Improving the sustainability of animal and crop agriculture: evaluation of biochar-swine manure mixture impact on soil nutrient availability and plant uptake

Presenter: ***XXXX XXXXX***, Horticulture

Mentor: XXXX XXXXXX, Agricultural and Biosystems Engineering

Abstract: Manure nitrogen (N) and phosphorus (P) are added into agricultural soils and serve as an effective alternative to synthetic fertilizers. However, the manure-to-soil application presents risk of N and P contamination of surface waters (via surface run-off or tile drainage) and release of carbon to the atmosphere. Our working hypothesis is that biochar (a carbon-rich material) mixed with manure would improve soil quality, reduce nutrient movement, and increase plant nutrient availability. The research objective was to assess the effect of a biochar-manure mixture in both (1) preventing nutrient leaching loss from soil (affecting plant nutrient availability) and (2) releasing additional nutrients to plants over time. Specifically, we evaluated the physicochemical properties of the biochar-manure mixture and its effect on plant-available macro/micronutrients, soil quality, plant biomass yield, and nutrient uptake. We incubated three types of biochar with manure. The experiment had two parts: a soil leaching trial (Part 1) and a greenhouse trial (Part 2). In Part 1, the three biochar-manure mixtures were applied (n=3) to the soil, then leached with water over 30 days. The physicochemical soil properties and nutrient availability of each biochar-manure treatments were then compared against each other and soil and manure controls. In Part 2, the three biochar-manure mixtures along with soil and manure controls were applied (n=4) to grow both corn and soybean. Both Parts 1 and 2 showed that biochar-manure mixture improved soil quality and nutrient availability compared to conventional manure application. Soil organic matter significantly ($p<0.05$) increased for all biochar-manure treatments. We recommend that a more long-term field study be conducted to examine the longitudinal effects of biochar-manure mixture on both plant and soil properties. This proof-of-the-concept study suggests that biochars could be used to solve both environmental and agronomic challenges and further improve the sustainability of animal and crop production agriculture.