Effects of biochar application on potting media chemical properties, arbuscular mycorrhizal fungi spore density, growth and nutrient uptake of sorghum (*Sorghum vulgare* L.)

[1]Reuben James C. Rollon, [2]Angela S. Almendras-Ferraren, [2]Dilberto O. Ferraren

[1] Caraga State University, College of Agricultural Sciences and Natural Resources, Ampayon, Butuan City, Philippines; [2] Visayas State University, College of Agriculture and Food Science, Baybay City, Leyte, Philippines. Corresponding author: R. J. C. Rollon, rollonreubenjames@gmail.com

Abstract. Two sets of laboratory incubation and pot experiments were conducted to characterize the chemical properties and to evaluate arbuscular mycorrhizal fungi (AMF) abundance, growth and nutrient uptake of sorghum grown in biochar–amended soil-sand potting media. Both experiments used pasteurized sand and two acid soils (Ultisol and Entisol) as the base substrate with rice hull char (RHC), coconut sawdust char (CSC), peanut hull char (PHC) and corn cob char (CCC) as potting amendment. A soil and sand without biochar served as the control. Application of PHC in Ultisol-based potting mix had shown marked increase in pH, electrical conductivity (EC), total N, total P, exchangeable K, Ca and Mg and decreased exchangeable acidity and Al. Similarly, PHC application in Entisol-based potting mix increased pH, total organic carbon (OC), total N, total P, exchangeable K and a significant decrease in exchangeable acidity and Al. On the other hand, CSC application in Ultisol- and Entisol-based potting mix resulted in higher EC and exchangeable Na values. Application of PHC and CSC in Entisol-based mix depressed plant height and biomass production. In Ultisol-based potting mixes, improved P concentration and uptake was obtained from PHC and RHC addition. Except for RHC, biochar application had reduced spore counts. Among biochar evaluated, PHC had the most superior influence on the chemical properties of potting mixes. However, increased in pH and P due to PHC and CSC application posed a detrimental effect on plant growth, biomass production and AMF abundance.

Key Words: biochar, arbuscular mycorrhizal fungi, Ultisol, Entisol, potting mix.

Introduction. Biochar is a stable and sterile solid carbon (C)-rich by-product of biomass pyrolysis, primarily intended as soil amendment to enhance soil quality and sequester C (Mukherjee et al 2011). Biochar is highly porous, nutrient-rich, usually alkaline and exhibit large specific surface area (Jindo et al 2014; Piash et al 2016). Biochar can boost soil fertility of degraded soils and reduce soil acidity by raising pH in acid soils. It also enhances water holding capacity, cation exchange capacity (CEC), adsorption of plant nutrients and creates suitable condition for soil micro-organisms (Ishii & Kadoya 1994; Lehmann et al 2003). As such, biochar can be utilized as component of potting medium for inoculum production of arbuscular mycorrhizal fungi (AMF).

The AMF play a key role in natural and agricultural ecosystems. As symbionts, AMF play an important role in plant nutrition by improving access to nutrients particularly phosphorus (P) and plant health by providing protection against soil-borne pathogens, heavy metal uptake regulation, salinity and drought tolerance and enhanced soil aggregation (Khade & Rodrigues 2009; Garg & Chandel 2010). In return, the fungi receive carbohydrates (sugars) and growth factors from the host plant (Habte 2000). With the benefits that can be provided by AMF on plant productivity and soil quality, AMF are essential to the sustainability of soil-plant systems.

Biochar can enhance mycorrhizal abundance and functioning due to the provision of suitable habitat for AMF to colonize, grow and reproduce (Thies & Rillig 2009). The surfaces and pores of biochar have the ability to adsorb soluble organic matter, gases