Effect of Biochar Application on pH and pH Buffering Capacity of Rubber Growing Soils

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Introduction

Rubber (*Heveabrasiliensis* L.Muell. Arg.) growing soils in Sri Lanka are less fertile and characterized by low cation exchange capacity (CEC), very high acidity, and low organic carbon (OC). This has resulted low fertilizer use efficiency and low productivity in rubber growing soils. In order to increase soil fertility effectively, amending these soils with biochar (BC) are being evaluated (Dharmakeerthi et al., 2012). Biochar, is a solid material produced from pyrolysis of biomass, is a highly alkaline material with high CEC and higher percentage of stable OC (Sohi et al., 2010). Amending soils with BC may change soil pH and pH buffering capacities (Xu et al., 2012). However, there is no data available on changes of soil pH after BC addition in rubber growing soils not only in Sri Lanka, but also anywhere else in the world. Therefore, this study was conducted to investigate the effect of rubberwood BC on pH and pH buffering capacity of some contrasting rubber growing soilsin Sri Lanka.

Methodology

Two soils from traditional rubber growing areas i.e. Red Yellow Podsol (RYP) from Paiyagala Estate, Dodangoda, Reddish Brown Latasol (RBL) from Parambe Estate, Parambe, and one soil from dry zone, Reddish Brown Earth (RBE) from Thanamalwila ,representing contrasting agro - ecological conditions were selected for the study. Those soils were mixed with BC made from rubber wood with two different rates, 0 and 2% by weight andincubated at 70% water holding capacity at room temperature 25±2ºC for 12 weeks. The change in pH was measured at 0, 1, 4, and 12 weeks after the biochar amendment. pH buffering capacity was measured in another set of amended soils, incubated for 40 days as above, using the methods given by Liyanage *et al.* (2012) with certain modifications. All treatments were replicated four times.

Results and Discussion

Application of biochar increased pH in all three soils; the increase was very small in Thanamalwila soil while the greatest observed in Payagala soil. Week after incubation, the pH increase in the three soils were 0.4, 0.9 and 0.9 for Tanamalwila, Parambe and Payagala soils, respectively (Figure 1). As incubation time increased from 1 to 12 weeks, the pH did not increase significantly ($p<0.05$) in Thanamalwila and Payagala soils, and the gap decreased in significantly ($p<0.05$) Parambe soils.

The pH buffering capacities were significantly different ($p<0.05$) among soil types. Thanamalwila soil had the highest pH buffer capacity (7.3mmol/kgpH) while Payagala soil had the lowest value (4.7mmol/kgpH) Parambe soil had (5.5mmol/kgpH) in between value. The pH buffering capacity was highly significantly correlated with CEC of the soils ($R^2=0.92$,$p<0.001$), indicating that CEC was an important factor determining soil pH buffering capacity.

The greatest pH buffer capacity was observed in Thanamalwila soils (7.03 mmol/kg.pH) and the lowest pH buffer capacity was observed in Payagala soil (4.96 mmol/kg.pH). Amending soils

with rubber wood biochar increased pH buffer capacity significantly ($P<0.05$) in all three different soils; but the greatest increase (46.2%) was observed in Paiyagala soils whereas the lowest buffer capacity was observed (Figure 3).

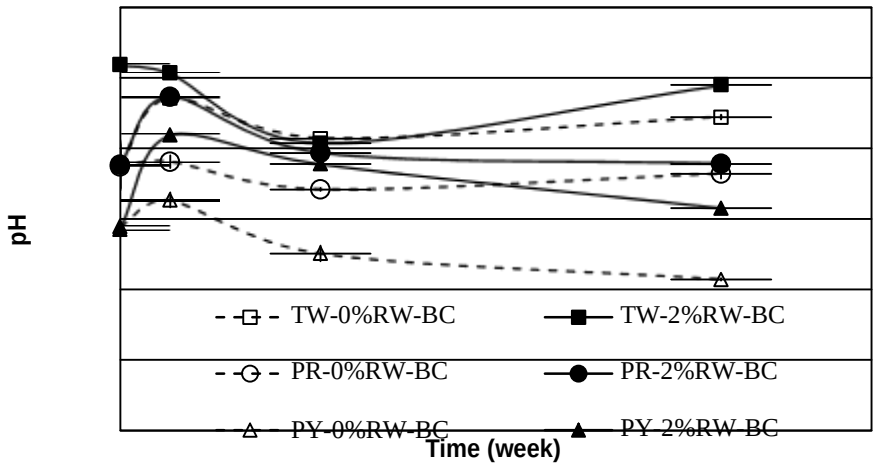

Figure 1. Changes of pH over time in biochar amended soils.

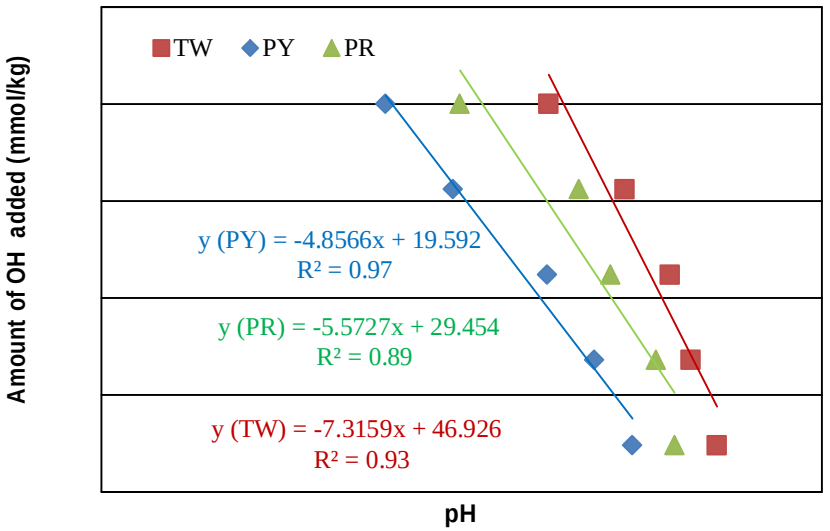

Figure 2. The relationship between the pH and the amount of alkali added. The slope of linear trend line is a measure of pH buffer capacity of three soil types.

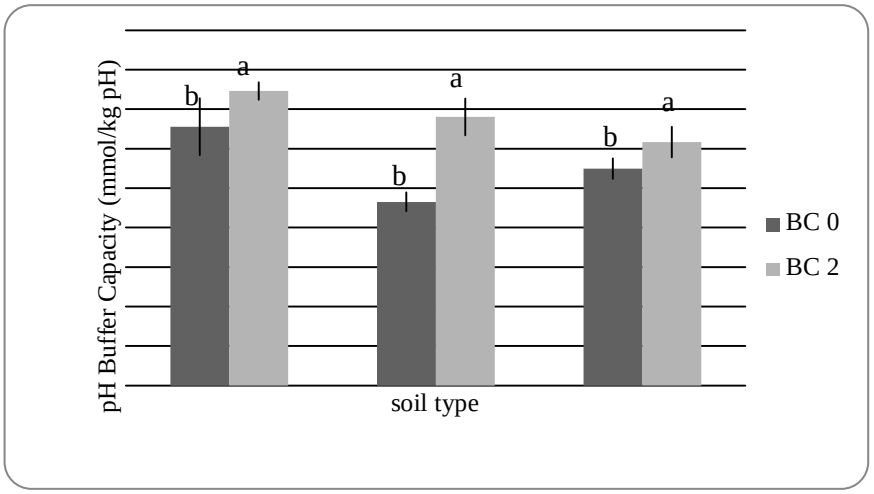

Figure 3. The change in soil pH buffering capacity as affected by addition of rubber wood biochar (error bars indicate the SE of the mean, n=4; columns with different letters in each soil types are significantly different at $p<0.05$).

Conclusions

This study showed that the application of rubber wood biochar increased soil pH in all three soils. The increase in pH was greatest in soils where pH Buffer Capacity was lowest.Application of rubber wood biochar could also increase pH buffer capacity by 13 to 45 % and this could have significant influence on effect of rubber wood biocharon soil pH.

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