ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 4 No. 5 September 2013

# GROWTH OF SUN FLOWER ON THE MEDIA OF SIDOARJO'S MUD SOIL WITH ORGANIC MATERIALS

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## ABSTRACT

*Sunflower (Helianthus annuus L) is a plant-producer of important edible oil and occupies the world's third-highest position after soybean oil and palm oil. This plant can grow in Indonesia which has various climate and soil types. Sidoarjo's mud soil is an alternative choice as a growth media with organic materials. This research's objective is to determine the best sun flower growth on media of Sidoarjo's mud soil in which mixed by organic materials. The sample of Sidoarjo's mud soil was mixed with rice husks, compost and cow manure with different doses into 10 types of growth media. The growth media were incubated for 5 weeks and then planted by sun flower seeds. The media M1 produced the best growth of sun flower compared to other media. This research concluded the best sun flower growth was in media M1 which was a mixture of Sidoarjo's mud soil of 20%, rice husks of 40%, compost of 20% and cow manure of 20%.*

**Keywords:** Sun Flower, Sidoarjo's mud soil, Organic materials

## INTRODUCTION

Sun flower (*Helianthus annuus* L) is a plant-producer of important edible oil and occupies the world's third-highest position after soybean oil and palm oil. Sun flower beans are source of protein; fat and carbohydrate that are potential with the content of it are 21%, 55% and 19%. Oil content as much as 40-50% of the seed weight. Unsaturated fatty acids (oleic and linoleic) found in sunflower oil men reaches 91%, it is higher if compared to the oleic and linoleic acid contained in soybean oil (85%), peanuts (82%), corn (87%) and palm oil (49%). The content of saturated fatty acids (linolenic, palmitic, stearic) which is low (9%) in sun flower oil makes it included as the oil that does not cause cholesterol. Sunflower beans are also rich in vitamin E, betaine, and phenolic acids as antioxidants and anti-carcinogenic that prevent cardiovascular. Nutritional quality of sunflower silage is higher than corn. Sunflower beans residue (meal) contains 28-42% protein so it is good for fodder and is the fourth largest source of fodder in the world (Gandhi et. al., 2005). According to the data from the Statistics Indonesia (2002), thousands of tons of sun flower beans has to be imported each year to meet domestic demand. In 1997 it was reported that 5089 tons of beans worth nearly U.S. $ 2.02 million was imported from China, Australia, the United States and Belgium. In addition to the form of seeds, the import was also in the form of oil. In 1998 the volume of imports reached 381 tons valued at U.S. $ 489.121, as much as 280 tons imported in 1999 which was valued at U.S. $ 328.382.

Sidoarjo's mud soil is a type of soils formed from the mud that came out at the former oil drilling of Lapindo Brantas Limited Company. This mud, according to Wiguna *et.al*. (2009),

its eruption ever reached of 120.000m$^3$ per day, cause the sinking of eight villages in the district of Sidoarjo, East Java Province, Indonesia. This soil is abundant and the area is getting wider which is expected to be an alternative choice as a growth media. According to Noerwarsito (2006), stated that Sidoarjo'mud soil has 3 types of components, namely clay of 71.43%, silt of 10.72% and sand of 17.86%. According to Munir (1996), stated that soil with high clay content, in agricultural terms, is identical with vertisol soil which has vertic characteristic 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 properties of the soil, if it is used for plants' growth, it is necessary to add porous materials or a number of organic materials.

The organic material is one of soil components closely related to soil quality and therefore an important component for the farming system. Organic materials become a part of the soil which is a complex and dynamic system derived from plants and/or animal residues contained in the soil that continuously change in shape as influenced by biology, physics, and chemistry factors (Madjid, 2007). Rice husks, compost and cow manure are organic materials that are often used to improve soil quality. Organic materials can increase the water holding power capacity, improve porosity, make soil aggregation better and thus the decomposition provides nutrients for plants growth. This research's objective is to determine the best growth of sun flower on media of Sidoarjo's mud soil in which mixed by organic materials of rice husks, compost and cow manure.

## METHODS

### Growth Media Treatment

The growth media were made from mixture of Sidoarjo's mud soil, rice husks, compost and cow manure. The sample of Sidoarjo's mud soil was dried, pulverized and sieved with a sieve with size of 2 mm. Then it was evenly mixed with rice husks, compost and cow manure in accordance with treatment for media. Furthermore, as much as 1000g of the media is put into a polybag of 25x12, 5x25 cm$^3$, and then incubated for 5 weeks in a state of water of field capacity.

Types of Growth Media:

1. Sidoarjo's mud soil of 20% + rice husks of 40% + compost of 20% + cow manure of 20% (M1)
2. Sidoarjo's mud soil of 50% + rice husks of 20% + compost of 10% + cow manure of 20% (M2)
3. Sidoarjo's mud soil of 50% + rice husks of 20% + compost of 20% + cow manure of 10% (M3)
4. Sidoarjo's mud soil of 50% + rice husks of 40% + compost of 10% (M4)
5. Sidoarjo's mud soil of 50% + rice husks of 40% + cow manure of 10% (M5)
6. Sidoarjo's mud soil of 80% + compost of 10% + cow manure of 10% (M6)
7. Sidoarjo's mud soil of 80% + rice husks of 20% (M7)
8. Sidoarjo's mud soil of 80% + compost of 20% (M8)
9. Sidoarjo's mud soil of 80% + cow manure of 20% (M9)
10. Sidoarjo's mud soil of 100% (M10)

ISSN-L: 2223-9553, ISSN: 2223-9944
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### Sun Flower Planting

The sun flower seeds which were 2 weeks in the age, i.e: 12.0-13.0 cm in height, the stem diameter ranged from 0.18 to 0.22 cm with a leaves number between 4 and 6 were moved (weaned) into growth media in a polybag. Furthermore sun flower plant seeds were maintained by watering them every morning and evening and protecting them from pests and diseases.

### Observation

The sun flower plant growth observations were carried out for 8$^{th}$ weeks. Each week it was observed and measured the height growth, the stem diameter, the leaves number. While at the 8$^{th}$ week, it measured the root length, the root dry weight and the leaves+stem dry weight.

### Experiments Design

This research used a completely randomized experimental design (CRD) with 10 types of media as treatments and each treatment were repeated 5 times. To determine the actual treatment it was done the analysis of variance (ANOVA) at a significance level of 95%, followed by Duncan's multiple range test (DMRT) at significance level of 95%.

## DISCUSSIONS

### Plants Height

The best average of height growth which was 42.5 cm was in growth media M1. The lowest height growths were in media M6: 29.4 cm and M10: 29.5 cm. The results of advanced significant difference test of Duncan (Table 1) showed that the average height growth of sun flower plants grown in media M1 was significantly different from all treatments. While the second best height growth in Media M4 which was 37.3 cm was not significantly different from the media M2, M3, M5 and M7 but significantly different with the height growth in media M6, M8, M9 and M10.

### Stem Diameter

The largest average of stem diameter growth was in media M1 and M2, namely 0.52 cm. The smallest diameter growth was in media M8 and M10, namely 0.45 cm. The results of advanced significant difference test of Duncan (Table 1), showed that the growth of stem diameter on media M6, M7, M8, M9 and M10 were also not significantly different each other but together they were significantly different with the stem diameter growth in media M1, M2, M3 and M4. Diameter growth in media M5 was not significantly different from the M3, M4, M6 and M7.

### The Leaves Number

The leaves growth for 8$^{th}$ weeks showed that media M1 and M2 have the highest leaves number namely 12 strands. While the lowest leaves growths with the lowest leaves number were in media M6: 8.0 and M10: 8.2 strands. The results of significant difference test of Duncan (Table 1), showed that the leaves growth in media M2, M3, M4, M5 and M7 were not significantly different. While the leaves growth in media M6, M8, M9 and M10 also showed no significant differences.

### Root Length

The results of measurements of the longest average of root length at the 8$^{th}$ week were found in media M1 which was 13.6 cm. The shortest root growth namely 5 cm was in growth media M9 and M10. Duncan's advanced test results (Table 1), showed that root growth in media

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M1 was not significantly different with one in media M2, M3, M4 and M5 but significantly different with one in media M6, M8, M9 and M10. Root growth in media M7 was not significantly different with media M2, M3, M4 and M5.

**Root Dry Weight**

Based on Table 1, the highest root dry weight was presented by sunflower grown in media M1 which was 0.6 g. The lowest root dry weight was 0.3 g of sunflower grown in media M6, M9 and M10. Duncan advanced test results (Table 1), showed that media M1 was not significantly different with media M2, M3, M4, M5 and M7 but significantly different with media M6, M8, M9 and M10.

**Leaves+Stem Dry Weight**

The highest stem+leaves dry weight was also found at sunflower grown in media M1, namely 2.7 g. The lowest one was found at sunflower grown in media M6, namely 1.6 g. Duncan advanced test results (Table 1), showed that medium M1 was not significantly different with media M2, M4 and M5. While media M6 was not significantly different with media M8, M9 and M10. Dry weight of media M7 was not significantly different with the dry weight of media M2, M3, M4 and M5.

**Table 1. Advanced Test of Duncan on Media Influence to Growth of Sun Flower**

| *Code of Treatment* | *Height Plants* | *Stem Diameter* | *Leaves Number* | *Root Length (cm)* | *Root Dry weight* | *Stem+Leave Dry Weight s* |
|---|---|---|---|---|---|---|
| | ---------*cm*--------- | | | | ----------*g*---------- | |
| M1 | 42.5c | 0.52d | 12.0c | 13.6c | 0.6c | 2.7d |
| M2 | 36.9b | 0.52d | 12.0c | 11.2bc | 0.5c | 2.4cd |
| M3 | 36.7b | 0.51cd | 11.0bc | 11.2bc | 0.5c | 2.3c |
| M4 | 37.3b | 0.50cd | 11.2bc | 12.0bc | 0.5c | 2.4cd |
| M5 | 36.7b | 0.49bc | 11.0bc | 11.0bc | 0.5c | 2.5cd |
| M6 | 29.4a | 0.48ab | 8.0a | 6.8a | 0.3ab | 1.6a |
| M7 | 36.6b | 0.48ab | 9.4bc | 10.0b | 0.5c | 2.1bc |
| M8 | 31.3a | 0.45a | 8.6ab | 6.4a | 0.4b | 1.8a |
| M9 | 30.9a | 0.46a | 8.6ab | 5.0a | 0.3ab | 1.7a |
| M10 | 29.5a | 0.45a | 8.2a | 5.0a | 0.3a | 1.7a |

Description: Numbers followed by the same letter are not significantly different at the level of 95%.

The growth shows the increase of the size and the dry weight of which is showing the protoplasm accretion due to increased size or number of it. Plant growth is affected by external factors such as nutrition or optimum conditions in the growth media. This research resulted in the growth of sun flower roots tends to be better at growth media condition with a mixture of rice husks than without. Growth media were given rice husks, according to Saleh and Fathurrahman (2011), physically growth media with rice husks has better porosity than

cow manure or palm pods waste. Growth media with good porosity causes the roots more easily expand and do penetration for looking for more nutrients.

The best average growth of sun flower root was in media M1 namely 13.6 cm. This growth media M1 had a mixture of Sidoarjo's mud soil of 20%, rice husks of 40%, compost of 20% and cow manure of 20%. The root growth was not significantly different from the growth of roots in the media that also had a mixture of rice husks which were media M2 (11.2 cm), M3 (11.2 cm), M4 (12.0 cm), M5 (11.0 cm) but significantly different with media M6, M8, M9, M10 which had no rice husks. This research proves that root growth is better in the growth medium with rice husks than in the media without. Sudomo et al, (2010), stated that rice-husks-media can create environment for growing conditions particularly physical and chemical properties of soil for better plant growth. Growth media containing rice husks, the rate of absorption of Ca and Mg is higher than others.

It is estimated that the poor root growth on media M6, M8, M9 and M10 was caused by the high Sidoarjo's mud soil mixture that was 80% and 100%. Sidoarjo's mud soil is known to contain high clay, when it has less water it is easy to harden and tends to have poor aeration and drainage so it becomes a mechanical barrier for root expanding. Anonymous (2012), stated that root development is highly dependent on the soil environment, such as oxygen, fertility and mechanical barriers.

Roots are an important part affecting plant growth and life. They have a main function to absorb nutrients and water needed for the growth of leaves and stems. Sun flower leaf growth (Table 1), indicates a relationship with root growth. The better root growth the larger the number of sun flower leaves. The larger average growth in leaf sun flower was one grown in media M1 and M2 which was 12.0 strands. Media M1 and M2 were not significantly different from the leaf growth in media M3, M4, M5 and M7. While media M6, M8, M9 and M10 had relatively low leaf growth. Leaves are the primary location of photosynthesis. According to Marjenah (2001), the number of leaves is a major determinant of growth rate. The larger number of leaves has a greater growth.

The greatest stem diameter growth was in plants grown in media M1 and M2 which was 0.52 cm. The Stem diameter growth in medium M1 was not significantly different with media M3 and M4, but significantly different from media M5, M6, M7, M8, M9 and M10. The stem Diameter growth is influenced by the rate of photosynthesis which of course related to the leaf growth. According to Simorangkir (2000), stem diameter growth of plants is closely related to the rate of photosynthesis. Daniel, *et. al.* (1992) stated that the inhibition of stem diameter growth is due to the plant photosynthetic products.

The best average height growth of sun flowers during the $8^{th}$ weeks was in media M1 namely 42.5 cm; this was significantly different from the other media (Figure 1). The second best one is in growth media M4: 37.3 cm which was not significantly different with the height growth in media M2, M3, M5 and M7**.** Sun flower in this reseacrh is low because sun flower of 'rusia himawari' type is low character. The research results from Hutauruk and Benedicta (2009), stated that the high growth of sunflower age $6^{th}$ weeks: 45.27 cm**.** According to Mashudi *et al*., (2005), the nutrients that play a role in the high growth are Nitrogen, Phosporus, and potassium. Sudiarto and Gusmaini (2004) said that organic materials can increase the availability of some nutrients and the efficiency of their absorption. The revamp of organic materials releases nutrients like nitrogen, phosporus, and potassium. Although the nutrient content of organic fertilizer is relatively low, it revamps relatively quickly especially in the tropics. Therefore, in order to effectively use the advantage of organic materials, it must be used in a large amount. According to Mulyono (2010), compost provides both macro and micronutrients. The major macronutrients are such as nitrogen, phosphorus, potassium,

ISSN-L: 2223-9553, ISSN: 2223-9944
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calcium and magnesium. While the important micronutrients are iron, sulfur, manganese, copper, zinc, boron and molybdenum which are essential for plant growth are also available in the compost. Meanwhile, Tan (1993) stated that besides containing nutrients needed by plants, manure also contains humic acids, fulvic and growth hormone etc that the growth of plants so the plants nutrients absorptions also increases.

One of the things determines the growth quality is the optimum conditions for growth media. This means that media M1 is able to create optimum conditions for the growth of sun flower. The optimum condition occurs because the organic material that is given produces organic compounds that enhance the nutrient availability that affects growth and physiology of plants. Anonymous (1991), celating organic acids (humic acid and fulvic acid) resulted from the decomposition of organic material helps to move nutrients into plant roots, especially for micro nutrients. With the availability of micro nutrients, it stimulates the enzymatic metabolism in plant tissues such as vegetative tissue formation and the extension of roots.

Based on the aggregate analysis of growth media at the end of the research, it showed that the provision of organic material increased aggregate stability of Sidoarjo's mud soil. The value of aggregation is as follows M1: 0.51, M2: 0.46, M3: 0.51, M4: 0.94, M5: 0.59, M6: 0.24, M7: 0.68, M8: 1.37, M9: 0.21 and M10: 0.09. Syukur (2005) stated that good soil aggregation indirectly improves nutrient availability. This is because good soil aggregation will ensure for 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.

The highest root dry weight and stem+leaves of sun flower is one grown in media M1 which are 0.6 g and 2.7 g. Root dry weight of media M1 was not significantly different with the root dry weight in media M2, M3, M4, M5 and M7 but significantly different with the root dry weight of sunflower grown in media M6, M8, M9 and M10. While the stem + leaves dry weight of sunflower in medium M1 was not significantly different from the dry weight of media M2, M4 and M5. The stem+leaves dry weight of media M2, M4 and M5 were not significantly different with the dry weight of media M3 and M7 but significantly different with the weight of media M6, M8, M9 and M10. The dry weight is a representation of growth. The higher the dry weight is the faster the plants growth. According to Saleh and Fathurrachman (2011) that the dry weight is a reflection of the vigor seedling sprouts because of the higher seedling dry weight means the higher the energy contained in the sprouts to establish normal growth in both optimum and sub-optimum conditions so that the faster growth of sprouts.


Figure 1. Growth Appearance of Sun Flowers (*Helianthus annuus* L) on the Age of 2 months

## CONCLUSIONS

1. Sidoarjo's mud soil mixed with organic rice husks, compost and cow manure can be a growth media for sunflower *(Helianthus annuus L).*
2. The growth of sun flower plants grown in media which had a mixture of organic rice husks (M1, M2, M3, M4, M5 and M7) responded better than the growth in growth media which no rice husks mixture (M6, M8, M9 and M10) .
3. The best growth of sun flower is in media M1 which was the mixture of Sidoarjo's mud soil of 20%, rice husks of 40%, compost of 20% and cow manure of 20%.

## ACKNOWLEDGMENTS

The research was carried out with facilitation and financial support of post graduate program of Brawijaya University and funded by the Directorate General of Higher Education, Ministry of Education and Culture Of Indonesia.

## REFERENCES

Anonymous. (1991). *Soil Fertility*. Jakarta: Directorat General of Higher Education, Department of Education and Culture.

Anonymous. (2012). A *Root Growth Capability*. Retrieved on May 20, 2012, from http://www.Silviculture.com/kemampuan pertumbuhan akar.html.

Anonymous. (2002*). Land Area Based on Its Use in Indonesia*. Agricultural Survey. Statistic Indonesia

Daniel, T. W. et al., (1992). *Principles of Silviculture (Translated).* Yogyakarta: Gadjah Mada University Press.

Gandhie, S. A. et al., (2005). The Self Incompatibility Locus and Quantitative Trait loci for Self Pollination and Seed dormancy in Sunflower. *Theor. And Applied Gen.,* 15, 57-64

Hutauruk, S., & dan Benedicta, S. (2009). The Growth and Production of Sunflower (Helianthus annuus L) on Top Soil of Several Soil Types Given Two Treatment Standard of Organic Materials. *Visi, 17*(2), 153-163.

Madjid, A. R. (2007). *Basic of Soil Sciences.* Faculty of Agriculture, Sriwijaya University. Palembang.

Marjenah. (2001). Effects of Different ShadesAgainst the Growth and Morphological Response of Two Types of Seeding of Timber Tree. *Journal of Forestry "Rimba Kalimantan", 6*(2).

Mashudi, et al., (2005). Variation Applications of Germination Media at Pulai Seeding. *Journal of Forest Plantation Research, 2*(1), 13-19

Mulyono, D. (2010). The Utilization Corn Waste as Organic Fertilizer for Agricultural Land Enrichment. *Journal of Environmental Engineering, 6*(1), 52.

Munir, M. (1996). *Main Lands of Indonesia*. Jakarta: Pustaka Jaya.

Noerwarsito, T. (2006*). Porits Clay Block*. Surabaya: Laboratory of Structure of Lanscaping. Surabaya Institute of Technology.

Saleh, M. S. & Fathurrahman. (2011). The Growth of Sprout of Palm Arenga pinnata Merr Sprouts from Parent Tree in Different Altitude with Provision of Organic Fertilizer. *J. Agron. Indonesia, 39*(1), 68-72.

Simorangkir, B. D. A. S. (2004). *The Analysis of Riap Dryobalanopslanceolata Burck on Different Line in Collection Forest*. East Borneo: University of Mulawarman Lempake. Frontier No. 32.

Sudiarto & Gusmaini. (2004). The Utilization of Organic Materials in Situ for the Efficiency Sustainable Cultivation of Ginger. *Journal of Agricultural Research and Development, 23*(2).

Sudomo, et al., (2010). Quality of Seed Manglid Manglieta glauca BI in Seven Types Weaning Media. *Journal of Research on Forest Plant, 7*(6), 262-272.

Syukur, A. (2005). Effects of Organic Materials against Soil Properties and the Growth of Caisim in the Sand Beach Soil. *Journal of Soil and Environmental Sciences, 5*(1), 30-38.

Tan, K. H. (1993). Environmental *Soil Science*. New York: Marcel Dekker Inc.

Wiguna et al., (2009). *Sidoarjo Mudflow Mitigation*. Surabaya: Surabaya Institute of Technology.