AGRONOMIC AND ENVIRONMENTAL IMPACTS OF LAND APPLICATION OF BIOSOLIDS TO BAHIAGRASS PASTURES IN FLORIDA

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1. PROJECT OVERVIEW

Biosolids have clear agronomic benefits, but concerns over nutrient accumulation in soils and subsequent impacts on water quality can limit land application in Florida. The ***objectives*** of this project are *(1) to establish a long-term, instrumented, research and demonstration field trial designed to evaluate the agronomic benefits of biosolids and biochar application on bahiagrass production and nutritive value, (2) to monitor the potential effect of biosolids application on water quality, and (3) to evaluate greenhouse gas (carbon dioxide, nitrous oxide, and methane) emissions and the potential impacts of biosolids and biochar application on soil chemical, physical and biological properties.* Our principal hypothesis is that most biosolids applied to pastures convey significant agronomic benefits and that they behave as "slow release" nutrient sources with minimal negative environmental impact.

2. PROJECT ACTIVITIES

Biosolids (Class AA and B materials) were surface applied to the experimental area on April 2016 and 2017 and compared to nutrition provided with mineral fertilizers. Biosolids sources were applied either alone or in combination with biochar to supply an estimated rate of 160 lb plant available N/A/yr, which correspond to UF/IFAS high N option for established bahiagrass and the most common application rate used by commercial cow-calf operations in Florida. The availability of the N in the biosolids was estimated using Florida -DEP factor of 1.5. Biochar was also applied in April 2016 and 2017 at 20 Mg ha^{-1} rate, which corresponds to an application rate of ~ 1% (wt. basis). Control treatments included plots receiving inorganic commercial fertilizer (ammonium nitrate + triple superphosphate alone and in combinations with biochar) and pastures receiving no biosolids, fertilizer, or biochar. Forage, soil, water quality, soil moisture, ground water levels, and gas emissions were monitored during the 2016 and 2017 growing seasons. Soil samples were collected at the beginning of the experiment and

at the end of 2016 and 2017. Analyses included soil pH, Mehlich-3 extractable P, K, Ca, Mg, Fe, and Al and total C, N, P, and trace element concentrations. Extractable NO_3-N and NH_4-N will also be determined. For each soil depth, the P saturation ratio [PSR = Mehlich-3-P / (Mehlich-3-Al + Mehlich-3-Fe)] was calculated. The PSR relate to soil P retention capacity. Leachate N and P were monitored in the treatments receiving the class B Bradenton biosolids and commercial fertilizer (total of 24 plots: 1 biosolids material + 1 commercial fertilizer, with or without biochar + 2 control * 4 replicates = 24). Groundwater level, soil moisture content, and weather data were continuously monitored in the experimental site. Leachate samples were collected at 2- or 4-wk intervals and analyzed for total and inorganic P, total N, NO_3-N and NH_4-N concentrations. Greenhouse gas fluxes were measured (same treatment as the water quality monitoring) using the static chamber technique. Gas samples were collected at 14-d intervals and analyzed for carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) concentrations.

3. RESULTS SUMMARY

Bahiagrass Responses - Compared to control treatments (no N or P added), addition of fertilizer (either as commercial N and P fertilizer or biosolids) increased annual bahiagrass herbage accumulation by an average of 68%; however, no difference between inorganic fertilizer vs biosolids treatments was observed (Figure 1). Although inorganic fertilizer resulted in greater bahiagrass herbage accumulation in the first harvest, at the end of the growing season (harvest 3), greater bahiagrass herbage accumulation was associated with treatments receiving biosolids. This response was due to the slow release nature of nutrients present in biosolids. Similarly, no differences in bahiagrass crude protein and digestibility were observed among fertilizer and biosolids treatments. Results from this study indicated that biosolids application can supplement or replace inorganic fertilizer in bahiagrass pastures, with the added benefit of providing a more continuous supply of nutrients throughout the growing season. No effect of biochar on bahiagrass responses was observed.

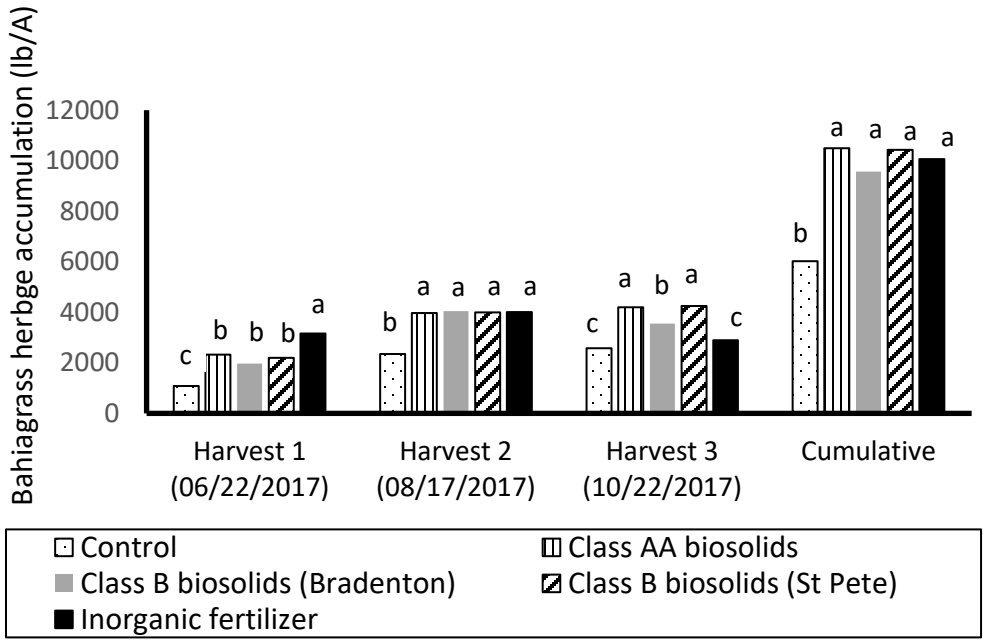

Figure 1. Bahiagrass herbage accumulation in 2017 as affected by biosolids and fertilizer application.

Water Quality and Greenhouse Gas Responses

Application of biosolids (either alone or in combination with biochar) had no significant impact on water quality and greenhouse gas emissions. However, when bahiagrass received commercial inorganic fertilizer, large pulses of N and P were observed immediately after fertilizer application. Similar responses were also observed for nitrous oxide emissions. Greater nitrous oxide emissions were generally associated with the treatments receiving commercial fertilizer, particularly during the first few weeks following fertilization application. These results indicated that N and P losses associated with treatments receiving biosolids can be lower than commercial fertilizer. Results also indicated no potential benefit of biochar in reducing N and P losses. Fertilizer and biosolids will be land applied in April 2018 and forage and environmental responses will be evaluated during the 2018 growing season.

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