BIOCHAR-NUTRIENT INTERACTIONS IN SOIL IN RELATION TO AGRICULTURAL PRODUCTION AND ENVIRONMENTAL PROTECTION

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Biochar application to soil has been shown to enhance carbon sequestration, soil health and remediation of contamination. Biochar application also influences nutrient interactions in soil through various processes that include: (i) by acting as a nutrient source, thereby supplying nutrients; (ii) by acting as a nutrient sink, thereby reducing their mobility and bioavailability; and (iii) by altering soil properties, thereby affecting nutrient reactions and cycling in soil.

As a source, biochar can supply nutrients such as nitrogen, phosphorus, potassium and other trace elements inherently present in the original feedstock used for biochar synthesis. While some of nitrogen and sulphur nutrients in the feedstock materials are lost through gaseous emission, most nutrients are released during the weathering of biochar in soil and becomes available for plant uptake. The nutrient content of biochar depends on the nature of feedstock materials and pyrolysis conditions. Biochars derived from manure- and biosolid-based feedstock materials generally contain higher levels of nitrogen and phosphorus than those derived from wood- and straw-based feedstock materials. While, the nitrogen content decreases with increasing pyrolysis temperature through gaseous emission, the phosphorus and potassium contents increase due an increase in ash content.

As a nutrient sink, biochar can retain nutrients thereby reducing their losses through leaching and gaseous emission. The nutrient retention capacity of biochar depends on its porosity and surface charge (cation and anion exchange capacity) characteristics. It has often been shown that biochar application reduces the loss of nitrogen, phosphorus and potassium through leaching, and nitrogen through nitrous oxide emission. However, the loss of nitrogen through ammonia emission depends mainly on the pH of the biochar.

Biochar application influences various soil properties including pH, bulk density, cation exchange capacity, water retention and biological activity. These changes in soil properties are likely to impact nutrient reactions with soil particles and microbial transformation of nutrients. For example, an increase in cation exchange capacity has been shown to reduce the leaching loss of cationic nutrients such as ammonium nitrogen (NH_4^+) and potassium (K+). This paper provides some case studies involving biochar-nutrient interactions (ammonia volatilization, nitrous oxide emission, and nitrate and phosphate leaching) in relation to promoting sustainable agricultural production and achieving environmental protection.

Editor's note: *An extended manuscript has not been submitted for this presentation.*
