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The identification of soil fungi isolated from rhizosphere in different varieties of jali (*Coix lacryma-jobi*) in Loa Kulu, Kutai Kartanegara, Indonesia

SOPIALENA[1♥], N. AKHSAN[1], A. SURYADI[1], JULI NURDIANA[2♥♥]

[1]Department of Agroecotechnology, Faculty of Agriculture, Universitas Mulawarman. Jl. Pasir Belengkong, Kampus Gunung Kelua, Samarinda 75119, East Kalimantan, Indonesia. Tel.: +62-541-749161, Fax.: +62-541-738341. ♥email: sopialena88@gmail.com
[2] Environmental Engineering Study Program, Faculty of Engineering, Universitas Mulawarman. Jl. Sambaliung No. 9, Kampus Gunung Kelua, Samarinda 75117, East Kalimantan, Indonesia. Tel.: +62-541-749315, Fax.: +62-541-736834. ♥♥email: jalmurdiana@gmail.com

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Abstract. *Sopialena, Akhsan N, Suryadi A, Nurdiana J. 2018. The identification of soil fungi isolated from Rhizosphere in different varieties of jali plants* (Coix lacryma-jobi) *in Loa Kulu, Kutai Kartanegara, Indonesia. Asian J Agric 2: 44-47.* The rhizosphere effect indicated the development of active microbial population around the roots driving from the loss of organic materials. This research was intended to identify rhizosphere microbes by identifying the potential microbes four different varieties of jali (*Coix lacryma-jobi* L.) in Loh Sumber, Loa Kulu, Kutai Kartanegara, Indonesia, i.e., *jelai beras*, *jelai ketan*, *ketan lekat*, and *jelai kaltara*. The soil samples were collected and isolated in the area of jali plantation in Loa Kulu, Kutai Kartanegara at 45 days after planting. As many as 16 isolated samples were used, collected from four different variety of jali and 4 times of replication. The result showed that a variety of microbes at Rhizosphere could be classified as *Trichoderma* sp. *Aspergillus* sp., *Pythium* sp., *Fusarium* sp., *Cunninghamelal* sp., and *Penicillium* sp..

Keywords: Rhizosphere, jali, *Coix lacryma-jobi*, fungus, Indonesia

INTRODUCTION

In Indonesia, the commodity of jali (*Coix lacryma-jobi* L.) can be found in Sumatra, Java and Kalimantan. However, to date, it has not been widely developed in East Kalimantan (Juliardi et al. 2014). Based on the information collected, there are more than one varieties of jali cultivated in East Kalimantan, namely (i) *jelai beras (padi jelai sumber rejeki I)*, (ii) *jelai ketan (padi jelai sumber rejeki II)*, (iii) *ketan lekat (padi jelai sumber rejeki III)*, and the variety of *jelai kaltara* (Suyadi 2011). Rhizosphere is part of the soil surrounding the roots and serving as a first layer defense for the pathogens (Nurbailis et al. 2014). Some rhizosphere microorganisms, have proven to play an important role in nutrient cycling and soil formation, the plant growth, microorganism activities and acting as a biological control against the pathogens surrounding the plant roots. The benefit of the microbial population around the rhizosphere to maintain the nutrient intake for the plants is quite certain (Budiarti et al. 2014).

In general, there are two types of microorganisms living at rhizosphere; microbial antagonists and pathogenic microbes (Beneduzi et al. 2012; Trabelsi and Mhamdi 2013; Barea 2015). Antagonists microorganisms commonly found in the root zone as *Trichoderma*, *Aspergillus*, and *Penicillium*, while pathogenic microorganisms are mostly found as *Phythopthora*, *Pythium and Fusarium* which can reduce the plant production which ultimately impact on the loss of productivity. Therefore, this study took into account this idea, to identify the rhizosphere microorganism in jali's at the village of Loh Sumber, Loa Kulu District of Kutai Kartanegara. The function of this research is to know the types of rhizosphere fungi living in the four types of jali. Though jali is commonly known as a fodder, it often be used by malt producer, and serving as kind of a health food. Nowadays, there is an attempt to utilize and cultivate jali is some part of Indonesia, included in the village Loh Sumber, Loa Kulu (Badan Ketahanan Pangan dan Penyuluhan 2016).

Microorganisms living at rhizosphere has a vital role in maintaining soil fertility because of their ability as decomposers. Some microorganisms living at the roots of healthy plants are known to be protective against pathogens. Naturally, they can hamper the development of pathogens in the soil. In addition, the ability of the organism to adapt to various environmental conditions is a great potential for them, serving as a biological control agent. Rizospheric fungi are among the groups of microorganisms that have been reported to induce plant resistance to various diseases, both ground-borne diseases. Besides, they also support the growth of the plant through various mechanisms such as increasing nutrient uptake, biological control of pathogens, and producing the hormone for the plants (Pereg and McMillan 2015; Jacoby et al. 2017).

The concept of rhizosphere was first proposed by Hiltner in 1904 (Larry et al. 2016). The population of microorganisms in the rhizosphere is usually more numerous and varied than in non-rhizosphere. Rhizosphere soil affected the roots and substances released from the roots into the soil solution, to create favorable conditions for fungi. The presence of antagonistic microorganisms in

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SOPIALENA[1,♥], N. AKHSAN[1], A. SURYADI[1], JULI NURDIANA[2,♥♥]

[1]Department of Agroecotechnology, Faculty of Agriculture, Universitas Mulawarman. Jl. Pasir Belengkong, Kampus Gunung Kelua, Samarinda 75119, East Kalimantan, Indonesia. Tel.: +62-541-749161, Fax.: +62-541-738341. ♥email: sopialena88@gmail.com

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the rhizosphere can inhibit the spread and root infection by pathogens, a condition called a natural microbial barrier (Rodrigo et al. 2013; de Boer et al. 2015). The main biological facts of rhizosphere or root-affected areas are the high number and high activity of soil microorganisms in this area compared to rootless soils (Fety et al. 2015; Suyadi et al. 2017). As biological control agents, the antagonist microorganisms will detain the spreading of the pathogens. This situation is called a natural and unlikely microbial barrier, this microbial antagonist is potentially developed as a biological control agent (Gusnawaty et al. 2014). In the rhizosphere, it is suggested that there are harmful organisms around the roots of unhealthy plants, on the other hand, it is found that beneficial organisms live at the roots of healthy plants. It is reported that the fungi of the genus Trichoderma and Gliocladium are antagonistic fungus that often be found in the area of the rhizosphere (Nurbailis et al. 2014). The results of several researches showed fungal isolates from potato plant rizosphere obtained were 8 isolates consisting of two isolates of *Trichoderma* genus, one *Penicillium* isolate, two *Phytopthora* isolates, one *Mucor* isolates and two isolates unknown to its genus (Budiarti and Nurhayati 2014). The rhizosphere effect indicated the development of active microbial population around the roots driving from the loss of organic materials. Consodering the rhizosphere effects, this reserach was aimed to identify the available potential microbes at different four varieties of jali (*Coix lacryma-jobi* L.) in Loa Kulu, Kutai Kartanegara, Indonesia. Though there are many disscussion around the microbes and rhizosphere, however, this study brought a scientific value in terms of the idenfication of microbes for jali in Loa Kulu which has not been widely explored before.

MATERIALS AND METHODS

This reserach was conducted from May to August 2017 in jali cultivation areas; Loh Sumber village, Loa Kulu, Kutai Kartanegara. The soil sampling was collected at 45 days after planting by drilling to reach a depth of 30 cm with 10 cm distance from the planting hole. There were 5 sample points taken by zigzag pattern, which then be composited into 1 kg mixture, and then be composited for second time into 1 ons. The total samples used were 16 pieces, consisting of 4 samples of each variety and 4 replications.

To identify the isolated fungi, the soil sample of four different varieties of jali was firstly weighed at 1 g and then inserted into a test tube containing 10 ml of sterile distilled water and then let it shaken for awhile. From the solution, 1 ml was taken and put into a test tube containing 9 ml of sterile aquadest. This process kept recurring until it reached a 10-3 dilution level of cpu (cell per unit). From the dilution, 1 ml was taken and then injected into the petri dish which had been filled with Potato Dextrose Agar (PDA) and let it for isolation for 3-7 days in a room temperature of 27-28°C. Later, a direct observation using the microscope was performed to identify the fungal colonies which taken by an ose of the needle and adding it with a methylene blue liquid. The purification process was carried out to fungal colonies. For each different fungi, it was taken and re-grown on a petri dish containing solid PDA. The fungi identification was then referred to Alexopoulus and Mims (1979) and Samson and van Reenen-Hoekstra (1988) using an optilab camera.

RESULTS AND DISCUSSION

Rhizosphere is part of the soil that has the highest metabolic activity defined as a small portion of the soil volume which is directly affected by the growth and metabolism of plant roots. Plants and microbes interact and stimulate each other caused by root exudates (Hunter et al. 2014). Whereas root exudates affect the growth and activity of microorganisms in Rhizosphere, Rhizoplan, and its surroundings. Various types of microorganisms inhabit the rhizosphere such as fungi, bacteria, actinomycetes, algae, and nematodes. The activity of microorganisms in rhizosphere and rhizoplan is different from the surrounding soil depending on the root exudate released. In this regard, this study came with the identification of fungal activity on rhizosphere to characterize the type of fungal microbes for specific plant and certain geographic area.

Based on the field information collected, this research classified the different varieties of isolated fungi at rhizosphere-based on jali's varieties and the replication from *Jelai Beras, Jelai Ketan, Bacteria, Actinomycetes, Ketan Lekat* and *Jelai Kaltara*. The result were presented in Table 1,.

The findings in Table 1 clearly shown that in the 1st, 2nd and 4th replication, the rhizosphere fungi of four different varieties of jali can be grouped as *Trichoderma* sp., *Aspergillus* sp. and *Pythium* sp. Only in 3rd replication, that showed a more varied fungi, i.e., *Trichoderma* sp. (Figure 1.A-B), *Aspergillus* sp. (Figure 2.A-B), *Pythium* sp. (Figure 3.A-B), *Fusarium* sp. (Figure 4.A-B),, *Cuninghamella* sp. (Figure 5.A-B),, and *Penicillum* sp. (Figure 6.A-B). This finding showed that more fungi can live in jali's rhizosphere. Meanwhile, Anggraeni and Usman (2015) identified that *Trichoderma sp*. and *Aspergillus sp*. were also mostly found in Banana's rhizosphere. It is suggested that the different variety and characteristic of the fungus depend on many factors including substrate and the environmental conditions (Sutton-Grier et al. 2011; Haleem Khan and Karuppayil 2012; Basu et al. 2015).

Table 1. Name of fungi isolated from rhizosphere in different varieties of jali

Name of jali's varieties	Number of replication			
	1st	2nd	3rd	4th
Jelai beras	1, 2	1, 2	2, 3	1, 2
Jelai ketan	1, 3	1, 3	1, 2, 5	1, 2
Ketan lekat	1, 2	1, 2, 3	1, 2, 4	1, 2, 3
Jelai Kaltara	1, 3	1, 2	1, 2, 6	1, 2, 3

Note: 1. *Trichoderma* sp., 2. Aspergillus sp., 3. *Pythium* sp., 4. *Fusarium* sp., 5. *Cunninghamella* sp., 6. *Penicillium* sp.

Substrate is the main source of nutrients for fungi. New nutrients can be utilized after the fungus excretes extracellular enzymes that can break down the complex compounds from the substrate into more simple compounds. Fungi that cannot produce enzymes according to substrate composition by themselves cannot utilize the nutrients in the substrate (Fety et al. 2015). While for environmental conditions, the environmental conditions that affect the presence of fungi, included the moisture and the temperature (Suyadi 2011; Suyadi et al. 2017). In addition, the humidity is also very important for the fungi growth. In general fungi such as *Aspergillus, Penicillium, Fusarium*, and many other *Hyphomycetes* can live on a lower relative humidity. A good temperature for fungus growth is very influential. Most fungi, including mushrooms have a mesophilic temperature, which allow them to grow in the optimum temperature between 25-35°C (Kapoor and Sharm 2014). Even so, it is also noted that there is thermophilic fungus which is able to grow at high temperatures (Saroj et al. 2017). Identifying the temperature range of the fungus growth is very important, in order to have a supporting environment for the fungus (Singh and Chauchan 2013; Lene 2014).

The results of this study supported the research conducted by Sopialena et al. (2017) which identified that besides Rhizoctonia, *Phytium* sp., *Penicillium* sp., *Aspergillus* sp., become among the four main types of fugal which are often found in East Kalimantan, particularly in post coal-mining areas. Also, they also located two other types of fungal; *Cuninghamella* sp. and *Trichoderma* sp. *Aspergillus* sp. and *Fusarium* sp. seems to be dominated in East Kalimantan, in particular for Kutai Kartanegara (Sopialena et al, 2018). Further, Rosfiansyah, et al. (2017) also noticed that likewise *Massarina* sp. and *Rhizoctonia* sp., *Phytium* sp., and *Penicillium* sp retain potential value as biofertilizer for land reclamation in post-coal mining areas in Samarinda. Therefore, this study deepens the knowledge of fungal inventory observed in East Kalimantan land that only a limited number of fungal found on the soil, mainly due to the climatic conditions i.e., rainfall and temperature, and the type of soil which is dominated by red yellow podzolic.

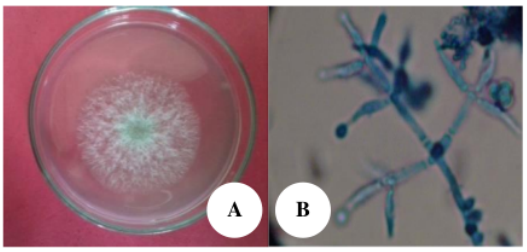

Figure 1. *Trichoderma* sp.

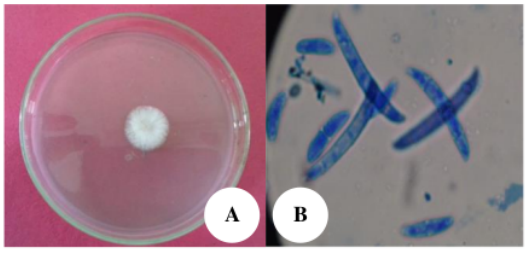

Figure 4. *Fusarium* sp.

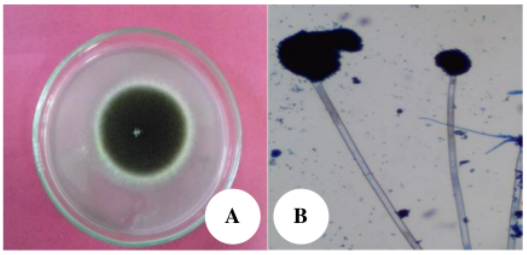

Figure 2. *Aspergillus* sp.

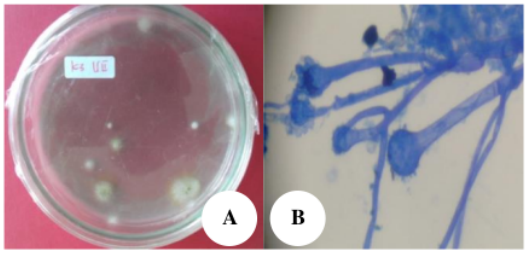

Figure 5. *Cuninghamella* sp.

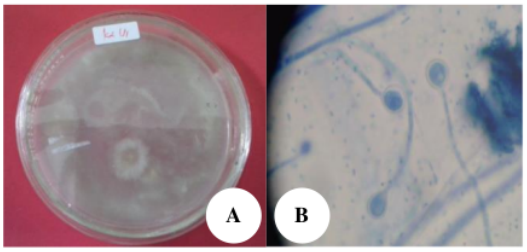

Figure 3. *Pythium* sp.

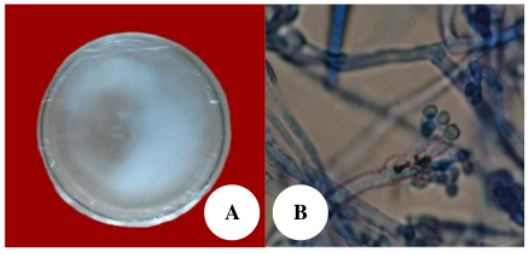

Figure 6. *Penicillium* sp.

In regard to the climate condition of Kutai Kartanegara area, the average of monthly rainfall is recorded at 259.8 mm/month, which suggests to become the main reason for the wet/ humid condition of the subsurface soil. This condition is advised to has have significant effect to soil microorganism activities, the speed of chemical synthesis, and the soil nutrients due to percolation and lessivation of water (Sopialena and Pratiwi 2017). The heavy rainfall has a significant impact of kinetic energy which may cause the changes in the composition and size of soil particles. Further, the run-off water on the soil surface may generate the erosion and material translocation, in particular for areas where the level of cover is ruined. High rainfall causes inundation or flooding in some flat areas and depression. In addition, the slight difference range temperature from day to night may also affect the organism decomposition process, which shown from the low rate of soil macro contents such as N, P and K.

In conclusion, this study brought a new finding of rhizosphere microbes of jali (*Coix lacryma-jobi* L.) in Loa Kulu, Kutai Kartanegara. It enriched the knowledge on the identification of microbes in three different varieties of jali in East Kalimantan. The results indicated that there are six main fungi found at the rhizosphere, namely *Trichoderma* sp. *Aspergillus* sp., *Pythium* sp., *Fusarium* sp., *Cunninghamella* sp., and *Penicillium* sp.

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