Phytoremediation Agents of Rice Biochar and Cage Fertilizer in Ex-Gold Mining and The Sunflower Growth

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Abstract. Degraded former gold mining land so that soil fertility is very minimal. Ameliorant mining with an open system causes increased oxidation of sulfurous minerals which reduces nutrient levels and accumulation of heavy metals on the soil surface. This research aims to improve the physical properties of the former gold mining area. This study used a completely randomized design method of 6 treatments with 4 replications. The treatment dose used was 40 tons/ha. The results of this study are that the application of rice husk biochar with manure can provide the best nutrients and growth for sunflower plants.

Keywords: gold mine, sunflower, ameliorant

1. Introduction
Along with the rapid development of technology, the rampant activity of PETI (Gold Mining Without Permits) is illegal mining that is illegal in nature. T. Based on the research of [1] the negative impact of gold mining activities is that the former gold mining area has a more sandy texture, the criteria for organic matter are very low, around 1.036%, the volume weight is >1 g/cm³ which causes the soil to become solid, the soil structure is damaged or unstable, sensitive to erosion, poor soil average and drainage and low water retention.

Decreasing the concentration of pollutants is by using a plant activity known as phytoremediation. The mechanism of the phytoremediation process is that plants absorb metals and accumulate them into plant biomass, which is called phytoextraction. Plants that can accumulate heavy metals at a high rate are called hyperaccumulators. One of the hyperaccumulator plants is the sunflower (Helianthus annuus L.).

Biochar rice husk is the result of incomplete combustion of rice husk which has the potential to add nutrients to plants and can also improve soil quality and is used as an alternative for repairers [2]. Manure is a type of organic fertilizer that comes from animal manure and can improve soil fertility. The use of manure aims to provide the nutrients needed by plants. So, with this research, namely through sunflower cultivation with ameliorant applications biochar rice husks and manure can gradually restore the ecology
of the former gold mining land. Besides, the harvest can support the regional economy because it has the potential to produce biofuel raw materials.

2. Materials and Methods

2.1. Time and Location of Research
This research was conducted from June to November 2020 in the greenhouse and laboratory of the Soil Department, Faculty of Agriculture, Andalas University, Padang, West Sumatra.

2.2. Tools and Materials
Tools that will be used during the research namely, a tool for making biochar, hoe, beaker, erlenmeyer, pot, dropper, sample ring, and others. Meanwhile, the materials used are land from ex-gold mining taken in Nagari Tebing Tinggi, Pulau Punjung District, Dharmasraya Regency, biochar rice husks that have undergone a pyrolysis process by heating 400 °C - 500 °C, composted manure, indicator crops used is the sunflower, and the basic fertilizers used are Urea, SP-36, and KCl.

2.3. Research Methods
The method used in this study was a completely randomized design (CRD) pot experiment method with 6 treatments and 4 replications, to obtain 24 experimental units. Based on research by Shalsabila et al. (2014) obtained a recommendation for an organic matter for ex-gold mining land, namely 40 tonnes/ha, equivalent to 100% of biochar rice husk and 100% manure. The treatments used consisted of treatment A (100% biochar rice husk), B (25% biochar rice husk + 75% manure), C (50% biochar rice husk + 50% manure), D (75% biochar rice husk + 25% manure), E (100% manure), and F (0% biochar rice husk + 0% manure) as control treatments.

2.4. Observation
In this study, an analysis of the former gold mining soil, the former gold mining soil after treatment, and plant analysis. Soil analysis consists of soil physics properties includes indicators of bulk density, total pore space, water content, Permeability, and soil texture.

2.5. Data analysis
The data obtained in the form of initial soil analysis, final soil analysis, and plant data will be processed based on statistical analysis, variety, and further test (DMRT) at 5% level. Meanwhile, plant growth is presented in graphical form.

3. Result and Discussion

3.1 Preliminary Soil Analysis Results
The initial soil analysis of ex-gold mining areas is presented in Table 1 consisting of an analysis of the physical properties of the soil.

Table 1. Preliminary soil analysis

| Parameter        | Score | Criteria |
|------------------|-------|----------|
| Bulk density (g/cm3) | 1.31  | Height$^1$ |
| Total Pore Space (%) | 49.82 | Low $^1$ |
| Water content (%) | 0.99  | Very low$^1$ |
| Permeability (cm/hr) | 211.65 | Very fast$^1$ |
| C-Organic (%) | 1.06  | Very low$^2$ |
| Texture | Sand (%) | 91.65    |


Dust (%) | 8.21 | Sand³)
Clay (%) | 0.14

¹) Soil Research Institute, 1979
²) Soil Research Institute, 2005
³) Triangle texture USDA

From Table 1 it can be seen that the total pore space value in the soil is 49.82% with low criteria, because organic matter becomes a source of energy for microorganisms in the soil, resulting in an increase in microorganism activity which causes soil pores to increase. This is in accordance [¹] stated that soils that have a large BD value have less organic matter content so that they will reduce soil porosity.

Due to gold mining activities, the soil has a high sand content and removes dust and clay content in the soil, so that the soil is easily eroded and easily loses water. This is because the sandy soil has more macropores. This is consistent with the statement of [¹] that sand soils are usually less fertile than clay, because the storage capacity of water and nutrients is very low. This is not beneficial for the plants that grow on it. Coupled with the statements of [³] that the high content of C-Organic in the soil is influenced by the clay and dust content. The higher the clay content, the soil's C-Organic content will increase. This is following[⁴] statement that soil physical properties that affect soil permeability are soil water content, soil volume weight, total porosity, fast drainage pores, slow drainage pores, coarse sand content, fine sand content, dust content, and clay content.

3.2 Soil Analysis After Treatment

Soil analysis after treatment the characteristics of the physical properties of the soil in table 2.

| Treatment Code                  | Water content (%) | BV (g/cm³) | TRP (%) | Permeability |
|--------------------------------|-------------------|------------|---------|-------------|
| 100% biochar rice husk          | 1.16 d            | 1.24 b     | 52.53 d | 25.28 b     |
| 25% biochar rice husk + 75% manure | 2.09 b            | 1.20 d     | 54.02 b | 19.04 d     |
| 50% biochar rice husk + 50% manure | 1.73 c            | 1.22 c     | 53.09 c | 21.81 c     |
| 75% biochar rice husk + 25% manure | 1.37 d            | 1.23 c     | 52.89 cd | 22.69 c     |
| 100% manure                     | 2.62 a            | 1.18 e     | 54.38 a | 15.36 e     |
| Control                         | 0.50 e            | 1.26 a     | 51.81 e | 42.14 a     |

Based on Table 2, this due to the low level of organic matter in the soil, so that water easily passes down and easily evaporates due to the rough soil texture. According to [⁵] water that evaporates from the soil surface will be retained by manure and return to the soil, so the soil has higher moisture compared to soil without manure application.

Organic material is one of the soil amendments in improving soil physical properties, one of which is the volume weight of the soil. The higher the organic matter that is fed into the soil, the soil volume weight will decrease. This is following[⁷] opinion that the amount of organic matter contained in the soil affects changes in soil BD, the more organic matter, the lower the volume weight, compared to soil that has low organic matter. According to [⁸] organic matter in the soil acts as a binder of soil particles so that soil aggregation is good, when organic matter is given into the soil it creates pore space in the soil so that the weight of the soil volume will decrease. Coupled with the opinion of [⁶] organic matter is porous,
Manure is an organic material. Organic matter that is given to the soil can reduce soil permeability. This is coupled with the statement of [9] that there is a positive correlation between soil organic matter content and soil permeability. Soil containing sand, when added with organic matter, can change the soil structure from single grained to lumpy shape, thereby increasing the structure and size of soil aggregates increasing soil capacity to drain water.

3.3 Plant Height and Number of Leaves 8 Weeks After Planting

The results of plant observations are presented in table 3 for plant height and number of leaves in table 3.

| Treatment                                         | Height (cm) |
|---------------------------------------------------|-------------|
| 100% biochar rice husk                            | 138 ab      |
| 25% biochar rice husk + 75% manure                | 160 a       |
| 50% biochar rice husk + 50% manure                | 152 ab      |
| 75% biochar rice husk + 25% manure                | 144 ab      |
| 100% manure                                       | 172 a       |
| Control                                           | 121 b       |

Based on table 3, the application of biochar rice husk and manure resulted in an increase in stem height compared to the control. A significant increase in stem height occurred in treatment 100% manure of 51 cm (control 121 cm to 138 cm).

| Treatment                                         | Leaves (sheet) |
|---------------------------------------------------|----------------|
| 100% biochar rice husk                            | 28 bc          |
| 25% biochar rice husk + 75% manure                | 35 ab          |
| 50% biochar rice husk + 50% manure                | 31 abc         |
| 75% biochar rice husk + 25% manure                | 30 bc          |
| 100% manure                                       | 38 a           |
| Control                                           | 25 c           |

Based on the table above, the development and growth of leaves were significantly different to the control. [10] stated that the number of leaves is influenced by the availability of nutrients and the environment. Environmental factors that affect the growth and development of plant leaves such as sunlight, which irradiates a role in the process of photosynthesis, besides pests, also affect the growth and development of leaves. Nitrogen and Mg elements play a role in leaf growth and development, where these elements will play a role in the formation of leaf chlorophyll.

4. Conclusion

The conclusion was giving manure treatment is the best treatment for physical properties of the ex-gold mine soil and the sunflower growth after application.

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