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Midwestern cornbelt nutrient sequestration: Fine tuning treatment technology

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Woodchip bioreactors have proven effective in removing nitrate-nitrogen (NO_3-N) from agriculturally drained water in the Midwest USA region. Other than NO_3-N, dissolved phosphorus (DP) and nitrous oxide (N_2O) are also pollutants of concern from intensive managed row-crops. Both NO_3-N and phosphorus can lead to algal bloom and hypoxia in the receiving surface waters and degrade the water quality. N_2O is one of the nitrification/denitrification by-products and a greenhouse gas that is 310 times more potent than the same amount the CO_2 gas. This study explored the effectiveness of bioreactor NO_3-N and DP treatment as well as N_2O emission. Three types of media were examined in a pilot-scale lab experiment: woodchips, biochar chips (created from the same type of woodchip) and corn cobs. Two different residence times were examined: 24 hours and 8 hours. NO_3-N reduction amount was very promising with all three media, although biochar showed a relatively long lag time. An average of 90% NO_3-N reduction was observed from the 24 hours retention time. An average of 80% of the DP was sequestered, with the biochar media providing the most reduction in outflow DP concentration. N_2O emission rates were reasonable. The biochar-based bioreactors emitted more gas during the start-up phase since the burning process due to the possible high N content of the char. Given recent development of state-wide nutrient management plans to reduce nutrient concentrations in surface water, study results of these technologies will help the row-crop producer community manage nutrient export to surface water.

Biography

Lu Zhang got her undergraduate degree in Environmental Sciences from the University of Minnesota. She is currently a second year MS student in Forest Hydrology program working with Professor Joe Manger at the same university. Her expected graduation date is June 2014. Her MS thesis work includes bioreactor nutrient removal and wetland denitrification addressing nitrous oxide emission.

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