Impacts of the Cow Dung Biochar to the Soil Fertility

Nandintsetseg.D*[1], Battulga.G[2], Sarantuya.S[3], Battsetseg.G[4]

[1] Department of Agro-Ecology, School of Agro-Ecology and Business, MULS (nandintsetseg@sub.edu.mn)
[2] Department of Basic Sciences, School of Agro-Ecology and Business, MULS
[3]Department of Chemistry, School of Animal Science & Biotechnology, MULS
[4]Doctorate, National Academy of Management

1.0 INTRODUCTION AND BACKGROUND

We have encountered a number of global ecological problems as reducing greenhouse gases, creating green mining, mitigating soil desertification and maintaining natural balance. Our country is the country of animal husbandry and one of our ecological problems is processing the animal waste and using it as organic raw material. Therefore, we studied the properties of the biochar produced from cow dung in Mongolia in order to study its impacts to the soil.

The United Nations Organization organizes annual forums on climate changes and one of the discussions in 2014 was bio-coal: a proposal on using the bio-coal as one of the technologies to mitigate climate change and to acclimatize it [1-3].

Biochar is a black residue of biomass hot decomposition. Biochar is a substance resulted from hot processing, has aromatic structure and contains mainly carbon; its chemical and biological properties ensure it as strongly reliable material (adsorbent) with much surface, high degree of porosity and good ability to absorb different substances in liquid, solid and gas mode [4-6].

Therefore, studied the properties of the biochar, which was produced from such common waste in Mongolia as cow dung, and studied its impacts to the soil.

2.0 MATERIALS AND METHODS

The research work was conducted at the School of Agro-ecology and Business of MULS in 2016 by following methodology:

1. Biochar was produced by TLUD furnace, its spectra analysis was made by ultra-violet spectroscopic method at the General laboratory of natural analysis of the Academy of Science and the structure and porosity were studied by microphoto electron microscope at the Chemical technology laboratory of new materials of NUM.
2. Moisture of the biochar containing soil was analyzed by weight method, soil humification was analyzed by I.V.Turin's method and the total microorganism number in the soil was analyzed by culture method at the Soil agro-chemistry laboratory and Soil microbiology laboratory of PSARTY-MULS [7-8].
3. In order to study the impacts of biochar to the soil, we prepared the soil by following 4 versions with 4 repeats and planted lettuce - lactuca sativa l in equal amount. The analysis included:

   Sample no. 1. Soil (100%) – Control
   Sample no. 2. Soil (70%) + Dung biochar (30%)
   Sample no. 3. Soil (50%) + Dung biochar (50%)
   Sample no. 4. Soil (30%) + Dung biochar (70%)

3.0 RESULTS AND DISCUSSION

1. Biochar spectra (Figure 2) produced from cow dung by TLUD furnace (Figure 1).

Biocarbon spectra from the dung shows that OH hydroxyl, C-H methylene group, R-C+O-NH_2 or amid group, C=O carbonyl group and C=C double connected unsaturated compound functional groups were found in its molecule, which ensures good adsorption and water/moisture absorption properties of this biochar.

Intensified dung char sample with 50x50 mkm size was observed by microphoto (Figure 3) enlarged by 0.09785x0.09785 mkm/pixel under grey light dimension, which shows that it consists of long mass and belt layers based on carbon atom branch structure.

As it was observed, particle length is 10.767 mkm and width is 2.687 mkm. Particle structure and edges were clarified by Roberts method, which showed that it consists of continued small parts of plant cells with dense positions, where some holes were observed in between them.

Figure 1. TLUD furnace

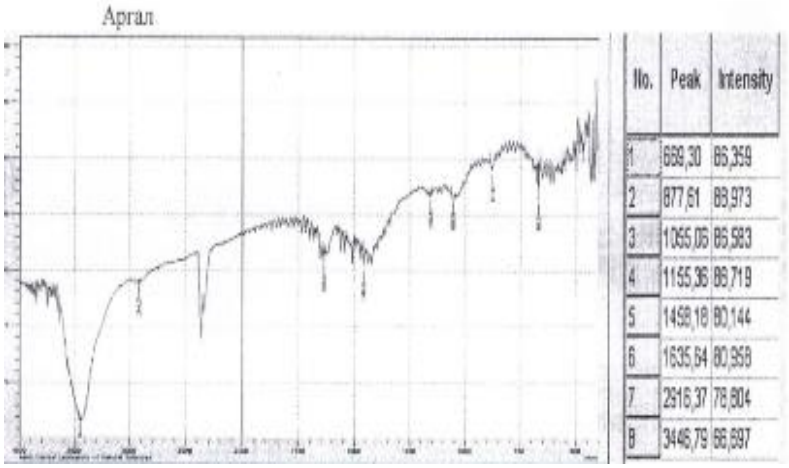

Figure 2. Biochar spectra produced from cow dung

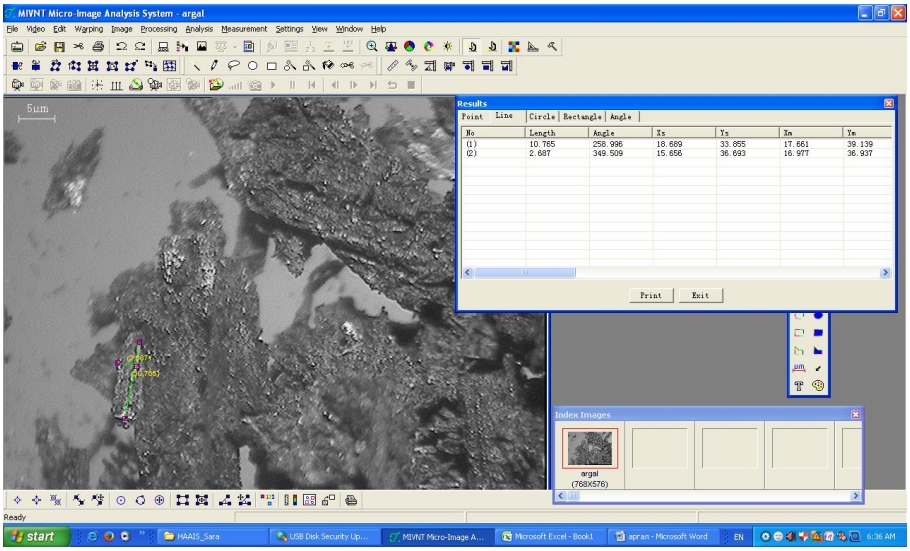

Figure 3. Microphoto produced from cow dung

2. Biochar was prepared to the soil according to the part 3 of the methodology and the moisture was determined. Measurements show that the soils mixed with biochar (Samples nos. 2,

3 and 4) had relatively higher moisture above 30% compared to the soil without mixture (Sample no. 1), which ensured its ability to accumulate water and keep moist for a long time.

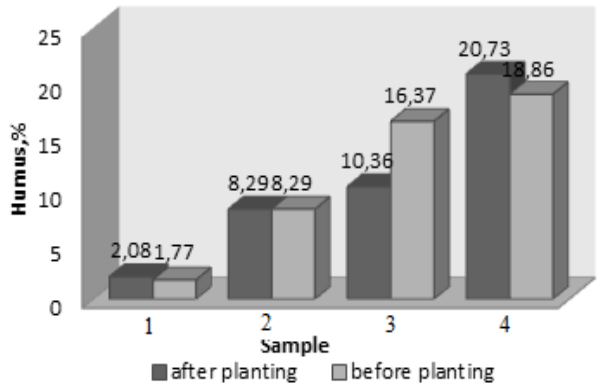

Figure 4. The amount of soil humus

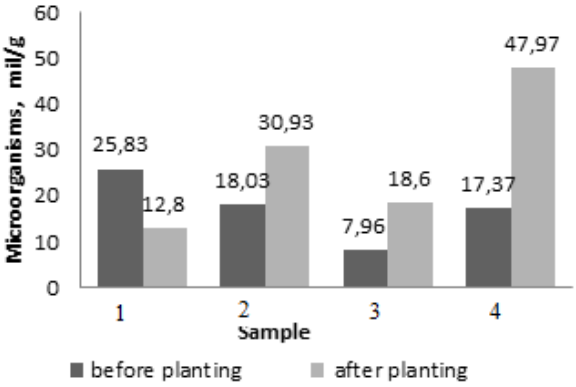

Figure 5. General number of microorganisms

Soil humus amount was determined by I.V.Turin's method (Figure 4). The results showed that the humus of the soil without mixture (Sample no. 1) was 1.77 and 2.08% before and after planting but the samples with biochar (Samples 2-4) showed increased amount of humus.

General number of microorganisms in the target soils was studied (Figure 5). The results showed that Sample 4 or soil-30% and biochar-70% sample had total number of bacteria between 17.37-47.97 million, which increased by 30.6 and as concluded, this soil created better conditions for the lettuce to grow compared to other samples. It proves the conclusion by Jeanne Pitikainen arguing that after testing strongly sparse materials as zeolite, active coal and charcoal, it was concluded that biomass decomposing bacteria nests on the material surface, which becomes the environment for the number to grow.

3. Observations were conducted to 4 different samples with 4 repeats at regular temperature of 21^0C for 45 days by planting lettuce to these samples. The experiments were conducted in winter or during plant sleeping period, however, the total survival is as follows:

Sample no. 1 – one sprout in 4 repeats but no survivals

Sample no. 2 – one grow in 4 repeats

Sample no. 3 – three grows in 4 repeats

Sample no. 4 – four grows in 4 repeats, meanwhile, the soil with biochar was much humid and sparse but the soil without mixture (Sample no. 1) was dry and glued, so it required regular scuffling. As we can see, as the amount of biochar in soil increases, the soil fertility increases as well.

4.0 CONCLUSION

1. The biochar, produced from Mongolian cow dung, is very light and strong, however, it scatters easily, does not contain fly ash, homogeneous powder and its molecule contains OH hydroxyl, C-H methylene group, R-C+O-NH_2 or amid group, C=O carbonyl group and C=C double connected unsaturated compound functional groups.
2. The structure and porosity of dung biochar is long mass with belt layers with particle length of 10.767 mkm and width 2.687 mkm based on the carbon atomic branch structure. It consists of small parts of plant cells with dense positions, where some holes were observed in between them.
3. The first target soil had low content of moisture (20.6%) and humus (2.08%) but after mixing with biochar and planting lettuce the moisture increased to 30.7-39.2% and humus to 8.29-

20.73%. When biochar was mixed to the soil, the total number of microorganisms increased 1.7-2.8 times during the plant growing period.

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