Project No: 16-0662

Evaluation of Biochar for On-Farm Soil Management in California

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Abstract

The proposed project will utilize a series of field, greenhouse, and lab studies to examine a variety of soil, biochar types, and application rates under management conditions, which represent mixed agricultural systems. Field plots will be established at the UC Davis Campbell Tract (Yolo County) and UC West Side Research and Extension Center (Fresno County) and biochar will be incorporated in combination with synthetic N-P-K fertilizer. Additionally, a robust set of greenhouse trials will be conducted at UC Davis to examine impacts on crop growth, nutrient retention/leaching, and water relations. As biochar feedstock and production parameters will have a significant impact on its performance and outcome as a soil amendment, full characterization and evaluation of the biochars, with different soils, will be conducted. We will work with our cooperators in Placer County to generate biochars from unwanted forestry and orchard biomass wastes, as well as utilize other common and locally available feedstocks. Additionally, biochars from two other producers operating in CA will be included in the study. Biochars pre-reacted with synthetic N-P-K fertilizers will be included in the experimental matrix. Fertilizer rates will be based on soil sample analysisand both low- and high-end of the recommended application rates will be used to evaluate biochar impact on nutrient use efficiency. This project will also assess the economic and agronomic efficacy of using biochars produced from locally available waste feedstocks to be used for agronomic benefits for CA crops (i.e., tomato, corn, sorghum). This project will provide critical baseline data for biochar use in California agriculture.

Project Objectives

1. Characterize biochars produced from locally available biomass (e.g., Placer County);
2. Evaluate the impact of biochar amendments on soil water and nutrient availability and loss (e.g., NO_3^-, NH_4^+, PO_4^{3-}), carbon stocks, and soil aggregation;
3. Evaluate soil conditions and biochar parameters, including biochar and fertilization application rates, which are most likely to lead to beneficial outcomes from biochar amendment;
4. Create the California Biochar Initiative as a central point for objective information regarding biochar use in CA agriculture.

Project No:16-0670

Evaluation of Certified Organic Fertilizers for Long-Term Nutrient Planning

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Abstract

The goal of this project is to develop guidelines for the efficient use of organic fertilizer sources by demonstrating general nitrogen mineralization patterns and combine the findings with modeling exercises to extend the results to predict long term responses to repeated organic fertilizer applications and C sequestration in many soil types. Key to effectively use the information on nitrogen mineralization generated in this research is the parameterization of the DayCent model, so that the model can accurately predict nitrogen mineralization rates at different soil temperatures under soil conditions in CA throughout the year. Most models use default values resulting in poor prediction outcomes. We will develop Q10 temperature coefficients for microbial nitrogen and carbon mineralization in a temperature range from 10 to 30^{o}C across a range of soils (3 - 4 major agricultural soil series) and various types of organic fertilizer amendments. Because the DayCent model includes crop nitrogen uptake and yield, it can be used to reassess fertilizer nitrogen inputs. We will initially use the FREP fertilizer guidelines and other sources for crop nitrogen requirements to run the model. Our results will provide for adjustments of nutrient management guidelines depending on organic fertilizer sources, soil type, and climate data. The information generated in this research will be used by UC Extension, CCAs and farmers to reassess nitrogen management across a variety of crops.

Project Objectives

1. Conduct an extensive literature review on soil N and organic N fertilizers;
2. Characterize the temperature response of N mineralization of organic based fertilizers in soils of the major agriculture production areas in CA;
3. Incorporate temperature response and N mineralization kinetics and turnover rates in the DayCent model to predict long-term N availability;
4. Conduct field trials to confirm lab and DayCent model results and to inform the Comet–Farm modeling tools; and
5. Conduct extensive engagement and outreach to inform on the value and to reassess organic fertilizer amendment rates to avoid N loss and promote healthysoils.