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Abundance and Impact of Mycorrhiza Fungi from Secondary Vegetation in Fallow Land on Growth of Local Maize in South Konawe, Indonesia.

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ABSTRACT

Present study was conducted in net house located in Sindang Kasih of village, District West Ranomeeto, Regency of South Konawe, Province of Southeast Sulawesi, Indonesia. Mycorrhyza fungi infection observated on plant roots was done in the Laboratory of the Faculty of Forestry and Environmental Science Halu Oleo University Kendari, Indonesia. This study aims to determine the impact of mycorrhiza fungi from fallow land to the growth of local maize from Muna Island under net house treatment. Study was conducted in compeletely randomized block design (CRBD) with five treatments. The treatment i.e: without mycorrhiza fungi (M_0), mycorrhiza fungi propagules @ 10 g per polybag (M_1), mycorrhiza fungi propagules @ 15 g per polybag (M_2), mycorrhiza fungi propagules @ 20 g per polybag (M_3) and mycorrhiza fungi propagules @ 25 g per polybag (M_4), each treatment was replicated with 3 replications. The observed variables in this study were abundance of mycorriza fungi from fallow land, plant height, number of leaves, leaves of area, stem diameter and percentage mycorrhiza fungi infection on rootings of maize. The kinds of mycorrhiza fungi isolated from fallow land were *Gigaspora* sp, *Glomus* sp and *Acauolospora* sp with variation in number of spores. Results of study revealed that all the treatments contain mycorrhiza fungi propagule improving the growth of maize under net house treatment. The treatment contained mycorrhiza fungi propagules @ 25 g per polybag (M_4) show superiority over all the tested treatment in improving maize growth characteristics.

Keywords: *Acalauospora* sp, *Gigaspora* sp*, Glomus* sp, local maize, weeds.

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INTRODUCTION

Maize is one of the food commodities that have a strategic position in agricultural development in Indonesia which demand is increasing with respect to its role as a source of food, fodder and industrial raw materials. Karimuna et al., (2012), stated that's maize plays as the main staple food after rice not only for human being but also for livestock feed industry. Specifically, in Province of Southeast Sulawesi maize is one of the staple foods so that on each region has a different local of maize such as local of maize from Muna, local of maize from Buton, local of maize from Ereke, local of maize from Tolaki as well as the other areas that have the potential for scaling up. Local of maize plants are usually was cultivated by farmers traditionally the concept of shifting cultivation, so the result is still relatively low. Therefore, it is necessary optimally to increase the local of maize production.

One of the efforts to do is utilize of mycorrhiza fungi isolated from the roots of weeds palnt (Halim, 2009; Halim, 2010; Halim et al., 2014) which been known to infect the the roots of weeds with infection rates between 60-90% (Halim et al., 2014). Result of research Brundrett (1999); Miyasaka et al. (2003), showed that generally mycorrhiza fungi found to associate with almost all the kinds of plants. The kinds of plants are scattered in the arctic regions to the tropics and from the desert to the forest area (Gupta dan Shubhashree, 2004). The kinds of mycorrhiza fungi were known are *Gigaspora margarita*, *Glomus mossae, Scutellospora castenea* serta *Acalauspora* sp (Wyss and Bonafante, 1993; Forbes et al., 1998). While the kinds of weeds associated with mycorrhiza fungi i.e *Imperata cylindrica*, *Eupatorium odorata* (Halim, 2009; Halim, 2010) and the other kinds of weed such as Ageratum conyzoides, *Ageratum haustianum Amaranthus gracilis*, *Alternanthera sessilis, Alternanthera philoxeroides, Croton hirtus* and *Cleome rutidosperma* (Halim et al., 2014).

MATHERIALS AND METHODS

Study Area and Experimental Setup

Present study was conducted in village Sindang Kasih, District of West Ranomeeto, South Konawe Regency, Southeast Province, Indonesia. Mycorrhiza fungi were isolated from rootings of secondary vegetation in fallow land. The soil sample a weigth of 250 g has been taken from secondary vegetatation rhyzophere with 9 plots observed was characterized with the standard identification key for mycorrhiza fungi. Identification the mycorrhiza fungi were done in Laboratory of the Faculty of Forestry and Environmental Science Halu Oleo University. Plants were grown in polybag (40 cm x 50 cm) and study was conducted in completely randomized block design (CRBD) with five treatments. The treatment i.e: without mycorrhiza fungi (M_0), mycorrhiza fungi propagules @ 10 g per polybag (M_1), mycorrhiza fungi propagules @ 15 g per polybag (M_2), mycorrhiza fungi propagules @ 20 g per polybag (M_3) and mycorrhiza fungi propagules @ 25 g per polybag (M_4), each treatment was replicated with 3 replications

Preparation of Planting Media

The soil has been taken from the study area field, it cleared from debris such as twigs, roots, leaves and small rocks. Cleared soil fifted into a polybag with a weight of 10 kg soil and recommended dose basic NPK fertilizer along with organic manure was added to each polybag. Mycorrhiza fungi isolated from secondary vegetation in fallow land propagated on goat weed (*Ageratum conyzoides* L.) for 3 month long time were transferred to the each polybag according the dose in treatment study (Halim et al., 2016a).

Observations of Variable

Mycorrhiza fungi were isolated from rootings of secondary vegetation in fallow land characterized with the standard identification key for mycorrhiza fungi. Various growth parameters such as height, number of leaves, leaf area and stem diameter were measured on the intervals of each seven days which start from the 7^{th} days after planting and continue up to 42 days after planting (DAP).

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Data Analysis

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

RESULTS

Kinds of and Abundance of Mycorrhiza Fungi Spores

The results showed that the fallow land was overgrown by various secondary vegetation found three kinds of mycorrhiza fungi that Gigaspora sp, Glomus sp and Acalauspora sp with the number of spores which vary at each of observation plot (Table 1). The *Glomus* sp found in the observation plots 4,5,7,8 and 9 with an overall number of 223 spores. The *Gigaspora* sp found in the observations plots 3-9 with an overall number of 436 spores. While the *Acalauspora* sp found in all the plots of observations with the overall number of 277 spores.

Plant Height

Analysis of variance showed that mycorrhiza fungi inoculation significantly affected to plant height at 28, 35 and 42 DAP (Table 2). The average height of corn plants at the age of 7 DAP is best obtained in treatment of mycorrhiza fungi propagules @ 10 g per polybag (M_1) is significantly different from with other treatments. At the age of 14 DAP, the highest of plant obtained in treatment of mycorrhiza fungi propagules @ 25 g per polybag (M_4) which significantly different from with other treatments. At the age of 21 DAP, the highest of plant obtained in treatment of mycorrhiza fungi propagules @ 25 g per polybag (M_4) which it is no significantly different from with other treatments. At the age of 28 DAP, treatment of mycorrhiza fungi propagules @ 15 g per polybag (M_2) which significantly different from with treatment of mycorrhiza fungi propagules @ 20 g per polybag (M_3) and mycorrhiza fungi propagules @ 25 g per polybag (M_4), but significantly different from with other treatments. At the age of 35 DAP, the highest of plant obtained in treatment of mycorrhiza fungi propagules @ 20 g per polybag (M_3) which no significant with other treatments with the treatment of mycorrhiza fungi propagules @ 15 g per polybag (M_2) and mycorrhiza fungi propagules @ 25 g per polybag (M_4), but significantly different from with other treatments. At the age of 42 DAP, the highest of plant obtained at the treatment of mycorrhiza fungi propagules @ 15 g per polybag (M_2) which significantly different with other treatments.

Number of Leaves

Analysis of variance showed that mycorrhiza fungi inoculation significantly affected to number of leaves at the age of 42 DAP (Table 3). The highest average numbers of leaves at the age of 7 DAP obtained in treatment of mycorrhiza fungi propagules @ 20 g per polybag (M_3) which no significantly with other treatments. At the age of 14 DAP, the highest average number of leaves obtained in treatment of mycorrhiza fungi propagules @ 10 g per polybag (M_1) and mycorrhiza fungi propagules @ 25 g per polybag (M_4) which it is no significantly different from with other treatments. At the age of 21 DAP, the highest of number of leaves obtained in treatment of mycorrhiza fungi propagules @ 15 g per polybag (M_2) which it is no significantly different from with other treatments. At the age of 28 DAP, the highest of number of leaves obtained in treatment of mycorrhiza fungi propagules @ 15 g per polybag (M_2) which significantly different from with other treatments. At the age of 35 DAP, the highest of number of leaves obtained in treatment of mycorrhiza fungi propagules @ 15 g per polybag (M_2) and mycorrhiza fungi propagules @ 25 g per polybag (M_4) which significantly with other treatments. At the age of 42 DAP, the highest of number of leaves obtained in treatment of mycorrhiza fungi propagules @ 25 g per polybag (M_4) which significantly different from with treatment of mycorrhiza fungi propagules @ 10 g per polybag (M_1), mycorrhiza fungi propagules @ 15 g per polybag (M_2) and treatment of mycorrhiza fungi propagules @ 20 g per polybag (M_3), which significantly different with treatment of without mycorrhiza fungi (M_0).

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Leaves of Area

Analysis of variance showed that mycorrhiza fungi inoculation no significantly affected to leaves of area at the age of 7-42 DAP (Table 4).

Stem Diameter

Analysis of variance showed that mycorrhiza fungi inoculation significantly affected to stem diameter at the age of 35 and 42 DAP (Table 5). The highest average stem diameter at the age of 7 and 14 DAP obtained in treatment of mycorrhiza fungi propagules @ 15 g per polybag (M_2) and mycorrhiza fungi propagules @ 25 g per polybag (M_4) which no significantly with the other treatments. At the age of 21DAP the highest average stem diameter obtained in treatment of without mycorrhiza fungi (M_0), treatment of mycorrhiza fungi propagules @ 10 g per polybag (M_1) and treatment of mycorrhiza fungi propagules @ 25 g per polybag (M_4) which no significantly with the other treatments. At the age of 28 DAP the highest average stem diameter obtained in treatment of mycorrhiza fungi propagules @ 10 g per polybag (M_1) and treatment of mycorrhiza fungi propagules @ 25 g per polybag (M_4) which no significantly with the other treatments. At the age of 35 and 42 DAP the highest average stem diameter obtained in treatment of mycorrhiza fungi propagules @ 25 g per polybag (M_4) which significantly different with the other treatments.

Percentage Mycorrhiza Fungi Infection on Rootings of Maize

Analysis of variance showed that mycorrhiza fungi to infect roots of maize plants in all treatments, except the treatment of without mycorrhiza fungi (M_0) with the rate of percentage infection different (Table 6). The highest average of percentage infection of mycorrhiza fungi as 63.33% which significantly different with the treatment of without mycorrhiza fungi (M_0).

Table 1. Kinds of mycorrhiza fungi and number of spores in secondary vegetation rhizosphere

Number of plot observed	Species of secondary vegetation	Kinds of mycorrhiza fungi and number of spores (250 g sample of soil)		
		Gigaspora sp	*Glomus* sp	*Acalauspora* sp
1	*Mimosa pudica* L., *Borreria alata* L., *Eleusine indica* L.	-	-	28
2	*Mimosa pudica* L., *Borreria alata* L., *Eleusine indica* L., *Eupatorium odorata* L.	-	-	32
3	*Mimosa pudica* L., *Borreria alata* L., *Eleusine indica* L., *Eupatorium odorata* L.	-	49	27
4	*Ageratum conyzoides* L., *Borreria alata* L., *Eupatorium odorata* L.	45	64	35
5	*Phyllanthus dubilis*, *Borreria alata* L., *Eleusine indica* L., *Mimosa pudica* L., *Eupatorium odorata* L.	46	48	30
6	*Ageratum conyzoides* L., *Phyllanthus niruri* L., *Phyllanthus dubilis* L., *Mimosa pudica* L., *Eupatorium odorata* L., *Borreria alata* L.	-	38	28
7	*Ageratum conyzoides* L., *Phyllanthus niruri* L., *Phyllanthus dubilis* L., *Mimosa pudica* L., *Eupatorium odorata* L., *Borreria alata* L., *Cyperus rotundus* L., *Cyperus kyllingia* L.	57	160	29
8	*Ageratum conyzoides* L., *Phyllanthus niruri* L., *Phyllanthus dubilis* L., *Mimosa pudica* L., *Eupatorium odorata* L., *Borreria alata* L., *Cyperus rotundus* L., *Cyperus kyllingia* L.	35	45	31
9	*Ageratum conyzoides* L., *Phyllanthus niruri* L., *Phyllanthus dubilis* L., *Mimosa pudica* L., *Eupatorium odorata* L., *Borreria alata* L., *Cyperus kyllingia* L.	40	32	37
	Total of spores	**223**	**436**	**277**

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Table 2. Effect of mycorrhiza fungi on the plant height (cm) at the age 7-42 DAP

Treatments	Average Plant Height					
	7 DAP	14 DAP	21 DAP	28 AP	35 DAP	42 DAP
without mycorrhiza fungi (M_0)	5.13^{b}	13.43^{b}	23.23^{a}	36.13^{b}	44.37^{b}	70.13^{b}
mycorrhiza fungi propagules @ 10 g per polybag (M_1)	5.33^{a}	13.60^{ab}	23.37^{a}	36.37^{ab}	44.63^{ab}	70.67^{b}
mycorrhiza fungi propagules @ 15 g per polybag (M_2)	5.23^{ab}	13.50^{ab}	23.43^{a}	36.70^{a}	44.87^{a}	77.17^{a}
mycorrhiza fungi propagules @ 20 g per polybag (M_3)	5.27^{ab}	13.67^{ab}	23.30^{a}	36.57^{a}	44.93^{a}	70.57^{b}
mycorrhiza fungi propagules @ 25 g per polybag (M_4)	5.13^{b}	13.70^{a}	23.50^{a}	36.63^{a}	44.73^{a}	70.57^{b}
DRMT 95%	2=0.175	2=0.247	2=0.248	2=0.349	2=0.329	2=4.879
	3=0.183	3=0.257	3=0.258	3=0.364	3=0.343	3=5.084
	4=0.187	4=0.263	4=0.264	4=0.372	4=0.350	4=5.199
	5=0.189	5=0.266	5=0.268	5=0.377	5=0.355	5=5.268

Notes: DAP = day after planting, the numbers followed by the same superscript letters in the same column are not significantly differ on DRMT 95%.

Table 3. Effect of mycorrhiza fungi on the number of leaves at the age 7-42 DAP

Treatments	Average Number of Leaves					
	7 DAP	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
without mycorrhiza fungi (M_0)	4.00^{a}	5.67^{a}	9.00^{a}	9.67^{b}	11.33^{b}	11.67^{b}
mycorrhiza fungi propagules @ 10 g per polybag (M_1)	4.33^{a}	6.67^{a}	9.00^{a}	11.67^{ab}	13.33^{ab}	14.00^{a}
mycorrhiza fungi propagules @ 15 g per polybag (M_2)	4.67^{a}	6.33^{a}	10.33^{a}	12.37^{a}	13.67^{a}	15.00^{a}
mycorrhiza fungi propagules @ 20 g per polybag (M_3)	5.00^{a}	5.67^{a}	9.33^{a}	10.67^{ab}	13.00^{ab}	15.00^{a}
mycorrhiza fungi propagules @ 25 g per polybag (M_4)	4.67^{a}	6.67^{a}	10.00^{a}	11.33^{ab}	13.67^{a}	15.33^{a}
DRMT 95%	2=1.166	2=1.140	2=1.575	2=2.063	2=1.649	2=2.382
	3=1.215	3=1.188	3=1.642	3=2.149	3=1.718	3=2.482
	4=1.242	4=1.215	4=1.679	4=2.198	4=1.757	4=2.538
	5=1.259	5=1.231	5=1.701	5=2.227	5=1.780	5=2.572

Notes: DAP = day after planting, the numbers followed by the same superscript letters in the same column are not significantly differ on DRMT 95%.

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Table 4. Effect of mycorrhiza fungi on the leaves of area (cm^2) at the age 7-42 DAP

Treatments	Average Leaves of Area (cm^2)					
	7 DAP	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
without mycorrhiza fungi (M_0)	4.73^a	6.00^a	6.20^b	6.63^a	8.33^a	9.60^a
mycorrhiza fungi propagules @ 10 g per polybag (M_1)	6.33^a	7.27^a	7.33^{ab}	7.60^a	8.23^a	11.93^a
mycorrhiza fungi propagules @ 15 g per polybag (M_2)	6.10^a	6.77^a	8.20^a	8.40^a	10.10^a	12.80^a
mycorrhiza fungi propagules @ 20 g per polybag (M_3)	6.67^a	7.10^a	7.90^{ab}	8.83^a	10.43^a	14.33^a
mycorrhiza fungi propagules @ 25 g per polybag (M_4)	5.47^a	7.63^a	7.67^{ab}	8.27^a	8.80^a	12.80^a
DRMT 95%	2=3.067	2=2.174	2=1.879	2=2.529	2=4.645	2=6.660
	3=3.196	3=2.265	3=1.958	3=2.636	3=4.840	3=6.940
	4=3.269	4=2.317	4=2.002	4=2.695	4=4.950	4=7.097
	5=3.312	5=2.347	5=2.029	5=2.731	5=5.015	5=7.191

Notes: DAP = day after planting, the numbers followed by the same superscript letters in the same column are not significantly differ on DRMT 95%.

Table 5. Effect of mycorrhiza fungi on the stem diameter (cm) at the age 7-42 DAP

Treatments	Average of Stem Diameter (cm)					
	7 DAP	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
without mycorrhiza fungi (M_0)	0.03^a	0.10^a	0.20^a	0,.20^a	0.20^b	0.23^c
mycorrhiza fungi propagules @ 10 g per polybag (M_1)	0.07^a	0.10^a	0.20^a	0.23^a	0.27^{ab}	0.30^{bc}
mycorrhiza fungi propagules @ 15 g per polybag (M_2)	0.10^a	0.13^a	0.17^a	0.20^a	0.23^{ab}	0.33^b
mycorrhiza fungi propagules @ 20 g per polybag (M_3)	0.07^a	0.07^a	0.13^a	0.17a	0.20^b	0.30^{bc}
mycorrhiza fungi propagules @ 25 g per polybag (M_4)	0.10^a	0.13^a	0.20^a	0.23^a	0.30^a	0.47^a
DRMT 95%	2=0.011	2=0.117	2=0.114	2=0.011	2=0.064	2=0.081
	3=0.096	3=0.126	3=0.119	3=0.096	3=0.067	3=0.084
	4=0.097	4=0.124	4=0.126	4=0.097	4=0.069	4=0.086
	5=0.098	5=0.111	5=0.123	5=0.098	5=0.069	5=0.088

Notes: DAP = day after planting, the numbers followed by the same superscript letters in the same column are not significantly differ on DRMT 95%.

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Table 6. Average of Percentage Mycorrhiza Fungi Infection (%)

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Treatments	Percentage Mycorrhiza Fungi Infection (%)	DRMT 95%
	0.00[b]	
without mycorrhiza fungi (M_0)	50.00 [a]	2=14.98
mycorrhiza fungi propagules @ 10 g per polybag (M_1)	53.33 [a]	3=15.61
mycorrhiza fungi propagules @ 15 g per polybag (M_2)	56.67[a]	4=15.97
mycorrhiza fungi propagules @ 20 g per polybag (M_3)	63.33[a]	5=16.18

Notes: the numbers followed by the same superscript letters in the same column are not significantly differ on DRMT 95%.

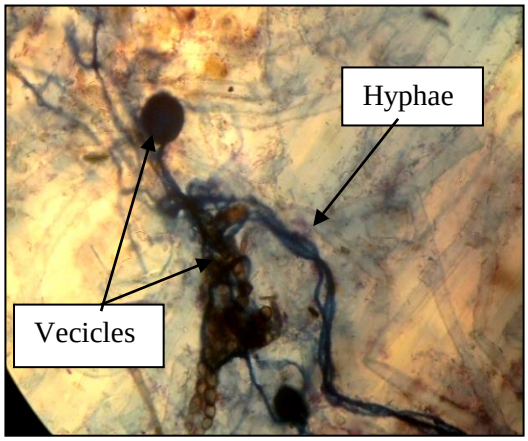

Figure 1. The form mycorrhiza fungi colonization on maize plant roots characterized by hyphae and visicles with magnification 40x

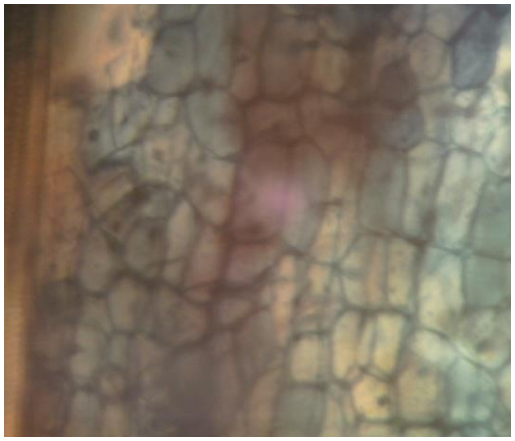

Figure 2. The roots were not colonized by mycorrhiza fungi with magnification 40x

DISCUSSION

On the fallow land were overgrown by secondary vegetation found three kinds of mycorrhiza fungi i.e: *Gigaspora* sp, *Glomus* sp and *Acalauspora* sp with the number of spores that vary for each plot of observation (Table 1). The *Glomus* sp was found in the observation plot of 4,5,7,8 and 9 with an overall number 223 spores. The *Gigaspora* sp was found in the observation plot of 3-9 with an overall number 336 spores. The *Acalauspora* sp was found at all the plot observation with an overral number 277 spores. The difference the number of spores on any type of mycorrhizal fungi are nothing to do with the type of vegetation that existed at each observation plot. The result this stuy indicated that the *Acalauspora* sp was found at the all plot observation with the amount of spores is low compared to *Glomus* sp and *Gigaspora* sp. This is consistent with the statement Halim (2010); Halim et al., (2016) that each kind of mycorrhiza fungi have different characteristics that impact on the level adaptation to the environment and its ability to infect the rootings of host plant. The *Gigaspora* sp and *Acalauspora* sp tolerant to acidic soils and high aluminum (Tomerup, 1994), however the *Acalauspora* sp more common in the acidic soils (Clark, 1997), while the *Glomus* sp more common in alkaline soils and the population is less in acidic soils (Corryanti et al., 2001).

The result study showed that inoculation of mycorrhiza fungi is not real affect to average of height plant at the age 7, 14 and 21 DAP (Table 2), average of leaves number at the age 7, 14, 21, 28 and 35 DAP (Table 3), average of leaves area at the age 7-42 DAP (Table 4) and average of stem diameter at the age 7, 14, 21 and 28 DAP (Table 5). This happens because at the beginning of growth stages of maize, mycorrhiza fungi has not interact optimally with plant roots so that it is functioning properly which causes the root system is still difficulty to absorb nutrients in the soil, in particular nutrients that are not available to plant. Smith and Read

(1997) stated that the optimum symbiosis between mycorrhiza fungi to plants can provide the dominant pathway for the supply of phosphorus in plant nutrients.

The result study showed that inoculation of mycorrhiza fungi is real affect to average of height plant at the age 28, 35 and 42 HST (Table 2). This is an indication that the mycorrhizal fungi have infects plant roots that directly helps plants to absorb nutrients. Bethlenfalvay and Linderman (1992), stated that the plants are infected by mycorrhiza fungi have a high ability to absorb nutrients in the soil. Furthermore, the presence of mycorrhiza fungi in the plant area can affect the quantity of phosphorus nutrients are absorbed by plants. In addition, mycorrhizal fungi can increase the plant's ability to compete with weeds (Halim, 2012) which impact on the growth of maize plants (Sanders dan Fitter, 1992). Mycorrhiza fungi inoculation significantly affected the number of leaves of maize plants at the age 42 DAP (Table 3). McGonigle and Miller (1994), states that the mycorrhiza fungi have the ability to help the process of photosynthesis of plants through root exudates in soil that has been infected by mycorrhiza fungi potentially as metabolites zinc. Metabolites of zinc is the process of absorption of zinc (Zn) in the soil until the process of spending on the absorption of Zn through stomata which causes the result of photosynthesis more moves to the roots which can further stimulate photosynthesis activity through stomatal opening, ion transfer and setting the amount of chlorophyll in the leaves.

The speed of photosynthesis activity has to do with the amount of nutrients, which were absorbed by plants after being infected by fungi mycorrhiza and high C-organic contained in the soil causing plants that have been infected by fungi mycorrhiza can affect the number of leaves of plants which will further stimulate the development of the stem. In addition, the nutrient supply to the formation of roots that have become wide catchment area and can accelerate the increase of plant height. Mycorrhiza fungi inoculation significantly affected the stem diameter at the age 35 and 42 DAP (Table 5). That is because the infection mycorrhiza fungi have been active in helping the absorption of nutrients in the soil. The plants infected by mycorrhiza fungi may affect the growth and development of plant stems (Delvian, 2006). The results showed that the roots of plant infected by the mycorrhiza fungi characterized by vesicles and hyphae (Figure 1) and they were not found in control treatment (Figure 2). Feronika (2003), states that the roots of plants infected by mycorrhizal fungi form a typical oval structure called vesicles and hyphae branching system.

The infection of mycorrhiza fungi on plant roots is highest at the treatment of mycorrhiza fungi propagules @ 25 g per polybag (M_4) as 63.33% (Table 6), although overall rooting observed indicate infected. It is caused the roots of maize faster association with mycorrhiza fungi where both mutual benefit where the roots of maize plants more easily absorb the nutrient phosphorus in the soil. Instead mycorrhizal will gain root exudates of plants as a source of energy (Juge et al., 2002).

CONCLUSSION

The kinds of mycorrhiza fungi isolated from fallow land were *Gigaspora* sp, *Glomus* sp and *Acauolospora* sp with variation in number of spores. Results of study revealed that all the treatments contain mycorrhiza fungi propagule improving the growth of maize under net house treatment. The treatment contained mycorrhiza fungi propagules @ 25 g per polybag (M_4) show superiority over all the tested treatment in improving maize growth characteristics.

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REFERENCES

[1] Bethlenfalvay.G.J. and R.G.Linderman, 1992. Mycorrhizae in Sustainable Agriculture. American Society of Agronomy. Inc. Madison. Wisconsin. USA.

[2] Brundrett.M., 1999. Introduction to Mycorrhizas. CSIRO Forestry and Forest Product. <http://www.ffp.csiro.au/research/mycorrhiza/intro.html>.

[3] Clark.R.B., 1997. Arbuscular Mycorrhizal Adaption, Spore Germination, Root Colonization and Host Plant Growth and Mineral Acquisition at Low pH. Journal of Plant and Soil. 192:15-22.

[4] Corryanti, F.Maryadi and Irmawati, 2001. Arbuscular Mycorrhizas under Teak Seed Orchard. Poster Presented on the Third International Conference on Mycorrhizas.Diversity and Integration in Mycorrhizas. Adelaide. South Australia.

[5] Delvian, 2006. Koleksi Isolat Cendawan Mikoriza Arbuskula Asal Hutan Pantai. Jurusan Kehutanan Fakultas Pertanian Universitas Sumatera Utara. <http://www.library.usu.ac.id/download/fp/06005280.pdfl>.

[6] Feronika, A. 2003. Mikoriza: Peran, Prospek dan Kendalanya. Fakultas Pertanian. Universitas Gadjah Mada. Yogyakarta.

[7] Forbes.P.J., S.William, J.E.Hooker and L.A. Harrier, 1998. Transformation of the Arbuscular Mycorrhizal Fungus *Gigaspora rosea* by Article Bombardment. Mycol.Res. 102:497-501.

[8] Gupta.N. and R.Shubhashree, 2004. Arbuscular Mycorrhizal Association of Weed Found with Different Plantation Crops and Nursery Plants. Regional Plant Resource Centre. Nayapalli. Bhubaneswar. Orissa. India. http://www.cababstractsplus.org>.

[9] Halim, T.Supriatun, L.Karimuna, R.Hasid, F.S.Rembon, Mariadi, 2016a. Impact of mycorrhiza fungi from weed plants on growth of pepper plant seedling (*Piper nigrum* L.) and Incidince of stem root desease (*Phytophtora capsici*) in net house treatment. International Journal of Current Research 8(5):31419-31426.

[10] Halim, F.S. Rembon, A.M. Kandari, Resman, A.Sani, 2014. Characteristics of indigenous mycorrhiza of weeds on marginal dry land in South Konawe, Indonesia. Journal of Agriculture, Forestry and Fisheries 3(6):459-463.doi:10.11648/j.aff.20140306.14.

[11] Halim, Karimuna, L., F.S. Rembon, Resman, T.Supriatun, 2016a. Growth and Potential of Goat Weed (*Ageratum conyzoides* L.) as Host Plant for Propagation of Mycorrhiza Fungi. Open Access Library Journal. 3(e2640):1-8.doi:10.4236/oalib.1102640.

[12] Halim, 2009. The role of endomycorrhiza indigenous of *Imperata cylindrica* (L.) Beauv and *Eupatorium odorata* (L.) in weed and corn competitive. Dissertation (unpublished). Graduate Programe of Padjadjaran University Bandung. Indonesia.

[13] Halim, 2010. Kelimpahan Populasi Mikoriza Indigen pada Hutan Sekunder. Majalah Ilmiah Agriplus 20(3):194-198.

[14] Halim, 2012. The role of indigenous mycorrhiza on maize and *Ageratum conyzoides* L.competitiv index. Berkala Penelitian Agronomi 1(1):86-92.

[15] Juge.C., J.Samson, C.Bestien, H.Vierheilig, A.Coughlan and Y.Pieche, 2002. Breaking Dormancy in Spores of the Arbuscular Mycorrhizal Fungus *Glomus intraradies.* A Critical Cold Storage Period. Journal of Mycorrhiza. 12:37-42.

[16] Karimuna.L., S.Leomo and L.Indriyani, 2012.Improvement of Maize and Peanut Production in Intercropping System Throught the Application of Organic Fertilizer and Mulch in Ultisol Soil. J.Nat.Sci.Special Issue on Agricultural & Natural Resources (1):387-394.

[17] McGonigle.T.P.M and M.H.Miller, 1993. Mycorrhizal Development and Phosphorus Absorption in Maize under Conventional and Reduce Tillage. Soil Sci.Soc. Am.J 57.

[18] Miyasaka.S.S., M.Habte, J.B.Friday and E.V.Johnson, 2003. Manual on Arbuscular Mycorrhizal Fungus Production and Inoculation Techniques. Cooperative Extension Service. College of Tropical Agriculture and Human Resource. University of Hawaii. Manoa. <http://www.ctahr.hawaii.edu>.

[19] Sanders.M.F and C.Fitter, 1992. The Role and Ecological Significance of Vesicular Arbuscular Mychorrizhal in Temperature Ecosystems. Agric. Ecos. Enviroment.

[20] Smith.S.E. and D.J.Read, 1997.Mycorrhizal Symbiosis. Second Edition. Academiz Press. Harcourt Brace & Company Publisher. London.

[21] Tommerup.I.C., 1994. Methods for Study of the Population Biology of Vesicular Arbuscular Mycorrhizal Fungi. Academic Press. London.

[22] Wyss.P and B.Bonafante, 1993. Amplifacation of Genomic DNA of Arbuscular Mycorrhizal (AM) Fungi by PCR Using Short Arbitrary Primers. Mycol Res. 97:51-57.