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THE EFFECT OF SIDOARJO'S MUD SOIL WITH ORGANIC MATERIALS TOWARD THE GROWTH OF ALBIZIAN (*Samanea saman* Merr)

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ABSTRACT

Sidoarjo's mud soil is a type of soils formed from the mud came out at the former oil drilling of Lapindo Brantas Limited Company.Albizian (Samanea saman Merr) is a type of plant that is often developed for environmental management. This research's objective is to investigate the effect of Sidoarjo's mud soil toward the growth of albizian. Sidoarjo's mud soil was dried, pulverized and sieved with a sieve with size of 2 mm then analyzed for characteristics. The sample of the Sidoarjo's mud soil was mixed with rice husks, compost and cow manure then incubated for 5 weeks. A hundred grams samples were analyzed for chemical, physical and biological characteristics. The albizian seeds on age 2 weeks were planted on media in the polybag. The results of the research showed that the treatment of M2 produced the best growth of albizian compared to other treatments. The growth of albizian on M2 treatment produced the plant height of 29.3cm, stem diameter of 0.48cm, leaves number of 15.8cm, root length of 19.0cm,root dry weight of 1.3g and stem+leaves dry weight of 4.2g. This research concluded that the best growth of the albizian in treatment of M2

Keywords: Sidoarjo's mud soil, Growth, Albizian

INTRODUCTION

Sidoarjo's mud soil is a type of soils formed from the mud came out at the former oil drilling of Lapindo Brantas Limited Company.This mud's eruption, according to Wiguna *et al.* (2009), ever reached of 120.000m^3 per day, cause the sinking of eight villages in the district of Sidoarjo, East Java province, Indonesia. The mud is still getting out with a small volume burst of leading to the wider spread of alluvial areas. The results of the Sidoarjo's mud soil analysis showed that the textured with a composition of 62 % clay, dust of 35% and sandof 3 %. Sidoarjo's mud soil has a value of cation exchange capacity (CEC) in high criteria, namely: 42.58 me/100g. Brady (1990) stated that the CEC indicates the ability of the soil to hold and exchange the cations including the cation of plant nutrients. Cation exchange capacity is important for soil fertility. High clay content according to Munir (1996) is identical to vertisol soil which has vertic characteristics which are expanding in wet and shrinking in drought. This trait is due to the high content of montmorillonite clay mineral. Soft structured soil (clay) is easy to get condensation that reduces the space of soil pores as well as reduces the water and air movement in the soil. To improve the physical characteristics of the soil, if it is used for plant's growth, it is necessary to add porous materials or a number of organic materials. Syukur and Harsono (2008), stated that important functions of organic materials are for improving soil structure and water holding power, supplying nitrate, sulfate, and organic acids to destroy the materials, supplying nutrients,

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improving nutrient holding capacity and cation exchange capacity (CEC), as well as being a source of carbon, minerals, and energy for the organism.

Atmojo (2003), stated that rice husks is an organic material that can also play a role in the improvement of soil physical characteristic in the form of: a) improving the structure of soil or losing it, b) increasing the water absorption, c) improving the drainage and air-conditioning in the soil and d) improving the lives of microorganisms that are useful in soil fertility. According to Wahyono (2010), the materials in compost can improve soil physical characteristic and provide nutrients for plants.

The addition of compost to sandy soil will increase the availability of water for plants that reduces the amount of irrigation water. While the addition of it to clay soil will improve air and water permeability and increase water infiltration, and thus reduces the flow of surface water. Syukur and Indah (2006), stated that the provision of20 tons/Ha of cow manure can improve soil quality, which is increasing the water holding capability and the availability of NH_4 and NO_3.According to Tien *et al*. (1997), organic materials are source of energy for soil macro- and micro-fauna. The addition of it in the soil will make the activity and population microbiology in the soil increase, particularly one that is related to decomposition and mineralization activity of organic materials. Some of the microorganisms playing role in the decomposition of organic are fungi, bacteria and actinomycetes.

Albizian (*Samanea saman* Merr) is a type of plant that is often used for environmental management. This plant has a wide canopy that serves as a shade and is widely used for the land greening. Additionally, rain trees are known to have a high ability to absorb carbon-dioxide within the atmosphere than some other plants do. According to Dahlan (2010), it is proven to absorb the most carbon dioxide and has the most powerful ability to absorb soil water. Within a year, this plant can absorb 28.488.39 kg of carbon-dioxide.

MATERIALS AND METHODS

The research on the characteristics of Sidoarjo's mud soil, rice husks, compost, and cow manure was conducted in the laboratory of chemical and physical soil of Agriculture Faculty, and the research of biological characteristics was conducted in the laboratory of microbiology of Mathematics and Natural Sciences Faculty, Brawijaya University, Malang Indonesia. While the research on the growth of albizian was conducted at the yard in Panjikidul village, Panji subdistrict, Situbondo district, East Java, Indonesia. The research was conducted from March to August 2012.

Sidoarjo's mud soil was taken from Siring village, Porong subdistrict, Sidoarjo district. The sample of Sidoarjo mud soil was dried, pulverized and sieved with a sieve with the size of 2 mm. Then it was evenly mixed with rice husks, compost and cow manure in accordance to the treatment for media (Table 1). Furthermore, as much as 1000g of the media is put into a polybag of 25x12,5x25 cm3, and then incubated for 5 weeks in a state of water field capacity.At the end of the incubation, a hundred grams of samples of the media were analyzed for the chemical, physical and biological characteristics. While the albizian seeds on age 2 weeks were planted on mediain the polybag.

The parameters observed were characteristics of chemical, physical and biological after incubation for 5 weeks. The parameter observed i.e. total nitrogen, phosphorus, potassium, porosity, aggregate stability, and microorganisms' population. For the growth, the parameters observed were the height of plants, the stem diameter, the leaves number, the root length, the root dry weight, the stem +leaf dry weight, and the root nodules. This research used a completely randomized experimental design (CRD) with 10 types of media as treatments and

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each treatment were repeated 5 times. To determine the actual treatment, the analysis of variance (ANOVA) was done at a significance level of 95%, followed by Duncan's multiple range test (DMRT) at significance level of 95%.

Table 1. Research treatment

Code of treatment	*Comparation of organic materials*
M1	Sidoarjo's mud soil of 20% + rice husks of 40% + compost of 20% + cow manure of 20
M2	Sidoarjo's mud soil of 50% + rice husks of 20% + compost of 10% + cow manure of 20%
M3	Sidoarjo's mud soil of 50% + rice husks of 20% + compost of 20% + cow manure of 10%
M4	Sidoarjo's mud soil of 50% + rice husks of 40% + compost of 10%
M5	Sidoarjo's mud soil of 50% + rice husks of 40% + cow manure of 10%
M6	Sidoarjo's mud soil of 80% + compost of 10% + cow manure of 10%
M7	Sidoarjo's mud soil of 80% + rice husks of 20%
M8	Sidoarjo's mud soil of 80% + compost of 20%
M9	Sidoarjo's mud soil of 80% + cow manure of 20%
M10	Sidoarjo's mud soil of 100%

RESULTS AND DISCUSSIONS

The results of Sidoarjo's mud soil analysis indicates that the total nitrogen content was 0.12%. The available phosphorus indicates that the content is low in only 4.86 mg kg^{-1}. The content of potassium available also indicates that it has a low amount, in 0.09me/100g. The result of physical analysis shows that Sidoarjo's mud soil has clay texture with content of 62%, 35% of dust, and 3% of sand. While the analysis of microbes is low with only total bacteria of $5.1x10^4$ cfu/g and total fungi of $1x10^2$ propagules/g.

While the results of variance analysis showed that all the tested treatments significantly affected the height of plant, stem diameter, the leaves number, root length, root dry weight, stem + leaves dry weight, root nodules .Based on the advanced test of Duncan, it shows that treatment of M2 is able to provide the height growth, which average height was of 29.3 cm, stem diameter of 0.48 cm, the leaves number of 15.8, root length of 19.0 cm, root dry weight of 1.3 g, stem + leaves dry weight of 4.2 g and root nodules of 0.2 g better than in other treatments (Table 2).

The treatment of M1 has the highest amount of organic materials (80%), the highest of total nitrogen of 0.46% (Table 3).According to Paje (1990), to be able to effectively use the organic materials, its provision must be in large amount. Syukur and Indah (2006) mentioned that the addition of organic fertilizer into the soil either in the form of compost or cow manure caused an increase in soil organic carbon. The more organic fertilizers added to the soil, the more organic carbon released into the soil. Then the addition of organic fertilizer plant waste compost and cow manure herbs in dose of 40 tons/Ha has increased total nitrogen.

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Table 2. Advanced test of Duncan on albizian's growth

Code of Treatment	*Height stem Diameter* ----------CM--------		*Leaves Number*	*Root Length (CM)*	*Root Dry Weight*	*Stem+Leave Dry Weight*	*Root Nodules*
					----------g----------		
M1	28.3e	0.48b	14.8bc	20.2c	1..3c	4.0b	0.2d
M2	29.3e	0.48b	15.8c	19.0c	1..3c	4.2b	0.2d
M3	28.4de	0.48b	15.8bc	19.2c	1..3c	4.1b	0.2d
M4	27.0cd	0.47b	15.2bc	19.2c	1.2bc	4.0b	0.1c
M5	27.0c	0.47b	15.2bc	19.2c	1.2bc	4.0b	0.06b
M6	24.2b	0.41a	12.8b	9.0ab	0.8a	2.0a	0.02a
M7	29.0e	0.49b	16.0c	12.8b	1.1b	4.3b	0.06b
M8	24.6b	0.43a	12.8b	9.0ab	0.8a	2.0a	0.01a
M9	24.8b	0.42a	12.0b	9.0ab	0.9a	2.1a	0.01a
M10	23.3a	0.41a	8.4a	7.4a	0.7a	1.8a	0.01a

Description: Number's followed by the same letter are not significantly different at the level of 95%

The low content of available phosphorus was related to the basic substances and the absence of organic matters in Sidoarjo's mud soil. According to Munir (1996), Sidoarjo's mud soil is synonymous to vertisol soil type. While Soepardi (1983) mentioned that low content of available phosphorus is generally produced by vertisol developed from marl or marl basic substance. According to Stevenson (1994), the availability of phosphorus in the soil can be directly through the mineralization process or indirectly by helping the release of fixed phosphorus. After the addition of organic rice husks, compost and cow manure on Sidoarjo's mud soil, the increase of available phosphorus content is very high (Table 3). According to Stevenson (1994), the process of decomposition and mineralization of organic matter, while releasing inorganic phosphorus, it will also release organic phosphorus compounds such as fitine and nucleic acid, and organic phosphorus compounds which suspected can be used by plants. The process of mineralization of organic matter will take place if the phosphorus content of organic matter is high, which is often expressed in the ratio of carbon and phosphorus. If the phosphorus content of materials is high, or the ratio carbon and phosphorus is low in less than 200,the mineralization or release of phosphorus into the ground will occur, but if the ratio carbon and phosphorus is higher than 300, the phosphorus will be immobilized or lost.

The potassium contents in Sidoarjo's mud soil are very low only in 0.09 me/100g. Sidoarjo's mud soil has a high clay fraction and is synonymous to vertisol soil type. According to Munir (1996), vertisol soil type is generally low levels of potassium. Vertisol clay mineral composition is always dominated by clay mineral type 2:1, particularly montmorillonite. While Indranada (1994) stated that low levels of potassium are available related to clay mineral type 2:1 (montmorillonite) capable fixation of potassium between mineral lattice clay. After the addition of organic rice husks, compost and cow manure, the available potassium content was also increasing significantly (Table 3). The results of research of Sudadi et al., (2007) concluded that adding mulching and cow manure to maintain soil

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moisture and potassium will increase the supply of available soil potassium at maximum vegetative phase of plant and soybean crops in vertisol.

The results of analysis on water holding capacity shows that all treatments have above 50% of water holding capacity (Table 3), which is expected to meet the needs of water for plant growth. Because according to Anonymous (1991), plant growth depends on the amount of water available in the soil. Growth will be limited by the very low water content and the very high one. However, plants have many ways to set themselves towards the conditions of limited water available. Water holding capacity is influenced by the existing pores. The results of this research showed that the higher the Sidoarjo's mud soil mixture, the more power to save water. Because Sidoarjo's mud soil has high clay content, it is easy for it to hold water and pass it a little bit. Organic materials only serve to increase the infiltration of water of which detained by the particles of Sidoarjo mud soil. Organic materials with the end result of decomposition in humus have larger surface area and absorption capacity than the clay. According to Syukur and Indah (2006), soil with a high clay fraction (55%) makes the soil have a high water holding power but have a low water passing power.

The use of rice husks, compost and cow manure increased the granulation aggregates that stabilizes the aggregates of Sidoarjo's mud soil even more (Table 3). Good soil aggregation indirectly improves nutrient availability. This is because good soil aggregation will ensure good system of air and also soil water, so that the activity of microorganisms can run properly and the availability of nutrients will increase as well. The results of this analysis accord to what raised by Sutedjo (2005), that organic materials act as the glue between the main mineral particles. The organic materials increase the aggregate stability. Then Syukur (2005) stated that good soil aggregation indirectly improves nutrient availability. This is because good soil aggregation will ensure good system of air and soil water too, so the activity of microorganisms can run properly and the availability of nutrients will increase as well. According to Djayadi et al. (2010), the addition of organic materials improves soil porosity, which is indicated by the increased proportion of macro-agregate of soil.

Table 3. Characteristics of Sidoarjo's mud soil (M10) and after the addition of organic materials (M1-9)

Characteristics	*Research Treatment*									
	M1	*M2*	*M3*	*M4*	*M5*	*M6*	*M7*	*M8*	*M9*	*M10*
Total Nitrogen (%)	0.46	0.34	0.38	0.43	0.29	0.23	0.35	0.17	0.19	0.12*
Phosphorus ($mgkg^{-1}$)	65.00	52.56	438.13	81.44	32.50	98.18	55.80	59.67	35.72	4.86*
Potassium(me/100g)	1.33	2.39	2.54	1.78	1.022	1.84	1.26	1.69	1.71	0.09*
Water holding	58.89	66.00	63.26	63.98	55.00	65.02	66.57	68.57	66.20	64.42
Aggregates (mm)	0.51	0.46	0.51	0.94	0.59	0.24	0.68	1.37	0.21	0.09
CEC (me/100g)	-	-	-	-	-	-	-	-	-	42.58
Sand (%)	-	-	-	-	-	-	-	-	-	3.0
Dust (%)	-	-	-	-	-	-	-	-	-	35.0
Clay (%)	-	-	-	-	-	-	-	-	-	62.0

Discription: *: low criteria is according to the Research center of soil (2005); - : no observed

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According to Rosmarkam and Yowono (2002), that the level of fertility can be seen from the availability of nutrients, the higher the nutrient content, the soil is more fertile. If the availability of N ranged between 0.20-0.75 % including moderate levels of fertility N, when N is less than 0.20 % including low fertility rate. While the value of P ≥ 35mgkg^{-1} including very high levels of P fertility. Nutrient value K ≥1.0me/100g including very high fertility rate. Based on the criteria for assessment of the level of soil fertility is the media M1, M2, M3, M4, M5, M6 and M7 have the availability of N ranging from 0.23 to 0.46 % including moderate levels of N fertility, and media M8, M9 and M10 in the range of 0.12 -0.19 % including low fertility rate. While the availability of P in media M1, M2, M3, M4, M5, M6, M7, M8 and M9 ≥ 35mgkg^{-1} including P very high fertility rate, only M10 medium availability of Pof 4.86mgkg^{-1} including infertile P. Furthermore, the availability of K nutrients in media M1 , M2 , M3 , M4 , M5 , M6 , M7 , M8 and M9 ≥1.0me/100g including very high fertility rate, and K nutrient availability M10 media just 0.09me/100g including infertile K.

The results of the analysis on the basic of microbiological obtained several isolates of bacteria and fungi with the amount of variety. Sidoarjo's mud soil bacteria have a total of: 5.1 x104 cfu/g. Bacteria are grouped in three isolates i.e. each isolate has a colony morphology namely Isolate A: circulair, entire, opaque, milky white and flat; Isolate B: rhizoid, undulate, opaque, white and flat, and Isolate C: circulair, entire, opaque, white and raised. In Sidoarjo's mud soil, there found fungus *Trichodermasp* 1 isolate in the total of: 1x102 propagules/g.In the rice husks was found bacteria with a total of: 1.56 x106 cfu/g. Bacteria are classified into three isolates; each isolate has a colony morphology namely Isolate A: rhizoid, lobate, transparent, beige and flat; Isolate B: curied, undulate, opaque, white and flat, and Isolate C: curied, undulate, opaque, white, umbonate. In addition to bacteria, in the rice husks were also found two isolates of the fungus which are *Penicilliumsp* and *Rhizopussp*.with the total of 3.15 x 104 propagules/g. While the total bacterial derived compost was 2.53 x 106 cfu/g to three isolates, each isolate has a colony morphology namely Isolate A: circulair, opaque, greenish white, convex; Isolate B: irregular, jagged, transparent, beige, flat, and Isolate C: circulair, entire, transparent, white. In compost also found two isolates of the fungus which are *Aspergillussp* and *Aspergilusniger*, with a total of fungus: 7.95 x104 propagules/g. For cow manure total bacterial found was 5.85 x104 cfu/g to three isolates, each isolate has a colony morphology namely Isolate A: circulair, entire, transparent, white; Isolate B: circulair, entire, opaque, white milk, flat, and Isolate C: circulair, entire, transparent, white, convex. In cow manure, there was is also found in one isolate of the fungus *Aspergillusniger*, with a total of 5.3 x106 propagules/g.

According to Suhardjo *et al.* (1993) it was reported that organic materials act as a source of energy for most bodies of soil microorganisms, so the more organic materials available the more the population of soil microorganisms. Tien *et al.* (1997) stated that organic materials are source of energy for soil macro and micro-fauna. The addition of it in the soil will make the activity and population microbiology in the soil increase, particularly one that is related to decomposition and mineralization activity of organic materials. Some of the microorganisms playing role in the decomposition of organic are fungi, bacteria and actinomycetes.

Treatment of M2 provided growth response which was not significantly different with treatments of M1 and M3 in height and the root nodules; not significantly different with treatments of M1, M3, M4, M5 and M7 in the growth of stem diameter, the leaves number and the stem + leaves dry weight, and not significantly different with treatments of M1, M3, M4 and M5 in the growth of root length and root dry weight. But treatment of M2 was significantly different with treatments of M6, M8, M9 and M10 in all growth parameters.

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The best growth of albizian was in treatment of M2 was suspected because of the presence of organic rice husks, compost and cow manure. According to Sudomo *et al*. (2010) rice husks media can create a better plants' growth environment especially for physical and chemical characteristic of the soil. According to Suriawiria (2002), soil microbe activities which are beneficial for plants will increase the addition of compost. These activities of microbes help plants to absorb nutrients from the soil and produce compounds that can stimulate plants' growth. Meanwhile, Tan (1993), stated that besides containing nutrients needed by plants, manure also contains humic acids, fulvic and growth hormone etc that spur the growth of plants so the plants nutrients absorptions also increases. Anonymous (2010), stated that the growth of albizian is good if the seeds are already 15 days old, moved (weaned) into poly bags containing seedling media which are in 20% of surface oil, 40% of rice husk, 10% of sand, and 30% of cow manure.

The growth of roots stems and leaves of plants that either produces a relatively high dry weight. High dry weight showed that the metabolic processes of the plant are running as it should. The measurement results showed that the dry weight of albizians good growth in media M1, M2, M3, M4, M5 and M7 also produces dry weight is relatively higher than the dry weight of the media M6, M8, M9 and M10. The results of measurements of root dry weight in media M1, M2, M3, M4, M5 and M7 ranged between 1.1 - 1.3g higher than in the media M6, M8, M9 and M10 in the range of 0.7 - 0.9g. Then the results of measurements of the dry weight of stem + leafin the mediaM1, M2, M3, M4, M5 and M7 ranged between 4. - 4.3g higher than in the mediaM6, M8 , M9 and M10 in the range of 1.8-2.1 g. Based on plant growth and dry weight of the seedlings can calculate quality index (CQI).The CQI calculation results showed that the growth of albizian seeds in themediaM1 , M2 , M3 , M4 , M5 and M7 have value 0.09 . While the value of CQI in the media M6, M8, M9, and M10 only between 0.04 to 0.05.The CQI calculation results indicate that albizian seeds on medium M1, M2, M3, M4, M5 and M7 deserves to be planted on the ground while a albizian seeds on medium M6, M8, M9 and M10 is not worth planting in the field .Because according to Hendromono (2003), states that the seeds in containers that have a CQI $\geq$ 0.09 would be empowered to live high on the field. Meanwhile, according to Indriyanto (2003), an index of high quality seeds that indicate the presence of a balanced translocation of photosynthesis into plant organs header section (stems and leaves) and to the roots. A balance translocation of photosynthetic plant organs to cause the seeds to have a balance of growth between the crown and root parts.

CONCLUSIONS

The best growth of albizianis in treatment of M2 which was the mixture ofSidoarjo's mud soil of 50%, rice husk of 20%, compost of 10%, and cow manure of 20%.

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