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Optimizing Nutrient and Quality of Second Ratoon Odot Grass through Biochar Application on Post-Nickel Soil

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ABSTRACT

This study aims to determine the application of various levels of biochar in post-nickel mining soil on the productivity and quality of second ratoon odot grass (*Pennisetum purpureum* cv. mott). This study used a completely randomized design (CRD) with 4 treatments and 4 replications. The treatments consisted of P0: without biochar (control), P1: 75 gr/polybag biochar, P2: 150 gr/polybag biochar, and P3: 225 gr/polybag biochar. Each treatment contained 30 kg/polybag of post-nickel mining soil and was given 150 g/polybag of goat manure. The data obtained were analyzed using analysis of variance and further tested with the Duncan Multiple Range Test on treatments that had a significant effect. Parameters observed included the content of dry matter (DM), organic matter (OM), crude fiber (CF), and crude protein (CP). The results showed that the application of biochar on post-mining soil had no significant effect on DM, OM, and CP content but significantly ($P<0.05$) different CF content of odot grass. P1 showed 9.06% DM, 84.70% OM, 21.60% CF, and 9.74% CP. This study concludes that the application of 75 g/polybag biochar on post-nickel soil showed the best quality of the second ratoon odot grass in this study.

Keywords: ODOT GRASS, BIOCHAR, POST NICKEL MINING SOIL

I. INTRODUCTION

The availability of adequate land strongly supports the availability of forage fodder. However, the expansion of residential and industrial areas causes the land for planting forage to become increasingly narrow. On the other hand, post-nickel mining land has a fairly large size and has not been utilized optimally for crops due to its low nutrient content. The nutrient content of post-nickel land includes K, Ca, Fe, Cu, Mn [1], and P in low amounts and high Ni content [2]. Post-nickel mining causes acid soil pH and soil compaction, making it difficult to cultivate, abnormal plant growth and

roots [3], small leaf size, and small plant volume and diameter [1].

Soil quality improvement strategies on post-mining land can be carried out through the use of humic materials and compost [4], biological ameliorants [5], [6], planting legume trees and creepers, giving manure and biochar [7]. According to [8], The application of biochar is very useful in improving the physical, chemical, and biological properties of the soil and increasing the availability of water. Biochar is also used for improving soil physical quality and water use efficiency [9] and dry land rehabilitation [10].

The use of biochar in planting media has been carried out on several plants, including sugar cane [11]; rice [12]; mung beans [13]; corn [14]; mustard greens [15]; upland rice [16] in planting forage, among others: Sweet sorghum (*Sorghum bicolor* L. Moench) [17]; Bengal grass (*Panicum maximum* Jacq) [18]; Indigofera (*Indigofera zollingeriana*) [19] and Mexican grass (*Euchlaena mexicana*) [20].

Odot grass (*Pennisetum purpureum* cv. Mott) is a superior grass species with high productivity (biomass, leaf-to-stem ratio) and nutritional value (protein and dry matter) as well as high palatability (fine hairy, soft leaves, soft stems). Odot grass can be used as a solution to ensure the availability of forage because it can be processed into silage or hay when production is abundant. In addition, odot grass can also grow in various places, is shade tolerant, responsive to fertilization, and requires high soil fertility. Odot grass is a type of grass that is given to livestock by cut and carry and undergoes regrowth with a higher number of tillers so that it can be utilized throughout the year [21]. Plants that experience regrowth in subsequent growth are called ratoons. Related to this, it is necessary to study the use of biochar on post-mining land on the production and quality of the second ratoon odot grass.

II. METHODS AND MATERIAL

Materials

This study used the second ratoon odot grass, which was planted using post-nickel mining soil. The soil amendment agents used were goat manure and biochar made from furniture scraps. The second ratoon odot grass was harvested at the age of 193 DAP.

Methods

The second ratoon odot grass was cultivated on post-mining soil in a greenhouse. After the plants were 60 days old (193 DAP), the plants were harvested and then observed for the production of fresh material and the percentage of leaves. CF content was analyzed at the Laboratory of Animal Feed Analysis Unit, Laboratory of Animal Feed Technology Unit, Faculty of Animal Husbandry, Halu Oleo University, and the content of DM, OM, and CP were analyzed at the Nuclear Isotope Application Center and Radiation (PAIR) of the National Nuclear Energy Agency (BATAN). The design used in this study was a completely randomized design (CRD) with 4 treatments and 4 replications. Treatment consists of P0 = control, without biochar, P1 = 75 gr/polybag biochar, P2 = 150 gr/polybag biochar, and P3 = 225 gr/polybag biochar. Each treatment was given 150 g/polybag of goat manure. The amount of post-nickel mining soil used in this study was 30 kg/polybag. The parameters observed were the content of DM, OM, CF, and CP. The data obtained were analyzed using ANOVA analysis of variance, and the treatment that had a significant effect was further tested using the Duncan Multiple Range Test (DMRT) test.

III. RESULTS AND DISCUSSION

The results showed that the application of biochar with different levels in post-nickel mining soil on the productivity and quality of second ratoon odot grass (*Pennisetum purpureum* cv. mott) grass can be seen in Table 1 below:

Table 1. Content (%) and nutrient production (ton/ha) of second ratoon odot grass

Parameter	Treatment			
	P0	P1	P2	P3
	Content of Second Ratoon Odot Grass (%)			
DM	9,04±0,48	9,06±0,74	9,74±0,53	9,38±0,78
OM	87,22±0,90	84,70±3,10	86,22±0,55	83,41±2,20
CF	17,75±1,56[a]	21,60±0,97[b]	20,22±1,86[ab]	21,93±2,09[b]
CP	8,73±0,37	9,74±0,85	8,71±0,52	9,80±0,14
	Nutrien Production (ton/ha)			
OM	2,24±0,59	4,08±2,02	2,70±1,54	1,83±1,92
CF	0,46±0,15	1,05±0,11	0,67±0,41	0,50±0,65
CP	0,22±0,05	0,47±0,01	0,26±0,14	0,19±0,23

Note: Different letters in the same line indicate that the treatment has a significant effect (*P<0.05*); P0 (without biochar, 10 tonnes/ha of manure), P1 (5 tonnes/ha of biochar, 10 tonnes/ha of manure), P2 (10 tonnes/ha of biochar, 10 tonnes/ha of manure), P3 (15 tonnes/ha ha biochar, 10 tonnes/ha of manure).

Dry Matter (DM)

The results showed that the application of biochar with different levels did not significantly affect the dry matter content of second ratoon odot grass (Table 1). This shows that the application of biochar has not been able to increase the dry matter content of the second ratoon odot grass. This is probably caused by the type of biochar used has not been able to increase the efficiency of the use of goat manure and has not optimally functioned as an ameliorant (soil improver) to provide and retain nutrients needed by plants to increase the DM content of the second ratoon grass. According to [22], the impact of giving biochar on plant productivity is very dependent on the characteristics of the nature of biochar, the dose used, and the ability to overcome the main constraints of the soil where biochar is applied. The DM content of the second ratoon odot grass in this study ranged from 9.04 - 9.74%. The average DM content in this study is lower than [21], i.e., 14.69% (spacing of 50x100 cm) and 13.77% (spacing of 75x100 cm) at a harvest interval of 60 days in open land. However, the DM content in this study was higher than [23], i.e. 7.49-7.83%. This is because the role of biochar to optimize the absorption of soil nutrients and the efficiency of using goat manure in this study only started in the second ratoon. This is in line with [24], which states that manure is an organic fertilizer that is slow to decompose in the soil.

Organic Matter (OM)

The analysis of variance showed that the application of biochar with different levels did not significantly affect the OM content of second-generation odot grass. This is because the application of biochar has not affected the DM content, where one of the constituents of DM is OM. According to [25], OM will increase along with the increase in DM in plants. The OM content of odot grass in this study ranged from 83.41 – 87.22%. The results obtained are in accordance with [21], i.e., 85.55% (harvesting interval: 60 days). The OM content of second ratoon odot grass is higher than [23], i.e., 79.09 - 79.55%. This is due to the use of goat manure, which is thought to have decomposed well in the soil during the second ratoon harvest so that the goat manure can be fully optimized by biochar. [22] stated that biochar is a soil enhancer that can last a long time and store large amounts of carbon in the soil so that it can improve the soil's physical and chemical properties and increase

plant productivity. Plant productivity was stable in the second and third plantings without the addition of biochar.

Crude Fiber (CF)

The application of biochar with different levels had a significant effect (P<0.05) on the crude fiber content of the second ratoon odot grass (Table 1). The CF content of P1, P2, and P3 was higher than P0, but P0 was not significantly different from P2. This shows that the use of biochar can increase the CF content of the second ratoon odot grass. This is presumably because the use of biochar can optimize nutrient uptake in the soil to produce higher CF. [26] and [27] stated that biochar increases the availability of soil nutrients, especially P concentration, exchangeable K and Na, total N, and soil cation exchange capacity. [28] stated that phosphorus plays an important role in most phosphorylase-dependent enzyme reactions. Phosphorus is part of the cell nucleus, so it is important in cell division, stimulates the development of plant meristem tissue, and forms new plant cells. According to [29], the application of biochar can increase plant growth and produce new tillers. The number of tillers, plant height, and number of leaves also affect the CF content of the plant. The greater number of tillers, number of leaves, and plant height can increase CF because each tiller or plant stem requires the same nutrients for plant survival. The average CF obtained in this study ranged from 17.75 to 21.93%. The percentage of CF obtained is lower when compared to [23], who reported that the fiber content of odot grass at the harvesting age of 60 days was 22.24 -23.19%. The crude fiber content obtained in this study is better because it is almost in accordance with the crude fiber needs of ruminants.

Crude Protein (CP)

The results of the analysis of variance showed that the application of biochar with different levels and manure did not affect the crude protein content of odot grass. This is because biochar and goat manure have not optimally provided the soil nutrients needed to support the availability of protein in the second ratoon odot grass. The average value of PK content in this study ranged from 8.71 to 9.74%. The results of this study are lower when compared to [23], which stated that the CP content of odot grass ranged from 10.96 - 12.66% at the harvest age of 60 DAP. In addition, the CP content of plants is also influenced by the age of harvest. The CP content of a plant decreases with increasing plant age [30]. Ratoon plants also had an older age (193 DAP) physiologically when compared to the main plant (60 DAP). This happens because the plant roots are ready to absorb nutrients after cutting the main plant so that the ratoon plant has faster growth. In the results of research by [31], it was seen that there was a drastic decrease in crude protein from 12.94% at 8 weeks of harvest to 8.77% at 12 weeks of harvest. [32] also reported that the crude protein content of elephant grass odot at 45 days of harvest was 13.90% and decreased to 11.75% at 60 days of harvest.

IV.CONCLUSION

The use of biochar with different levels had no significant effect on DM, OM, and CP content but significantly (P<0.05) on the CF content of second ratoon odot grass. The best treatment was in treatment P1 with 9.06% DM, 84.70% OM, 21.60% CF, and 9.74% CP.

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