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The Compatibility of Arbuscular Mycorrhizal Fungi with Corn and Sorghum Plant in the Dry Land of Central Lombok



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Keywords

growth; mycorrhiza density; mycorrhiza diversity; plant; soil quality;

Abstract

The research aims to promote AMF compatibility on corn and sorghum host plants in the dry land of central Lombok. The study was conducted using a complete random design factorial, with 2 factors, factor 1. Isolate type with 4 levels i.e. IO = without isolates, I1 = Ash isolates, I2 = isolate black and I3 = isolate mixture of ash and black. Factor 2 is the type of host with 2 levels is M1 = host corn and M2 = host sorghum. The results showed that there was a noticeable influence on the host type factor on the high measurement parameters of plants, the number of leaves and the broad index of leaves. There is an increase in soil nutrient levels, especially nutrient levels C and P. Spores density increased significantly from 50 spores inoculated into thousands of spores at the end of research with an effective and superior spore namely the Genus Gigaspora.

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1 Introduction

The potential of dry land in Indonesia is very large in supporting national food security. Almost 84% of West Nusa Tenggara region is dry land. NTB people mostly utilize dry land as planting land in agriculture. (Suwardji, 2007).

Dry land in Indonesia generally has low fertility and soil suitability. The low indicator of soil fertility is the poor of organic matter in the soil so that the existence of macro nutrients N, S and P are limited. Organic materials play an important role in improving the chemical, physical, and biological properties of soils. Although the contribution of nutrients from soil organic matter is relatively low, the role is quite important because in addition to the element NPK, organic materials are also the source of other essential elements such as C, Zn, Cu, Mo, Ca, Mg, and Si (Nguyen *et al.*, 2008).

Dry-land farms need to be optimised and have specific challenges especially with regards to the barrier factor of land biophysical. Limited agricultural support infrastructure also has a major influence on agricultural cultivation (Suzuki *et al.*, 2007). These factors are known as the biggest contributor to crop failure, low crop productivity and decreased quality of agricultural soil fertility and the growing land of land degradation process (Bastia *et al.*, 2010).

One of the efforts to improve dry land productivity is to utilize Mikoriza. Mikoriza is one of the soil microbes that is expected to improve soil fertility and overcome drought-surfaced obstacles (Parman et al., 2000). Mycorrhiza is a form of mutualism symbiotic between fungi and the roots of high crops. Symbiotic occurs because of root exudate. Bertham (2006), describes the plant to release root exudate in the form of a flavonoids compound to form symbiosis with AMF. Flavonoids compounds positively affect the growth of mycorrhiza at the prasimbiotic stage.

The AMF spores that are ininterlinked at the root of the host plant are expected to interact positively by increasing the growth and yield of crops through the provision of nutrients and plant growth hormone (Suhartatik & Sisimiyati, 2000; Purba 2015), facilitates the absorption of various nutrients, synthetic phytohormones and antagonistic to bacteria and pathogenic fungi (Jone & Thompson, 1981; Kesaulya *et al.*, 2015). Parman *et al.*, (1997); Sastrahidayat *et al.* (2011); Fisher & Jayachandran (2008), proving the AMF associated with the plant can increase the efficiency of the absorption of macro and micro nutrients that impact the growth of better than the plant without AMF.

Each AMF strain has varying capabilities in increasing plant growth (Tian *et al.*, 2004). It needs to be selected AMF isolates that are compatible with cultivated plants. AMF symbiotically with a responsive host plant and has a lot of rooting (Simanungkalit, 2004).

Season crops such as corn and sorghum are hosts that are highly compatible with endomycorrhizae (Simanungkalit, 2004; Hapsoh 2008), so that both plants are considered the appropriate host for the multiplication of endomycorrhizae spores (Widiastuti, 2004) Corn with The magnoloid type of rooting is sensitive to AMF infections so it is highly liked as a host plant. While sorghum which is a type of cereal plant contains quite high carbohydrate. Sorghum is tolerant of dryness and can grow almost in every type of soil, as well as forming secondary roots twice as much. Deeply rooted and typical making it more effective in absorbing nutrients and water.

The selection of the host plant on this research is supported by the results of the research of Paul and Clark that plants with a rough rooting system and the long root is not too long more often infected with AMF and its growth depends more on the presence of AMF. Hasanah *et al.* (2012), added that mycorrhizal applications can increase the growth of corn crops in real life. These results indicate that the average height of the plant applied with Mycorrhiza tends to be higher compared to the control (without mycorrhizal). Similarly, the weight of corn agility and the weight of corn cob in plants given higher AMF than without AMF (Kernaghan, 2005; Bonnardeaux *et al.*, 2007). Based on the results of previous research, research needs to be done with the aim is to know the compatibility of AMF isolate isolates from several host plants.

2 Materials and Methods

This study was conducted in Green House Faculty of Agriculture University of Nahdlatul Wathan Mataram, in August to October 2019. The design used is complete random design with 2 factors namely factor 1 is a type of AMF Indegenus consisting of 4 levels; Without AMF, AMF is grey, FMA is black, AMF is brown. The second factor is the host plant type namely corn and sorghum crops.

The experiment was preceded by a trial of the diversity of arbuscular mycorrhiza fungi in the plant's 5 host crops namely corn, peanut, peanut, mung beans and soy. Trial followed by testing AMF application in greenhouse. The planting medium used is the ground media of zeolite and soil mixture with a comparison of 3:1. Before being used as a planting medium, the soil in sterilization was heated to drum for 3-5 hours at 105 °c with the aim to kill bacteria and other microbes. The ground Media is composed by putting 2.5 kg of zeolite on the bottom layer and 1 kg of ground on the next layer and covered with 0.5 kg of zeolite on the topmost layer.

AMF types used are obtained from trapping Glomus sp, Acaulospora sp and Gigaspora sp. AMF trapping results are reproduced for 2 months according to the host of each treatment. Where the seed used in this study is corn varieties of Kumbara and sorghum seed is verised Super Sagritan by means of soaking up the seed of corn and sorghum for 3 hours before being planted with the aim to break the dormancy. All the data obtained in this research was analyzed using analysis On Varias (ANOVA) in the real level 5%, then followed by a real difference test honestly on the same real level.

3 Results and Discussions

3.1 Crop growth

The results of the print analysis (Test F) showed that some types of host plants have significant effect on crop growth (plant height, leaf count and broad index of leaves). There is no effect of interaction between host plant types and isolates to plant growth (Nakamura *et al.*, 1984; Stebbing, 1982). The results of the different lamence of the influence of several types of host crops, isolates and interactions with plant growth are presented in table 1.

Table 1
Data on Plant Growth parameter observations ANOVA Summary

Source of diversity	TT	JD	ILD	
Isolate type	NS	NS	NS	
Host type	S	S	S	
Interaction	NS	NS	NS	

Description: S = significant (real effect)

NS = Non significant (no real effect)

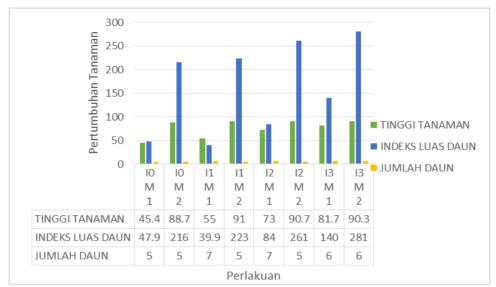


Figure 1. The best host plant type is Sorghum host plant (M2) with the best isolates

Figure 1 shows that the best host plant type is Sorghum host plant (M2) with the best isolates is a black spore which is a genus of Gigaspora for high parameter crops and a broad index of leaves. Gigaspora found high in sandy soil with the pores of the soil greater than clay soil and is a habitat that is thought to be suitable for the development of a Gigaspora spores larger than the Glomus spores (Baon, 1998). Sorghum infects easier, has adaptation capabilities in broad ecological range, can grow in very hot conditions or high rainfall conditions. Sorghum is also a type of plant rapidly growing; this plant will quickly perform the process of photosynthesis and produce carbohydrates that will be used in the process of forming an intridatic hypha in the root of the host plant (Deptan, 2009).

The AMF does not have a specific specificity for the host plant, but the ability to infect and colonizer the root differs between species of one another. This is thought to be due to differences in the adaptation to soil conditions, the propagation and physiological properties of the Propagul and the development of fungi in the root after infection (Mosse 1981).

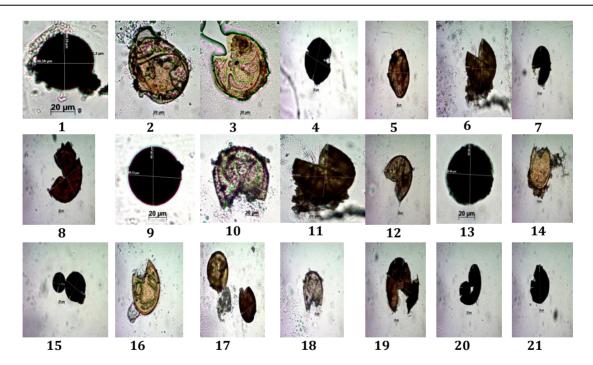
3.2 FMA spore's density and diversity

The observed density of spores in corn and sorghum plant shows that the number of spores varies. The spore's amount in the sorghum host plant at 6 sample points of the 12 sample points indicate a greater number of corn host plants with the range of 867spores up to 1442 spores/25 g soils. The number of spores on the corn host plant on the 6 sample points representing the 12 sample points shows fewer amounts with a range of 669 to 1267 spores/25 g of soil example i.e. in the range of 872 to 1265 spores (table 2). Spore density increased from inoculation as much as 50 grain spores each polybag pot into thousands of spores. The AMF lifecycle begins when the propagate is spores and the hypha is experiencing contact with the appropriate host. Hifa will penetrate by forming the Appresoria to enter into the root cells of the host plant. The Hifa AMF will develop extensively in the intercellular chamber in the cortex, forming arbuscular and vesicular. The final cycle of the AMF will form a defensive organ in the form of spores (Smith & Read, 2008).

Table 2
Density and diversity of spores from soil samples after trapped origin on corn and sorghum host crops

Source Inoculum	Plant Type Host	Types AMF	Spores' amount/25g ground
Rhizosfer Zea mays	Zea mays sp	Gigaspora sp (672), Glomus (563) Gigaspora sp (822),	1260 1025

	Glomus sp (157) Gigaspora sp (747),	1257
	Glomus sp (423)	1237
	Gigaspora sp (469),	669
	Glomus sp (145)	
	Gigaspora sp (606),	967
	Glomus sp (339)	
	Gigaspora sp (903),	1149
	Glomus sp (189)	
Sorghum L	Gigaspora sp (690),	1100
	Glomus sp (378)	
	Gigaspora sp (654),	1122
	Glomus sp (426)	
	Gigaspora sp (439),	867
	Glomus sp (380)	
	Gigaspora sp (979),	
	Glomus sp (158)	1205
	Gigaspora sp (804),	
	Glomus sp (585) Gigaspora	1442
	sp (753), Glomus sp (193)	1005



The AMF genus found in corn and sorghum host plants shows the AMF isolate Genus found at the end of the research of the Genus Gigaspora and Glomus SP in accordance with the genus inoculated in the implementation of the research. The Gigaspora Genus is predominantly found in both hosts. This condition can occur due to the physical nature of the soil appropriate for the life needs of the Gigaspora Genus. In the inoculum rhizosphere corn and sorghum found 3 Genus AMF Gigaspora and 5 Genus Glomus sp. The diversity of host plant types, spores' type and environmental conditions such as soil conditions directly indicate a different response to the number of spores and Variety of spore's type (Quilambo, 2003).

3.3 Soil quality

From the results showed that in the parameters of soil nutrient levels such as pH, moisture content, level N, P content and nutrient levels C not show a noticeable difference in the types of isolates, host type and its interaction, but there is increased nutrient levels in the soil Albeit in small quantities.

Table 3
Soil analysis results data before and after research

	Soil Chemical Properties			
Parameters	Initial Data	Range of Data	Assessment Criteria for analysis results	
		End data	Early Land	Land End
pH H2O	6,83	7,40 - 8,40	Neutral	Near Alkalis
Moisture content	8,39	1,53 - 2,21	Low	Very low
P available	4,64	11,07 - 17,86	Very Low	High
N total	0,23	0.07 - 0.14	Moderate	Very low-low
C-organic	3,25	2,71 - 3,18	High	Moderate-high

The moisture content and absorption of N, P and C plants are influenced by host types and isolates. N, P and C nutrient levels increase in treatment with Myciza application. The highest N nutrient levels are found in the I2M2 treatment combination in the sorghum host and a black I2 sported application with the Gigaspora Genus. The highest C-organic content is obtained at the I1M2 treatment while the highest P nutrient levels are obtained at I2M1. Soil quality improvement suggests that the application of mycotic in the sorghum host plant and the Gigaspora isolates present higher results than corn hosts (Shukla et al., 2006; Logsdon & Karlen, 2004; Gil-Sotres et al., 2005; Reeves, 1997). Greater water absorption by the plant Bermikoriza, which carries the nutrients that are easily dissolved and carried over the flow of time such as N will cause nutrient absorption is also increasing. Increase in the value of sorghum plant variable on inoculatory source treatment of sorghum rizosfer compared with other inoculatory source, because more yes spores than inocation derived from other host crops. This is due to the root of the sorghum plant that is longer than other host plants, so the number of hypha and spores produced more. Muis et al. (2016), states the FMA is symbiotic with a host plant that is responsive and has plenty of rooting and a wide rooting system. The N content of sorghum plants is influenced by the cultivation of power and single insignificant sources, and there is no real interaction between the two factors. Content N Sorghum plant on the treatment of host type and isolate greater 27.27% compared with the treatment of the host corn plant. This condition increases the plant N levels thereby increasing the growth of host crops. This research shows that inocentation of corn rizosphere causes P nutrient levels to increase and the relative efficiency of P nutrient absorption as well as relative inoculatory efficiency is higher compared to other treatments. Rate P on Corn host plant is greater than 7.59% compared to the sorghum host while the Corganic nutrient rate of the sorghum host plant is higher than 0.66% compared to the corn host plant. Hatch (1937), states the root of a plant infected with Mycorrhiza can increase the intake capacity of nutrients, since the life time of infected roots is extended and the degree of fornication and diameter enlarged, so the surface area of absorption Expanded.

4 Conclusion

Based on the results of the research and the limited reception in the scope of research, it can be concluded as follows:

- a) On the parameters of plant growth does not give a different impact on the isolate type and interaction of isolate type with host but different from the real type of host factor
- b) There are 3 Genus Gigaspora and 5 genus Glomus sp in the host crops sorghum and corn
- c) There is no real influence on the nature of the soil Kimi such as pH, water content and P available soil but there is an increase in the C-organic and P nutrient levels in the soil.

d) Inang sorghum more resposnsif from the host corn and the Genus of Gigaspora more adaptive than the Genus Glomus sp.

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