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Effects of integrated use of residual sulfur-enhanced biochar with effective microorganisms on soil properties, plant growth and short-term productivity of Capsicum annuum under salt stress

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Abstract

Salinity and drought are among the greatest threats hindering global food security. Over the last decade, biochar use in agriculture has received increasing attention and enhancing biochar through composting and chemical modification offers a potential strategy for improving soil productivity. However, there is limited knowledge on how residual sulfur-enhanced biochars alone, or in combination with effective microorganisms (EMs) impact on soil properties, and how this influences agricultural productivity in the short and long-term. To investigate this, a field experiment was conducted in 2017 to study the effect of residual sulfur-enhanced biochar (RSBC). A 5:100 (w/w) mixture of elemental sulphur (S) and citrus wood biochar (BCH), respectively combined with EMs was applied to soil. The effects on soil properties, growth, and productivity of salt-stressed pepper plants was then evaluated to determine if supplementation with RSBC and/or EMs bio-protected plants could mitigate the deleterious effects of soil salinity. These applications resulted in several beneficial effects which included: improving dehydration tolerance, nutritional status, and photosynthetic efficiency, while significantly reducing Na^+ and Cd^{2+} concentrations in plants. The integrated RSBC+EMs treatment significantly increased plant growth, and productivity, macro- and micro-nutrient concentration, as well as, dehydration tolerance and irrigation use efficiency. A reduction in Na^+ and Cd^{2+} uptake was also observed in conjunction with a concomitant increase in N, P, K^+, Ca^{2+}, Fe, Mn, Cu and Zn uptake. Overall, applications of residual sulfur-enhanced biochar combined with effective microorganisms show short-term beneficial effects on peppers can be attained in the presence of high salinity. This study opens up a wide avenue for research exploration; subsequent studies to examine the benefits of long term or repeated applications and could yield even more positive applications or results.