas Cakra Hijau*. *6*(2), 26–33.

[7] Febriyantiningrum, K., Oktafitria, D., Nurfitria, N., Jadid, N., & Hidayati, D. (2021). Potential of Arbuscular Vesicular Mycorrhiza (MVA) as Biofertilizer in Corn Plants (Zea mays). (In Indonesian). *Biota : Jurnal Ilmiah Ilmu-Ilmu Hayati*, *6*(1), 25–31. https://doi.org/10.24002/biota.v6i1.4131

[8] Herawati, Subaedah, S., & Saida. (2021). The Effect of Micoriza and Compost Applications on the Growth and Production of Soybeans. (In Indonesian). *Agrotekmas*, *2*, 54–63. https://jurnal.fp.umi.ac.id/

[9] Kamila, I. Y., Maharijaya, A., & Sobir. (2023). Genetic Variability and Stability Analysis of Chili in Three Environments. *Indonesian Journal of Agronomy*, *51*(2), 210–220.

[10] Khumaira, K., Yustendi, D. Y., & Puspita, D. E. (2020). Mycorrhiza and Growth of Cuttings Coffee Seeds. (In Indonesian). *Serambi Saintia : Jurnal Sains Dan Aplikasi*, *8*(2), 79–85. https://doi.org/10.32672/jss.v8i2.2420

[11] Krisdayani, P. M., Proborini, M. W., & Kriswiyanti, E. (2020). Effect of Bio-Fertilizer, Endomicorrhiza, Trichoderma spp., and Compost Combination on the Growth of Sengon Seedlings (Paraserianthes falcataria (L.) Nielsen). (In Indonesian). *Jurnal Sylva Lestari*, *8*(3), 400–410.

[12] Latief, N., Musa, N., & Pembengo, W. (2019). Effect of Frequency of Giving Water and Phonska Dosage on the Growth and Crop Yield of Chili (Capsicum frutescens L.). (In Indonesian). *JATT*, *8*(3), 330–336.

[13] Lizawati, Kartika, E., Alia, Y., & Handayani, R. (2014). The Effect of the Combination of Arbuscular Mycorrhiza Fungi Isolates On The Vegetative Growth of Jatropha cucrcas L. Planted on Post Coal Mining Land. (In Indonesian). *Biospecies*, *7*(1), 14–21.

[14] Lopang, A. I., Yusran, Umar, H., & Taiyeb, A. (2020). The Growth of Ketapang Seedling (Terminalia catappa L.) At Various Dosages of Arbuscular Mycorrhizal Fungi. (In Indonesian). *Warta Rimba*, *8*(2), 262–267.

[15] Madusari, S., Yama, D. I., Jumarjin, Liadi, B. T., & Baedowi, R. A. (2018). Effect of Arbuscular Mycorrhizal Fungal Inoculation on The Growth and

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(5), 109-118 | ISSN:2251-6727

Production of Chili (*Capsicum annum* L.). (In Indonesian). *Seminar Nasional Sains Dan Teknologi Fakultas Teknik UMJ*, *2*, 1–8.

[16] Mahanani, A. U., Tuhuteru, S., Haryanto, T. A. D., & Rif'an, M. (2020). Evaluasi Kesesuaian Lahan Padi Gogo Pada Tiga Kawasan Agroekosistem Di Kabupaten Jayawijaya. *Jurnal Tanah Dan Sumberdaya Lahan*, *7*(1), 77–86. https://doi.org/10.21776/ub.jtsl.2020.007.1.10

[17] Mahmudi, Iwan, S., & Ramadhan, T. H. (2023). Growth and yield of rice from mycorrhizal enrichment seedlings on different soil water content. *Indonesian Journal of Agronomy*, *51*(2), 173–180.

[18] Ngadiani, & Andriani, V. (2022). Arbuscula Mycorrhizal Fertilizer (AMF) Gigaspora sp. In Chili Breeding (Capsicum frutescens L.). (In Indonesian). *Bioscientist : Jurnal Ilmiah Biologi*, *10*(1), 218–225.

[19] Panataria, L. R., Sitorus, E., Saragih, M., & Sitorus, J. (2022). The effect of mycorrhizal and phosphorous fertilizer applications on soybean plant production (Glycine max L. Meriil). (In Indonesian). *Jurnal Agrotek Ummat*, *9*(1), 35. https://doi.org/10.31764/jau.v9i1.7043

[20] Pareira, M. S., Mansur, I., & Wulandari, D. (2019). Utilization of AMF and Host Plant to Increase The Growth of Sandalwood Seedlings (Santalum album Linn.). (In Indonesian). *Journal of Tropical Silviculture*, *9*(3), 151–159. https://doi.org/10.29244/j-siltrop.9.3.151-159

[21] Permatasari, A. D., & Nurhidayati, T. (2014). Effect of Inoculant Nitrogen Fixing Bacteria, Phosphate Dissolving Bacteria and Mycorrhizae from Condro Village, Lumajang, East Java on the Growth of Cayenne Pepper Plants. (In Indonesian). *Jurnal Sains Dan Seni ITS*, *3*(2), E-44-E-48. http://ejurnal.its.ac.id/index.php/sains_seni/article/view/6868

[22] Prastyo, K. A., & Laily, A. N. (2015). Leaf Chlorophyll Concentration Test of <i>Curcuma mangga,/i> Val., *Curcuma xanthorrhiza*, and *Curcuma aeruginosa* with Different Type Filter Paper Using Spectrophotometer. (In Indonesian). *PKLH-FKIP Uns*, *1*, 188–191.

[23] Pratiwi, A. J., Susila, D. A., & Suketi, K. (2022). Respon Tanaman Cabai Rawit (Capsicum frustescens L.) pada Sistem Irigasi Tetes Terhadap Aplikasi Nanosilika lewat Daun Response of Cayenne Pepper (Capsicum frutescens L.) Grown in Drip Irrigation System to Foliar Application of Nano Silica. *Buletin Agrohorti.*, *10*(3), 360–368.

[24] Pratiwi, A., & Sega, S. (2018). Keefektifan Pupuk Hayati Sebagai Upaya Peningkatan Produktivitas Kedelai (Glycine max) dan Unsur Hara Tanah. *Jurnal Agriekstensia*, *17*(1), 51–57.

[25] Proborini, M. W., & Yusup, D. S. (2017). Study on the Distribution of Endomycorrhizal Fungi in Some Species Root-Plants in Bali. *OnLine Journal of Biological Sciences*, *17*(4), 415–419.

[26] Proklamaningsih, E., Prijambada, I. D., Rachmawati, D., & Sancayaningsih, R. P. (2012). Laju Fotosintesis dan Kandungan Klorofil Kedelai pada Media Tanam Masam dengan Pemberian Garam Aluminium. *Agrotop*, *2*(1), 17–24.

[27] Puspitasari, S. A., & Indradewa, D. (2018). Growth and Yield Chrysanthemum (Dendranthema sp.) Bakardi Putih and Lolipop Ungu Under Additional Light. (In Indonesian). *Vegetalika*, *7*(4), 58. https://doi.org/10.22146/veg.41168

[28] Rajmi, S. L., Margarettha, & Refliaty. (2018). Increasing the Availability of P Ultisol by Administering Arbuscular Mycorrhizal Fungi. (In Indonesian). *Journal Agroecotania*, *1*(2), 42–48.

[29] Rochmana, N. F., & Ngadiani, N. (2020). Compare Test of Fish Liquid Waste, Azolla and Banana Peel Waste As Additional Nutrition for Quality Production of Cayene Chili (Capsicum frutencens L.). (In Indonesian). *STIGMA: Jurnal Matematika Dan Ilmu Pengetahuan Alam Unipa*, *10*(2), 16–24. https://doi.org/10.36456/stigma.vol10.no2.a1028

[30] Rokhminarsi, E., Hidayat, P., Febriani, A., & Leana, N. W. A. (2022). The Effect of Mycorrhizal-Trichoderma Fertilizer and Reducing Inorganic Fertilizer Doses on Growth and Yield of Tomato (Lycopersicum esculentum L.). (In Indonesian). *Agronomika (Jurnal Budidaya Pertanian Berkelanjutan)*, *21*(2), 10–18.

[31] Rosita, I., Wilarso B, S., & Wulandari, A. S. (2017). Effectiveness of Arbuscular Mycorrhizal Fungi and P Fertilizer on Seedling Growth of Leda (Eucalyptus deglupta Blume) at Post Mined Soil Media. (In Indonesian). *Jurnal Silvikultur Tropika*, *08*(2), 96–102.

[32] Saidah, L., Nurhatika, S., & Muhibuddin, A. (2019). The Role of VAM (Vesicular Arbuscular Mycorrhiza) on Photosynthetic Activity and Production of Osmoprotectants in Soybean Plants (Glycine max L.) in Dry Soil. (In Indonesian). *Jurnal Sains Dan Seni ITS*, *7*(2), E47–E52. https://doi.org/10.12962/j23373520.v7i2.37056

[33] Saputri, B., Sofyan, A., & Rabiatul, W. (2020). The Effect Of Biochar Oil Palm Empty Fruit Bunches And Arbuscular Mycorrhiza On Growth Of Hiyung Chili Plant (Capsicum frustescens L.) In Ultisol Soil. (In Indonesian). *EnviroScienteae*, *16*(2), 168–177.

[34] Saragih, M., Trizelia, Nurbailis, & Yusniwati. (2021). Aplikasi cendawan Beauveria bassiana melalui perendaman benih dan pengaruhnya terhadap kolonisasi dan kandungan klorofil daun tanaman cabai merah (Capsicum annuum L.). *Jurnal Pertanian Tropik*, *8*(2), 107–116. https://doi.org/10.32734/jpt.v8i2

[35] Supriansyah, Lasmini, S. A., & Hadid, A. (2021). Pertumbuhan dan Hasil Tanaman Cabai Rawit (Capsicum frutescens L .) pada Pemberian Limbah Cair Industri Tahu dan Pupuk Fosfor. *Jurnal Agrotekbis*, *9*(4), 1024–1033.

[36] Syamsiah, J., Sunarminto, B. H., Hanudin, E., & Widada, J. (2014). Effect of Arbuscular Mycorrizhal Fungi Inoculation on Glomalin, Growth and Rice Yield. (In Indonesian). *Sains Tanah – Jurnal Ilmu Tanah Dan Agroklimatologi*, *11*(1), 39–46.

[37] Tuhuteru, S., Sulistyaningsih, E., & Wibowo, A. (2018). Responses growth and yield of three shallot cultivars in sandy coastal land with PGPR (Plant Growth Promoting Rhizobacteria). *International Journal on Advanced Science, Engineering and Information Technology*, *8*(3), 849–855. https://doi.org/10.18517/ijaseit.7.6.1093

[38] Utari, D., & Rachmawati, D. (2022). Growth Response and Capsaicin Levels of Red Chili Pepper (Capsicum annuum L.) Against Drought and Arbuscular Mycorrhizae Application. (In Indonesian). *Vegetalika*, *11*(1), 63–77. https://doi.org/10.22146/veg.66916

[39] Yulina, N., Ezward, C., & Haitami, A. (2021). Characteristics of Plant Height, Age at Harvest, Number of Tillers and Harvest Weight of 14 Local Rice Genotypes. (In Indonesian). *Jurnal Agrosains Dan Teknologi*, *6*(1), 15. https://doi.org/10.24853/jat.6.1.15-24

[40] Zahara, F., & Fuadiyah, S. (2021). The Influence of Sunlight On The Photosynthesis Process. (In Indonesian). *Prosiding Seminar Nasional Biologi 2021*, *1*, 1–4. https://doi.org/https://doi.org/10.24036/prosemnasbio/vol1/2