Improvement of acidic soil quality using red mud and biochar

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Red mud (RM) is a by-product of bauxite smelting process.Approximately 120 million tons of red mud are generated annually worldwide.In Korea, about 200,000 tons/per year of red mud (RM) sludgeis generated and it is increasing every year. Due to residual sodium hydroxide,red mud (RM) is highly alkaline (pH> 11).Therefore, it was expected that the addition of red mud (RM) to the acidic soil would increase the acidic soil qualitysuch as pH, CEC and nutrient availability. (Park and Jung (2017))

Recently, there are many studies which isutilizing biochar(BC) for soil amendment. The key advantage of biochar(BC) is that it is cheap to produce which is because, the feedstock is an agricultural by-product or a by-product of the forest.In Korea, 9 million tons of agricultural by-products are generated annually, so the potential for biochar(BC) production is sufficient. Bio-char(BC) could also be added to acidic soil to increase the soil quality (such as pH, water retention, and CEC). Therefore, we used red mud(RM) and biochar(BC) in this study to improve the acidic soil quality. Results showed that the pH and CEC of the acidic soil were greatly improved by using RM and BC. (S. Abrishamkesh*et al* (2015), Lee *et al* (2017))

The characteristics of the materials used in this study are as follows.

Table 1. Properties of soil

	Particle size distribution(%) Sand / Silt / Clay	pH
Soil	59.8 / 26.0 / 14.2	4.96

Table 2. EDS analysis result of Red mud

	Chemical composition(wt%)				pH
	Na_2O	Fe_2O_3	SiO_2	Al_2O_3	
RM	10.69	34.87	17.14	22.11	11.54

Table 3. Production condition and property of Biochar

	Biomass	Production condition Reaction temp(°C) / Time(min)	pH
BC	Rice husk	440~460 / 30	7.66

The above materials are mixed by weight ratio, as follows:control(soil), treatment 1(soil: RM= 1 : 0.01), treatment2(soil: RM : BC = 1 : 0.01 : 0.02).
The physico-chemical properties of the materials were measured as follows:pH and EC are 1: 5 (material: water), particle size distribution is pipette method, and CEC (cation exchange capacity) is brown method.
After that, a pot experiment was conducted and 30 lettuce seeds were planted in each group.

The results of treating RM and BC in soil are as follows.

Table 4. Effect on soil by treatment

	Control	Treatment1	Treatment2
pH	4.96	6.97	7.21
EC(dS/m)	0.20	0.99	1.06
CEC($cmol_c$/kg)	6.10	8.89	10.17
Dry weight of lettuce(g)	0.07	0.08	0.10

Asthe results of adding RM and BC to acidic soil, the pH was improved from 4.96 to 7.21.Because RM and BC have high alkalinity.On the other hand, EC showed the maximum value (1.06 dS/m) in treatment 2 (Table 4).Generally, it is recommended that the ECshould be keep below 2.0 in the soil. Due to the fact that if the value is 2.0 or higher, the crop may suffer from salt damage.The CEC wasincreased from 6.10 (in control) to 10.17(in Treatment 2). The increase in CEC in soil is due to the highCEC of RM and BC.In the pot experiment, the dry weight of lettuce was 0.07 g in control and 0.10 g in treatment 2.It suggested that the addition of RM and BC led to an increase in pH and CEC, which is beneficial for plant growth.

RM and BC were applied to improve the acidic soil quality.As the results, have been shown the positive effect on pH, CEC, and lettuce growth.RM has caused a significant increase in pH and CEC and have been shown to be more effective when mixed with BC.This study suggested that industrial by-products such as RM could be applied to the improvement of soil.

References

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