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Effects of Mycorrhizal on The Growth and Yield of Cayenne Pepper (*Capsicum frutescens* L.)

Effects of Mycorrhizal on The Growth and Yield of Cayenne Pepper (*Capsicum frutescens* L.)

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ABSTRACT

Innovations are required to increase the production of cayenne pepper (*Capsicum frutescens* L), mainly due to the need for more quality land, such as dry land in Wamena. The innovation uses biological microorganisms that positively impact plants, such as arbuscular mycorrhizal fungi (AMF). Therefore, this experiment aimed to determine the response of the growth and yield of cayenne pepper plants cultivated in dry land to the application of mycorrhiza. The research was conducted using a completely randomized design with one factor: the mycorrhizae dose (0, 20, 50, 80, and 120 g). The research results were analyzed using ANOVA, and the analysis process continued with the 5% level DMRT test. The research results on the growth of cayenne pepper are visible in the plant height parameters of the 80 g treatment (75 DAP: 93.4 cm) and the 120 g treatment (95 DAP: 103.3 cm). Then, the stem diameter parameter showed a real influence by the 120 g mycorrhiza treatment at 35 and 75 DAP and the 80 g mycorrhiza treatment at 95 DAP. The excellent response of plants to the 80 g and 120 g mycorrhiza treatments also impacted the plant's total chlorophyll content and the number of leaves produced, which then impacted the number of productive branches. So, the effect on the yield of cayenne pepper plants is that the number of fruits treated with 80 g of mycorrhiza was 89.7 fruits, with the weight of the heaviest cayenne pepper fruit being 68.0 g by the treatment of 120 g of mycorrhiza with a fresh weight of 17.6 g and a total dry plant of 10.2 g compared to the control.

Keywords: arbuscular mycorrhiza, Biofertilizers, fungi, marginal land, Wamena

ABSTRAK

Diperlukan inovasi dalam meningkatkan produksi cabai rawit (*Capsicum frutescens* L), terutama karena kebutuhan lahan yang lebih berkualitas, seperti lahan kering di Wamena. Inovasi yang dimaksud menggunakan mikroorganisme hayati yang berdampak positif pada tanaman, seperti jamur mikoriza arbuskular (AMF). Penelitian ini bertujuan mengukur respons pertumbuhan dan hasil tanaman cabai rawit yang dibudidayakan di lahan kering terhadap aplikasi mikoriza. Penelitian menggunakan rancangan acak lengkap dengan satu faktor, yaitu dosis mikoriza (0, 20, 50, 80, dan 120 g). Hasil penelitian dianalisis menggunakan ANOVA, dan dilanjutkan dengan uji DMRT kadar 5%. Hasil penelitian tentang pertumbuhan cabai rawit terlihat pada parameter tinggi tanaman perlakuan 80 g (75 DAP: 93,4 cm) dan perlakuan 120 g (95 DAP: 103,3 cm). Parameter diameter batang menunjukkan pengaruh nyata dengan perlakuan mikoriza 120 g pada DAP 35 dan 75 dan perlakuan mikoriza 80 g pada DAP 95. Respons tanaman yang baik terhadap perlakuan mikoriza 80 g dan 120 g juga berdampak pada kandungan klorofil total tanaman dan jumlah daun yang dihasilkan yang kemudian berdampak pada jumlah cabang produktif. Jadi, efek pada hasil tanaman cabai rawit adalah bahwa jumlah buah yang diberi perlakuan dengan 80 g mikoriza adalah 89,7 buah dengan bobot buah terberat adalah 68,0 g dengan perlakuan 120 g mikoriza dengan bobot segar 17,6 g dan total tanaman kering 10,2 g dibandingkan dengan kontrol.

Kata kunci: Biofertilizer, cendawan, lahan marginal, mikoriza arbuskular, Wamena

INTRODUCTIONS

Cayenne pepper (*Capsicum frutescens* L.) is a horticultural crop commodity that has high economic value. Cayenne pepper is widely used as a seasoning ingredient, the main ingredient for the sauce industry, the chili powder industry, the instant noodle industry, to the pharmaceutical industry (Rochmana & Ngadiani 2020). Cayenne pepper is also known to contain essential oils which give a spicy taste and are in great demand by the people of Indonesia. On the other hand, chili also has the opportunity as an export commodity and can increase farmers' income. The need for chilies increases yearly in line with the increasing population and the development of industries that require raw materials for cayenne

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pepper. The need for cayenne pepper continues to increase, as data from the Central Statistics Agency (BPS) records that cayenne pepper production in Indonesia will be 1.55 million tons in 2022. This number has increased by 11.5% compared to the previous year, 1.39 million tons. Papua is one of the suppliers of cayenne pepper, with a production of 4,335 tons, with the total consumption of cayenne pepper in Indonesia reaching 569,650 tons in 2022; this figure has increased by 7.86% or as much as 41,510 tons compared to 2021 and is the highest amount of cayenne pepper consumption in this period last five years. It means that the demand for cayenne pepper is getting higher (BPS 2023). So, it requires innovations in increasing the production of cayenne pepper, especially due to the lack of quality land, such as dry land in Wamena. *Cayenne pepper* is an important vegetable crop that most people consume. Cayenne pepper production is also influenced by varieties and low adaptability to grow in different environments (Kamila *et al.* 2023).

Cayenne pepper (*Capsicum frutescens* L.) is a horticultural crop commodity that has high economic value. The pepper is widely used as a seasoning ingredient, the main ingredient for the sauce industry, the chili powder industry, the instant noodle industry, and the pharmaceutical industry (Rochmana & Ngadiani 2020). The product is also known to contain essential oils that have a spicy taste and are in great demand by the people of Indonesia. On the other hand, chili also has the opportunity as an export commodity and can increase farmers' income. The need for chilies increases yearly in line with the increasing population and the development of industries that require raw materials for cayenne pepper. The need for it continues to increase, as data from the Central Statistics Agency (BPS) records that cayenne pepper production in Indonesia will be 1.55 million tons in 2022. This number has increased by 11.5% compared to the previous year, 1.39 million tons. Papua is one of the suppliers of cayenne pepper, with a production of 4,335 tons, with the total consumption of cayenne pepper in Indonesia reaching 569,650 tons in 2022; this figure has increased by 7.86%, or as much as 41,510 tons compared to 2021, and is the highest amount of cayenne pepper consumption in this period of the last five years. It means the demand for cayenne pepper is increasing (BPS 2023). So, innovations are required to increase the production of cayenne pepper, mainly due to the need for more quality land, such as dry land in Wamena. *Cayenne pepper* is an important vegetable crop that most people consume. Cayenne pepper production is also affected by varieties and their low adaptability to grow in different environments (Kamila *et al.* 2023).

The low production of cayenne pepper in Wamena is caused by decreased soil fertility as a result of the farmers' land being classified as marginal, namely dry and sandy loam in nature which cannot be avoided, and land management that does not pay attention to its sustainability aspects. Therefore, efforts are needed to improve land management that can support the sustainability of crop production. One effort can be made using soil microorganism inoculums (Herawati *et al.* 2021). The use of soil microorganisms, also known as biological fertilizers, adds certain nutrients or facilitates the availability of nutrients in the soil for plants (Herawati *et al.* 2021). The provision of nutrients takes place through symbiotic or non-symbiotic relationships. One of the widely used biological fertilizers is Arbuscular Mycorrhiza which forms a symbiotic association with plant roots and functions to assist P absorption by plants.

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Mycorrhiza helps plants absorb water and certain nutrients in the soil that 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 growth hormone production, increasing the rate of photosynthesis, and increasing the osmotic pressure of cells experiencing salinity stress and drought (Utari & Rachmawati 2022). In addition, mycorrhiza can also be used as a bioindicator to determine environmental quality (Febriyantiningrum *et al.* 2021). Giving mycorrhiza at 6 g/plant has increased the yield of cayenne pepper plants planted in sandy soil. However, cayenne pepper planted in soil media still provides better growth than sandy soil (Adetya *et al.* 2018).

Mycorrhiza helps plants absorb water and certain nutrients in the soil that plants use in metabolic processes in their bodies. Furthermore, mycorrhiza's results on plant metabolism are used as a source of nutrients (Puspitasari & Indradewa 2018). Arbuscular mycorrhizal fungi positively impact plant growth by stimulating growth hormone production, increasing the rate of photosynthesis, and increasing the osmotic pressure of cells experiencing salinity stress and drought

(Utari & Rachmawati 2022). In addition, mycorrhiza can also be used as a bioindicator to determine environmental quality (Febriyantiningrum *et al.* 2021). Giving mycorrhiza at 6 g/plant has increased the yield of cayenne pepper plants planted in sandy soil. However, cayenne pepper planted in soil media still provides better growth than sandy soil (Adetya *et al.* 2018).

Dry land is the impact of the drought that has hit Wamena in the last few months. It is a serious problem for agriculture because it directly or indirectly impacts agricultural output. This is because water plays an important role in plant growth and development. If plants lack water, it will reduce turgor pressure in the cells and directly decrease 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, this research is important to study the response of growth and yield of cayenne pepper cultivated in dry land to mycorrhiza.

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MATERIAL AND METHOD

The materials used in this study were cayenne pepper seeds purchased at the Wamena farm shop, water, polybags measuring 25 cm x 25 cm, soil, cow dung compost, and arbuscular mycorrhizal fertilizer stamp MycoVir obtained from the farm shop. The main tools used in this study were digital scales, spectrophotometers, rulers, calipers, and fangs. This research was carried out in June–August 2023 in a homemade Plastic House and Plant Science Laboratory, Faculty of Agriculture, Halu Oleo University Kendari. The method used in this study was experimental with a non-factorial, completely randomized design (CRD). The factor tested was the level of mycorrhizae, namely the application of mycorrhizae at different doses (0 g (Control), 20 g, 50 g, 80 g, and 120 g). Each treatment with six replications. The analysis was continued with the ANOVA test, which, if the research results showed a significant effect, then would be continued with Duncan's test at the 5% level using the SAS 9.0 program.

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Mycorrhiza treatment is given when the plants are 30 DAP (days after planting) or when transplanting by mixing directly in the planting medium before filling it into each polybag that has been prepared according to the specified treatment. Furthermore, variables observed included plant height, stem diameter, productive of branches number, fruit number and fruit weight per plant, and total chlorophyll content of leaves. Chlorophyll content was measured when the plants were 80 DAP while plant height and stem diameter were measured when the plants were 35, 75, and 95 DAP. The number of fruits and fruit weight were measured at the time of harvesting.

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Chlorophyll content was measured on the leaves of cayenne pepper using a spectrophotometer. The leaves are mature in the first primary branch of each bird's eye chili plant. After that, 0.1 g of cayenne pepper leaf sample was mixed in a mortar with 10 mL of 80% acetone after the leaves were completely dissolved, filtered through 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 a wavelength of 645 nm and 663 nm (Prastyo & Laily 2015). Total chlorophyll content ($mg.L^{-1}$) was calculated using the formula: Total Chlorophyll = 17.3xA645 + 7.18 x A663. Then 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/g.

Chlorophyll content was measured on the leaves using a spectrophotometer. The leaves were mature in the first primary branch of each bird's eye chili plant. After that, 0.1 g leaf sample was mixed in a mortar with 10 mL of 80% acetone after the leaves were dissolved entirely, filtered through 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 a wavelength of 645 nm and 663 nm (Prastyo & Laily 2015). Total chlorophyll content ($mg.L^{-1}$) was calculated using the formula: Total Chlorophyll = 17.3 ×A645 + 7.18 × A663. Then, the results of calculating the total chlorophyll content from the formula were converted into units of mg/g with the formula: (1/100 × total chlorophyll content)/ 0.1 mg/g.

In the Analysis of Variance, if the calculated F is greater than the F_{table} or the probability (sig) is <0.05, then H0 is rejected, and H1 is accepted (Utari & Rachmawati 2022). Further tests were conducted by comparing the treatment mean (post hoc) multiple range test or DMRT (Duncan).

RESULT AND DISCUSSION

The observations of plant growth showed a significantly different effect on the height of the cayenne pepper after being analyzed using variance. The results showed no significant effect on the 35-day observation, while the 75 and 95-day observation pads showed a significant effect by the mycorrhizal treatment of 80 g (75 DAP) and 120 g (95 DAP). It was also seen in the observation of stem diameter, which showed a significant effect by treating 120 g mycorrhizae (at 35 and 75 DAP). In the 95 DAP observation, the 80 g mycorrhizal treatment showed a significant effect, which was not significantly different from the 120 g mycorrhizal treatment. The results of observations after further testing DMRT at the 5% level can be seen in Table 1.

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This is supported by the results of analysis of the nutrient content of the soil (Table 2). The increase in height and diameter of cayenne pepper stems is caused by the addition of mycorrhiza in the planting area which causes the soil to become loose so that the nutrient absorption cycle by the plant roots occurs well. Nasution et al. (2019) report of stated that nutrient uptake would be more effective by adding mycorrhizal biofertilizers, resulting in better plant growth and yields (Rosita *et al.* 2017). It has been proven by Abror & Mauludin (2016) research which states that cayenne pepper plants that have a symbiosis with mycorrhiza can increase the growth and production of cayenne pepper compared to

Table 1 The results of observations of cayenne pepper plant height and stem diameter at 35, 75, and 95 DAP

Mycorrhiza dose (g per polybag)	Plant height (cm)/DAP			Stem diameter (mm)/DAP		
	35	75	95	35	75	95
0	60.5	85.7b	94.5b	6.6a	8.6a	9.9c
20	67.8	83.7b	96.4b	3.4b	9.1ab	10.5bc
50	61.1	86.5b	102.4a	7.2a	10.3a	11.7b
80	61.2	93.4a	101.5ab	6.3ab	10.0a	13.0a
120	60.3	92.4a	103.3a	14.7a	10.8a	12.9ab

Description: Numbers followed by different letters are significantly different according to the DMRT test at the 5% level.

Table 2 Result of soil chemical analysis

Component	Treatments (g)				
	0	20	50	80	120
pH H_2O	5.570	4.650	4.800	5.000	5.010
C-Organic (ppm)	2.190	2.831	3.010	3.027	3.870
N-Available (ppm)	2.370	2.440	2.560	3.020	3.740
N-Total (ppm)	0.410	1.040	1.870	1.430	2.540
P-Available (ppm)	14.960	15.610	17.830	18.630	20.570
BO (%)	3.780	5.450	5.590	6.230	6.480

Source: Soil Science Laboratory Analysis, UHO Kendari (2023).

those without mycorrhiza. In addition, mycorrhizal plants can increase the diameter of the plant stem. Stem diameter is an important parameter for plant growth. Because plants that are tall with a small stem diameter will be at risk of the plant falling easily, especially when entering the generative phase (Madusari *et al.* 2018). The more mycorrhizae are given the larger the plant stem's diameter. One of the reasons for the large stem diameter is the availability of P elements in the soil. The more mycorrhizal treatments, the more P elements that plants can absorb. The results of the soil P analysis that has been carried out show that the availability of P in the 120 g/polybag treatment is 20.57 ppm (Table 2). It is supported by research conducted by Permatasari & Nurhidayati (2014), which also stated that N-fixing bacteria and phosphate-dissolving bacteria affected a stem diameter of 0.4 mm.

It is supported by the results of the soil's nutrient content analysis (Table 2). The increase in height and diameter of cayenne pepper stems is caused by the addition of mycorrhiza in the planting area, which causes the soil to become loose so that the nutrient absorption cycle by the plant roots occurs well. Nasution et al. (2019) stated that nutrient uptake would be more effective if mycorrhizal biofertilizers were added, resulting in better plant growth and yields (Rosita *et al.* 2017). It has been proven by Abror & Mauludin (2016) that cayenne pepper plants that have a symbiosis with mycorrhiza can increase the growth and production of cayenne pepper compared to those without mycorrhiza. In addition, mycorrhizal plants can increase the diameter of the plant stem. Stem diameter is an essential parameter for plant growth. Plants that are tall with a small stem diameter will be at risk of falling quickly, especially when entering the generative phase (Madusari *et al.* 2018). The more mycorrhizae were given, the more significant the plant stem's diameter. One of the reasons for the large stem diameter is the availability of P elements in the soil. The more mycorrhizal treatments are used, the more P elements plants can absorb. The results of the soil P analysis that has been carried out show that the availability of P in the 120 g/polybag treatment was 20.57 ppm (Table 2). It is supported by Permatasari & Nurhidayati (2014), which also stated that N-fixing and phosphate-dissolving bacteria affected a stem diameter of 0.4 mm.

It shows that systematically, the average growth of cayenne pepper that was given mycorrhiza significantly gave higher plant height and stem diameter by the treatment of 120 g/polybag compared to without mycorrhiza (Control), which means that giving mycorrhiza as much as 120 g/polybag can increase growth. vegetative of cayenne pepper plants. Based on research by Jamilah *et al.* (2017), it is known that the treatment of mixed MVA (*Acaulospora* sp*., Glomus* sp*.,* and *Gigaspora decipiens*) can increase the growth of red chilies. Then, the use of arbuscular mycorrhizae is known to play a role in forming symbiotic associations in plant roots and helping plants absorb P by plants (Herawati *et al.* 2021).

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Plant height is affected by N and P nutrients, as can be seen from the amount of N and P content in the soil of the area where the plants grow (Tabel 2). N elements are needed by plants in the largest quantities, and their availability affects the biomass between roots and stems. Phosphorus is a key nutrient for plant growth and is required 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).

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Plants with mycorrhizae can absorb P in quantities several times greater than plants without mycorrhizae, especially in soils that are poor in P (Table 2). The working principle of this mycorrhiza is to infect the root system of the host plant, producing hyphae intensively so that plants containing these mycorrhizae will be able to increase their capacity to absorb nutrients (Abror & Mauludin 2016). Furthermore, the differences in plant heights which were not significantly different at 35 DAP observations, were thought to be caused by plant genetic traits. It follows Yulina (2021) that plant height is influenced by genetic traits or plant genotype and environmental conditions for the growth of these plants. Besides affecting the parameters of plant height and stem diameter, mycorrhizal treatments also affected the average leave number, chlorophyll content, and the productive of branches number of cayenne pepper.

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Table 3, the average leave number of cayenne pepper aged 42 DAP was significantly higher than without mycorrhiza, which also affected the total chlorophyll content and the productivity of branches number. It is known that the ability of plants to photosynthesize more optimally is influenced by the leaf number formed.

In Table 3, the average leaf number of cayenne pepper aged 42 DAP was significantly higher than without mycorrhiza, which also affected the total chlorophyll content and the productivity of branch numbers. It is known that the ability of plants to photosynthesize more optimally is influenced by the leaf number formed.

The results of the current study showed that the left number formed had a significant effect on the treatment without mycorrhiza (Table 3). (Proborini & Yusup 2017) stated that plants that actively photosynthesize would have a positive effect on increasing the leave number, plant weight, root weight, and crown so that mycorrhizal plants will have a higher leave number and plant weight than non-mycorrhizal plants.

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The leave number total chlorophyll content, and productive of branches number showed a significant effect by giving 120 g of mycorrhiza (Table 3). The highest leaf number is 106.7 with a total chlorophyll content of 5.3 mg.L^{-1} and has some productive branches number or those that produce flowers and fruit, as many as 12.8 branches. It is presumably due to the presence of mycorrhizae which is significantly higher than without mycorrhizae due to the ability of mycorrhizae to increase nutrient availability for plants. This was proven by the results of soil chemical analysis which showed differences in nutrient content such as organic matter, N-total, available N, and P-available (Table 2).

The leaf number, total chlorophyll content, and productive branch number showed a significant effect by giving 120 g of mycorrhiza (Table 3). The highest leaf number was 106.7, with a total chlorophyll content of 5.3 mg.L^{-1}, and has some productive branch numbers, such as those that produce flowers and fruit, as many as 12.8 branches. It is presumably due to the presence of mycorrhizae, which is significantly higher than without mycorrhizae due to the ability of mycorrhizae to increase nutrient availability for plants. It was proven by the results of soil chemical analysis, which showed differences in nutrient content such as organic matter, N-total, available N, and P-available (Table 2).

Mycorrhiza is a microorganism that can help plants absorb nutrients from the soil. According to Herawati *et al*. (2021), mycorrhiza is a fungus that can enter plant roots to help meet the availability of nutrients for plants. Leaves have a role in absorbing solar radiation for photosynthesis (Zahara & Fuadiyah 2021).

The left number could maximize light absorption and assimilation. Thus, the ability of plants to carry out photosynthesis is largely determined by the good absorption of solar energy by the leaves of the cayenne pepper. If the leave number 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, such as the number of leaves that appear. So, it is thought to affect the total chlorophyll amount of plants. Leaves are an important part of a plant because they are where photosynthesis takes place, and the consequences impact the productivity of branch numbers in a plant. Furthermore, it

Table 3 Leave number, plant chlorophyll content, and productive of branches number

Mycorrhiza dose (g per polybag)	Leave number (strands)	Total chlorophyll content (mg.L^{-1})	Productive of branches number (branch)
0	50.8c	2.8c	6.9c
20	65.6bc	3.6bc	9.5ab
50	87.4ab	4.4ab	7.6bc
80	100.2a	5.3a	11.4a
120	106.7a	5.3a	12.8a

Description*:* Numbers followed by different letters are significantly different according to the DMRT test at the 5% level.

can affect the amount of leaf chlorophyll, especially the N nutrient (Afa *et al.* 2022). Nitrogen is one of the essential nutrients for plants, so it is very important for their growth and development (Fathin *et al.* 2019).

The leaf number could maximize light absorption and assimilation. Thus, the ability of plants to carry out photosynthesis is primarily determined by the excellent absorption of solar energy by the leaves of cayenne pepper. If the leaf number is high, it is clear that the amount of sun absorption is also high. If so, it will affect the plant's vegetative growth, such as the number of leaves that appear. So, it is thought to affect the total chlorophyll content of plants. Leaves are an essential part of a plant because they are where photosynthesis occurs, and the consequences impact the productivity of branch numbers in a plant. Furthermore, it can affect the amount of leaf chlorophyll, especially the N nutrient (Afa *et al.* 2022). Nitrogen is one of the essential nutrients for plants, so it is very important for their growth and development (Fathin *et al.* 2019).

The photosynthesis results are translocated to vegetative utilization areas, namely roots, stems, and leaves which affect plant growth and development due to the ability of mycorrhiza to absorb P from P mineral sources which are difficult to dissolve because they produce organic acids and phosphatase enzymes. Plants treated with mycorrhizae can absorb high levels of N and P nutrients because mycorrhizae will encourage hyphae on the roots of mining plants to develop (Syamsiah *et al.* 2014). It is in line with the results of research by Basri (2018) stating that good adaptation among mycorrhizae has good adaptability and growth even in polluted areas and tropical areas.

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The high leaf chlorophyll produced, in addition to having an impact on the number of real productive branches number, also has an impact on the results achieved. The results showed a significant effect of the 80 g mycorrhiza treatment on the control treatment, with a total of 89.7 fresh fruit and not significantly different from the 120 g mycorrhiza treatment (87.1 fruit). The resulting weight was also significantly affected by 120 g mycorrhiza treatment, with a fruit weight of 68.0 g per sample plant (Table 4).

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The impact of giving mycorrhiza is seen in the plant's vegetative phase and the results achieved. It is related to the benefits of mycorrhiza in the host plants due to increased nutrient uptake, resistance to drought, production of growth hormones and growth regulators, and protection from root pathogens and toxic elements. Meanwhile, fungi benefit from the supply of photosynthetic products and places to grow (Basri, 2018). It is caused by the symbiotic association between fungi and plants that colonize the root cortex tissue of plants and occurs during the plant's active growth period (Basri 2018). Picture of the fruit for each treatment at first harvest are as follows (Figure 1).

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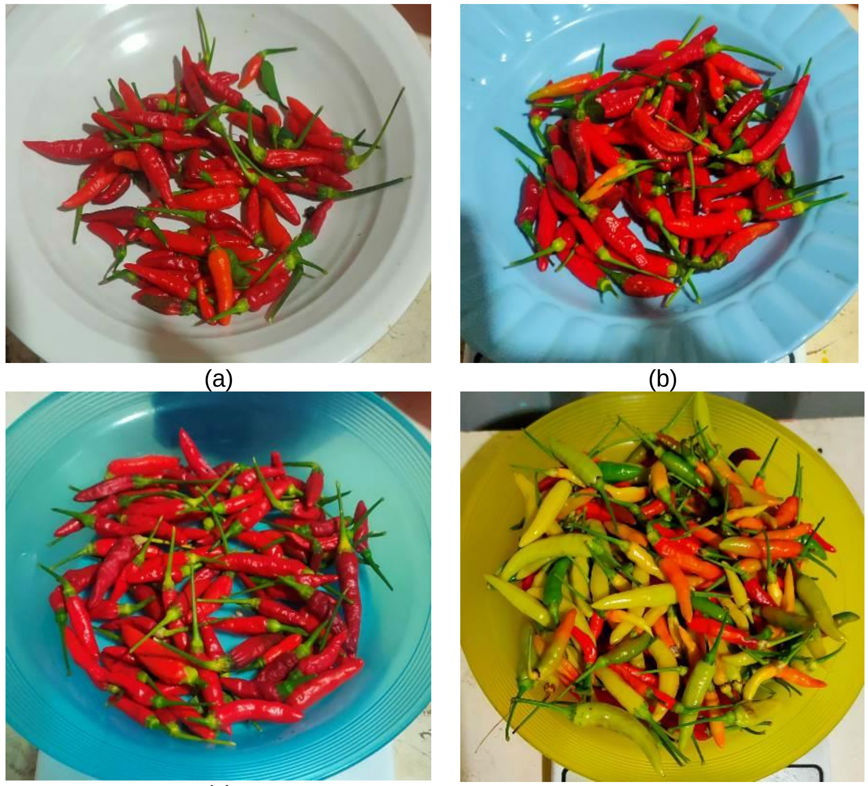
Table 4 Observation of fruit amount at harvest per sample plant, fruit fresh weight per sample plant, plant fresh weight, and plant dry weight

Mycorrhiza dose (g per polybag)	Total fruit number per plant	Fruit fresh weight per plant (g)	Plant fresh weight (g)	Plantwdry Weight (g)
0	53.5c	41.7b	15.5b	8.0b
20	62.0b	51.9ab	16.8a	9.7b
50	73.5b	45.3ab	16.4a	9.3b
80	89.7a	60.1ab	16.8a	9.6b
120	87.1ab	68.0a	17.6a	10.2a

Descriotion*:* Numbers followed by different letters are significantly different according to the DMRT test at the 5% level.



(a) (b)

(c) (d)

Figure 1 The first harvest of cayenne pepper with the treatment of mycorrhiza. a) Treatment of 0 g Mycorrhiza, b) Treatment of 50 g Mycorrhiza, c) Treatment of 80 g Mycorrhiza, and d) Treatment of 120 g Mycorrhiza.

and occurs during the plant's active growth period (Basri 2018). The fruit for each treatment at first harvest is depicted in Figure 1.

It is found in various research facts that have been conducted, which are suspected to be due to the role of mycorrhizal fungi in increasing plant growth (Abror & Mauludin 2016). It affects the amount of production achieved. In addition, the working principle of mycorrhizae is to infect the host plant's root system, producing hyphae intensively so that plants containing mycorrhizae will be able to increase their capacity to absorb nutrients (Pareira *et al.* 2019; Lopang *et al.* 2020).

It follows the previous statement by Rajmi et al. (2018), which stated that Arbuscular Mycorrhizal Fungi (AMF) could be used as an alternative in increasing the available P-content in soil, namely mycorrhizal hyphae secrete phosphatase enzymes so that P bound in the soil will be dissolved and available to plants, and plant roots infected with mycorrhiza will cause more root growth, resulting in faster absorption of P by plant roots. The increase in yield also affected the plants' fresh and dry weight.

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The results showed that the treatment of mycorrhiza (120 g) was 17.6 g and showed a significant effect of the treatment without mycorrhiza (control). It is supported by plant physiological processes, especially photosynthesis, which increases (seen from the total amount of chlorophyll formed) (Afa *et al.* 2022). Then, as a result of an increase in plant growth, plant biomass also increases through nutrient uptake, which is absorbed, and this can occur because the symbiotic mechanism of fungi and plant roots supports more optimal plant growth so that there is an increase in plant fresh weight, which means that giving mycorrhiza can increase plant fresh weight (Rokhminarsi *et al.* 2022). Like, research results show that mycorrhiza can 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), absorbed nutrients play a role in cell division, increasing plant growth, including increasing size, volume, biomass and number of cells (Saidah *et al.* 2019).

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which increases (seen from the total amount of chlorophyll formed) (Afa *et al.* 2022). Then, because of an increase in plant growth, plant biomass also increases through nutrient uptake, which is absorbed, and this can occur because the symbiotic mechanism of fungi and plant roots supports more optimal plant growth so that there is an increase in plant fresh weight, which means that giving mycorrhiza can increase plant fresh weight (Rokhminarsi *et al.* 2022). Likewise, research results show that mycorrhiza can 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); absorbed nutrients play a role in cell division, increasing plant growth, including increasing size, volume, biomass, and number of cells (Saidah *et al.* 2019).

The same thing was also seen in the plant dry weight parameter, which showed a significant effect by 120 g mycorrhiza treatment, resulting in a total plant dry weight of 10.2 g compared to the control. It is known that a plant's dry weight is an indicator to determine the amount of water content absorbed by plants and nutrient status (Khumaira *et al.* 2020). Therefore, plants with 120 g of mycorrhizal treatment absorbed water and nutrients well. According to Lizawati *et al.* (2014), plant dry weight indicates the protein and other organic matter resulting from photosynthesis, which can be precipitated after plants whose water content is dried. The greater the dry weight of a plant, the more efficient the photosynthesis process takes place. These results are supported by the research of Ngadiani & Andriani (2022), who tested the spores and propagules of *Gigaspora* sp. Cayenne pepper affects the total dry weight of plants so that it is said to be relevant to the growth rate of cayenne pepper plants, which are given an inoculant better than without inoculant (control), which can increase dry weight through total weight compared to the control.

The same thing was also seen in the plant dry weight parameter, which showed a significant effect of the 120 g mycorrhiza treatment, resulting in a total plant dry weight of 10.2 g compared to the control. It is known that a plant's dry weight is an indicator to determine the amount of water content absorbed by plants and nutrient status (Khumaira *et al.* 2020). Therefore, 120 g of mycorrhizal-treated plants absorbed water and nutrients well. According to Lizawati *et al*. (2014), plant dry weight indicates the protein and other organic matter resulting from photosynthesis, which can be precipitated after plants' water content is dried. The greater the dry weight of a plant, the more efficiently the photosynthesis process takes place. These results are supported by the research of Ngadiani & Andriani (2022), who tested the spores and propagules of *Gigaspora* sp. Cayenne pepper affects the total dry weight of plants so that it is said to be relevant to the growth rate of cayenne pepper plants, which are given an inoculant better than without an inoculant (control), which can increase dry weight through total weight compared to the control.

Then, the amount of plant fresh and dry weight is also influenced by the number of planting leaves, i.e., the more the leaves number produced, the more likely it is to produce higher fresh weight and total plant dry weight. The existence of a significant effect of using mycorrhizae on increasing the total dry weight of plants is in line with the results of research using mycorrhizae on soybean plants (Panataria *et al.* 2022). It is supported by Krisdayani *et al.* (2020) that treatment of mycorrhizae can increase plant dry weight because the activity of endomycorrhizal hyphae in absorbing nutrient P also occurs through the phosphatase enzyme produced by mycorrhizae. Furthermore, mycorrhiza is good for rice nurseries because it can increase plant growth and yield in limited soil water content (Mahmudi *et al.* 2023). Thus, the treatment of mycorrhiza in this study on dry land conditions owned by farmers in Wamena City increased the growth and yield of cayenne pepper plants.

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CONCLUSION

The mycorrhiza treatment had a good impact on increasing the growth and yield of cayenne pepper compared to without mycorrhiza. The results of research on the growth of cayenne pepper are clearly visible in the plant height parameters of the 80 g treatment (75 DAP: 93.4 cm) and the 120 g treatment (95 DAP: 103.3 cm). Then, the stem diameter parameter showed a real influence by the 120 g mycorrhiza treatment at 35 and 75 DAP and the 80 g mycorrhiza treatment at 95 DAP. The good response of plants to the 80 g and 120 g mycorrhiza treatments also had an impact on the total chlorophyll content of the plant and the number of leaves produced which then had an impact on the number of productive branches. So, the effect on the yield of cayenne pepper plants is that the number of fruits treated with 80 g of mycorrhiza was 89.7 fruits with the weight of the heaviest cayenne pepper fruit being 68.0 g by the treatment of 120 g of mycorrhiza with a fresh weight of 17.6 g and a total dry plant of 10.2 g compared to the control.

The mycorrhiza treatment had a good impact on increasing the growth and yield of cayenne pepper compared to without mycorrhiza. The results of research on the growth of cayenne pepper are clearly visible in the plant height parameters of the 80 g treatment (75 DAP: 93.4 cm) and the 120 g treatment (95 DAP: 103.3 cm). Then, the stem diameter parameter showed a real influence by the 120 g mycorrhiza treatment at 35 and 75 DAP and the 80 g mycorrhiza treatment at 95 DAP. The good response of plants to the 80 g and 120 g mycorrhiza treatments also had an impact on the total chlorophyll content of the plant and the number of leaves produced which then had an impact on the number of productive branches. Hence, the effect on the yield of cayenne pepper plants is that the number of fruits treated with 80 g of mycorrhiza was 89.7 fruits with the weight of the heaviest cayenne pepper fruit being 68.0 g by the treatment of 120 g of mycorrhiza with a fresh weight of 17.6 g and a total dry plant of 10.2 g compared to the control.

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