Proceedings of the World Congress on New Technologies (NewTech 2015)
Barcelona, Spain – July 15 - 17, 2015
Paper No. 178

The Characteristics of Bagasse-based Biochar and its Effect on Properties of Tropical Soil in South China

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Extended Abstract

Acidic laterite, one of the most important soil resources in tropical regions, is the major soil type in South China. Due to strong acid, aluminium toxicity and low fertility levels, crops planted on acidic soils could not be well harvested. Therefore, looking for a kind of modifier to improve the acidic soil is current research hotspot. Application of biochar to soils is currently gaining considerable interest globally due to its agronomic benefits it may provide.

In the present study, there was no sufficient report to study the soil improvement effect of biochar. The objectives were to focus on the characteristics of biochars prepared by bagasse, a kind of agricultural waste in South China, from pyrolysis under three temperatures (350, 450 and 550℃), labelled by BC350, BC450 and BC550 and simulate its effects on properties of tropical soil in south China, providing data support for practical application. The paper studied the characteristics of laterite amended with soil after incubating 30 d at a constant temperature of 25℃. The results showed that the yields of Bagasse-based biochars were reduced by increasing pyrolysis temperature and ranged from 25.27% to 18.20% due to the decomposition of lignin, cellulose and hemicelluloses. By contrast to biochar yield, the pH, the ash contents and CEC of biohchars increased with increasing pyrolysis temperature. With an increase in the pyrolysis temperature from 350 to 550℃, the carbon contents of the biochars ranged from 68.86% to 84.83%, with the order of BC550 > BC350 > BC450, which was similar to sulfur contents with the order of BC550 (1.56%) >BC350 (1.12%) > BC450 (1.11%). However, the hydrogen content decreased from 1.75% to 1.41% with temperature. As pyrolysis temperature rose, C/H atomic ratios gradually enhanced from 41.79% to 60.16%, implying that the biochars became more aromatic and carbonacedous. The SEM analysis for biochars presented that the surface area and pore properties of biochars improved significantly with pyrolysis temperature. After applying biochars to the laterite, the pH values of the soils changed significantly. When BC550 was added to laterite, the amended soils had a higher soil pH (at least 0.1 units) than the control samples and the soil pH values enlarged with the proportion of biochar in soils, increased from 5.28 to 7.11 units. With biochar treatment, soil available P and available K were increased by 12.2%~886.6% and 344.3%~2712.0% respectively, compared with no-biochar treatment. Moreover, the order of increase amplitude of soil exchangeable base content was BC550 (171.3% ~ 912.9%) > BC350 (112.6% ~ 907.6%) > BC450 (72.0% ~204.9%). The content of exchangeable K, exchange Ca and exchangeable Mg enlarged in biochar-amended soils as compared to without treatment and increased with the increasing levels of biochar. In addition, when BC350, BC450 and BC550 were respectively amended into laterite, the concentrations of soil active aluminum were respectively decreased by 14.3% ~ 71.5%, 18.8% ~ 59.5% and 13.0% ~ 59.5% as compared to without biochar control, alleviating the harm of aluminum toxicity to acid soil.