3rd Annual Applied Science and Engineering Conference (AASEC 2018)

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Preface

The 3rd Annual Applied Science and Engineering Conference (AASEC) 2018 organized by Technology and Vocational Education Study Program, School of Postgraduate Studies, Universitas Pendidikan Indonesia (UPI) and UPI Publication Center, and is jointly organized with Universitas Negeri Jakarta (UNJ), Environmental Engineering Universitas Trisakti, Universitas Syiah Kuala (UNSYIAH), Universitas Negeri Surabaya (UNESA), Politeknik Negeri Malang (POLINEMA), Sekolah Tinggi Teknologi Garut (STT Garut), Universitas Islam Negeri Sunan Gunung Djati Bandung (UIN SGD), Universitas Kanjuruhan Malang (UNIKAMA), Universitas Muhammadiyah Sidoarjo (UMSIDA), Universitas Wijaya Kusuma Surabaya (UWKS), and Universitas Warmadewa. Promoting its theme “Ideas for Sustainable Green Energy”, the conference was held on 18 April 2018 at Grand Tjokro Hotel, Bandung, Indonesia.

This year, the conference invited a keynote speaker, Dr. Abdulkareem Shafiq Mahdi Al-Obaidi from Taylor’s University, Malaysia and four invited speakers from different countries with a variety of expertise as follows: 1) Dr. Eng Tedi Kurniawan from Universiti Malaysia Pahang, Malaysia; 2) Dr. Lala Septem Reza from Universitas Pendidikan Indonesia; 3) Dr. Eng. Topan Setiadipura from National Nuclear Energy Agency, Indonesia; and 4) Dr. Eng. Farid Triawan from Tokyo Institute of Technology Japan/ Sampoerna University, Indonesia. Both the keynote speaker and invited speakers are academics and practitioners in the field of green sustainable energy with numerous works on international publication.

There are 353 papers published in the proceedings of the 3rd AASEC 2018. The papers discuss several fields comprising mathematics, physics, computer science, material science, chemistry, biology, pharmacology, sport science and technology, management science, mechanical engineering, chemical engineering, civil engineering, electrical engineering, electronics engineering, material engineering, environmental engineering, industry engineering, information engineering, computer and communication engineering, and architecture. All the published papers have been through a series of rigorous review process to meet the requirements and standards of international publication.

We would like to thank each co-host for the efforts to give significant contribution particularly on paper selection. We would also like to acknowledge vice rector on research, business, and partnership affairs of Universitas Pendidikan Indonesia for the endless support to the conference. Last but not least, we would like to express our most sincere gratitude to the international advisory board, scientific committee, steering committee, organizing committee, and everybody taking parts in the success of the conference. We hope to see you in the 4th AASEC 2019.

The Editors
Dr. Ade Gafar Abdullah
Dr. Eng. Asep Bayu Dani Nandiyanto

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2018
Ideas for Sustainable
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Peer review statement

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Peer review statement

All papers published in this volume of *IOP Conference Series: Materials Science and Engineering* have been peer reviewed through processes administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

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2018 ANNUAL AASEC APPLIED SCIENCE AND ENGINEERING CONFERENCE

CERTIFICATE

No. 25/UN40.B.17/TU/2018

This certificate is awarded to

Y P Situmeang, M Suarta, I K Irianto and A A S P R Andriani

as **Presenter** of a paper entitled

Biochar bamboo application on growth and yield of red amaranth (*Amaranthus tricolor* L)

in the **Annual Applied Science and Engineering Conference**
"Ideas for Sustainable Green Energy"
Bandung, Indonesia. April 18th 2018

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Biochar Bamboo Application on Growth and Yield of Red Amaranth *(Amaranthus tricolor* L)

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Biochar Bamboo Application on Growth and Yield of Red Amaranth (*Amaranthus tricolor* L)

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Abstract. This study aims to obtain a proper dose of biochar for the growth and yield of red amaranth plants. This study used a complete randomized design of one factor with 4 replications. The tested treatment was bamboo biochar with 4 dose levels (0, 3, 6, 9, and 12 t ha^{-1}). The results showed that biochar treatment gave significant effect to fresh weight of economic yield and oven dry weight of economic yield, but not significant to a variable of plant height and number of the leaf. Biochar as a soil enhancer has been able to improve soil physical properties, increase microbial activity, and improve soil fertility. With soil fertility improvements, it will enhance the ability of plants to absorb nutrients and water in the soil, and encourage the vegetative growth of plants and sunlight interception by leaves to produce photosynthesis. The highest fresh weight of amaranth yields was obtained at biochar 9 t ha^{-1} of 14.53 g which increased by 34.41% when compared with the fresh weight value of the lowest economic yield on biochar without 10.81 g.

1. Introduction

Plants Red amaranth known as the scientific name of *Amaranthus tricolor* L. is a yearly plant of shrubs (shrubs) are much loved by all levels of society. This red amaranth besides tastes good and soft also can facilitate digestion. Red amaranth as one source of antioxidants needs to be developed because of the potential as a vegetable is very useful because of the high content of phenols and flavonoids that function as antioxidant compounds [1].

Biochar contains high carbon (more than 30%), has large pores and large surface area, and has high water holding capacity. Biochar containing high carbon (more than 30%) will experience more weathering so that when applied in the soil can survive for long periods of time.

Biochar is much more effective in nutrient retention and availability for crops than other organic materials such as compost or manure. Biochar is more persistent in the soil than any other organic matter, so all the benefits associated with nutrient retention and soil fertility can go much longer than any other common organic form [2]. Biochar can be made from a variety of biomass, even eligible agricultural wastes. History shows, biochar has been used traditionally by farmers in various parts of the world. Various studies show biochar has the potential to improve soil structure and fertility. In the long run, biochar does not disturb the carbon-nitrogen balance, but it can hold and make water and nutrients more available to plants. When used as a soil enhancer with organic and inorganic fertilizers, biochar can increase productivity, as well as retention and nutrient availability for plants.

The effect of biochar on crop productivity depends on the dose used. The results of [3] show that the utilization of bamboo waste biochar dose of 10 tons ha-1 gives a real effect on the plant height and the total wet weight of corn plant. Further research [4] showed that the best growth response of maize crops was obtained at the treatment of 10 tons ha-1 biochar, 20 tons ha-1 of compost, and 300 kg ha-1 phonska. [5-7] show that utilization of bamboo waste biochar dose of 5-15 ton ha-1 can increase the growth and yield of maize. Furthermore, [8] reported that 5-15 t ha-1 bamboo biochar had not responded significantly to the yield of the pakchoy plants. The results of [9] show that growth and performance results of amaranth plants were significantly higher when planted in a regular pot mixture receiving 100 percent NPK compared with biochar treatment. The biochar application showed no significant variation in growth and amaranth results [9]. Through this research, it is hoped that the application of the exact real biochar dosage can improve the growth and yield of red amaranth plants.

2. Materials and methods

The materials used in this study are red amaranth, biochar from bamboo waste, and soil media. This experiment was conducted at a greenhouse, Experimental Garden of Agriculture Faculty of Warmadewa University, Denpasar. This study has been conducted from June to Agustus 2016.

The experiment used a complete randomized design of one factor. The treatments were tested for biochar with 4 dose levels, with the treatment as follows: B0 = 0 t ha^{-1} (without biochar), B1 = 3 t ha^{-1} (4.2 g pot^{-1}), B2 = 6 t ha^{-1} (8.4 g pot^{-1}), B3 = 9 t ha^{-1} (12.6 g pot^{-1}), B4 = 12 t ha^{-1} (16.8 g pot^{-1}). Thus there were 5 treatments, each treatment was repeated 3 times so that there were 15 pot experiments.

The variables observed included plant length, number of leaves, fresh weight of economic yield, and oven dry weight of economic yield of red amaranth. Research data were analyzed statistically with F (ANOVA) test using Microsoft Excel program. If the F test shows a significant effect on the 5% test level, then proceeded with a 5% Duncan test.

3. Results

The significance of biochar (B) on the observed variables can be seen in Table 1. From Table 1, biochar treatments showed a significant effect ($P < 0.05$) on the fresh weight of economic yield and oven dry weight of economic yield, but unstable ($P \geq 0.05$) to variables of plant height and number of leaves.

Table 1. The significance of biochar on all observed variables.

Variable	Treatment
	Biochar dosage
1. Plant height	ns
2. Number of leaves	ns
3. Fresh weight of economic yield	*
4. The dry weight of economic yield	*

* = significant ($P<0.05$), ns = not significant ($P \geq 0.05$)

3.1. Plant height

The result of statistical analysis on plant height showed that biochar treatment (B) was not significant ($P \geq 0.05$) to plant height (Table 1). The average plant height in biochar treatment is presented in Table 2.

Based on Table 2 it can be seen that the average plant height tended to be obtained at a biochar dose of 9 t ha^{-1} (B3) of 34.13 cm was not significantly different from other biochar dose treatments, whereas the lowest value of plant height was obtained in treatment without biochar (B0) of 29.35 cm. The biochar dose relationship with average plant height can be seen in Figure 1.

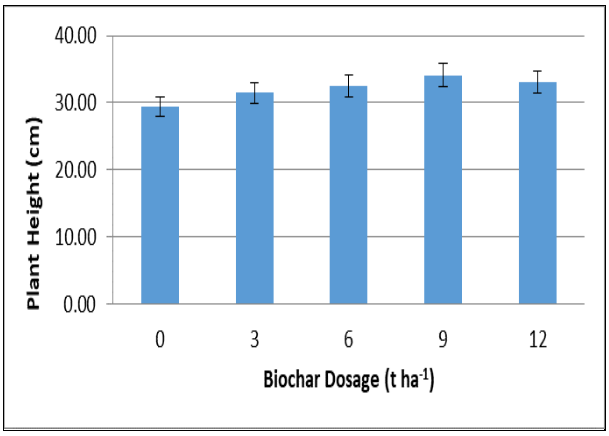

Figure 1. Relationship dosing biochar with average plant height.

3.2. *Number of leaves*

The results of statistical analysis showed that the giving of biochar (B) was not significant (P≥0.05) on the number of leaves (Table 1). The average number of leaves on the biochar treatment can be seen in Table 2.

From Table 2, the average value of the highest leaf number tends to be obtained at the dose of biochar 9 t ha^{-1} (B3) of 9.25 strands is not significantly different from the biochar dosage treatment others, while the lowest value of the number of leaves obtained in the treatment without biochar (B0) of 7.50 strands. The biochar dose relationship with the average number of leaves can be seen in Figure 2.

Table 2. The average of plant height and leaf number on biochar dosage.

Dosage of Biochar	Plant height (cm)	Number of leaves (strands)
0 t ha^{-1} (B0)	29.35 a	7.50 a
3 t ha^{-1} (B1)	31.48 a	8.25 a
6 t ha^{-1} (B2)	32.43 a	8.75 a
9 t ha^{-1} (B3)	34.13 a	9.25 a
12 t ha^{-1} (B4)	33.00 a	8.75 a
CD (%)	9.66	10.52

The average value followed by the same letter in the same treatment and column different, not significant at 5% Duncan test level.

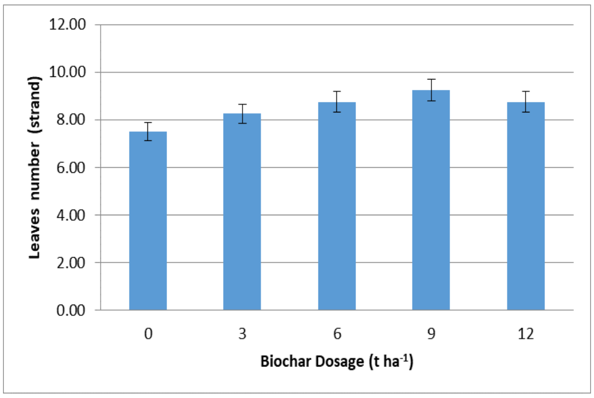

Figure 2. Relationship of dose biochar with the average leaves number.

3.3. Fresh weight of economic yield

The results of statistical analysis showed that biochar application (B) had a significant effect ($P < 0.05$) on fresh weight of economic yield (Table 1). The average fresh weight of economic yields on biochar treatment can be seen in Table 3.

From Table 3, the highest value of the fresh weight of economic yields was obtained at a biochar dose of 9 t ha^{-1} (B3) of 14.53 g, but the lowest value of the weight fresh economic yields was obtained on treatment without biochar (B0) of 10.81 g. The biochar dose relationship with the average fresh weight of economic yield can be seen in Figure 3.

Table 3. The average fresh weight of economic yields and dry weight of economic yield on biochar treatment.

Treatment Dosage of Biochar	Fresh weight of economic yield (g)	Oven dry weight of economic yield (g)
0 t ha^{-1} (B0)	10.81 b	0.92 b
3 t ha^{-1} (B1)	12.37 ab	1.08 ab
6 t ha^{-1} (B2)	13.22 ab	1.15 ab
9 t ha^{-1} (B3)	14.53 a	1.29 a
12 t ha^{-1} (B4)	13.95 a	1.18 ab
CD (%)	10.65	13.19

The average value followed by the same letter in the same treatment and column different, not significant at 5% Duncan test level.

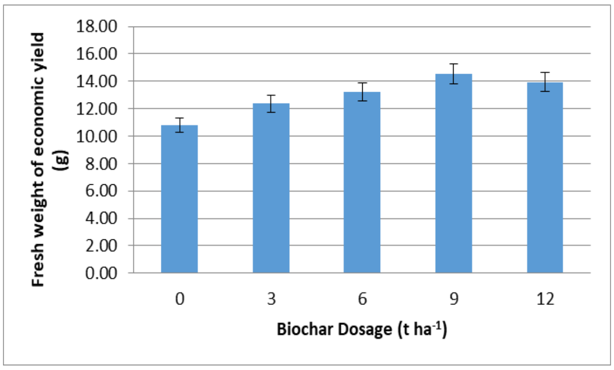

Figure 3. Relationship dosing of biochar with a fresh weight of economic yield.

3.4. Oven dry weight of economic yield

The result of the statistical analysis showed that biochar application (B) had the significant effect ($P < 0.05$) on oven dry weight of economic yield (Table 1). The average oven dry weight of economic yield on biochar treatment can be seen in Table 3.

Base on Table 3, it can be seen that the highest value of oven dry weight of economic result is obtained at dosage biochar 9 t ha^{-1} (B3) of 1.29 g, but the lowest value of oven dry weight of economic yields was obtained in the treatment without biochar (B0) of 0.92 g. The biochar dose relationship with the average oven dry weight of economic yield can be seen in Figure 4.

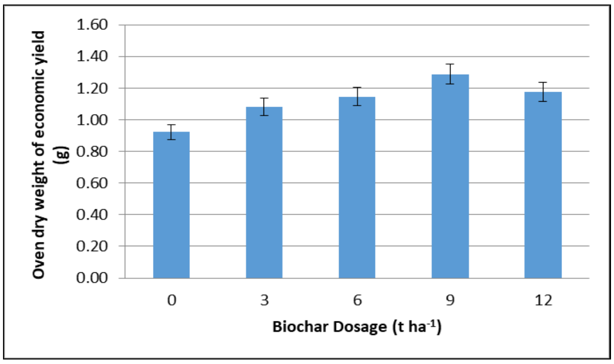

Figure 4. Relationship dosing biochar with an average oven dry weight of economic yield.

4. Discussion

The results of this study showed that the highest fresh weight of the highest economic yield was obtained on biochar 9 t ha^{-1} (B2) of 14.53 g or increased by 34.41% when compared with the freshest weight value of the lowest economic yield on biochar (B0) of 10.81 g (Table 3). The high yield of a fresh yield of a red amaranth economic result is supported by the positive correlation of maximum plant height variable (r = 0.995**), maximum leaf number (r = 0.983**), and oven dry weight of economic result (r = 0.985**) (Table 4).

This is presumably because biochar as a soil enhancer can improve soil physical properties, encourage increased microbial activity, and improve soil fertility. With the improvement of soil fertility, it will increase the ability of plants to absorb nutrients and water in the soil, and encourage the vegetative growth of plants and sunlight interception by the leaves to produce photosynthesis. These photosynthates will be transferred to the plant organs that are active in the metabolism process to encourage the growth of roots, stems, and leaves of plants to obtain the results of fresh weight of the maximum plant economy.

Table 4. The value of correlation coefficient between variables (r) due to the effect of biochar dosage.

Variables	X1	X2	X3
X2	0.993**		
X3	0.995**	0.983**	
X4	0.997**	0.992**	0.985**
r (0.05; 13; 1) = 0.514		r (0.01; 13; 1) = 0.641	

X1 (Plant length), X2 (Number of leaves), X3 (Fresh weight of economic results), X4 (Oven dry weight of economic results)

Biochar serves as a soil aggregate and adhesive agent between soil particles to form soil aggregates, so biochar is essential in the formation of soil structures. In soils, porous biochar granules, in addition to nutrient and water retention in the soil, may also provide habitat for soil microorganisms. Nutritional and water retention has an effect on the addition of nutrients to the plant, causing an increase in soil porosity, water holding capacity, C-organic, and microbial activity in the soil [10].

Application of biochar made from raw bamboo to the soil can improve the fertility of the agricultural soil. In this case, the properties of soil repaired by biochar are aggregation and soil water retention capacity, pH, and cation exchange capacity (CEC) and the increase of biological population and activity in the soil [6], [11-13].

5. Conclusion

Application of soil enhancers from bamboo biochar showed the significant effect on the fresh weight of economic yield and oven dry weight of economic yield, but not significant to plant height and number of leaves of red amaranth plant. The highest yield of fresh weight of economic yield on red amaranth plants was obtained in the application of biochar dose of 9 t ha-1 of 14.53 g, which increased 34.41% when compared with the fresh weight of the lowest economic yield on biochar without 10.81 g.

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