Influence of Gliricidia dried biochar amendment on rhizosphere nutrient availability and nutrient uptake of soybean: A column study

N.A.S.A. Neththasinghe[1], A.K. Karunarathna[2] and D.M.S.B. Dissanayaka[1*]

[1]Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka
[2]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Sri Lanka

Abstract

Biochar amendment to cropping lands is a promising management tool to increase crop productivity while mitigating soil degradation. Biochar application influences the nutrient availability in soil and other soil properties. Rhizosphere is the root-soil interface that plays a predominant role in nutrient uptake by plants. Rhizosphere nutrient dynamics and its relation to nutrient uptake of crops as influenced by biochar amendment remains poorly understood. A pot experiment was conducted in a greenhouse to investigate the impact of Gliricidia biochar application and incubation period on plant growth and nutrient uptake of soybean (*Glycine max* L.). Plants were grown with (2.5% weight basis) or without biochar amendment coupled with (one month incubation period) or without an incubation period. Rhizosphere nutrient availability, plant growth, uptake of nitrogen (N), phosphorus (P) and potassium (K), and yield parameters were measured. A soil column leaching experiment was conducted separately to test the soil nutrient retention ability of biochar-applied soil. Irrespective of the incubation condition, pod dry weight was significantly increased ($P< 0.05$) when plants were cultivated in biochar-amended soil. There was a tendency of increasing rhizosphere concentration of N, P, and K in biochar-treated soil compared to soil without biochar at physiological maturity of soybean. Further, concentrations of the same nutrients were lower in rhizosphere soil than those in non-rhizosphere soil indicating the plant uptake. Total plant uptake of N, P, and K greatly enhanced under biochar amendment compared with the plants grown without biochar. Without incubation, soybean plant increased its P and K uptake, respectively by 52% and 48% with biochar amendment compared to those without biochar. With incubation, the relevant increases were 42% and 32%, respectively. The results from soil column leaching experiment suggest that the application of biochar in planting media could be an effective way to retain soil N through reducing the leaching losses. At six weeks after planting, N leaching from soil under biochar amendment was reduced by 57% compared to that of soil without biochar. Hence, the results confirm that the application of biochar could increase nutrient availability in rhizosphere and their subsequent root uptake.

Keywords: Incubation, Nutrient leaching, Nutrient retention, Soil improvement

[*]***Corresponding Author***: dissanayakauop@yahoo.com