

ABSTRACT

Acuña Guzman, Salvador Francisco. Ph.D., Purdue University, December 2009. Nutrient availability as affected by periodic flooding and amending the soil. Major Professors: L. Darrell Norton and Bernard A. Engel.

Agricultural systems require large inputs of fertilizers and pesticides. The purpose of this dissertation was to evaluate the physical and chemical changes in a soil due to periodic saturation, and the addition of soil conditioners and herbicide glyphosate. Three experiments were performed to evaluate: 1) physical changes in a saturated soil due to different application methods of polyacrylamide and gypsum; 2) chemical changes in a waterlogged soil due to the addition of gypsum and herbicide glyphosate; and 3) the effects of a perched water table, the addition of gypsum and herbicide glyphosate in nutrient uptake by corn. The first experiment was a simulated rainfall experiment. It was found that surface application of PAM and gypsum increased infiltration, decreased soil loss, and reduced soil erosion. The second experiment was held under constant temperature, and oxygen-free conditions using a biogeochemical reactor. Waterlogged soil samples were incubated for 1, 3, 7 and 14 days to determine changes in soil chemistry. No significant differences were found among treatments for Eh and pH values. Statistical differences in nutrient and redox sensitive species correlated to gypsum application. Gypsum application decreased phosphate in solution; chemical equilibrium models suggested precipitation of hydroxyapatite. Greater amounts of soil exchangeable K^+ and NH_4^+ were observed during extended incubation periods. K^+ was thought to come from the clay lattice and NH_4^+ due to mineralization of organic matter. The third experiment was conducted in a greenhouse. No measured or visual effects were observed due to glyphosate. Soil below the water table presented anoxic conditions. Denitrification of the soil and low N content in plant tissue were measured for soils with perched water table. Gypsum application enhanced root development, there were roots which survived and remained active below the water table. Increases in soil exchangeable K^+ were observed under perched water table conditions; increases were less than those measured in the biogeochemical reactor possibly due to plant uptake and difference in moisture content. The results of this research are relevant in preventing soil nutrient losses due to periodic saturation and improving water quality.