Allelopathic Effects of Aquatic Vegetation on Seed Germination and Root Growth.

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Floating aquatic vegetation are very common in south Florida canals, and are sometimes harvested and put back on fields. There is a potential of using these aquatic plants as soil amendments, but it would be useful to test if there is any allelopathic effect on seed germination and root growth. This study investigated the allelopathic effects of water lettuce (WL) (*Pistia stratiotes*) and filamentous algae (FA) (*Lyngbya ssp*) on five plant species: beans, corn, rice, sorghum and lamb quarters. In a petri dish, dried WL and FA were applied at multiple rates (0.03, 0.06, 0.12, 0.25, 0.50, 1.00 g) and compared to control (0.00 g). Percent germination and root length was measured after one week. Both amendments showed variable yet significant reduction in percent germination between the control and highest application (1.00 g); however rice did not show any significant reduction. A 73% reduction in germination was observed in beans between control and highest application rate using WL, while 43% reduction was observed using FA. Both amendments showed a greater inhibitory effect to root growth with higher application rates, with the exception of corn. For example, lamb quarters showed a 99% and 75% root length reduction using WL and FA respectively, between control and highest application rates. Based on these results, allelopathic compounds associated with WL and FA inhibits germination and root length with the exception of rice. Future work will entail a pot experiment to test the allelopathic effects of dried versus composted WL and FA on plant growth.

Detection of activity and syntrophic acetate-oxidizing bacteria along a nutrient gradient in the Florida Everglades

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The Florida Everglades is historically limited in phosphorus; however, runoff from the Everglades Agricultural Area has resulted in a gradient in phosphorus concentrations running into the interior of the northern Everglades. Phosphorus enrichment resulted in a P- limitation along the gradient, such that a detailed understanding of the impacts of P-enrichment on the methanogenesis which has been recognized as an important final step in the carbon cycle. Syntrophic acetate-oxidation is one pathway for the production of methane, providing hydrogen to a hydrogen-utilizing methanogenic bacterial group. Ultimate objective of this study is to investigate the role(s) of syntrophic acetate-oxidizing bacteria (SAO) and their community in sediments along the nutrient gradient in Water Conservation Area 2-A, including a site previously exposed to high levels of nutrients (F1), a transition site (F4), and a site unimpacted by nutrient additions (U3). In the current study, we have sought to isolate diverse microorganisms capable of growing syntrophically on acetate by using a multipronged approach. A total of eight strains have been isolated to date, including one homoacetogen capable of fixing nitrogen. Confirmation of the strains' ability to produce methane syntrophically from acetate in co-culture with a hydrogenotrophic methanogen is currently being tested. The results obtained from this study will provide the better understand how SAO control the methane production along with nutrient gradients in the Everglades.

An Emergy approach to evaluate impacts of soil subsidence on biofuels production sustainability in South Florida

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Soil erosion and subsidence are serious threats to the ecological sustainability of plant-based farming systems on organic soils in the everglades agricultural area of South Florida. In this study, a sugarcane farming system on organic soil was compared with a similar cropping system on a sandy mineral soil. The comparative study is designed to assess the differences in terms of the systems' use of renewable indigenous resources, their use of non-renewable indigenous resources, their purchased inputs of energy and materials, and profitability. The representative farm for both systems was based on a 640-acre farm assumed to be already established in South Florida. The case study is carried out by performing a quantitative inventory of both natural and economic input flows to each farming system then valued in terms of the equivalent amount of solar energy required for their production using the emergy method of H. T. Odum. The emergy method is able to account for, on the same basis, both renewable and non-renewable (soil loss or subsidence) inputs, including goods and labor involved in a process. The preliminary results showed that the largest energy flows for organic soil production were associated with soil erosion or subsidence (38%), fuel (16%) and services (13%). However, for mineral soil production, the largest contributions were fertilizers (32%), fuel (17%) and services (16%). The emergy analysis suggests that a reduction in the soil subsidence on organic soils will make this biofuel production system more efficient at transforming natural resources into goods and services and increase profitability of that system. The calculated performance indicators provide an advantage for mineral soil production in terms of its renewability.

Bioremediation of Landfill Leachate: Utilizing Photosynthetic Algae to Assimilate Waste Nutrients

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Locally and globally, landfills are the most widespread means of solid waste disposal. Municipal solid waste landfills in the United States are required to have an impermeable lining to prevent groundwater contamination. As a result, leachate is collected on the liner and must be appropriately managed. Landfill leachate must be remediated prior to discharge to ensure the health of the surrounding ecosystem and human communities. Management of landfill leachate must continue for 30 years post landfill closure and represents a significant cost in the disposal of solid waste. This research investigates the possibilities of utilizing biological pathways, specifically photosynthetic algae, to remediate landfill leachate. Collectively the algae represent a diverse group of autotrophic microorganisms capable of assimilating mineralized elements within landfill leachate. Landfill leachate was analyzed for macro and micronutrients essential for photosynthetic growth. Total ammonia nitrogen was present at approximately 1,100 mg/L, a quantity high enough to yield a theoretical maximum of 111 g/L algal biomass. Additionally, elemental phosphorus was present within the leachate at levels of 9.98 mg/L, enough to yield a theoretical maximum of 19.96 g/L algal biomass. The co-product of photosynthetic-based remediation is the accumulation of carbon-rich biomass. Algae biomass is of interest in the production of renewable petroleum replacements, high-value products, and carbon sequestration. Furthermore, N and P incorporated during remediation can be recycled for additional photosynthetic growth. Applying photosynthetic organisms to remediate wastewaters, while generating biomass for energy production and/or carbon sequestration offers a societal advancement towards sustainability.

Response of ‘Floratam’ St. Augustinegrass to nitrogen fertilizer and reclaimed water application rate

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Reclaimed water (RW) is increasingly viewed as a resource for supplying irrigation water and nutrients for landscape plants growing in urban environments. The objective of this research was to evaluate nitrogen (N) leaching and turf response to N fertilizer application and reclaimed water irrigation rate in ‘Floratam' St. Augustinegrass. This greenhouse study was a fixed factorial experiment with two factors and was conducted on the UF campus from August 2011to August 2012. Nitrogen (N) was applied in two treatments: IFAS standardized N recommendation and one-half IFAS standardized N recommendation which equaling the annual rates of 196 and 98 kg ha^{-1}, respectively. Irrigation treatments consisted of 5 rates of RW: 200, 300, 400, 600, 800 mL per lysimeter tub per day. Irrigation rates significantly affected the turfgrass clippings yield and tissue TKN concentrations ($p<0.001$, $p<0.05$) and subsequently affected the N uptake by turf during the period of the first three clipping collections. Lowest dry matter yields were found with the 200 mL/tub daily irrigation rate, which can be explained by lack of water. From the results of leaching loss and plant growth, the optimum daily irrigation rate was determined to be 300-400 mL/tub which is equal to 1.5-2 cm of irrigation weekly. The one-half IFAS fertilizer rate resulted in similar growth compared with the full N application according to the IFAS recommendations.

Predicting the effects of climate change on Everglades ecosystems

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Climate change has the potential to greatly alter existing hydrologic and nutrient regimes in the south Florida Everglades because of its low topographic relief, and unique hydrologic conditions, complicating restoration planning. This vast ecosystem, which has been subject to considerable human-induced shifts for more than a century, is now becoming vulnerable to climate change. For the effective future ecosystem restoration of the Everglades, it is critical to enhance our understanding about the impacts of climate variability on hydroecological variables in a regional landscape level. In this study, we investigated the sensitivity of key variables of the Everglades ecosystem (surface water depth and net phosphorus accumulation rate) in response to the projection of future climate change using Everglades Landscape Model (ELM). ELM integrates processes of hydrology, water quality, soils, periphyton, and vegetation over a decadal time scales, and has been validated against spatio-temporal observations of variables including water levels, chloride, and total phosphorus concentrations from many sites in the Everglades region using long-period historical data (1981 to 2000). We used the General Circulation Model (MRI-CGCM3, an upgraded version of MRI-CGCM2.3.2), developed by the Meteorological Research Institute, Japan to predict current and projected changes in the climate variables of precipitation, temperature and specific humidity. Then, we evaluated how changes in these climate forcing translate into changes in hydrologic and total phosphorus regimes. This analysis is expected to provide useful insights for the effective management of Comprehensive Everglades Restoration Plan (CERP) projects.

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A Study on Cropland Organic Carbon Sequestration in Soil Aggregates of Long-Term Experimental Sites in the Northeast Plain of China

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Abstract:
Soil organic carbon (C) storage in cropland ecosystems in the Northeast Plain of China is of significance in the global C cycle and is an important influence on local food security for increasing fertility in the black or brown soils of China. This study is currently underway to determine C sequestration in different aggregate size classes in soils under maize cropping in the northeast plain of China. Carbon fate was assessed using a buried bag approach with additions of ^{13}C-labeled maize straw as a tracer. Carbon fractions are being monitored including total organic C, dissolved organic C, microbial biomass C, particulate organic C, and light fraction organic C in different soil aggregate fractionations under six different fertilization treatments during five periods up to 2 years. The data from this study will help provide better estimates of C accumulation in the Northeast Plain of China as well as an improved understanding of the role of climate (temperature and precipitation) and cropland management (fertilization) in SOC decomposition and sequestration in these soil types.