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Growth and Yield of Red Chili through the Application of Biochar and Poschar

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Abstract
This study aims to determine the effect of the type of biochar and various doses of poschar and their interactions on the growth and yield of red chili plants. The design used in this study was a factorial randomized block design consisting of 2 treatment factors, namely factor one: type of biochar (B) which consisted of 3 levels, namely: without biochar treatment and with cow biochar and chicken biochar. Second factor: Poschar dose consists of 2 levels, namely: Poschar 0 tons/ha and goat poschar 15 tons/ha. Thus there were 6 treatments and repeated 3 times, so 18 experimental plots were obtained. The interaction between biochar type treatment and poschar dose did not significantly affect all observed variables except stem diameter and the number of productive branches. Biochar treatment significantly affected maximum plant height, stem diameter per plant, number of fruits per plant, and fruit weight per plant, but did not significantly differ on maximum number of leaves, number of productive branches per plant, fruit length per plant, fruit diameter per plant. Poschar treatment had a significant effect on maximum plant height, maximum number of leaves, number of fruits, and fruit weight per plant, but did not significantly affect stem diameter, number of productive branches, fruit length, and fruit diameter per plant. The highest weight of chili fruit was obtained from biochar cow which was 1465.81 g which was significantly different or increased by 63.72% compared to without biochar, which was 895.32 g. The highest fruit weight per plant was obtained in goat poschar application at a dose of 15 tons/ha which was 1440.87 g, significantly different or increased by 42.96% from without poschar which was 1007.90 g.

Keywords: *Biochar, Compost, Poschar, livestock waste, chili plants.*

1. Introduction

Chili (Capsicum annuum L.) originated in Mexico and then spread to South America and Central America and Europe. Chili is consumed fresh, dried, or processed as a vegetable and seasoning. Apart from being a food flavoring, chili is also widely used in the pharmaceutical industry. Chili contains nutrients including 1.0 g protein, 0.3 g fat, 7.3 g carbohydrates, 29 mg calcium, phosphorus, iron, 18 mg vitamin C, 0.05 mg vitamin B1, and alkaloid compounds such as capsaicin. [1]. Big red chili is one of the important vegetables cultivated commercially in tropical countries [2]. Big red chili with a production contribution of 1,074,602 tons or about 9.02 percent of the national vegetable production is in fourth place [3].

The low productivity of chili plants can be caused by a decrease in the level of soil fertility. This is due to intensive agricultural activities and the uncontrolled use of chemical fertilizers. The continuous use of chemical fertilizers without returning organic matter to the soil has caused a decrease in the fertility level of agricultural land because the population of soil microorganisms is reduced. This causes the soil structure to become damaged and hard, the ability of the soil to hold water is reduced, the soil is poor in nutrients, and makes agricultural land a crisis. Another impact is that it can cause damage to the physical condition and porosity of the soil on agricultural land.

This decrease in the fertility of agricultural land can be overcome by adding organic matter that can improve the physical and chemical properties of the soil. Indonesia, which is a tropical

country, has a high level of organic matter decomposition so the natural organic soil enhancer used is more temporary. Potential organic material as an ameliorant or soil enhancer is biochar. Biochar is black charcoal produced from the heating process of biomass under conditions of limited or no oxygen. Biochar is also an organic material that has stable properties and can be used as a soil enhancer in dry land. Biochar can last a long time in the soil or has a relatively long effect, or is relatively resistant to attack by microorganisms so the decomposition process runs slowly [4]. The ability of biochar to hold soil moisture can be used to help plants during the dry season. In addition, biochar can act as a plant growth promoter and retain nutrients in the soil so that nutrients in the soil are not easily lost in the leaching process in the soil and will ultimately affect crop yields [5].

The addition of biochar in the composting process known as poschar fertilizer can improve the quality of the compost produced. The presence of compost in the soil can also be an attraction for organisms to carry out activities as decomposers so that the soil which is initially hard and difficult for water and air to penetrate becomes loose [6]. Application of a dose of 15 tons/ha of compost and biochar from livestock manure on the growth and yield of red chili plants [7, 8, 9]. Application of biochar and poschar from cow, goat, and chicken manure at a dose of 15 tons/ha can increase soil fertility and yield of red chili [10, 11]. This study aims to determine the effect of biochar type and poschar dose and their interaction on the growth and yield of red chili plants. The hypothesis proposed in this study is that giving chicken biochar and a dose of 15 tons/ha of poschar from goat manure can increase the growth and yield of red chili plants.

2. Materials and Methods

This research was conducted in Buduk Village, Mengwi District, Badung Regency, Bali. With a height of 65 meters above sea level. This research was conducted from April to July 2021. The research design used in this study was a factorial Randomized Block Design (RBD) consisting of 2 factors. The first factor is the type of biochar (B) which consists of 3 levels, namely: without biochar (Bo), cow dung biochar (B1), and chicken manure biochar (B2). The second factor is the dose of poschar (P) which consists of 2 levels, namely 0 tons/ha poschar (Po) and 15 tons/ha goat poschar (P1). Based on the arrangement of treatments (6 treatment combinations with 3 replications), 18 experimental plots were obtained.

The materials used in this study were red chili seeds of Pilar F1 variety, goat Poschar, cow and chicken biochar fertilizer, NPK fertilizer, Furadan, Demolish, Curachon, and Herbicide. The tools used in this study were: hoes, harrows, lawnmowers, hand tractors, scales, calipers, measuring cups, silver black plastic mulch, paper labels, hoses, sprayers, punch hole mulch, cutters, sickles, knives, ruler, raffia rope, thread, bamboo, pencil, and other documentation tools.

Data was collected by direct observation in the field and measurements using a meter and scales. The variables observed were maximum plant height, maximum number of leaves, stem diameter per plant, number of productive branches per plant, fruit length per plant, fruit diameter per plant, number of fruit per plant, and fruit weight per plant. The research data were statistically analyzed using analysis of variance (ANOVA). If the treatment has a significant effect, then it is continued with the Duncan 5% test. Meanwhile, to find out the relationship between variables, a correlation test was carried out.

3. Results and Discussion

The effect of biochar type and poschar dosage and their interactions on all observed variables can be seen in Table 1. Based on Table 1, it can be seen that the interaction between biochar type treatment and poschar dose (BxP) had no significant effect ($P \geq 0.05$) on all observed variables except stem diameter and the number of productive branches. Treatment of the type of biochar significantly ($P < 0.05$) on maximum plant height, stem diameter per plant, number of fruits per plant, and fruit weight per plant, but not significantly different ($P \geq 0.05$) on the maximum number of leaves, number of productive branches per plant, fruit

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length per plant, fruit diameter per plant. Poschar dose treatment had a significant effect (P<0.05) on maximum plant height, the maximum number of leaves, the number of fruits, and fruit weight per plant, but had no significant effect (P≥0.05) on stem diameter, number of productive branches, length fruit, and fruit diameter per plant. The results of this study showed that the highest chili fruit weight was obtained in the cow biochar (B1) type, which was 1465.81 g, which was significantly different or increased by 63.72% compared to without biochar, which was 895.32 g (Table 1 and Figure 1).

Table 1. Effect of biochar type and poschar dose and their interactions on all observed variables

Treatment	Plant height (cm)	Number of Leaves (sheet)	Rod diameter (mm)	Number of productive branches (fruit)	Fruit length (cm)	Fruit diameter (mm)	Number of Fruits (fruit)	Fruit Weight (g)
Biochar Type	*	ns	*	ns	ns	ns	*	*
Bo	83.04 b	235.38 a	13.33 d	70.17 a	13.89 a	18.15 a	54.96 a	895.32 b
B1	91.83 a	262.04 a	14.39 b	73.92 a	14.51 a	18.31 a	82.75 b	1465.81 a
B2	92.90 a	295.71 a	14.14 a	78.67 a	14.55 a	18.28 a	80.75 a	1312.03 ab
LSD 5%	7.77	63.97	0.73	12.56	0.99	0.80	23.99	453.02
Poschar Dosage	*	*	ns	ns	ns	ns	*	*
Po	85.90 b	238.19 b	13.76 a	75.14 a	14.26 a	18.22 a	62.19 b	1007.90 b
P1	92.62 a	290.56 a	14.14 a	73.36 a	14.38 a	18.28 a	83.44 a	1440.87 a
LSD 5%	6.34	52.23	0.60	10.26	0.81	0.66	19.59	369.89
Interaksi	ns	ns	**	*	ns	ns	ns	ns
BoPo	79.53 a	193.08 a	12.50 d	62.08 b	13.48 a	17.98 a	34.75 a	619.41 a
BoP1	86.55 a	277.67 a	14.16 abc	78.25 ab	14.30 a	18.33 a	75.17 a	1171.23 a
B1Po	89.45 a	218.00 a	13.98 abc	81.83 a	14.68 a	18.23 a	69.92 a	1078.10 a
B1P1	94.22 a	306.08 a	14.81 ab	66.00 ab	14.35 a	18.40 a	95.58 a	1853.53 a
B2Po	88.72 a	303.50 a	14.81 a	81.50 a	14.61 a	18.45 a	81.92 a	1326.20 a
B2P1	97.09 a	287.92 a	13.47 cd	75.83 ab	14.48 a	18.12 a	79.58 a	1297.85 a

Note:

- * = significant (P<0.05), ** = very significant (P<0.01), ns = very significant (P≥0.05)
- These numbers are followed by the same lowercase letters in the same column, not significantly different in the LSD test level 5% on single factors and Duncan test level 5% on interaction

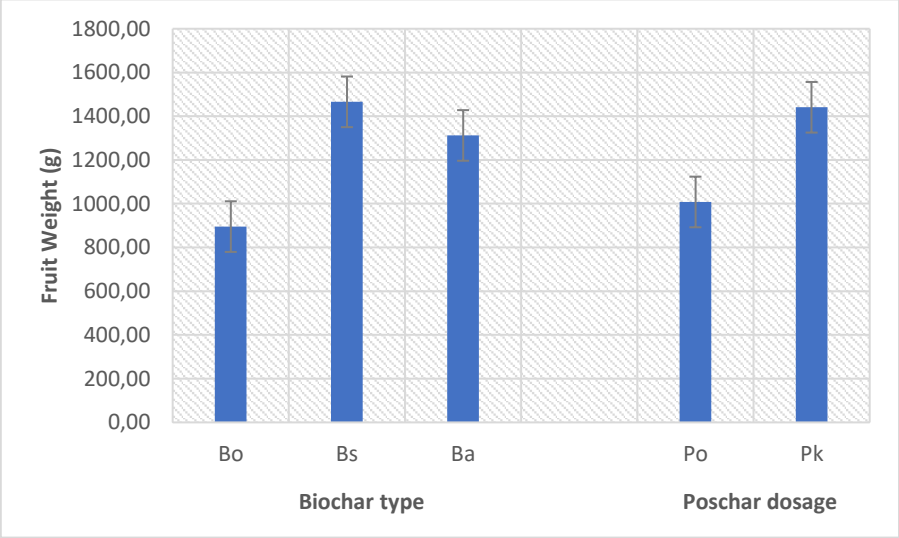

Figure 1. Relationship between biochar type and poschar dose with fruit weight per plant

The high fruit weight per plant in bovine biochar (B1) was supported by a significant and positive correlation in the observed variables such as maximum plant height (r = 0.93**), stem diameter per ton (r = 1.00**), number of productive branches per bunch (r = 0.90**), fruit length per bunch (r = 0.96**), fruit diameter per bunch (r = 1.00**), and number of fruit per bunch (r = 0.98**) (Table 2). The high weight of chili fruit in biochar cows (B1) is caused by

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the biochar ability of cow dung which has encouraged improvements in soil physical fertility, namely by increasing soil porosity and decreasing soil volume weight which causes the soil to become loose. become more porous, brittle, and brittle. This will encourage the process of absorption of nutrients by plant roots better so that the growth and yield of chili plants will increase compared to other treatments. As a soil enhancer, biochar can retain nutrients and water in the soil. The ability of nutrient and water retention by biochar is caused by an increase in soil porosity and a decrease in soil compaction. This is in line with research [10, 12, 13], with the provision of biochar that can increase soil porosity, reduce soil volume weight, and increase soil fertility and yield of red chili.

Table 2. The value of the correlation coefficient between variables (r) due to the influence of the type of biochar

	X1	X2	X3	X4	X5	X6	X7
X2	0.88**						
X3	0.95**	0.68*					
X4	0.88**	1.00**	0.68*				
X5	1.00**	0.85**	0.96**	0.85**			
X6	0.97**	0.73*	1.00**	0.73*	0.98**		
X7	0.99**	0.79*	0.99**	0.79*	0.99**	1.00**	
X8	0.93**	0.66ns	1.00**	0.66ns	0.95**	1.00**	0.98**

r (0.05; 7; 1) = 0,666 r (0.01; 7; 1) = 0,798

X1 = Maximum plant height
X2 = Maximum number of leaves
X3 = Stem diameter per plant
X4 = Number of productive branches per plant
X5 = Fruit length per plant
X6 = Diameter of fruit per plant
X7 = Number of fruits per plant
X8 = Weight of fruit per plant
* = Significance (P<0.05)
** = Very significant (P<0.01)
ns = not significant (P≥0.05)

The results of this study also showed that the application of goat poschar at a dose of 15 tons/ha (P1) gave the highest yield of fruit weight per plant, namely 1440.87 g which was significantly different or increased by 42.96% from without poschar (Po), which is 1007.90 g. The increase in fruit weight per plant in goat poschar treatment of 15 tons/ha (P1) was due to the presence of biochar from goat manure which can improve soil physical properties where the soil becomes more friable, encouraging active root movement to absorb nutrients. needed by plants such as macronutrients (N, P, K) and micronutrients for use in photosynthesis. The absorbed nutrients will be used in the process of metabolism and photosynthesis to be supplied in the formation of plant parts such as roots, stems, leaves, and fruit.

4. Conclusion

The interaction between biochar treatment and poschar dose had no significant effect on all observed variables except stem diameter and the number of productive branches. Biochar treatment significantly affected the maximum plant height, stem diameter per plant, number of fruits per plant, and fruit weight per plant, but did not significantly affect the maximum number of leaves, number of productive branches per plant, fruit length per plant, and fruit diameter per plant. Poschar treatment had a significant effect on maximum plant height, maximum number of leaves, number of fruits, and fruit weight per plant, but did not significantly affect stem diameter, number of productive branches, fruit length, and fruit diameter per plant. The highest stem diameter values were obtained from the interaction of chicken biochar without poschar and the interaction of cow biochar with goat poschar or increased by 18.51% and 18.47%, respectively, compared to without biochar and poschar. The highest weight of chili fruit was obtained in the type of cow biochar, namely 1465.81 g which was significantly different or increased by 63.72% compared to without biochar, which was 895.32 g. The highest fruit weight per plant was obtained in goat poschar application at a dose

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of 15 tons/ha which was 1440.87 g, significantly different or increased by 42.96% from without poschar which was 1007.90 g.

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Reference

[1] Rubatzky, V & Yamaguchi, M. (1999). *Sayuran Dunia: Prinsip, Produksi, dan Gizi ed. Kedua*. Penerbit ITB, Bandung.

[2] Nofita, I. (2015). Analisis Usahatani Cabai Merah Besar (Capsicum annum L) di Desa Andongsari, Kecamatan Ambulu, Kabupaten Jember (*Doctoral Dissertation*, Universitas Muhammadiyah Jember).

[3] Direktorat Jenderal Hortikultura (2014). Data Produksi Buah-buahan Tahun 2014. Departemen Pertanian. Direktorat Jenderal Hortikultura. Jakarta.

[4] Tang, J., Zhu, W., Kookana, R., & Katayama, A. (2013). Characteristics of Biochar and Its Application in Remediation of Contaminated Soil. Journal of Bioscience and Bioengineering. 116(6), 653-659

[5] Lehmann, J., da Silva Jr., J.P., Steiner, C., Nehls, T., Zech, W., & Glaser, B. (2003). *Nutrient availability and leaching in an archaeological Anthrosol and a Ferrasol of the Central Amazon Basin: fertilizer, manure and charcoal amendments.*

[6] Sutanto, R. (2002). *Pertanian Organik: Menuju Pertanian Alternatif dan Berkelanjutan.* Yogyakarta: Kanisius.

[7] Dapa, D. S., Situmeang, Y. P., & Sudewa, K. A. (2019). The Use of Biochar From Cow Feces and Bioboost in The Red Chili Plant (*Capsicum Annum* L.). *SEAS (Sustainable Environment Agricultural Science)*, *3*(2), 118-123.

[8] Mahendra, K. A., Situmeang, Y. P., & Suarta, M. (2020). Effect of Biochar and Compost from Chicken, Goat, and Cow Manure on Cultivation of Red Chili (*Capsicum annuum* L). *SEAS (Sustainable Environment Agricultural Science)*, *4*(2), 95-101.

[9] Damayanti, S., Situmeang, Y. P., & Wirajaya, A. A. N. M. (2020). Biochar and Compost Application of Livestock on The Growth and Results of Red Chili Plants. *SEAS (Sustainable Environment Agricultural Science)*, *4*(2), 88-94.

[10] Situmeang. Y.P., Sudita I. D. N., & Suarta, M., (2019). Manure Utilization from Cows, Goats, and Chickens as Compost, Biochar, and Poschar in Increasing the Red Chili Yield. *International Journal on Advanced Science, Engineering and Information Technology*, *9*(6), 2088-5334.

[11] Situmeang. Y.P., Sudita I. D. N., & Suarta, M., (2021). Application of Compost and Biochar from Cow, Goat, and Chicken Manure to Restore Soil Fertility, and Yield of Red Chili. *International Journal on Advanced Science, Engineering and Information Technology*, 11(4).

[12] Amaral, H. D. D. R., Situmeang, Y. P., & Suarta, M. (2019). The effects of compost and biochar on the growth and yield of red chili plants. In *Journal of Physics: Conference Series* (Vol. 1402, No. 3, p. 033057). IOP Publishing.

[13] Mesa, I. M., Situmeang, Y. P., Wirajaya, A. A. N. M., Udayana, I. G. B., & Yuliartini, M. S. (2021). Utilization of rabbit manure and biochar chicken manure and its effect on the growth and yield of pakchoy plants. In *Journal of Physics: Conference Series* (Vol. 1869, No. 1, p. 012045). IOP Publishing.

DOI: https://doi.org/10.22225/aj.3.1.2023.49-52