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The effect of planting media and application of PGPR on growth and yield of Okra (*Abelmoschus esculentus* L.)

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Planting Okra on polybag can be done by focusing on planting media used. The addition of organic material on the planting media was able to supply nutrients for plants. Besides that, with the addition of PGPR which is a group of beneficial bacteria has potential to stimulate the growth of plants and improve yields. The purpose of this research was to determine the effect and get the best combination of PGPR interval application with the use of planting media on the growth and yield of okra. This research used a randomized completely block design (RCBD) with PGPR interval as the first factor, consisting of 5 levels and planting media as the second factor consisting of 2 levels, so overall there were 10 treatment combinations with 3 replications. The results showed that there was no interaction between the treatment of planting media and PGPR. Separately, PGPR treatment gave no significant difference to number of fruit. While media two's treatment (M2) consisting of soil, goat manure and charcoal husk with a volume ratio 1 : 1 : 1 gave the highest result on observation of plant height, number of leaves, leaf area, leaf area index, number of fruit, fruit length, total fresh weight, and also total dry weight. The result number of fruit in this research was 23.69 fruit/plant and 473,8 g /plant for fresh weight of fruit.

Keywords: Okra, PGPR, Planting Media, Polybag.

INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is a vegetable crop that is a public interest, in addition to being used as vegetables, okra can also be used as a medicine. Okra is a multipurpose plant because almost all parts of the plant can be utilized (Ikrarwati and Rohkmah. 2016) But increasing number of population hugely limit agricultural land, so innovation is needed in the use of limited land. The way to solve that problem is by planting okra in polybag. The success of planting okra in polybag cannot be separated from the use of planting media. The use of planting media with the addition of organic matter is expected to support the growth of okra. This is because organic materials can supply nutrients to plants. Soil with more organic material is more porous, so that the soil aeration will be better and compaction does not occur in that soil, it also has a darker color, absorbs more light, more nutrients, oxygen and water absorbed by the plant root and relatively few nutrients fixed soil minerals, so that this soil is more available for plants Sutanto, (2002).In addition to the use of planting media, PGPR which is a group of beneficial bacteria, has the potential to stimulate crop growth and increase yield (Saharan and Nehra. 2011).Plant with application of PGPR exhibits better growth than those without PGPR (Taufiq, 2010).

MATERIALS AND METHODS

2.1 Experimental Time and Place

This research was conducted from January to april 2018, at *screen house* CV. Kurnia Kitri Ayu Farm, Sukun, Malang and at the Laboratory of Environmental Resources, Agricultural Cultivation, Faculty of Agriculture, University of Brawijaya.

2.2 Experimental Tools and Materials

The Tools of this research used polybag 35 cm x 35 cm, ruler, sliding wheel, measuring cup, digital scale, lux meter, thermohygrometer, oven and camera.

The materials used during the research were seed of okra, soil, goat manure, charcoal husk, water and PGPR consisting of *Azotobacter sp.* 10^8 *cfu/ml, Azospirilum sp.* 10^8 *cfu/ml, Pseudomonas sp.* 10^8 *cfu/ml, dan Bacillus sp.* 10^8*cfu/ml.*

2.3 Experimental Methods

This research used a randomized completely block design (RCBD) with the first factor was PGPR interval consisted of 5 levels, control (P0), 5 ml/l (P1), 10 ml/l (P2), 15 ml/l (P3), dan 20 ml/l (P4). While the second factor was planting media that consisted of 2 levels, the first was soil and goat manure (M1) and the second level was soil with goat manure and charcoal husk (M2). So that, there were 10 combination of treatments, P0M1, P0M2, P1M1, P1M2, P2M1, P2M2, P3M1, P3M2, P4M1, dan P4M2. Every treatment was repeated 3 times, so there are 30 unit experiments and each of that consisted of 3 polybags, so totally there were 90 polybags.

Observation in this research consisted of growth, yield and harvest and also environmental observation. Observation about growth of plants included plant height, number of leaf, leaf area, and leaf area index, and observation about yield of okra include fruit length, number of fruit, total fresh weight, and total dry weight of okra. Environmental observations consisted of N analysis on initial media before planting and final N analysis after harvest, bacterial analysis, temperature and humidity observation, intensity of solar radiation, pH, temperature and moisture of planting media.

2.4 Data Analysis

Data analysis using ANOVA and continued test with LSD 5% level, if there was significant effect.

RESULTS

3.1 Growth Parameters

Growth is the process of adding size and weight of plant. In this research, the aspects that were observed were plant growth components that consisted of plant height, number of leaf, leaf area, and Leaf Area Index. On plant height, the result of this research shows that there was no interaction between PGPR and different composition of planting media. Separately, PGPR treatment was not significantly different on height of okra in all ages of observation (Figure 1), this was different from the planting media treatment which significantly showed different plant height at 40, 60, 80 and 100 dap (Figure 2).

In observation number of leaf showed that there was no interaction between PGPR with planting media. Separately, PGPR treatment did not significantly different on all ages of observation (Figure 3). It was different from planting media which was significantly different at all ages of observation (Figure 4).

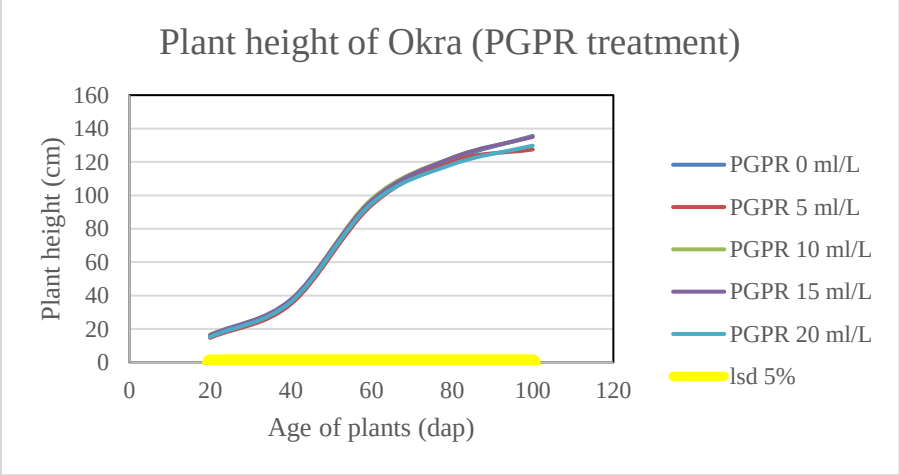

Figure 1: Plant Height (cm) of Okra Treatment by PGPR

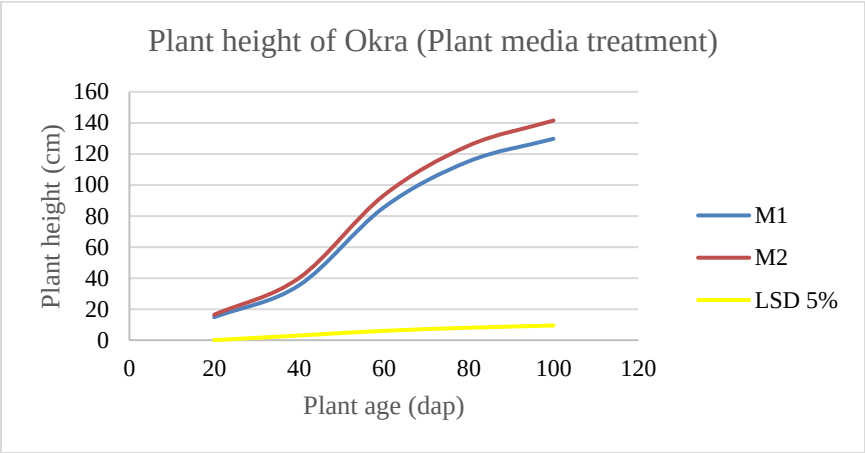

Figure 2: Plant Height (cm) of Okra Treatment by Planting Media

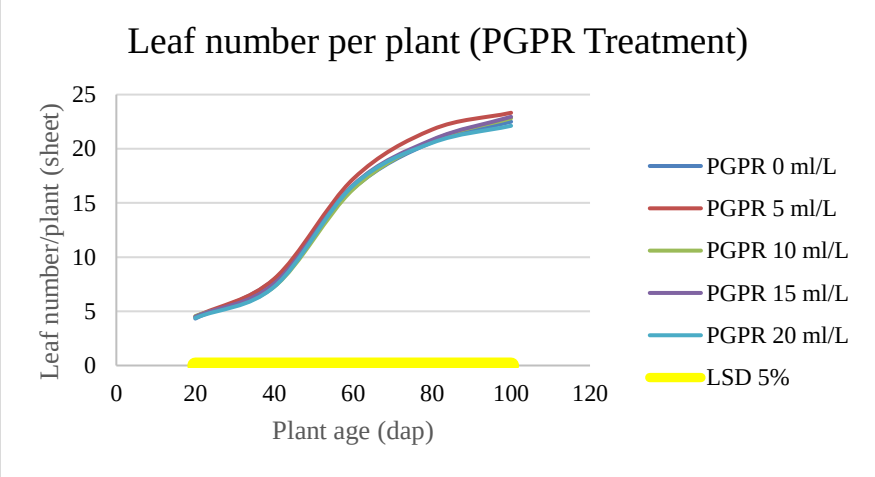

Figure 3: Number of Leaf of Okra Treatment by PGPR

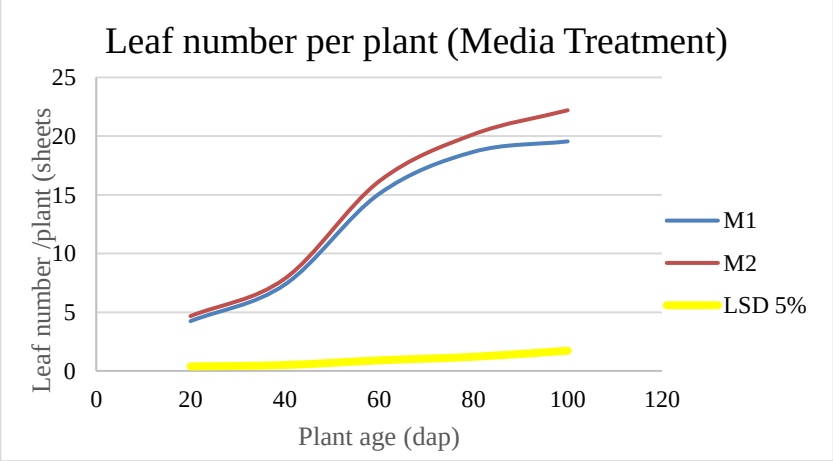

Figure 4: Number of Leaf of Okra Treatment by Planting Media

In observation Leaf Area and Leaf Area Index (LAI) of Okra showed that there was no interaction between PGPR with planting media. Separately, PGPR treatment was not significantly different on all time of observation (Figure 5 and Figure 7). Contrast to the planting media that was significantly different in all ages of observation (Figure 6 and Figure 8).

This research indicates that all of growth parameters revealed that there was no interaction among the treatments consisting of PGPR and different planting media. Separately, PGPR treatment did not significantly different on all ages of observation. Contrary, planting media showed significance difference at all ages of observation.

Media treatment consisting of soil + goat manure + charcoal husk (M2) exhibited significant difference and higher results than soil and goat manure (M1) on growth of okra including plant height, number of leaf, leaf area and leaf area index.

3.2 Yield Parameters

The observation of fruit number showed that there was no interaction among the treatments. Separately, PGPR treatment was not significantly different on number fruits of okra (Figure 9), but the treatment of planting media had a significant effect on number of fruits of okra (Figure 10).

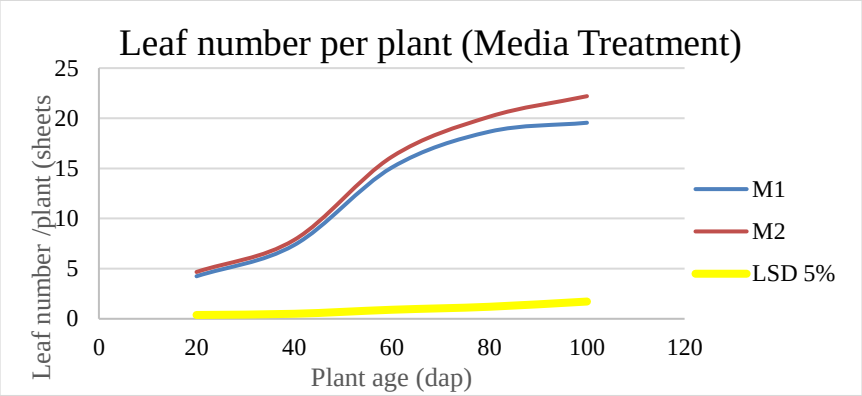

Figure 5: Leaf Area (cm²/plant) of Okra Treatment by PGPR

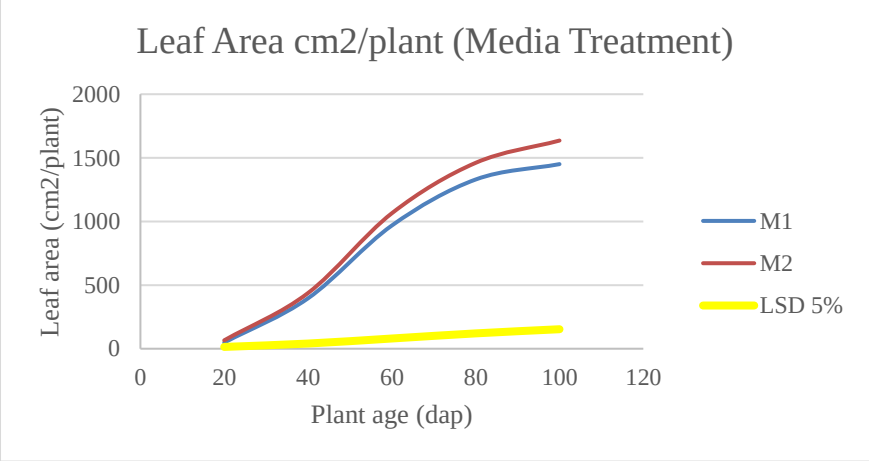

Figure 6: Leaf Area (cm²/plant) of Okra Treatment by Planting Media

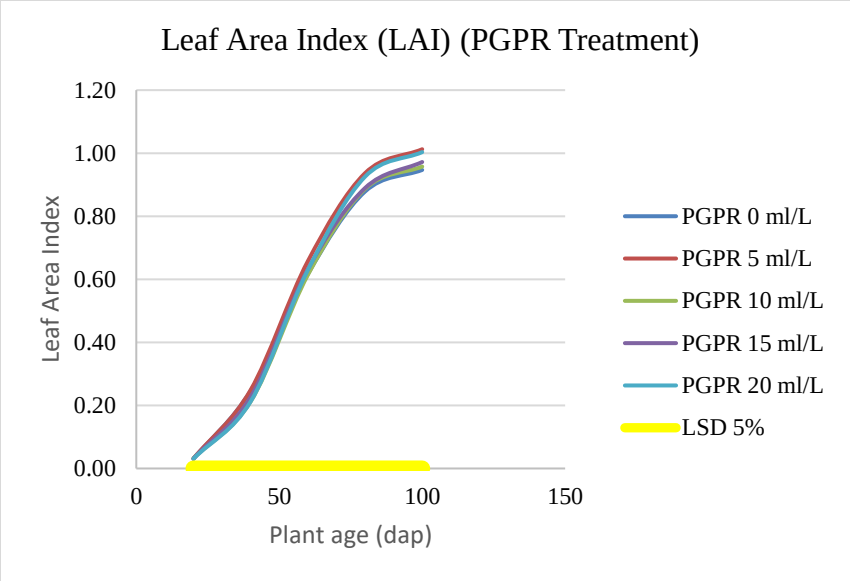

Figure 7: Leaf Area Index (LAI) of Okra Treatment by PGPR

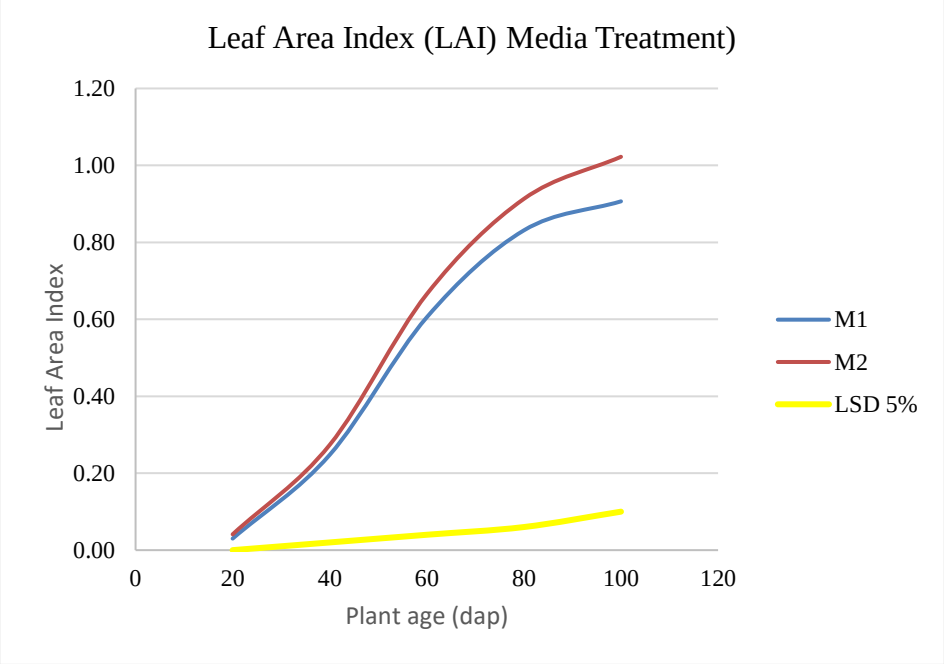

Figure 8: Leaf Area Index (LAI) of Okra Treatment by Planting Media

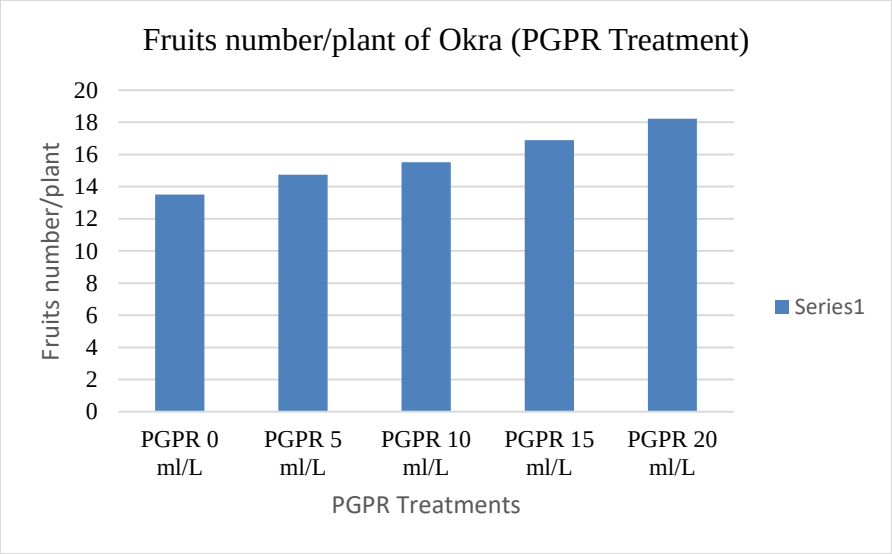

Figure 9: Number Fruits of Okra Treatment by PGPR

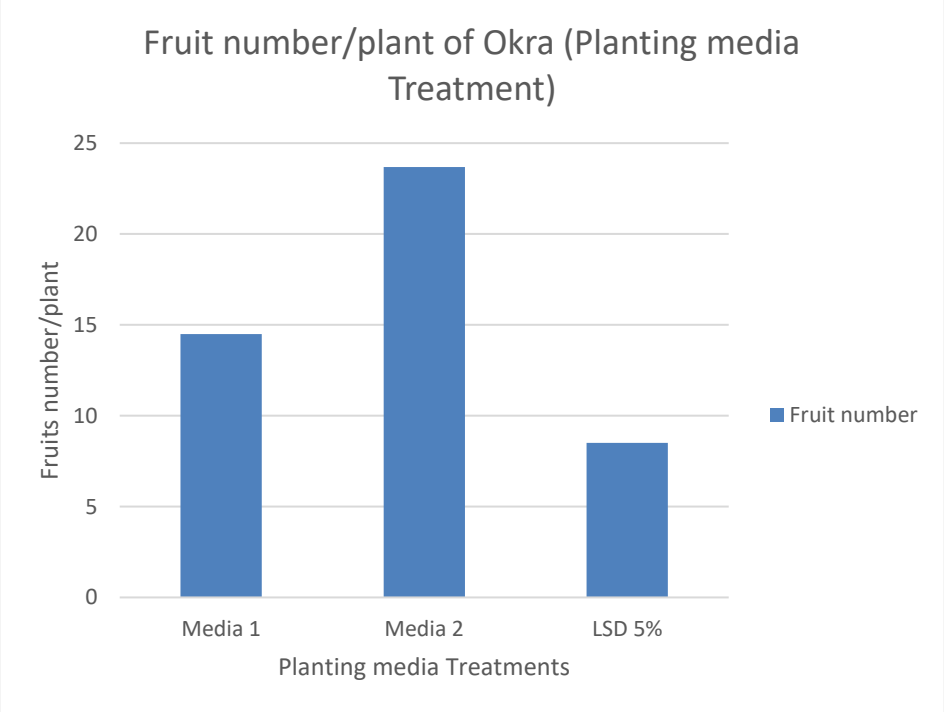

Figure 10: Number Fruits of Okra Treatment by Planting Media

Fruit Length observation showed that there was no interaction among the treatments. Separately, PGPR treatment was not significantly different on fruit length of okra (Figure 11), but the treatment of planting media had a significant effect on fruit length of okra (Figure 12).

Total fresh weight and total dry weight of okra observation showed that there was no interaction among the treatments. Separately, PGPR treatment was not significantly different on total fresh weight (Figure 13) and total dry weight (Figure 15). It was different from planting media, it showed a significant effect on total fresh weight (Figure 14) and total dry weight (Figure 16)

All observation of yield parameters showed that there was no interaction on the treatment that consist of PGPR and different planting media. Separately, PGPR treatment was not significantly different on all of observation. It differs from the planting media which was significantly different at all of observation.

Media treatment containing soil + goat manure + charcoal husk (M2) showed a significant difference and higher results than soil and goat manure (M1) on number of fruits, fruits length, total fresh weight and total dry weight.

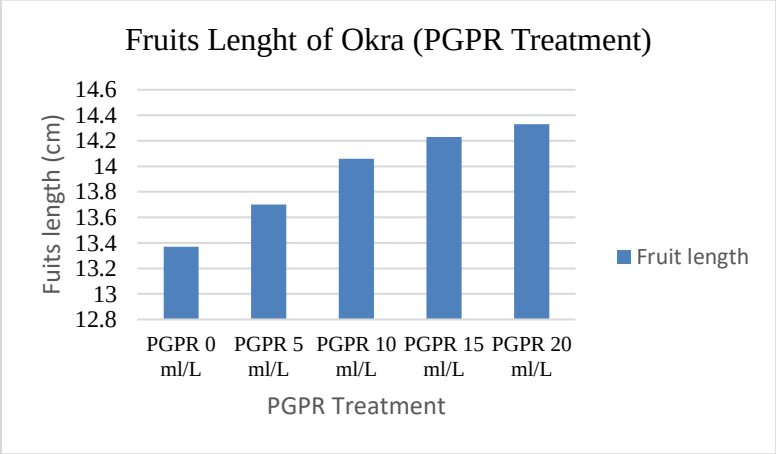

Figure 11: Fruits Length of Okra Treatment by PGPR

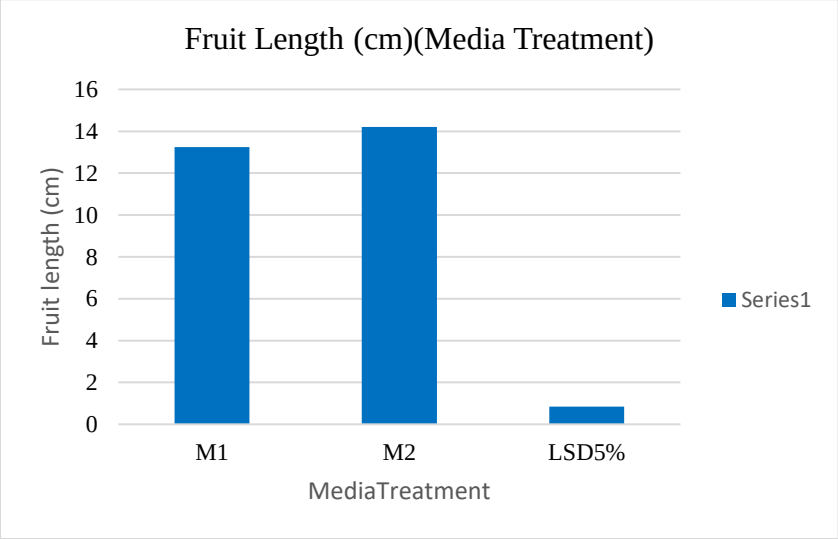

Figure 12: Fruits Length of Okra Treatment by Planting Media

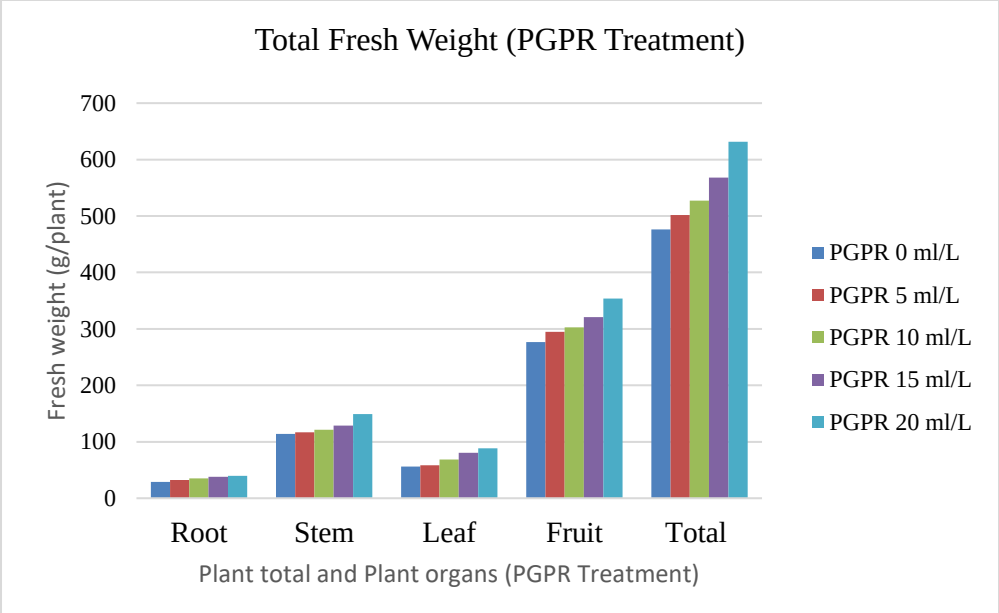

Figure 13: Total Fresh Weight of Okra Treatment by PGPR

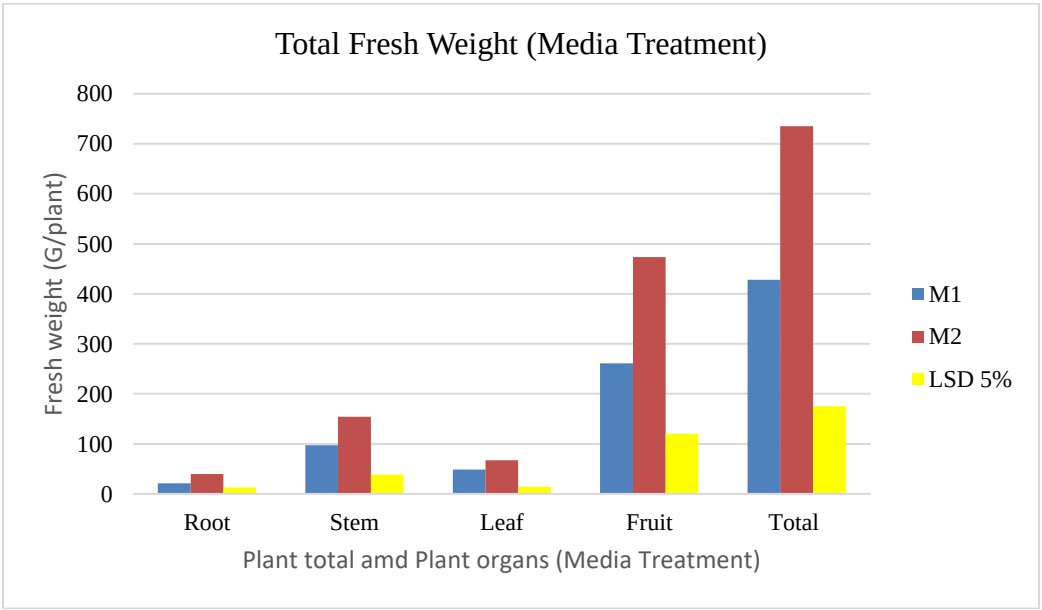

Figure 14: Total Fresh Weight of Okra Treatment by Planting Media

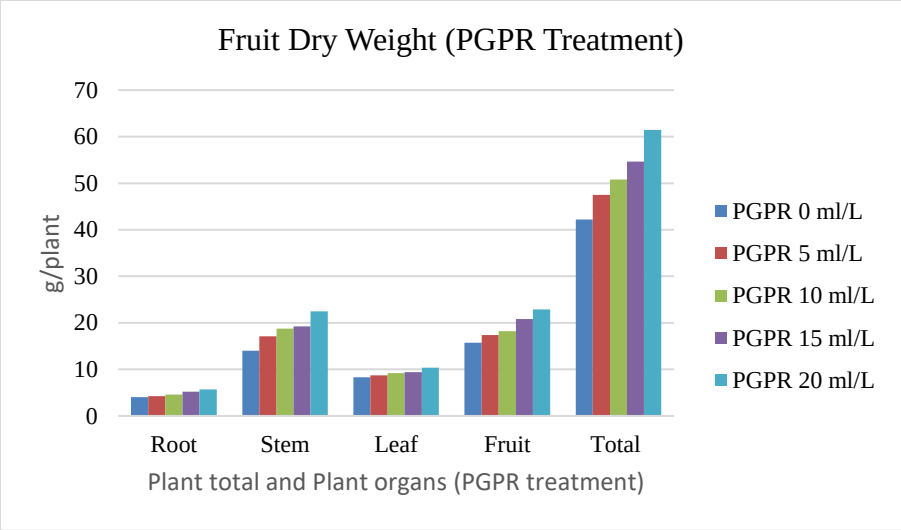

Figure 15: Total Dry Weight of Okra Treatment by PGPR

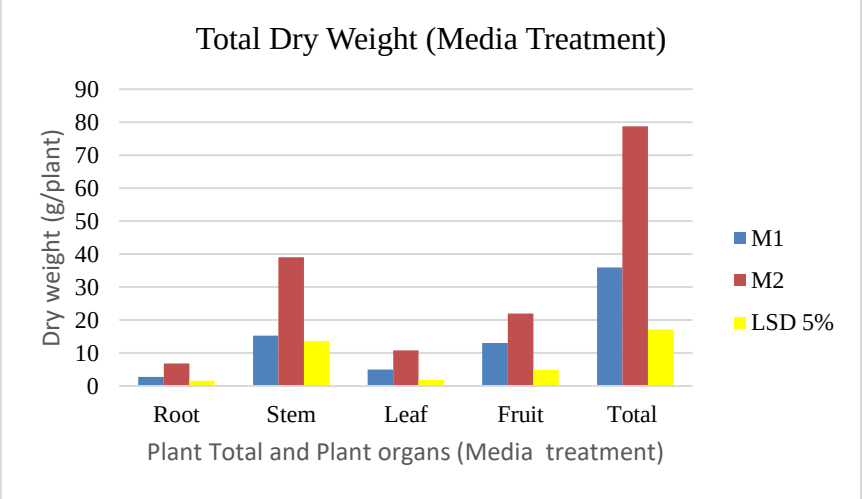

Figure 16: Total Dry Weight of Okra Treatment by Planting Media

DISCUSSION

4.1 Effect PGPR and Planting Media on Growth of Okra

Plant growth is influenced by internal and external factors. Internal factors is influenced by plant genetic, and external factors are influenced by environmental condition around the plants like temperature, humidity, and intensity of solar radiation, and also the addition of external input to increase the growth of plants. Those inputs can effect metabolic process and optimized plant growth. On okra cultivation in this research, the use of planting media with different composition combined with PGPR is expected to increase the growth of Okra. From the result of analysis, there is significant difference at all parameters of plant growth. It is shown by planting media treatment. The result of media treatment consisting of soil + goat manure + charcoal husk (M2) shows a significant difference and higher results than soil and goat manure (M1). Based on preliminary analysis, this result is due to N content in the media; planting media contained soil + goat manure + charcoal husk (M2) and soil and goat manure (M1) respectively at 0,52% and (high category) and 0,47% (high category), so that planting media 2 (M2) contained higher N than

planting media 1 (M1). N has main roles to stimulate vegetative growth of the plant as a whole, especially stem growth which is able to increase plant growth (Suryati et al.,2015).

The differences in the use of planting media also gave significantly different on number of leaves, leaf area and leaf area index. On all ages of observation, planting media 2 (M2) gave the higher result than planting media 1 (M1). The increased number of leaves followed and directly proportional to the increase in leaf area. Number of leaves and leaf area were closely related, more numbers of leaves, the leaf area also showed great result (Junita et al.,2002) It also affected leaf area index. The wider the leaf area, the greater the effect to leaf area index (Wati et al.,2014) Leaf area index also closely related to net assimilation rate, where increasing of leaf area index would increase net assimilation rate, and then would affect the increasing of plant growth(Zakariyya. 2016)

4.2 Effect PGPR and Planting Media on Yield of Okra

Like the observation of leaf number, leaf area and leaf area index, number of fruits, fruit length and fresh weight of fruit, it is found that higher yields are shown by M2 treatment compared with M1 treatment. Leaf is an organ of plant that becomes direct indicators for the growth and yield of okra. This is because the process of photosynthesis taking place on the leaf increases number and wide of leaf, makes greater result of photosynthesis, then makes greater result of assimilation so that it will improve the number of fruit and fresh weight of fruit will be more severe. Reference Tatik and Ihsan. 2014 that the number of leaf will affect the assimilation produced by plants and will be circulated to all parts of the plant. The addition of charcoal husk on the media also causes the results obtained from different media. Reference (Utami et al.,2017) that soil added with charcoal husk will have good porosity and aeration. Aeration on good soil makes well nutrient uptake, and also has a high carbon (C) making this planting media becomes loose, and that condition causes nutrients and water will be easily absorbed by plants. In addition, the greater N content of media 2 also is also effective. The adequacy of macro nutrients will lead to optimal growth and production of plants so that the nutrients are transported and carried by water and functioned throughout the plant organs to increase the weight and enlargement of the fruit in each plant .(Ichsan et al.,2015)

The results observation on the number of fruit and fresh weight of fruit in this research are 23,69 fruit/plant and 473,8 g/plant, if those results are compared to the potential yield from the descriptions of variety show lower yields that is 29,62 fruit/plant and 760,35 g/plant. The results that have not been achieved according to the genetic potential can be caused by external factors, that is the way of cultivation and environmental factors.

Viewed from the way of cultivation, it is probably caused by the time of cultivation of okra plants only until 100 dap, while the varieties of okra plants that used in this research can be up to 120-150 dap or 4 - 5 months from the beginning of planting until the plant perishes. Additionally, other factors are suspected to affect the low results of the okra due to environmental factors. One of the environmental factors is the intensity of radiation received by okra plants just 81.8%. That result appears because the planting is done inside the screen house, while okra plants require bright environmental conditions and get enough sunlight. So that, planting okra outside the greenhouse can provide more optimum environmental conditions, because there is no cover that can block the light conditions received by plants, and also the intensity of the sun can be received equally by all plants.

The results of fresh weight of the okra are closely related to the leaf surface area. This is because the greater the value of plant leaf area will affect the amount of fresh weight of the plant. Reference Sakya and Rahayu, (2010).that plants with broad leaf surface will affect factors that plants need for photosynthesis, then it will be easily fulfilled and the process maximum photosynthesis. Activity of carbohydrate formation of photosynthesis process will be more efficient so that it can improve yield.

The treatment of planting media also gives a significant effect on total dry weight of okra. The results obtained is that the media 2 gives the highest results compared with the media 1. The presence of charcoal husk in media 2 gives a good effect on okra in increasing the rate of photosynthesis due to more optimal absorption of nutrients. Reference (Agustin et al.,2014) that charcoal husk has been through the combustion process so that the carbon content is high, and easy to decompose, besides that charcoal husk has high absorption because it has bigger pore so it can absorb the surrounding nutrients to be stored in the pores. That conditions have a good effect on the rate of plant photosynthesis. The

higher rate of photosynthesis will also increase the dry weight of plant. The rate of photosynthesis affecting the dry weight of plants where the higher rate of photosynthesis increase the dry weight of plants. The process of photosynthesis occurs on the leaf, so the number of leaf and leaf area also affect the dry weight of the plant (Fitrianah et al.,2012)

Total dry weight of plants is closely related to the number of leaf and leaf area (Hadi et al.,2015).

. Figure 4 and figure 6 show the increasing number of leaf and leaf area so total dry weight of plants (Figure 16) also increase.

Contras to planting media treatment, PGPR treatment did not significantly different on all of observation in this research. But based on bacterial analysis showed that there was increase number of bacterial colonies, from 4 x 10^8 cfu/ml to be 4,8 x 10^8 cfu/ml. Those result showed that PGPR bacteria that are applied to palnting media of okra can grow and provide an increase number of bacterial colonies. This condition showed that planting media still relatively fertile. So that, planting media who applied PGPR can be used again for the next planting.

CONCLUSION

The results showed that there is no interaction among the treatments of planting media and PGPR. Separately, PGPR treatment gives no significant difference to number of fruits. While media two treatment (M2) that consist of soil, goat manure and charcoal husk with a volume ratio 1 : 1 : 1 gives the highest result on observation of plant height, number of leaves, leaf area, leaf area Index, number of fruit, fruit length, total fresh weight, and also tatal dry weight. The result number of fruits in this research is 23.69 fruit/plant and 473,8 g /plant for fresh weight of fruit.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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REFERENCES

Agustin, A.D., M. Riniarti, and Duryat. 2014. Utilization of Sawdust Saw and Charcoal Husk As Sapih Media For Yellow Cempaka (*Michelia champaca*). J. Syl. Lest. 2. (3) : 49 – 58.

Fitrianah, L., Siti and Yunin. 2012. The effect of Planting Media Composition to Growth and Saponin Content on Two Varieties of Gendola Plant (*Basella sp.* J. Agrov. 5 (1): 34 – 46.

Hadi, R. Y., Heddy, Y. B., and Sugito, Y. (2015). Effect of Plant Spacing and Dosage of Goat Manure on Growth and Yield of Beans (*Phaseolus vulgaris* L.). J. Prod. Tan. 3 (4): 294 – 301

Ichsan, M. C., P. Riskiyanda. dan I. Wijaya. 2015. Response of Okra Productivity (*Abelmoschus esculentus*) Against Giving Dosage of Petroganic Fertilizer and N Fertilizer. Agritrop J. Ilmu - Ilmu Pertanian: 29 – 41.

Junita, F., S. Muhartini and D. Kastono. 2002. Effect of Watering Frequency and Fertilizer Dosage On Growth and Yield of Pakchoi.J. Ilmu Pert. 9 (1): 32 – 45.

krarwati, and N.A. Rohkmah. 2016. Cultivation of Okra and Kelor in Pot. Balai Pengkajian Teknologi (BPTP) Jakarta.

Saharan, B.S and V. Nehra. 2011. Plant Growth Promoting Rhizobacteria: A Critical Review. Life Sciences and Medicine Research. Vol. 2011: LSMR-21.

Sakya, A. T., and Rahayu, M. (2010). Effect of Iron Micro Element (Fe) On Anthurium Quality. J. Agro, 12 (1) : 29-33.

Suryati, D., Sampurno, and E. Anom. 2015. Test Some Concentrations of Azolla Fertilizer (*Azolla pinnata*) On Growth of Oil Palm Seedlings (*Elaeis guineensis* Jacq.) In the Main Breeding. JOM Fap. 2 (1) 1 – 13.

Sutanto, R. 2002. Application of Organic Agriculture Socialization and Development. Kanisius. Yoyakarta.

Tatik, T. R. and M. Ihsan. 2014. Vegetative

Propagation Review of Binahong Plants (*Anredera cordifolia* (Ten) Steenis) On Several Planting Media. J. Agro. 9 (2) : 179-188.

Taufiq, M, I. 2010. Resistance Mechanism Induced by Plant Growth Promoting Rhizobacteria (PGPR) in Chili Plants Infected Cucumber Mosaik Virus (CMV). J. Hort. 20. (3): 274 – 283.

Utami, C.P., R. Sarwitri, and H. Rianto. 2017. Effect of Organic Materials Media and Soil Latosol Dosage on Sand Merapi Eruption on Yield of Onion (*Allium cepa* fa. ascolanicum). VIGOR: J. Ilmu Pert Trop dan Subtrop. 2 (1} : 5 – 7.

Wati, Y.N., E.E Nulaelih dan M. Santosa. 2014. The Effect of Biourine Aplication on Growth and Yield of Shallot (*Allum ascalonicum* L.) J. Prod Tan. 2 (8): 613 – 619.

Zakariyya, F. 2016. Measuring Leaf Area Index as an Important Variable in Cocoa Plant Growth. Warta. 28 (3) : 8 – 12.