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Application of Biochar and Poschar from Several Types of Animal Manure on the Growth and Yield of Red Chili Plants (*Capsicum annuum* L.).

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Abstract
This study aims to determine the effect of doses of biochar and various types of poschar and their interactions on the growth and yield of red chili plants. This research was conducted in Buduk village, Mengwi sub-district, Badung district at an altitude of 65 meters above sea level. This research activity took place from April to July 2021. The design used in this study was a factorial randomized block design (RBD) consisting of 2 treatment factors. The first factor is the dose of biochar (B) which consists of 2 levels (0 and 15 tons/ha), while the second factor is the type of poschar (P) which consists of 3 levels (without poschar, beef poschar, and goat poschar). The results showed that the interaction between the dose of biochar and the type of poschar (BxP) had a significant effect on the number of leaves and fruit number, fruit weight and had a very significant effect on stem diameter, but had no significant effect on plant height, number of productive branches, fruit length, and diameter. fruit per plant. Biochar treatment had a very significant effect on the variables of plant height, number of leaves, and fruit weight per plant and significantly affected the number of fruits, number of productive branches per plant, and fruit length per plant but had no significant effect on stem diameter. Poschar application showed no significant effect on all observed variables except for plant height which had a significant effect. The highest fresh weight of chili fruit per plant was obtained from the interaction of chicken biochar with no poschar, which was 1326.20 g, followed by the interaction between chicken biochar and goat's poschar, which was 1297.85 g, and the interaction between chicken biochar and beef poschar, which was 1081.71 g which increased by 114.11%, 109.53%, and 74.64% respectively compared to the interaction between the treatment without biochar and without poschar which was 619.41 g.

Keyword: *Biochar; poschar; red chili*.

1. Introduction

Red chili is one type of vegetable plant that has business opportunities in almost all parts of the world, including Indonesia. Various types of red chili in traditional markets are sold at quite high prices. Not only has economic value, but chili also has good nutritional content for health. Red chili provides color and taste that can stimulate appetite, contains many vitamins, and can also be used as medicine, food, and livestock [1]. So that the demand for red chili in the market increases according to the needs of households and industry. Big red chili is one of the important vegetables cultivated commercially in tropical countries [2]. Big 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].

Based on data from [4], the production of large red chili plants in 2015 reached 1,045,200 tons. In 2016 the production of large red chilies reached 1,045,601 tons. In 2017, the production of large red chilies reached 1,206,266 tons. In 2018 the production of large red chilies reached 1,206,750 tons. Although production increases every year, productivity must be increased because the demand for big red chili is very high. The need for large red chilies per year in Bali is very large, reaching 6,000 tons, this is in line with the increasing population every year, while

the production of large red chilies is unstable. The production of large red chilies in Bali in 3 years (2017-2019) experienced ups and downs every year, in 2017 the production of large red chilies reached 44,164 tons while the following year 2018 increased to 45,155 tons, in 2019 there was a drastic decrease of 38,844 tons.

This condition is a challenge for chili farmers to produce red chilies in large quantities. Red chili production is supported by soil conditions, soil pH, soil moisture, use of fertilizers, and organic matter. In general, the benefit of fertilizer is to provide nutrients that support plant growth. Plants can grow optimally if the elements N, P, and K are available in sufficient soil. Organic materials needed for chili production include biochar soil repairer and compost sourced from livestock manure such as cows, goats, and chickens. The joint use of compost and biochar are known as poschar fertilizer is now being encouraged by farmers for agriculture. The results of the study [5, 6], the application of poschar can increase soil fertility and red chili yields. Poschar, which is a mixture of compost and biochar, when applied to soil plays a complementary role in increasing soil fertility.

Compost is an organic fertilizer produced from the decomposition of various livestock manure and plant waste. Compost has many advantages, namely, it contains carbon (C) which helps the soil to become loose, and it also contains nitrogen (N) which in plants plays a role in stimulating the growth of stems, branches, and roots [7]. Compost and biochar are also known as organic matter, but the difference between the two is only in the level of decomposition. Compost decomposes faster in the soil, while biochar is difficult to decompose in the soil. Biochar is a carbon-rich material that is tough to weather and can persist for hundreds of years in the soil. According to [8], biochar is a solid material formed from the carbonization of biomass, commonly called activated charcoal.

Biochar functions as a soil enhancer from agricultural, livestock, and forestry wastes such as rice husks, straw, coconut shells, sawn wood, tree branches, wood chips, corn cobs, and various livestock wastes. The use of biochar helps to improve the physical properties of the soil, especially increasing the porosity of the soil and its ability to absorb nutrients and water. As a soil enhancer, biochar can slow down the decomposition process, and slowly mineralize into carbon dioxide, and other nutrients that plants need. Organic matter should be added each growing season to maintain soil productivity. In agricultural cultivation, biochar can be used as a soil enhancer to improve soil fertility, soil quality, and crop productivity, especially in nutrient-poor soils and lack of water [9]. Research conducted by [10] the use of biochar can improve soil quality and yield of hybrid maize and upland rice. The results of research [11, 12, 13], the use of compost and biochar from manure on red chili plants can increase crop yields. Based on the foregoing, it is necessary to conduct research on the utilization of various livestock manures that are processed into compost and biochar to increase the yield of chili plants. This study aims to determine the effect of the dose of biochar and various types of poschar and their interactions on the growth and yield of red chili plants. The hypothesis proposed in this study is that the dose of biochar 15 tons ha-1 and 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 an altitude of 65 meters above sea level. This study was conducted from April to July 2021. The design used in this study was a factorial randomized block design (RBD) consisting of 2 treatment factors. The first factor is the dose of biochar (B) which consists of 2 levels, namely: without biochar treatment 0 tons/ha (Bo) and biochar dose of 15 tons/ha (Ba). The second factor, poschar type consists of 3 levels, namely: without poschar (Bo), cow poschar (Ps), and goat poschar (Pk) with a dose of 15 tons/ha. Based on the arrangement of treatments (6 treatment combinations with 3 replications), 18 experimental plot units were obtained.

The materials used in this study were red chili seeds of the Pilar F1 variety, biochar from chicken manure, poschar fertilizer from cow manure, and poschar from goat manure. The basic fertilizers used were NPK, Furadan, Dense, Demolish, Curachon, and Roundup herbicides. The tools used in this study were: hoes, harrows, lawn mowers, hand tractors, scales, calipers,

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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, the 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.

3. Results and Discussion

Based on the results of statistical analysis of the effect of biochar dose and poschar type on the variables observed during the study, the significance can be seen as shown in Table 1.

Table 1. Significance of the effect of dose of biochar (B) and type of poschar (P) and their interaction (BxP) on growth and yield variables of chili plants

No	Variable	B	P	BxP
1.	Maximum plant height	**	*	ns
2.	Maximum number of leaves	**	ns	*
3.	Stem diameter per plant	ns	ns	**
4.	Number of productive branches per plant	*	ns	ns
5.	Fruit length per plant	*	ns	ns
6.	Fruit diameter per plant	ns	ns	ns
7.	Number of fruits per plant	*	ns	*
8.	Fruit weight per plant	**	ns	*

* = significant effect (P<0.05), ** = very significant effect (P<0.01), non-significant = (P≥0.05)

Based on Table 1, it can be seen that the interaction between the treatment effect of biochar dose and type of poschar (BxP) had a significant effect (P<0.05) on the number of leaves and number of fruits, fruit weight and had a very significant effect (P<0.01) on diameter stems, but had no significant effect (P≥0.05) on plant height, number of productive branches per plant, fruit length per plant, and fruit diameter.

Table 2. The effect of biochar and poschar doses and their interactions on all observed variables

Treatment	Maximum plant height	Maximum number of leaves	Rod diameter	Number of branches per plant	Fruit Length per plant	Fruit diameter per plant	Number of fruits per plant	Fruit weight per plant
	cm	sheet	Mm	Buah	cm	Mm	fruit	g
Biochar (B)								
Bo	81.83 b	236.36 b	13.76 a	69.56 b	13.98 b	18.23 a	58.8 b	943.06 b
Ba	88.46 a	293.33 a	14.14 a	78.06 a	14.51 a	18.33 a	76.3 a	1235.25 a
BNT 5%	4.28	34.26	-	7.66	0.46	-	15.5	196.51
Poschar (P)								
Po	81.46 b	248.29 a	13.66 a	71.79 a	14.04 a	18.22 a	58.3 a	972.80 a
Ps	85.55 ab	267.50 a	14.37 a	72.58 a	14.30 a	18.40 a	66.8 a	1060.13 a
Pk	88.42 a	278.75 a	13.81 a	77.04 a	14.39 a	18.22 a	77.4 a	1234.54 a
BNT 5%	5.25	-	-	-	-	-	-	-
Interaction (BxP)								
BoPo	77.62 a	193.08 c	12.50 c	62.08 a	13.48 a	17.98 a	34.75 b	619.41 c
BoPs	82.86 a	238.33 bc	14.62 ab	68.33 a	14.17 a	18.39 a	66.33 a	1038.54 abc
BoPk	85.02 a	277.67 ab	14.16 ab	78.25 a	14.30 a	18.33 a	75.17 a	1171.23 ab
BaPo	85.30 a	303.50 a	14.81 a	81.50 a	14.61 a	18.45 a	81.92 a	1326.20 a
BaPs	88.25 a	296.67 ab	14.13 ab	76.83 a	14.43 a	18.42 a	67.25 a	1081.71 ab
BaPk	91.82 a	279.83 ab	13.47 bc	75.83 a	14.48 a	18.12 a	79.58 a	1297.85 ab
Duncan 5%								

Notes: Numbers followed by the same lowercase letters on the same factors mean that they are not significantly different at the 5% BNT test level in the single treatment and the 5% Duncan test in the interaction treatment.

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Biochar treatment had a very significant effect (P<0.01) on the variables of plant height, number of leaves, and fruit weight per plant and significantly (P<0.05) on the number of fruit, number of productive branches per plant, and fruit length. per plant but had no significant effect (P≥0.05) on stem diameter and fruit diameter per plant. Poschar treatment did not show a significant effect (P≥0.05) on all observed variables except plant height which had a significant effect (P<0.05).

Hasil penelitian ini menunjukkan bahwa bobot segar buah cabai tertinggi diperoleh pada interaksi perlakuan biochar ayam tanpa poschar (BaPo) yaitu sebesar 1326,20 g, diikuti interaksi antara perlakuan biochar ayam dengan poschar kambing (BaPk) yaitu sebesar 1297.85 g, dan interaksi antara perlakuan biochar ayam dengan poschar sapi (BaPs) adalah 1081,71 g meningkat masing-masing sebesar 114.11%, 109.53%, dan 74.64% dibandingkan interaksi antara perlakuan tanpa biochar dan tanpa poschar (BoPo) sebesar 619.41 gram (Tabel 2).

Tingginya bobot buah per ton pada interaksi perlakuan biochar ayam tanpa poschar (BaPo), didukung oleh korelasi yang signifikan pada variabel yang diamati seperti tinggi tanaman maksimum (r = 0,82**), jumlah daun maksimum (r = 0,90 **), diameter batang per tandan (r = 0,70*), jumlah cabang produktif per tandan (r = 0,90**), panjang buah per tandan (r = 0,97**), diameter buah per tandan (r = 0,60 *), dan jumlah buah per ton (r = 0,99**) (Tabel 3).

Table 3. The value of the correlation coefficient between variables (r) due to the effect of the interaction between biochar and poschar

	X1	X2	X3	X4	X5	X6	X7	X8
X1	1							
X2	0.80**	1						
X3	0.33^{tn}	0.68**	1					
X4	0.72**	0.97**	0.67**	1				
X5	0.83**	0.96**	0.76**	0.93**	1			
X6	0.30^{tn}	0.70**	0.96**	0.66**	0.71**	1		
X7	0.80**	0.89**	0.75**	0.90**	0.97**	0.65**	1	
X8	0.82**	0.90**	0.70**	0.90**	0.97**	0.60*	0.99**	1

r (0.05; 16; 1) = 0.497 r (0.01; 16; 1) = 0.623

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 tan
X8 = Fruit weight per ton
* = Significance (P<0.05)
** = Very significant effect (P<0.01)
tn = not real(P≥0.05)

The high weight of chili fruit in the interaction between chicken biochar treatment without poschar (BaPo) was due to the ability of biochar sourced from chicken manure to improve soil physical properties such as its ability to hold water and nutrients in the soil, increase soil porosity, and reduce soil volume weight. This causes the soil to become more porous, friable, and friable. Such soil conditions encourage the process of better absorption of nutrients by plant roots and the growth and yield of chili plants as a whole looks better than other treatments. Biochar is a soil enhancer that has the ability to hold nutrients and water in the soil to support the supply of nutrients and water for plants. The ability of nutrient and water retention by biochar is caused by improved aeration and soil drainage conditions due to increased soil porosity and decreased soil compaction. This is in line with research [14], by giving biochar from chicken manure can increase soil porosity, reduce soil volume weight, and increase soil fertility and red chili yields. Biochar application can increase soil pH and aggregates so as to increase soil water content and soil ability to provide Ca, Mg, P and K, as well as increase soil microbial respiration, soil microbial biomass, cation exchange capacity, and increase crop yields [15].

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The increase in fruit weight per plant in the interaction of chicken biochar treatment and without poschar due to improved soil fertility has encouraged plants to actively absorb nutrients needed by plants to be used in the photosynthesis process, namely as a constituent of carbohydrates, fats, proteins, minerals. and vitamins to be translocated to the fruit storage section [16]. Fruit development is strongly influenced by the formation of auxin in developing seeds and other parts of the fruit that serve to supply food reserves to increase fruit development.

4. Conclusion

Interaction between treatments, the effect of biochar dose and type of poschar had a significant effect on the number of leaves and number of fruits, fruit weight and a very significant effect on stem diameter, but had no significant effect on plant height, a number of productive branches per plant, fruit length per plant, and fruit diameter. Biochar treatment had a very significant effect on the variables of plant height, number of leaves, and fruit weight per bunch and significantly affected the number of fruit, number of productive branches per bunch, and fruit length per tonne but had no significant effect on stems diameter. Poschar treatment had no significant effect on all observed variables except plant height which had a significant effect. The highest fresh weight of chili fruit per plant was obtained from the interaction of chicken biochar without poschar which was 1326.20 g, followed by the interaction between chicken biochar and goat poschar of 1297.85 g, and the interaction between chicken and beef biochar. Poschar (BaPs) treatment of 1081.71 g increased by 114.11%, 109.53%, and 74.64% respectively compared to the interaction between treatment without biochar and without poschar of 619.41 g.

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Reference

[1] Marliah, A., Nasution, M., & Armi, A. (2011). Pertumbuhan dan Hasil Beberapa Varietas Cabai Merah pada Media Tumbuh yang Berbeda. Jurnal Floratek, 6(1), 84-91.
[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). Petunjuk Umum Program Peningkatan Produksi, Produktivitas dan Mutu Produk Hortikultura Berkelanjutan Tahun Anggaran 2014. Direktorat Jenderal Hortikultura. Departemen Pertanian.
[4] BPS (2018) Ringkasan Eksekutif Pengeluaran dan Konsumsi Penduduk Indonesia Berdasarkan Hasil Susenas September 2017. Badan Pusat Statistik. Jakarta
[5] Situmeang. Y.P., Sudita I. D. N., dan 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.
[6] 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(5), 2008. https://doi.org/10.18517/ijaseit.11.5.13845
[7] Anggraini, D., & Widowati, H. (2013). Perbandingan produksi cabai merah (Capsicum annum, L.) antara yang menggunakan media tanam sekam bakar kompos dengan sekam bakar pupuk kandang sebagai sumber belajar biologi SMA. BIOEDUKASI (Jurnal Pendidikan Biologi), 4(2).
[8] Widiastuti, D., & Magdalena, M. (2016). Analisis Manfaat Biaya Biochar di Lahan Pertanian untuk Meningksatkan Pendapatan Petani di Kabupaten Merauke. Jurnal Penelitian Sosial dan Ekonomi Kehutanan, 13(2), 135-143.
[9] Adhi, R. K. (2013). Biochar sang pembenah tanah. Balai Besar Pelatihan Binaung.
[10] Rostaliana,P., Prawito, P., & Turmudi, E. (2012).Pemanfaatan biochar untuk perbaikan kualitas tanah dengan indicator jagung hibrida dan padi gogo pada system lahan tebang dan bakar. Naturalis, 1(3), 179-188.

[11] 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.
[12] 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.
[13] 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.
[14] Gani, A., (2009). Biochar Penyelamat Lingkungan. Warta Penelitian dan Pengembangan Pertanian. Vol. 31, No. 6.
[15] Nurjannah, S. (2013). Hubungan Beberapa Sifat Kimia dan Populasi Rhizobia Tanah Inceptisol dengan Keragaan Tanaman Kedelai Varietas Baluran di Beberapa Wilayah Jawa Timur.
[16] Suprihartini, E. B., & Kurniawan, R. A. (2013). Uji Efek Anti Inflamasi Seduhan Buah Mahkota Dewa (Phaleria Macrocarpa (Scheff.) Boerl) pada Tikus Jantan (Ratus Norvegicus) yang Telah Diinduksi Karagenin. Jurnal Ilmu Kesehatan dan Farmasi, 1(2), 27-29.

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