Mycorrhizal Species Diversity in Salam Rhizosphere (*Syzigium Polyanthum*) in Ex-Sand Mining Land in Cipancur, Ciawigebang District, Kuningan Regency

Nina Herlina*, Ai Nurlaila, Bambang Yudayana, Haidar Rahadian, M. Razan Farras

Forest Faculty, Kuningan University, Kuningan, Indonesia

{nina.herlina@uniku.ac.id}

Abstract. Mining activities on ex-excavated land C cause critical land damage and will affect the ecosystem of the land. As one of the efforts to restore the condition of the former C excavated land is by reclamation or revegetation. The use of Arbuscular Mycorrhizal Fungi (AMF) is an alternative that can be developed with various benefits including increasing plant growth, increasing soil nutrient absorption, and increasing plant tolerance to extreme conditions. This study aims to identify the types of mycorrhizae in the rhizosphere of salam (Syzygium polyanthum) in the ex-sand mines of Cipancur Village, Kalimanggis District, Kuningan Regency. The identification and observation of AMF colonization was carried out at the Laboratory of the Faculty of Forestry, Universitas Kuningan. The materials used were soil and root samples under a Salam tree (Syzygium polyanthum) stand. Spore morphology was identified using INVAM (2008). The results showed that the number of spores found under stands of Salam trees (Syzygium polyanthum) from 16 sample plots was 1,949 spores consisting of 3 types of AMF, namely Glomus sp., Gigaspora sp., and Acaulosprora sp

Keywords: Arbuscular Mycorrhizal Fungi; Ex-Dug C; Reclamation

1 Introduction

Utilization of non-renewable natural resources through sand mining activities must be able to reduce the level of environmental damage for human welfare. Post-mining land damage begins with the destruction of the physical, biological, and chemical properties of the soil followed by changes in the shape and structure of the landscape [1]. The decrease in the quality of the topsoil on ex-mining land is characterized by damage to soil structure, accelerated erosion, excessive washing, soil compaction, decreased soil pH, accumulation of heavy metals in the soil, depletion of organic matter, decreased plant nutrients, and decreased exchange capacity. cations, decreased microbial activity [2]. Changes in the structure and function of the landscape, both in the form of natural events and human disturbances, will have an impact on changes in the composition of plant and animal species [3]. The return of the soil layer to the former post-mining excavation is not able to restore the land condition to the same as the condition before mining [4]. However, knowledge about functional soil microbial changes in land as a result of reclamation with vegetation succession is still inadequate [2].

UNISET 2021, December 02, Kuningan, Indonesia

DOI 10.4108/eai.2-12-2021.2320202

The post-sand mining land in Cipancur Village has soil with a composition that is poor in nutrients. This is an obstacle for the success of revegetation activities. The existence of arbuscular mycorrhizal fungi (AMF) from plant rhizosphere in nature has an important role because of the mutualism symbiosis with almost 90% of land plant species [5]. Efforts to improve these conditions need to be carried out by land reclamation using biological agents with mycorrhizae in addition to improving the local ecosystem, intervention in the reclamation of ex-sand mining land is needed to accelerate the succession process [6].

One of the silvicultural techniques that can be used to implement it is the application of isomic technology (microbe isolates) or the utilization of potential soil microbes such as mycorrhizae [7]. All genera of arbuscular mycorrhizal fungi do not have the same morphological characteristics, so it is necessary to know their identity so that the existence and diversity of arbuscular mycorrhizae is required. Identification of mycorrhizae found in ex-sand mining areas is very important as an initial effort for land reclamation. The purpose of this study was to determine the diversity of mycorrhizal species in the rhizosphere of salam (Syzygium polyanthum) in the former sand mining area of Cipancur Village.

2 Methodology

Research site at the Silviculture Laboratory, Faculty of Forestry, Universitas Kuningan and soil samples on ex-sand mining land in Cipancur Village, Ciawigebang District, Kuningan Regency.

The tools used to take soil samples and plant roots were plastic bags, hoes and markers. The tools used for observation in the laboratory are sieves graded 1mm, 425um, 106 um, 45um, and 0.0308 um. Centrifuge, test tube, test tube rack, computer, circular needle, dropper, tweezers, slide, backerglass, digital microscope, digital scale, spray bottle, petri dish, measuring cup, small bucket, gloves [8].

The materials consisted of soil samples and roots of Salam trees (Syzygium polyanthum) with a solution of 60% granulated sugar, 10% KOH, 2% HCL, Melzer and Aquades reagents.

Soil samples were taken as much as 500 grams/sample. Isolation of spores from soil samples was carried out by referring to the wet pour and filter method [9] with modified centrifugation [10]. The AMF spores obtained from the isolation were then isolated and prepared with PVLG solution to be identified. The data obtained were analyzed descriptively and presented in the form of identification results of arbuscular mycorrhizal fungi, starting from spore morphology based on: color and size shape. The morphology of the spores was identified using [11] Mycorrhizal colonization was observed on the roots of the sample plants using the root staining technique. The method used for cleaning and staining the sample roots. The percentage of mycorrhizal colonization can be calculated using the colonized root length method [12]. The degree or percentage of infected roots is calculated using the following formula:

$$\text{Infected roots (\%)} : \frac{\sum infected\ roots}{\sum all\ observed\ roots}\ x\ 100\%$$

3 Result and Discussion

The presence of AMF is characterized by the presence of internal hyphae, external hyphae, vesicles, arbuscules, or internal spores in the plant root system [13]. The results of the identification of AMF spores in the rhizosphere of salam (Syzygium pollyantum) in Cipancur Village were obtained as many as 1,949 different AMF spores. The types of spores obtained have the characteristics of different spore shapes and colors. The spores were then grouped based on shape and color so that three types of AMF spores were obtained, namely Acaulospora, Glomus, and Gigaspora.

Table 1. Total Spores found in the rhizosphere of Salam (*Syzygium polyanthum*)

Sample	Total Spores FMA		
	Acaulospora	**Glomus**	**Gigaspora**
Salam 1	20	384	127
Salam 2	17	221	99
Salam 3	22	421	194
Salam 4	12	287	145
Total	71	1313	565

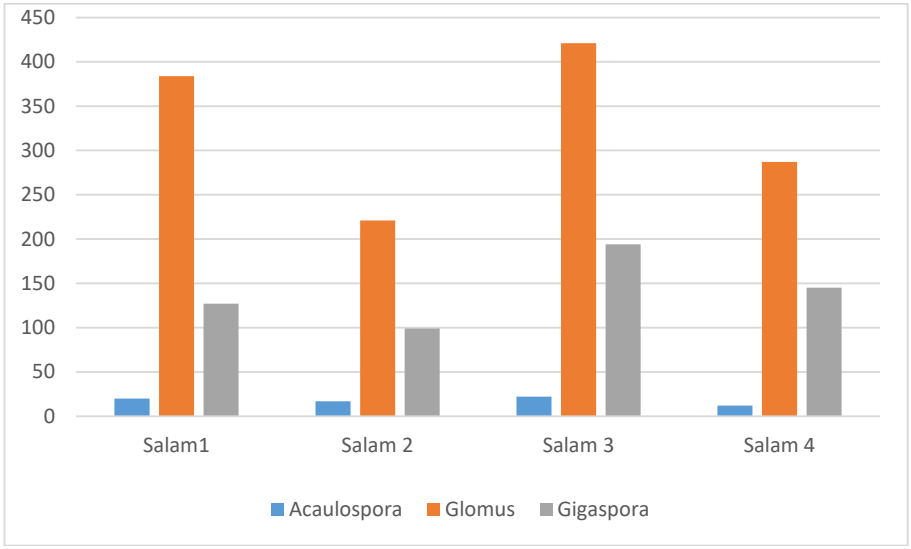

Figure 1. Graph of total spores in the rhizosphere of Salam (*Syzygium polyantum*)

Based on Table 1, the genus glomus was found in the rhizosphere of Salam (Syzygium polyanthum) as many as 1,313 spores, this is in line with research [14] which said that the distribution of the genus was very dominant in each tree stand. In line with research [15], the genus glomus in its distribution always dominates in every plant root. While the genus Acaulospora as many as 71 spores, and the genus gigaspora as many as 565 spores.

The genus Acaulospora is characterized by having a globus, sub-globus, irregular to elliptical shape. The spore wall consists of 2 layers where the innermost spore wall is equipped with a germination orb.

The color of the spores varies from yellow, orange, brownish, dark red to brownish red [11]. The acaulospora spores found were round and elliptical, orange and yellow in color, the spore wall consists of 2 layers.

The genus Glomus is characterized by a round shape, the spore wall consists of more than one layer. The color of the spores of the glomus genus varies from yellow, brownish yellow, yellowish brown, light brown, to dark brown and black. [11] The spores found are round to oval in shape, the color of the spores ranges from clear, yellow to brownish.

The genus Gigaspora is characterized by its characteristic bulbous suspensor. Gigaspora spores are spherical in shape and relatively large in size. The color of the spores varies from yellow, greenish yellow, brownish yellow to yellowish brown [11]. Gigaspora spores found are round, yellow in color, have only 1 layer of walls and are sized.

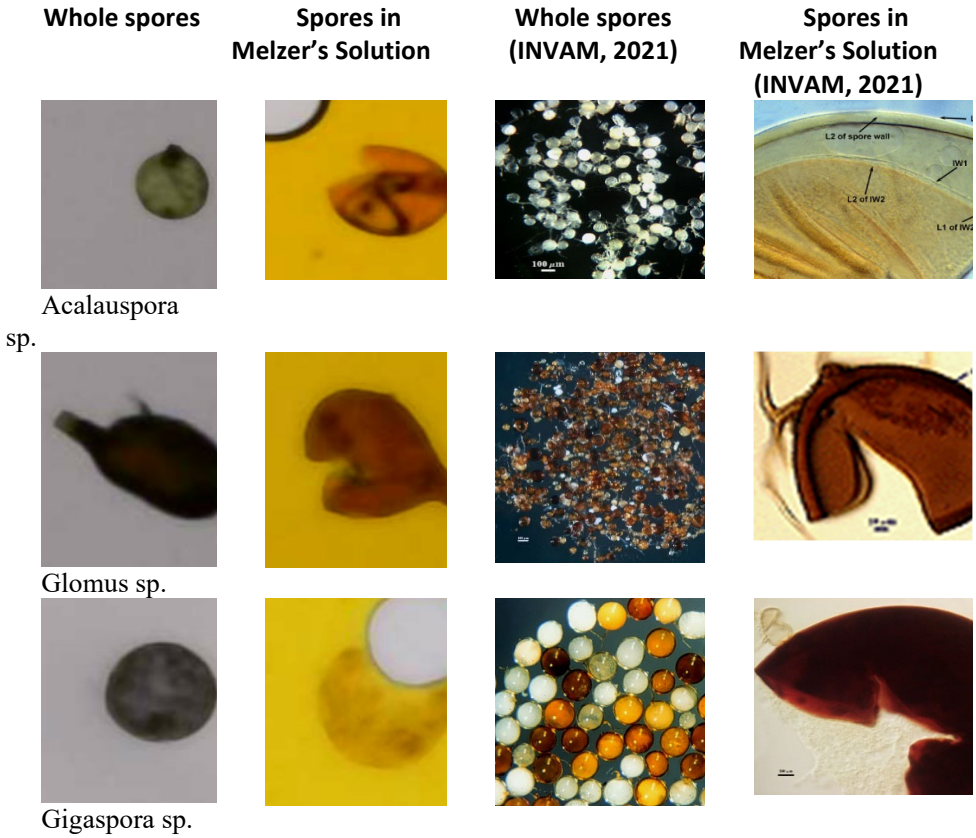

Figure 2. Types of mycorrhizae found under stands of Salam trees (*Syzygium plyanthum*)

Environmental or edaphic conditions are very decisive in the distribution of arbuscular mycorrhizal genera. Genus Glomus, Acaulospora and Gigaspora are 3 different genera and indirectly have different environmental adaptations. According to [11], the level of adaptation of this genus has variations in tolerance and its own uniqueness in each genus.

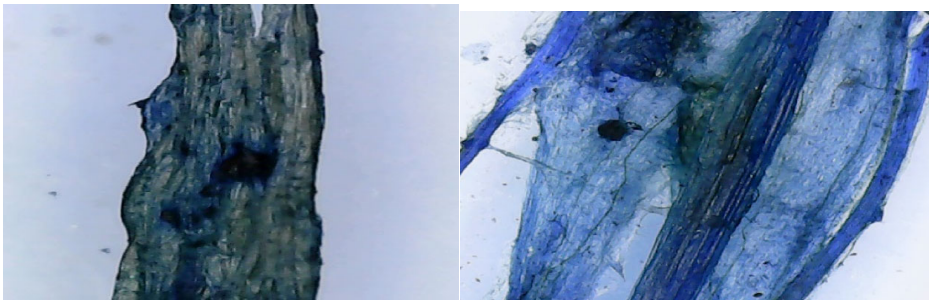

Figure 2. Salam root (Syzygium polyanthum) infected with roots

The observations obtained after staining the roots showed the presence of round structures called vesicles and arbusculars. The appearance of these structures indicates that there has been infection or symbiotic colonization between the observed plant roots and AMF.

4 Conclusion

The diversity of species of Arbuscula Mycorrhizal Fungi (AMF) in stands of Salam trees (Syzygium pollyanthum) from 16 sample plots was 1,949 spores consisting of 3 types of AMF, namely Glomus sp., Gigaspora sp., and Acaulospora sp.

References

[1] X. Cui, J. Hu, J. Wang, J. Yang, and X. Lin, "Reclamation negatively influences arbuscular mycorrhizal fungal community structure and diversity in coastal saline-alkaline land in Eastern China as revealed by Illumina sequencing," *Appl. Soil Ecol.*, vol. 98, pp. 140–149, 2016, doi: 10.1016/j.apsoil.2015.10.008.

[2] A.Parulian, Hamzah, R. Puspitasari, "Eksplorasi dan Identifikasi Fungsi Mikoriza Arbuskula (FMA) Indegeneous Pada Tanah Bekas Tambang Batubara, Prosising Seminar Nasional Fakultas Pertanian Universitas Jambi, 2018.

[3] I. Ashofie and B. Prasetya, "Pengaruh Aplikasi Kompos Dan Mikoriza Arbuskuar Pada Tailing Tambang Emas Terhadap Pertumbuhan Dan Serapan Fosfor Tanaman Bunga Matahari," *J. Tanah dan Sumberd. Lahan*, vol. 6, no. 1, pp. 1133–1144, 2019, doi: 10.21774/ub.jtsl.2019.00.

[4] M. Ulfa, A. Kurniawan., Sumardi., and I. Sitepu, "Population of indigenous Arbuscular Mycorrhizal Fungi (AMF) in Post Coal-Mining Land," *J. Chem. Inf. Model.*, vol. 8, no. 3, pp. 301–309, 2011.

[5] Moh. Ega Elman Miska, A. Junaedi1, A. Wachjar dan I. Mansur, "Karakterisasi FungiMikoriza Arbuskula Pada Rhizosfer Aren (Arenga pinnata (wurmb) Merr). Jurnal Silvikultur Tropika., vol 07, no. 1, pp. 18-23, 016

[6] S. A. Sihombing and D. Elfiati, "Eksplorasi Mikoriza pada Lahan Bekas Tambang Emas

Masyarakat di Mandailing Natal. (The mycorrhizal on Land Explore Former Gold Mine Community in Mandailing Natal)."
[7] P.M. Krisdayani, M.Y. Proborini, E. Kriswiyanti. " Pengaruh Kombinasi Pupuk Hayati Endomikoriza, Trichoderma spp., dan Pupuk Kompos terhadap Pertumbuhan Bibit Sengon (Paraserianthes falcataria (L.) Nielsen)" Jurnal Sylva Lestari Vol. 8 No.3. 2020
[8] A.D. Nusantara, Y.H. Bertham dan I. Mansur, "Pengambilan Contoh Tanah dan Akar,"*Bekerja Dengan Fungi Mikoriza Arbuskula*," Bogor, Seameo Biotrop, 2012.
[9] Brundrett M, Abbott LK, Jasper JA. " Glomalean mycorrhizal fungi from tropical Australia. I. Comparison of the effectiveness and specificity of different isolation procedures". Mycorrhiza. 8:305- 314. 1999.
[10] Gerdemann JW, Nicolson. "Spores of mycorrhizae Endogone extracted from soil by wet sieving and decanting". Trans Br Mys Soc. 46:235-244.1963
[11] INVAM. 2021. International Culture Collection of (Vesicular) Arbuscular Mycorrhizal Fungi. Tersedia di < URL: http://invam. caf. Wvu. Edu/Myco-info/Taxonomy/species descrip tions/>. Diakses pada Tanggal 20 Oktober 2021.
[12] Giovanneti, M. dan Mosse B. "An Evaluation of Technique for Measuring Vesicular-Arbuscular Mycorrhizae Infection in Roots". New Phytol. 84:317- 321. 1980.
[13] Suharno, Retno Peni Sancayaningsih, Endang Sutariningsih Soetarto dan Rina Sri Kasiamdar,"KEBERADAAN FUNGI MIKORIZA ARBUSKULA DI KAWASAN TAILING TAMBANG EMAS TIMIKA SEBAGAI UPAYA REHABILITASI LAHAN RAMAH LINGKUNGAN" (The Presence of Arbuscular Mycorrhizal Fungi in the Tailings of Mining Gold Timika as An Attempt of Environmentally Friendly Land Rehabilitation)," J. MANUSIA DAN LINGKUNGAN, Vol. 21, No.3, pp. 295-303, 2014.
[14] T.W. Yuwati dan W.S. Putri,"Keragaman Spora Mikoriza Arbuskula ndi Bawah Tanaman Shorea balangeran (Korth.) Burck. Sebagai Bioindikator Keberhasilan Revegetasi,"J. Galam, Vol. 1 No. 1, pp. 16-26, 2020.
[15] Hermawan, H. Muin dan Wulandari,"Kelimpahan Fungi Mikoriza Arbuskula (FMA) Pada Tegakan Ekaliptus (Eucalyptus pellita) Berdasarkan Tingkat Kedalaman di Lahan Gambut,"J. Hutan Lestari, Vol. 3. No. 1 pp.124-132, 2015.