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RESEARCH ARTICLE

IMPACT OF MYCORRHIZA FUNGI ISOLATED FROM WEED PLANTS ON GROWTH OF PEPPER PLANT SEEDLING (*Piper nigrum* L.) AND INCIDINCE OF STEM ROT DESEASE (*Phytophthora capsici*) IN NET HOUSE TREATMENT

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ABSTRACT

This study aims to determine the effect of mycorrhiza fungi porpagules on growth of the pepper plant seedling and incidences of plant rot disease. Study was conducted in net house located in Sindang Kasih of village, District of Ranomeeto Barat, Regency of South Konawe, Province of Southeast Sulawesi and Laboratory of the Faculty of Forestry and Environmental Science Halu Oleo University Kendari, Indonesia. This research is compiled using a randomized design completelly (RDC) with two treatments combination: fungi mycorrhiza (FM) with four levels and *Phytophthora capsici* (Pc) with three levels. The variables observed for results were plant height, number of leaves, number of tendrils, dry plant weight, incidences of disease and percentage of mycorrhiza fungi infection on plant roots. Results of study revealed that mycorrhiza fungi inoculation 10 g polybag^{-1} and *P.capsici* inoculum 15 g polybag^{-1} (A_2B_1) can promote the growth of plant height, number of leaves, number of trindles in 70 DAT and dry plants weight. Mycorrhiza fungi inoculation 20 g polybag^{-1} and *P.capsici* inoculum 10 g polybag^{-1} (A_3B_2) cause disease incidences is lowest at 5th week is 24.30%. Mycorrhiza fungi inoculation 10 g polybag^{-1} and *P.capsici* inoculum 10 g polybag^{-1} (A_1B_1), mycorrhiza fungi 15 g polybag^{-1} and *P.capsici* inoculum 20 g polybag^{-1} (A_2B_2) constitute the highest percentage of mycorrhiza fungi infection in pepper plant roots respectively 80.00%.

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INTRODUCTION

Pepper (*Piper nigrum* L.) one of plants have economic significance for the people of Indonesia because it is one of the main foreign exchange earner of export crops as rubber, coffee, tea and palm oil. Specialty Southeast Sulawesi, central areas of the development of pepper plants among regions i.e: Anggoya, Lambuya, Unaaha, Wawotobi, Abuki (District of South Konawe), Maginti, Kabangka (Disctrict of Muna) and some regions in district of Buton Island.

The low production of pepper grown by farmers due to the cultivation techniques are conventionally obtained from the experience handed down from generation to generation (Rismunandar, 1993), hard to find wood that is resistant to pole propagation (Sarpin, 2003), preparation of seedlings poor (Rachmawati and Halim, 2011) as well as the base of stem rot

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disease caused by *Phytophthora capsici* (Manohara *et al*., 2006). The attack of *P.capsici* on the base of the stems of plants are marked with black pepper, the dampness will appear bluish mucus, attacks on the root causes wilt and the leaves turn yellow (Mulya *et al*, 2003). Symptoms on the leaves that the bones of leaves become pale and defoliation begins from the bottom branch, and then spread to the top. Once symptoms appear, the disease usually will grow faster so the whole plant will die. According Rismunandar (2001), the plant seem withered, on the surface of the leaves appear dark brown circles with shades of gray in the middle, bottom leaves falling preceded wilt symptoms and yellowing which then quickly spread to the top. The measures undertaken to control the plant disease by farmers in general remains focused on the use of chemical pesticides (Elizabeth and Hendayana, 2010). The use of chemical pesticides is not wise will cause resistance to disease, adverse effects on the environment, as well as the toxicity to non-target organisms (Untung, 2008). Therefore, it is necessary to find alternative safe control and run naturally after the agents were on the ground. One disease control agent which can be used are mycorrhiza fungi. The use of fungi mycorrhizae can reduce or even replace chemical fungicides, because some of the results showed that the fungi mycorrhizae can improve resistance properties of plants against soil-born pathogens (Perrin, 1990; Mariadi, 2003), increase plant resistance to drought (Auge and Stodola, 1990; Auge, 2001) as well as able to increase the uptake of N, P, K in marginal dry lands (Al-Kariki *et al*., 2003). The presence of associations between plants and fungi mycorrhizae provide good benefits for the soil and host plants that infect the root system of the host plant, producing interwoven hyphae intensively so that the plants are infected by fungi mycorrhizae will be able to increase capacity in the absorption of nutrients (Delvian, 2005). Applications mycorrhizal fungi can increase significantly the number of leaves and other growth components of the pepper plant seeds in net house treatment (Rahmawati and Halim, 2011).

MATERIALS AND METHODS

Study area and Experimental setup

Present study was conducted in the Sindang Kasih of village, District of West Ranomeeto, Regency of South Konawe, Province of Southeast Sulawesi and Laboratory of the Faculty of Forestry and Environmental Science Halu Oleo University Kendari, Indonesia.

This research is compiled using a randomized design completelly (RDC) with two treatment combinations: fungi mycorrhiza (FM) with four levels and *Phytophthora capsici* (Pc) with three levels.

The combination between FM and Pc i.e.: with out FM and Pc (A_0B_0/as control), 0 g FM + 15 g Pc polybag^{-1} (A_0B_1), 0 g FM + 30 g Pc polybag^{-1} (A_0B_2), 10 g FM + 0 g Pc polybag^{-1} (A_1B_0), 10 g FM+15 g Pc polybag^{-1} (A_1B_1), 10 FM+30 g Pc polybag^{-1} (A_1B_2), 20 g FM + 0 g Pc (A_2B_0), 20 g FM + 15 g Pc polybag^{-1} (A_2B_1), 20 g FM + 30 g Pc polybag^{-1} (A_2B_2), 30 g FM + 0 g Pc polybag^{-1} (A_3B_0), 30 g FM + 15 g Pc polybag^{-1} (A_3B_1), 30 g FM + 30 g Pc polybag^{-1} (A_3B_2).

Preparation of planting Media and Applications Mycorrhiza Fungi and *P. capsici* Inoculum

***Preparation of Seed Pepper*:** Pepper plant used in this study is the petaling varieties. The cuttings used pepper plant seeds derived from climbing vines and tendrils hanging over the age of 2-3 years. Tendrils that have been taken, then cut to obtain cuttings, then planted in a nursery pot already containing a mixture of soil and organic fertilizer with a ratio of 1: 0.5. The pepper plant seedling be conducted for 3 months. The cuttings planted in a nursery pot treated to form buds on the road. Cuttings that have sprouted then transferred in a polybag which has been prepared in accordance with the treatment. Each polybags contains two cuttings pepper plant seeds.

Preparation of Sterile Soil and infested P.capsici: The soil that is used as a positive control is land taken out of the field, then sterilized using a stove oven. The soil that has been sterilized mixed composite, then stuffed into a polybag with weighing 10 kg each polybags. While the soil infested by *P.capsici* is taken directly from the rizosphere of pepper plant and indicated *P.capsici* inoculum. The soil acquisition done in a composite of 20 rizosphere pepper plants attacked by rot stem with a depth of 30 cm - 15 cm. The soil is then mixed evenly, cleaned and polished to obtain a source of inoculum representative as research needs. Seeds of pepper used in this study is the first grown in polybag with size of 10 cm x 15 cm, after 3-month-old transplanting in polybag size 30 cm x 40 cm as test plant.

***Applications Mycorrhiza Fungi and P. capsici inoculums*:** Applications mycorrhiza fungi and *P.capsici* inoculum done by mixing the two evenly, then placed in the hole planting of pepper plant. Mixing between mycorrhiza fungi with *P.capsici* inoculum so that both have the same opportunities to interact with rooting pepper plant seeds. While laying mycorrhiza fungi and *P.capsici* inoculum in the hole pepper plant seeds so that they directly interact with pepper plant roots without requiring a lot of energy to approach the plant roots.

Observation of Variables

The variables were observed in this study include:

(a). The plant height; plant height measured at 14, 28, 42, 56 and 70 day after transplanting (DAT). Plant height is measured from the base of the primary stem above ground level to the highest plant shoots.

(b).The number of leaves; leaf number measured at 14, 28, 42, 56, and 70 DAT. The number of leaves that are calculated are the leaves on the main stem and the shoots formed from the main stem.

(c).The tendrils number; measured at 14, 28, 42, 56, and 70 DAT. Tendrils number calculated starting from the rootstock to the highest stem.

(d).Dry weight; measured at the end of the study. Pepper plants lifted and separated between shoots and roots. Once it is done at a temperature of 80°C oven for 24 hours.

(e).Incidences of disease; made by observing the external symptoms on plants. The calculation is performed every week after the onset of initial symptoms. The incidence

rate of the disease was calculated by using the formula proposed by Abbolt (1925) in Asniah and Khaeruni (2006):

$$KP = \frac{n}{N} x100\ \%$$

Note :
KP = the incidence rate of disease (%)
n = the number of affected leaves
N = the number of leaves observed

(f). The percentage of mycorrhiza fungi infection; preceded with staining roots. Furthermore, mycorrhiza fungi infection was calculated by using the formula proposed by Brian and Schults (1980): IP = $\frac{r1}{r1+r2}$ x 100%.

Note:

IP= the percentage of mycorrhiza fungi infection
r1= the number of root infected examples
r2= the number of root not infected examples

***Data analysis*:** Data of each variable were observed were analyzed by variance of analysis. If the F count is greater than the F table, then continued with Duncan Range Multiple Test (DRMT) at 95% confidence level.

RESULTS

The Plant Height

Applications of mycorrhiza fungi and *P.capsici* inoculum significant effect on plant height at the age of 14-70 DAT (Table 1). Table 1 shows that the highest average of pepper plant at 14 DAT and 28 DAT occurred in the treatment of A_2B_1 as 58.00 cm and 61.00 cm, which is significantly different from with the treatment of A_1B_0, A_1B_1, A_2B_2 and A_3B_1, but no significant effect with treatment of A_0B_0, A_0B_2, A_0B_1, A_1B_2, A_3B_2, A_2B_0 and A_3B_0.

Table 1. Effect of aplication of mycorrhizal fungi and *P.capsici* inoculum to the average plant height (cm) at the age of 14-70 DAT

Treatment	Average plant height (cm)				
	14 DAT	28 DAT	42 DAT	56 DAT	70 DAT
with out FM and Pc (A_0B_0/as control)	38.66 ef	41.00 ef	43.00 de	45.00 ef	48.00 e
0 g FM + 15 g Pc polybag^{-1} (A_0B_1)	36.33 fg	38.33 fg	41.00 ef	43.66 f	47.33 e
0 g FM + 30 g Pc polybag^{-1} (A_0B_2)	39.33 ef	41.66 ef	44.00 de	46.00 ef	48.66 e
10 g FM + 0 g Pc polybag^{-1} (A_1B_0)	48.33 cd	50.33 cd	52.00 bc	54.66 bc	57.33 bc
10 g FM+15 g Pc polybag^{-1} (A_1B_1)	26.00 h	27.66 h	29.00 g	31.00 h	32.66 g
10 g FM+30 g Pc polybag^{-1} (A_1B_2)	36.33 fg	38. 66 fg	41.00 ef	45.00 ef	47.00 e
20 g FM + 0 g Pc polybag^{-1} (A_2B_0)	43.00 de	45.00 de	48.00 cd	50.66cd	53.66 cd
20 g FM + 15 g Pc polybag^{-1} (A_2B_1)	58.00 a	61.00 a	63.00 a	65.33 a	67.33 a
20 g FM + 30 g Pc polybag^{-1} (A_2B_2)	55.00 ab	57.00 ab	60.33 a	63.66 a	66.33 a
30 g FM + 0 g Pc polybag^{-1} (A_3B_0)	43.00 de	45.00 de	47.66 cd	49.66 de	52.00 de
30 g FM + 15 g Pc polybag^{-1} (A_3B_1)	50.00 cb	52.66 cb	55.00 cd	57.33 b	59.66 b
30 g FM + 30 g Pc polybag^{-1} (A_3B_2)	32.66 g	34.33 g	37.00 f	37.00 f	42.33 f
DRMT 95%	2 = 5.21	2 = 5.57	2 = 4.92	2 = 4.44	2 = 4. 66
	3 = 5.47	3 = 5.85	3 = 5.17	3 = 4.66	3 = 4.90
	4 = 5.64	4 = 6.03	4 = 5.33	4 = 4.80	4 = 5.05
	5 = 5.85	5 = 6.16	5 = 5.44	5 = 4.90	5 = 5.15
	6 = 5.85	6 = 6.25	6 = 5.53	6 = 4.98	6 = 5.23
	7 = 5.92	7 = 6.33	7 = 5.59	7 = 5.04	7 = 5.29
	8 = 5. 97	8 = 6.38	8 = 5.64	8 = 5.08	8 = 5.34
	9 = 6.02	9 = 6.43	9 = 5.69	9 = 5.12	9 = 5.38
	10 = 6.05	10 = 6.47	10 = 5.72	10 = 5.15	10 = 5.41
	11 = 6.08	11 = 6.50	11 = 5.75	11 = 5.18	11 = 5.44
	12 = 6.11	12 = 6.53	12 = 5.77	12 = 5.20	12 = 5.46

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%

Table 2. Effect of aplication of mycorrhiza fungi and *P.capsici* inoculum to the average number of leaves at the age of 14-70 DAT

Treatment	Average number of leaves				
	14	28	42	56	70
with out FM and Pc (A_0B_0/as control)	9.33 abc	11.33 abc	11.66 abc	13.33 ab	15.00 e
0 g FM + 15 g Pc polybag^{-1} (A_0B_1)	5.66 d	9.00 bcd	10.33 bc	12.33 ab	13.66 ab
0 g FM + 30 g Pc polybag^{-1} (A_0B_2)	8.00 bcd	10.33 abc	11.00 abc	13.00 ab	14.66 ab
10 g FM + 0 g Pc polybag^{-1} (A_1B_0)	10.66 ab	13.00 a	14.00 ab	15.66 a	17.00 a
10 g FM+15 g Pc polybag^{-1} (A_1B_1)	5.66 d	6.66 c	7.66 c	9.00 b	9.66 b
10 g FM+30 g Pc polybag^{-1} (A_1B_2)	6.33 cd	8.00 cd	9.33 c	11.33 ab	13.00 ab
20 g FM + 0 g Pc polybag^{-1} (A_2B_0)	10.66 ab	12.33 ab	14.33 ab	15.66 ab	17.33 a
20 g FM + 15 g Pc polybag^{-1} (A_2B_1)	7.00 cd	8.66 cd	10.00 bc	11.66 ab	13.33 ab
20 g FM + 30 g Pc polybag^{-1} (A_2B_2)	11.66 ab	13.66 a	15.00 a	16.33 a	18.33 a
30 g FM + 0 g Pc polybag^{-1} (A_3B_0)	7.00 cd	9.00 bcd	11.66 abc	13.33 a	14.33 ab
30 g FM + 15 g Pc polybag^{-1} (A_3B_1)	12.00 a	13.66 a	15.00 a	16.33 a	18.00 a
30 g FM + 30 g Pc polybag^{-1} (A_3B_2)	7.00 cd	9.33 bcd	10.33 bcd	11.66 ab	13.00 ab
DRMT 95%	2 = 3.16	2 = 3.21	2 = 3.84	2 = 4.46	2 = 4.59
	3 = 3.32	3 = 3.37	3 = 4.03	3 = 4.69	3 = 4.82
	4 = 3.42	4 = 3.48	4 = 4.15	4 = 4.83	4 = 4.97
	5 = 3.49	5 = 3.55	5 = 4.24	5 = 4.93	5 = 5.08
	6 = 3.55	6 = 3.60	6 = 4.31	6 = 5.04	6 = 5.16
	7 = 3.59	7 = 3.65	7 = 4.36	7 = 5.07	7 = 5.22
	8 = 3.62	8 = 3.68	8 = 4.40	8 = 5.12	8 = 5.26
	9 = 3.65	9 = 3.71	9 = 4.43	9 = 5.15	9 = 5.30
	10 = 3.67	10 = 3.73	10 = 4.46	10 = 5.18	10 = 5.34
	11 = 3.69	11 = 3.75	11 = 4.48	11 = 5.21	11 = 5.36
	12 = 3.70	12 = 3.76	12 = 4.50	12 = 5.23	12 = 5.38

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%

The highest average pepper plants at the age of 42 DAT is treatment of A_2B_1 is 63.00 cm, significant with the treatment of A_1B_1, but no significant effect with treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_0, A_1B_2, A_2B_0, A_3B_0, A_3B_1 and A_3B_2. The highest average pepper plants at the age of 56 DAT is treatment of A_2B_1 as 67.33 cm significantly different with the treatment of A_1B_1, A_2B_0, A_3B_0 and A_3B_2, but had no significant with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_0, A_1B_2 and A_3B_1. The highest average pepper plants at the age of 70 DAT is treatment of A_2B_1 as 67.33 cm, which is significantly different from with the treatment of A_1B_1, A_2B_0 and A_3B_2, but no significant effect with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_0, A_1B_2, A_3B_0 and A_3B_1. Variations differences of influence the mycorrhiza fungi and disease inoculum on plant height pepper as an indication that the mycorrhiza fungi inoculation could contribute to pepper plants to absorb nutrients and protect plant roots from disease (Rachmawati and Halim, 2011).

Number of Leaves

Applications of mycorrhiza fungi and *P.capsici* inoculum significant effect on number of leaves at the age of 14-70 DAT (Table 2).

Table 2 shows that the most average number of leaves of pepper plants at 14 DAT occurred in the treatment of A_3B_1 is 12.00 sheets, which is significantly different from with the treatment of A_0B_0, A1B_0, A_2B_0 and A_2B_2 but not significant to the treatment A_0B_1, A_0B_2, A_1B_1, A_1B_2, A_2B_1, A_3B_0 and A_3B_2. The most average number of leaves at 28 DAT is the treatment of A_3B_1 is 13.66 sheets, significantly different from with the treatment of A_0B_0, A_0B_2, A_1B_0, A_2B_0 and A_2B_2, but no significant effect with the treatment of A_0B_1, A_1B_1, A_1B_2, A_2B_1, A_3B_0 and A_3B_2. The most average number of leaves at 42 DAT ocurred in the treatment of A_3B_1 is 15,00 sheet, which is significantly different from with the treatment of A_0B_1, A_1B_1, A_1B_2, A_2B_1 and A3B2, but no significant effect with the treatment of A_0B_0, A_0B_2, A_1B_0, A_2B_0, A_2B_2 and A_3B_0.

The most average number of leaves at 56 DAT ocurred in the treatment of A_3B_1 is 16.33 sheet which is significantly different from with the treatment of A_1B_1, but no significant effect with treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_0, A_1B_2, A_2B_0, A_2B_1, A_2B_2, A_3B_0 and A_3B_2.

The most average number of leaves at 70 DAT ocured in the treatment of A_2B_2 is 18.33 sheets which significantly different from with the treatment of A_0B_0 and A_1B_1, but no significant effect with the treatment of A_0B_1, A_0B_2, A_1B_0, A_1B_2, A_2B_0, A_2B_1, A_2B_1, A_3B_0, A_3B_1 and A_3B_2. Based on the results of this study show that an increasing of number of leaves in line with the age of the plant. This is an indication that mycorrhiza fungi help plants absorb nutrients optimally impact on the increasing number of plant leaves. This is consistent with the statement (Sieverding, 1991) in Sasali, 2004), that plants infected by fungi mycorrhizae will be able to improve its capacity to absorb nutrients and water, and fungi mycorrhizae can modify physiological roots that can excrete organic acids and acid phosphatase into soil and able to transform into a fixed Phosphorus is more soluble and readily taken up by plants. (Mansher and Dell 1994), states that the mycorrhiza fungi have an important role in improving plant growth by expanding the area of nutrient uptake by plant roots.

The Tendrils Number

Applications of mycorrhiza fungi and *P.capsici* inoculum significant effect on tendrils number at the age of 14-70 DAT (Table 3).

Table 3 shows that the most average number of tendrils at 14 DAT ocured in the treatment of A_1B_0 is 6.66, which is significantly different from with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_1, A_1B_2, A_3B_0 and A_3B_2, but no significant effect with the treatment of A_2B_0, A_2B_1, A_2B_2 and A_3B_1. The most average number of tendrils at 28 DAT is treatment of A_1B_0 is 6.66, which are significantly different from with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_2, A_3B_0 and A_3B_2, but no significant effect with the treatment of A_2B_0, A_2B_1, A_2B_2 and A_3B_1.

Table 3. Effect of aplication of mycorrhiza fungi and *P.capsici* inoculum to the average of tendrils number at the age of 14-70 DAT

Treatment	Average of tendrils at the age of				
	14 DAT	28 DAT	42 DAT	56 DAT	70 DAT
with out FM and Pc (A_0B_0/as control)	3.66 bc	3.66 bcd	4.33 bcd	5.33 bc	5.33 bc
0 g FM + 15 g Pc polybag^{-1} (A_0B_1)	2.66 bc	3.00 bcd	4.33 bcd	4.66 bc	4.66 bc
0 g FM + 30 g Pc polybag^{-1} (A_0B_2)	2.00 c	2.33 cd	3.33 cd	4.33 bc	4.33 bc
10 g FM + 0 g Pc polybag^{-1} (A_1B_0)	6.66 a	6.66 a	7.66 a	8.00 a	8.00 a
10 g FM+15 g Pc polybag^{-1} (A_1B_1)	1.66 c	1.66 d	2.66 d	3.33 c	3.66 c
10 g FM+30 g Pc polybag^{-1} (A_1B_2)	2.66 bc	3.00 bcd	4.00 bcd	4.33 bc	4.33 bc
20 g FM + 0 g Pc polybag^{-1} (A_2B_0)	4.00 b	4.33 abc	5.00 bcd	6.00 ab	6.33 ab
20 g FM + 15 g Pc polybag^{-1} (A_2B_1)	4.33 b	5.00 ab	5.66 abc	5.66 bc	5.66 abc
20 g FM + 30 g Pc polybag^{-1} (A_2B_2)	4.66 b	5.00 ab	5.66 abc	6.33 ab	6.33 ab
30 g FM + 0 g Pc polybag^{-1} (A_3B_0)	2.66 bc	3.00 bcd	3.33 cd	4.00 bc	4.66 bc
30 g FM + 15 g Pc polybag^{-1} (A_3B_1)	4.66 b	5.00 ab	6.00 ab	6.33 ab	6.33 ab
30 g FM + 30 g Pc polybag^{-1} (A_3B_2)	1.66 c	2.66 bcd	3.33 cd	4.00 bc	4.33 bc
	2 = 1.77	2 = 2.22	2 = 2.06	2 = 2.10	2 = 2.21
	3 = 1.86	3 = 2.34	3 = 2.16	3 = 2.20	3 = 2.32
	4 = 1.92	4 = 2.41	4 = 2.23	4 = 2.27	4 = 2.39
	5 = 1.96	5 = 2.46	5 = 2.28	5 = 2.32	5 = 2.44
DRMT 95%	6 = 1.99	6 = 2.50	6 = 2.31	6 = 2.35	6 = 2.48
	7 = 2.01	7 = 2.53	7 = 2.34	7 = 2.38	7 = 2.51
	8 = 2.03	8 = 2.55	8 = 2.36	8 = 2.40	8 = 2.53
	9 = 2.05	9 = 2.57	9 = 2.38	9 = 2.42	9 = 2.55
	10 = 2.06	10 = 2.58	10 = 2.39	10 = 2.44	10 = 2.56
	11 = 2.07	11 = 2.60	11 = 2.40	11 = 2.45	11 = 2.58
	12 = 2.08	12 = 2.61	12 = 2.41	12 = 2.46	12 = 2.59

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%

The most average number of tendrils at 42 DAT ocured in the treatment of A_1B_0 is 7.66, which are significantly different from with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_1, A_1B_2, A_2B_0, A_3B_0 and A_3B_2, but no significant effect with the treatment of A_2B_1, A_2B_2 and A_3B_1. The most average number of tendrils at 56 DAT and 70 DAT ocured in the treatment of A_2B_2 is 16.33 and 18.33 were significantly different from with the treatment of A_1B_1, but no significant effect with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_0, A_1B_2, A_2B_0, A_2B_1, A_2B_2, A_3B_0, A_3B_1 and A_3B_2 at 56 DAT. At the 70 DAT significantly different from with the treatment of A_2B_2 A_0B_0 and A_1B_1, but no significant effect with the treatment of A_0B_1, A_0B_2, A_1B_0, A_1B_2, A_2B_0, A_2B_1, A_2B_2, A_3B_0, A_3B_1 and A_3B_2. The result this study show that the formation of buds on the plants tend to be more pepper on plants treated with mycorrhiza fungi compared with no provision of mycorrhiza fungi although there *P.capsici* disease inoculum. This is an indication that the mycorrhiza fungi are very helpful in improving the growth of plants and to provide protection roots of plants through its external hyphae. This is reinforced by the opinions Clarka and Zeto (2000), that the plants were inoculated with mycorrhiza fungi can grow well as mycorrhiza fungi can expand the volume of distribution of roots in the soil so that nutrients more available to plants.

Dry Weight

Applications of mycorrhiza fungi and *P.capsici* inoculum significant effect on dry weight (Table 4).

Table 4 shows that the highest average dry weight is treatment of A_2B_2 as such as 7.79 g plant^{-1}, which is significantly different from with the treatment of A_1B_1, but no significant effect with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_0, A_1B_2, A_2B_0, A_2B_1 A_3B_0, A_3B_1 and A_3B_2. This happens because the mycorrhiza fungi are able to produce growth hormones that can stimulate the growth of plant roots of pepper, so the plants are well developed causing the absorption of nutrients and water is also going well so it will increase the biomass of roots, stems and leaves (Bolan, 1991). Dependence plants against mycorrhiza fungi is identical to the percentage increase in dry weight of plants inoculated with mycorrhiza fungi (Supriatun *et al*, 2006). This means that the higher the dependence on mycorrhiza plants, the percentage increase in plant dry weight also higher. Result of research Halim *et al*., (2016), that's higher fres and dry plant weight was obtained by the application of mycorrhiza Thus, there is a positive correlation between plant dry weight were dashed with a value dependence of plants to mycorrhiza (Halim, 2009).

Incidences of Disease

Applications of mycorrhiza fungi and *P.capsici* inoculum significant effect on incidences of disease at the 1st-5th week after disease symptoms appearance (Table 5).

Table 5 shows that the highest average of disease incidences in 1st and 2nd week is treatment of A_3B_2 each 21.115% and 19.44%, which is significantly different from with the treatment of A_1B_0, A_1B_1, A_2B_2, A_3B_1 but no significant with the treatment A_0B_0, A_0B_1, A_0B_2 , A_1B_2, A_2B_0, A_2B_1 and A_3B_0. The highest average disease incidences in 3th weeks is treatment of A_3B_2 is 19.52%, which is significantly different from with the treatment of A_1B_0, A_1B_1, A_2B_2, A_3B_1, but no significant effect with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_2, A_2B_0, A_2B_1 and A_3B_0. The highest average disease incidences in the 4th and 5th weeks is treatment of A3B2 i.e.:23.23% and 24.30%, which is significantly different from with the treatment of A_1B_0, A_1B_1, A_2B_2, A_3B_1, but no significant effect with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_2, A_2B_0, A_2B_1 and A_3B_0. The slow onset of disease in the crop either treated mycorrhiza or inoculum disease caused by fungi mycorrhizae provide physical protection by forming a layer structure hyphae thin on the root surface, thereby inhibiting the entry of pathogens into root tissue causing pathogens are not easily penetrate the tissue (Setiadi, 1991). In addition, fungi mycorrhizae can create an environment that is not suitable for pathogens as fungi mycorrhizae use almost all the excess carbohydrates and root exudates more issued by plant roots, releasing antibiotic substances that can kill the pathogen (Cordier *et al*., 1998), as well as improving lignifikasi network plants that are not easily damaged by pathogens (Volpin *et al*., 1994;Shaul *et al*., 2001).

The Percentage of Mycorrhiza Fungi Infection

Applications of mycorrhiza fungi and *P.capsici* inoculum significant effect on percentage of mycorrhiza fungi infection on roots of pepper plant seedling (Table 6).

Table 6 shows that the highest percentage ofmyorrhiza fungi infetion on roots is treatment of A_1B_1 as such as 80.00%, which is significantly different from with the treatment of A_3B_1, A_1B_2, A_2B_2 and A_3B_2, but no significant effect with the treatment of A_0B_0, A_0B_1, A_0B_2, A_1B_0, A_2B_0, A_2B_1, A_3B_0 and A_3B_2. The high percentage of mycorrhiza fungi infection on roots of plants causes the plants more resistant to pathogen attacks the roots. Mycorrhiza fungi that infect the root system of the host plant will produce intensively interwoven hyphae mycorrhiza fungi infected so that the plants will be able to improve its capacity to absorb nutrients and water (Sieverding, 1999). Characteristic roots of infected plants by the mycorrhiza fungi shown in Figure 1. The result of research that's mycorrhiza fungi infection on roots plant indicated with arbuscular, vesicles and hyphae. Halim *et a.l* (2015), that's visicles was thick-walled structure and serves as a repository and exchange of food reserves. While, the internal hyphae which serves as liaison between vesicles with other one. Acording Brundrett (2006), that arbuscular is hyphae entering into the cell cortex host plants, then formed the branching hyphae. The form mycorrhizal fungi infection in pepper plant roots characterized by vesicles, arbuscular and hyphae with 40x magnification

The percentage level mycorrhiza fungi infection in the roots of pepper plants related to levels of responsiveness and power plants as host mycorrhiza fungi infection of the roots and the number of spores contained in propagules. While the colonization of mycorrhiza fungi on plant roots pepper happen easily if the pepper plants that there is no pathogen inoculum. Meanwhile, if there is a pathogen inoculum, the mycorrhiza fungi infection has been slow.

Table 4. Effect of aplication of mycorrhiza fungi and *P.capsici* inoculum to the average of dry weight

Treatment	Average of dry weigth (g plant^{-1})
with out FM and Pc (A_0B_0/as control)	6.91 a
0 g FM + 15 g Pc polybag^{-1} (A_0B_1)	5.29 ab
0 g FM + 30 g Pc polybag^{-1} (A_0B_2)	7.55 a
10 g FM + 0 g Pc polybag^{-1} (A_1B_0)	7.28 a
10 g FM+15 g Pc polybag^{-1} (A_1B_1)	3.56 b
10 g FM+30 g Pc polybag^{-1} (A_1B_2)	5.58 ab
20 g FM + 0 g Pc polybag^{-1} (A_2B_0)	6.63 a
20 g FM + 15 g Pc polybag^{-1} (A_2B_1)	5.40 ab
20 g FM + 30 g Pc polybag^{-1} (A_2B_2)	7.79 a
30 g FM + 0 g Pc polybag^{-1} (A_3B_0)	6.24 a
30 g FM + 15 g Pc polybag^{-1} (A_3B_1)	7.48 a
30 g FM + 30 g Pc polybag^{-1} (A_3B_2)	5.65 ab
SEM value	
	2 = 2.19
	3 = 2.30
	4 = 2.37
	5 = 2.42
DRMT 95%	6 = 2.46
	7 = 2.49
	8 = 2.51
	9 = 2.53
	10 = 2.54
	11 = 2.56
	12 = 2.57

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%

Table 5. Average of incidences of disease (%) at the 1st-5th week after disease symptoms appearance

Treatmnet		Observation at the				
		1st week	2nd week	3th week	4th week	5th week
with out FM and Pc (A_0B_0/ as control)	X	0.00	0,00	0,00	0.00	0.00
	Y	2.86 b	2,86 b	2,86 b	2.86 b	2.86 b
0 g FM + 15 g Pc polybag^{-1} (A_0B_1)	X	0.00	0,00	0,00	0.00	0.00
	Y	2.86 b	2,86 b	2,86 b	2.86 b	2.86 b
0 g FM + 30 g Pc polybag^{-1} (A_0B_2)	X	0.00	0,00	0,00	0.00	0.00
	Y	2.86 b	2.86 b	2.86 b	2.86 b	2.86 b
10 g FM + 0 g Pc polybag^{-1} (A_1B_0)	X	5.80	4.94	6.66	8.33	7.62
	Y	12.39 ab	11. 48 ab	13.08 ab	14.79 ab	14.13ab
10 g FM+15 g Pc polybag^{-1} (A_1B_1)	X	15.87	16.66	15.74	16.66	21.66
	Y	20.11 a	20.95 a	20.33 a	20.88 ab	24.03 a
10 g FM+30 g Pc polybag^{-1} (A_1B_2)	X	0.00	0.00	0.00	0.00	0.00
	Y	2.86 b	2.86 b	2.86 b	2.86 b	2.86 b
20 g FM + 0 g Pc polybag^{-1} (A_2B_0)	X	0.00	0.00	0.00	0.00	0.00
	Y	2.86 b	2.86 b	2.86 b	2.86 b	2.86 b
20 g FM + 15 g Pc polybag^{-1} (A_2B_1)	X	0.00	0.00	0.00	0.00	0.00
	Y	2.86 b	2.86 b	2.86 b	2.86 b	2.86 b
20 g FM + 30 g Pc polybag^{-1} (A_2B_2)	X	8.33	9.52	15.55	14.21	16.82
	Y	14.58 ab	15.76 ab	20.17 a	19.23 ab	21.0 ab
30 g FM + 0 g Pc polybag^{-1} (A_3B_0)	X	0.00	0.00	0.00	0.00	0.00
	Y	2.86 b	2.86 b	2.86 b	2.86 b	2.86 b
30 g FM + 15 g Pc polybag^{-1} (A_3B_1)	X	5.89	5.15	6.73	8.36	7.40
	Y	12.46 ab	11.71 ab	13.22 ab	14.77 ab	13.9 ab
30 g FM + 30 g Pc polybag^{-1} (A_3B_2)	X	21.11	19.44	19.52	23.23	24.30
	Y	23.78 a	22.70 a	22.79 a	25.07 a	25.68 a
		2 = 13.22	2 = 12.07	2 = 13.33	2 = 14.68	2 = 16.80
		3 = 13.89	3 = 12.68	3 = 14.00	3 = 15.42	3 = 17.65
		4 = 14.32	4 = 13.07	4 = 14.43	4 = 15.89	4 = 18.19
		5 = 14.62	5 = 13.35	5 = 14.74	5 = 16.23	5 = 18.57
DRMT 95%		6 = 14.84	6 = 13.55	6 = 14.96	6 = 16.68	6 = 18.86
		7 = 15.02	7 = 13.71	7 = 15.14	7 = 16.67	7 = 19.08
		8 = 15.15	8 = 13.84	8 = 15.28	8 = 16.82	8 = 19.26
		9 = 15.27	9 = 13.94	9 = 15.39	9 = 16.95	9 = 19.40
		10 = 15.36	10 = 14.02	10 = 15.48	10=17.05	10 = 19.51
		11 = 15.43	11 = 14.09	11 = 15.56	11=17.13	11 = 19.61
		12 = 15.49	12 = 14.15	12 = 15.62	12=17.20	12 = 19.69

Note: X = the original data, Y = data after transformed in arcosinus. *The numbers are followed by the same letters in the same column, no significant based DRMT 95%*

Table 6. Average of percentage of mycorrhiza fungi infection (%) on roots of pepper plant seedling

Treatment	Percentage of mycorrhiza fungi infection (%)
with out FM and Pc (A_0B_0/as control)	63.33 ab
0 g FM + 15 g Pc polybag^{-1} (A_0B_1)	76.66 ab
0 g FM + 30 g Pc polybag^{-1} (A_0B_2)	63.33 ab
10 g FM + 0 g Pc polybag^{-1} (A_1B_0)	63.33 ab
10 g FM+15 g Pc polybag^{-1} (A_1B_1)	80.00 a
10 g FM+30 g Pc polybag^{-1} (A_1B_2)	56.66 bc
20 g FM + 0 g Pc (A_2B_0)	73.33 ab
20 g FM + 15 g Pc polybag^{-1} (A_2B_1)	73.33 ab
20 g FM + 30 g Pc polybag^{-1} (A_2B_2)	40.00 cd
30 g FM + 0 g Pc polybag^{-1} (A_3B_0)	63.33 ab
30 g FM + 15 g Pc polybag^{-1} (A_3B_1)	60.00 abc
30 g FM + 30 g Pc polybag^{-1} (A_3B_2)	23.33 d
DRMT 95%	2 = 19.86 3 = 20.86 4 = 21.50 5 = 21.95 6 = 22.29 7 = 22.55 8 = 22.76 9 = 22.93 10 = 23.06 11 = 23.18 12 = 23.27

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%

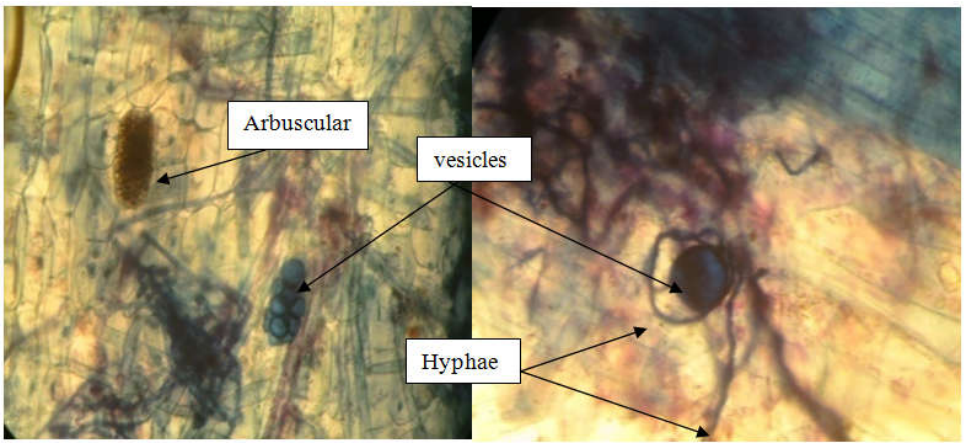

Figure 1. The form mycorrhizal fungi infection in pepper plant roots characterized by vesicles, arbuscular and hyphae with 40x magnification

This is seen in the results of this study that the higher the dose of mycorrhiza fungi is causing the higher the mycorrhiza fungi infection in pepper plant roots as the treatment of A_2B_1 (73%), A_2B_2 (80%), and A_3B_1 (60%). However, if the pathogen inoculum dose is higher, then lower mycorrhiza fungal infections such as treatment of A_1B_2 (56%).

Conclusions

From the results of this reserach, the following conclusions can be drawn:

(a). Mycorrhiza fungi inoculation 10 g polybag^{-1} and *P.capsici* inoculum 15 g polybag^{-1} (A_2B_1), mycorrhiza fungi 20 g polybag^{-1} and *P.capsici* inoculum 10 g polybag^{-1} (A_2B_2), can promote the growth of plant height, leaf number, the number of trindles in 70 DAT as well as the dry weight of the plant at the end of the study, namely a row of 67.33 cm, 18.33 sheet, 8.00 tendrils and 7.79 g.

(b) Mycorrhiza fungi inoculation 20 g polybag^{-1} and *P.capsici* inoculum 10 g polybag^{-1} (A_3B_2) cause disease incidence is lowest at 5th week is 24.30%.

(c). Mycorrhiza fungi inoculation 10 g polybag^{-1} and *P.capsici* inoculum 10 g polybag^{-1} (A_1B_1), mycorrhiza fungi 15 g polybag^{-1} and *P.capsici* inoculum 20 g polybag^{-1} (A_2B_2) constitute the highest percentage of mycorrhiza fungi infection in pepper plant roots respectively 80.00%.

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