

Productivity of Different Types of Grass That is Produced on Ex Coal Mining Land

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ABSTRACT

This study aims to determine the productivity of cut and carry grass in ex-coal mining land. Samples of soils for analysis at the Soil Research Institute were taken at three points. The design used was a Randomized Block Design (RBD), with plant varieties as treatment, namely *Brachiaria brizantha* cv. Mulato (A), *Paspalum atratum* (B), *Panicum maximum* cv Riversdale (C), *Vetiver zizanoides* (D), *Panicum maximum* cv Purple (E), *Pennisetum purpureum* cv Taiwan (F), *Pennisetum purpureum* cv Mott (G). The grass is planted in a 5 x 7 m plot, repeated three times over a planting distance of 0.5 x 0.5 m. The results of soil analysis showed that the organic matter content (%) for C, N was 1.67 and 0, 11, respectively, P and K content (%) was 0.04 and 0.43 and mineral (ppm) was for Ca, Mg, Na, Fe, Al, Mn, Cu, Zn and B : 0.08; 2.07; 0.60; 543.00; 24.33; 54.00 and 6.01. The results showed that plant varieties had a significant effect ($P < 0.05$) on biomass production (gram plot⁻¹), plant height (cm), and number of tillers. The highest biomass and height plant was *Panicum maximum* cv Purple and the highest number of tillers was *Panicum maximum* cv Riversdale. It is concluded that *Panicum maximum* cv Purple can be developed as cut and carry grass on ex-coal mining land.

Keywords: Ex-coal mining land, Forage, Productivity

1. INTRODUCTION

Indonesian mining is usually done by open-pit mining. Mining ore is done by removing the mine area of the vegetation first (land clearing) and peeling the layers of soil into the ore deposit. Topsoil is transferred for storage or reclamation to a special place. After the ore is taken, the mine pit is filled back with overburden and tailings, compacted, and then covered with a layer of topsoil that had previously been set aside for later planting. This condition generally means that ex-mining land has a thin layer of surface soil and subsoil, which means that organic matter and the microbes in the earth are not essential for the growth of plants. Ex-mining soil has to be replanting. The criteria for tree recovery are: 1) the local type of pioneer, 2) Rapid growth, but not needing many nutrients, 4) A good root system and symbiotic with certain microbial products, can produce loads of litters and are easily partially decomposed 5) Stimulate the introduction of seed vectors; 6) Easy and cheap to propagate, plant and maintain [1]

For the development of animal feeds, one of the uses is ex-coal mining. In mining vegetation areas, the growth of various kinds of grass such as signal grass (*Brachiaria*

decumbens) and *uraso* (Scharum Sp) is very rapid and the overall coverage is high, allowing them to use them as animal forage and triggering livestock pasturing in the area [2]. In ex-coal mining areas pH, organic matter composition, low levels of micro-organism population, and heavy metal residues form part of the problems in the production of forage. These problems can be addressed by providing lime, organic matter, organic fertilizers, micro-organisms like mycorrhizal fungi, and plant remediation to develop forage for livestock [3]. The use of manure and urea may increase animal feed productivity in former mining soil [4]

One of the uses of ex-mining land is for the development of cut and carry grass. Some of the cut grass types include *Pennisetum purpureum* cv Taiwan, *Pennisetum purpureum* cv Schum (Mott), *Brachiaria brizantha* cv.Mulato, *Paspalum atratum*, *Vetiver zizanoides*, *Panicum maximum* cv Riversdale, *Panicum maximum* cv Purple.

Pennisetum purpureum cv Taiwan which was fertilized with N,P,K added with CMA resulted in dry matter digestibility, organic matter, and crude protein which were relatively the same as those without the addition of CMA [5]. *Pennisetum purpureum* cv Schum

(mott) grows well with the addition of compost in former mining land .1.5 kg m⁻² [6], has a dry matter, crude protein, and raw fiber content 16.4; 8.8 dan 33.1[7] The use of *Brachiaria brizantha* cv.Mulato enhances the soil microbes' function to use carbon to improve soil fertility [8], but waterlogging intolerant[9]. *Paspalum atratum* is tolerant of summer but sensitive to winter [10], So ex-coal mines are tolerant. One kind of grass for phytoremediation is *Vetiver zizanoides* [11]. This study aims to determine the productivity of the grasses *Pennisetum purpureum* cv Taiwan, *Pennisetum purpureum* cv Schum (Mott), *Brachiaria brizantha* cv Mulato, *Paspalum atratum*, *Vetiver zizanoides*, *Panicum maximum* cv Riversdale, *Panicum maximum* cv Purple for cut grass on ex-coal mining land.

2. MATERIALS AND METHOD

The research was done in Kutai Kartanegara, East Kalimantan, on a former coal mine at PT Kitadin from December 2016 to April 2017.

2.1. Materials

Soil samples at three predetermined points as deep as ± 20 cm, distance from points ± 25 m were collected at each location. After being cleaned, soil samples have been cleaned and placed into plastic bags with 1 kg each of plant residues and roots. At predetermined points, soil samples were taken to a depth of ± 20 cm at three points. The first point to the second is ± 25 m and the second point to the third point is the same distance.

2.2. Method

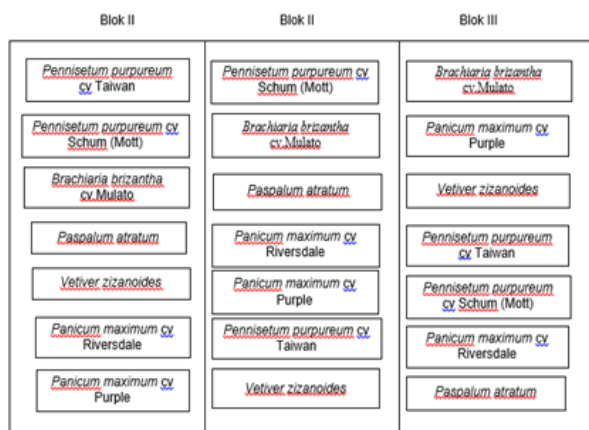


Figure 1. The layout of the planting of forage plant

The following were observational parameters and methods of soil analysis: pH 1:5 with H₂O organic matter C, N, P, K, Ca, Mg, Na, Fe, Al, Mn, Cu, Zn, and B in the Soil Research Institute Laboratory, Total Ex (HNO₄) (ppm).

Observational parameters and analysis methods on the soil were as follows: pH 1:5 with H₂O, organic matter C, N, P, K, Ca and Mg, the mineral content of Na, Fe, Al, Mn, Cu, Zn, and B with Total Ex (HNO₃) (ppm) in Soil Research Institute Laboratory

This study used the type of grass as treatment and the group for the replication in a randomized block design (7 x 3). *Pennisetum purpureum* cv Taiwan, *Pennisetum purpureum* cv Schum (Mott), *Brachiaria brizantha* cv Mulato, *Paspalum atratum*, *Vetiver zizanoides*, *Panicum maximum* cv Riversdale, *Panicum maximum* cv Purple were planted in plots of 5 x 7 m each and are spaced 0.5 x 0.5 m and repeated three times.

The data obtained were analyzed for variance, with a randomized block design (RBD) using SPSS 16 software, if there is a significant difference, continue with the Duncan test.

3. RESULT AND DISCUSSION

3.1. Soil Chemical Content in The Former Coal Mining Area

The results of the soil analysis can be seen in Table 1. In Table 1 it can be seen that the degree of acidity (pH) of H₂O is alkaline, with organic matter content (C, N, P, K, Ca, and Mg) including low to very low. The low organic matter due to intensive alkaline leaching, and partly carried away by erosion.

Organic matter represents the principal source of N in the soil and plays an essential role in improving soil's physical, chemical, and biological properties. This is due to a decrease in the topsoil layer on the ex-mining land [12]. The physical and biological characteristics of the soil are enhanced[13][14]. The use of organic material in the form of empty fruit bunches of composted oil palm gave the most effective results in improving the mining area of former coals [15]. The results are different from the results of research into Kaltim Prima Coal (KPC) for ex-coal mines of a pH of <4.5 but also a high level of Mn and Cu [16]. Other studies have shown that soil acidity (pH) levels are classifying as very sour in five former coal mine locations (4.10-6.46), low-organic C-(0.48-4.82%), low organic materials (1.85-8.30%), low-medium C/N (12.47-22.9%), very low-medium total N (08-11%), very low-to-medium available P (3.52-7.72 ppm), low-total K (11.47-92.80 ppm and low-to-middle) (4.87-16.40 ppm) [17]. With the increase in land restoration age, density, porosity, infiltration, durability, organic matter, and soil pH improved[18].

Table 1. Results of analysis of soil chemicals

No	Properties of soil	Pre research	After a Research study	Quality of standards TCLP**)
1.	pH H ₂ O	6.51	-	-
2.	Organic matter (%)			
	C	1.79	1.67 low *	-
	N	0.11	0.11 low*	-
	P	-	0.04 low*	-
	K	-	0.43 low*	-
	Ca	-	0.23 very low *	-
	Mg	-	0.31 very low*	-
	P ₂ O ₅	67.38	-	-
	K ₂ O	20.63	-	-
3.	Eks Total (HNO ₃) (ppm)	16.25 (high)	-	5.0
	Na	-	0.08	-
	Fe	-	2.07	-
	Al	-	0.60	-
	Mn	-	543.00 (high)	-
	Cu	-	24.33 (high)	10.0
	Zn	-	54.00 (high)	50.0
	B	-	6.01	-

Note: *) [22] ; **) [23]

Ultisol soils in ex-coal mines are affected by low organic matter content, high saturation, phosphate (P element) and KCl need for liming or fertilizing[19]. In this study, there is quite a high mineral content of Mn, Cu, and Zn. Soil sludge enhancement in former coal mines can reduce Fe, Mn, Zn, and Cu concentrations[20]. Ex-coal mining land for animal feed crops can be used after recovery and rehabilitation. The former mining area may be used after rehabilitation to develop animal feed crops [21].

3.2. Forage of Crop Productivity

Average production, plant height, and the number of tillers can be seen in Table 2. Based on the statistical analysis results, it was stated that the type of cut grass had a significant effect on P<0.05 on the production of g plot-1, height, and some tillers. The highest grass production was *Panicum maximum* cv Purple, *Paspalum atratum*, *Pennisetum purpureum* cv Taiwan, *Pennisetum purpureum* cv Schum (mott), *Braziaria brizantha* cv mulato, *Panicum maximum* cv Riversdale, *Vetiver zizanoides*. The highest production was *Panicum maximum* cv Purple at 77175.39 grams plot-1, this result was higher than the production on dry acid soil, which was 25894.4 grams plot-1[24]. *Panicum maximum* and

Brachiaria decumbens grasses proliferate after the eruption of Merapi and are used for animal feed and pioneer crops [25].

The highest plant heights were *Panicum maximum* cv Purple, *Pennisetum purpureum* cv Taiwan, *Vetiver zizanoides*, *Panicum maximum* cv Riversdale, *Pennisetum purpureum* cv Schum (Mott), *Paspalum atratum*, *Brachiaria brizantha* cv Mulato. The height of *Panicum maximum* cv Purple is 230.86 cm, this is because *Panicum* grass grows faster shoots so that it absorbs many nutrients faster for plant growth. The highest plant height in a row is *Panicum maximum* cv Purple, *Pennisetum purpureum* cv Taiwan, *Vetiver zizanoides*, *Panicum maximum* cv Riversdale, *Pennisetum purpureum* cv Schum (Mott), *Paspalum atratum*, *Brachiaria brizantha* cv Mulato. The maximum height of *Panicum maximum* cv Purple is 230.86 cm, this is because *Panicum* grass grows faster shoots so that it absorbs many nutrients faster for plant growth [26]. The increase in vertical height, number of tillers, dry weight production was observed parameters of the growth and productivity of a grass. The appearance of the size of plant height is one aspect that can be observed and is easily assessed for the quality of its growth. Plant height is an easily visible measure of growth.

Table 2. Grass production, height, and tiller

Treatments	Grass Type	Production (g plot-1)	Height (cm)	Tiller
1.	<i>Brachiaria brizantha</i> cv Mulato	22728,38±8201,084c	67,51±13,81d	25,11±14,00ab
2.	<i>Paspalum atratum</i>	62051,69±18694,77ab	102,99±22,06c	18,34±4,72abc
3.	<i>Panicum maximum</i> cv Riversdale	22398,33±12837,4c	111,39±20,54c	32,90±21,27a
4.	Vetiver zizanoides	19195,74±4350,275c	126,32±14,06ab	24,58±8,22ab
5.	<i>Panicum maximum</i> cv Purple	77175,39±6977,141a	230,86±28,28a	10,37±7,92bc
6.	<i>Pennisetum purpureum</i> cv Taiwan	52809,63±22134,61b	168,04±33,97b	18,38±4,45abc
7.	<i>Pennisetum purpureum</i> cv Mott	52716,57±6366,128b	104,26±2,46c	5,42±1,17c

The highest tillers were *Panicum maximum* cv Riversdale, *Vetiver zizanoides*, *Brachiaria brizantha* cv Mulato, *Paspalum atratum*, *Pennisetum purpureum* cv Taiwan, *Panicum maximum* cv Purple, *Pennisetum purpureum* cv Schum (Mott). *Panicum maximum* cv Riversdale had the highest number of tillers, namely 32.90. The number of tillers is one part that shows the growth and development of plants in the vegetative phase. The number of tillers can be used to estimate the weight of the resulting forage. Besides tiller count, plant height has a direct impact on forage weight. The number of tillers in plants with lower production is thought to be affected by competition for nutrients, affecting the number of tillers. The number of tillers and plant height is closely related to the number of leaves so that more energy absorption can increase the rate of photosynthesis and ultimately increase forage dry matter [27]. The number of seedlings on *Panicum maximum* cv Purple guinea on acid dry land 13.91 [28].

4. CONCLUSION

Panicum maximum cv Purple has the potential to be developed as a cut and carry grass in ex-coal mining areas.

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