A Novel Method for the Inclusion of Categorical Covariates in Latent Variable Models for Factorial Modeling of Soil Carbon in Florida

Setyono H. Adi, Sabine Grunwald, and Denis Ribeiro do Valle

Abstract. Soil-environmental correlation has been extensively studied as a cost-effective method for regional-scale soil attribute modeling. However, the limitations of commonly used statistical methods in soil-factorial modeling entail multicollinearity in Bigdata soil-factorial prediction data and mixed type of soil-environmental variables (categorical and continuous). Both of these shortcomings were addressed resulting in a new soil-factorial modeling approach. The objective of this study was to develop a novel statistical technique for factorial modeling of topsoil soil total (TC), organic (SOC), recalcitrant (RC), moderately-available (MC), and hot-water extractable carbon (HC) in Florida. We introduced a two-step regression technique combining linear regressions (i.e., Ridge Regression—RR and Bayesian Linear Regression) and latent variable models (i.e., Partial Least Squares Regression—PLSR and Sparse Bayesian Infinite Factor—SBIF) for the integration of mixed type soil-environmental datasets. Results of this research showed the new technique capabilities to derive acceptable models for TC, SOC, RC, and MC predictions (R^2>0.65; residual prediction deviation, RPD>1.6), but fair for HC prediction (R^2=0.6; RPD=1.6). This novel method improved TC, SOC, and MC prediction accuracies compared with standard PLSR and RR methods. In conclusion, the new modeling approach that incorporates categorical along with continuous soil-environmental predictor variables in latent variable models has profound potential to improve soil predictions in other regions.

Sensitivity Analysis Reveals Critical Factors that Affect Wetland Methane Emissions using Soil Biogeochemistry Model

Carla Alonso-Contes, Stefan Gerber, Isaac Duerr, Nikolay Bliznyuk

One of the largest sources of methane are wetlands, contributing about 20 to 40 % to global sources. We developed a simple Methane model for tropical and subtropical forests following the approaches used in more complex global biogeochemical emission models (LPJWhyMe and CLM4Me). The model was designed to replace model formulations with data streams for 2 essential drivers: plant productivity and hydrology. This simplifies the model considerably and allows us to directly focus on the central processes of methane production, consumption and transport. One of our long-term goals is to make the model available to scientists interested in including methane modeling in their location of study. Another goal is to evaluate the model with field soil moisture and soil temperature data against field emissions in the Ordway-Swisher Biological Station (OSBS) field site. Here, we present results from a global sensitivity analysis of the model order to determine which parameters and processes contribute to the model's uncertainty of methane emissions. Results show that parameters related to water table behavior, carbon input (in form of plant productivity) and rooting depth affect simulated methane emissions the most. Other models have found that parameters influencing methane production (Q_{10}, the CH_4/CO_2 of production), oxidation, and aerenchyma area, caused the most variability in methane emissions

Reduced Soil Nutrient Enrichment and *Typha* Presence due to Restoration Efforts: A Temporal Analysis of Taylor Slough in Everglades National Park

Kaylee A. August, Lorae T. Simpson, Todd Z. Osborne

Located in northeastern Everglades National Park, Taylor Slough (TS) is a prominent drainage feature with predominantly marl prairies underlain by limestone bedrock. Enriched waters from agriculture and development coupled with variation in water management practices from 1960-2000 resulted in variable phosphorus (P) loading into TS, contributing to enriched soils and *Typha Domingensis* proliferation. After 2000, the onset of restoration efforts supported the reduction in surface water P concentrations. This study aims to assess P enrichment and *Typha* proliferation temporally after the onset of restoration efforts by evaluating soil biogeochemical properties and species composition within TS. Soil biogeochemical properties include total carbon (TC), total nitrogen (TN), total phosphorus (TP), inorganic P, loss on ignition (LOI), and bulk density (BD) while species composition was collected via recording dominant species and percent cover; data were collected in 3 separate sampling events (2007, 2012, and 2018). Soil enrichment (TP > 500 mg kg^{-1}) decreased in the main channel of TS temporally (87%, 78%, and 61% for 2007, 2012, and 2018 respectively) with marl/mineral soil accretion contributing to a reduction in soil concentrations. Outside the main channel of TS, soils displayed no increase or decrease in soil P concentrations. A decline in soil P concentrations in the main channel lead to a plateau in *Typha* presences over time. However, analysis of vegetative communities displays species shifts between dominant communities and declining species richness. With soil P decreasing at a rate faster than previously thought, this study proves that restoration efforts are effectively decreasing soil P enrichment within a 10-year period. In order to further encourage reduced soil enrichment, oligotrophic conditions, and slow *Typha* expansion, restoration efforts must continue in TS and the Everglades.

Ammonium and Nitrate Distributions, Water- and Nitrogen-use Efficiencies as Affected by Irrigation Scheduling in Open-Field Fresh-Market Tomato Production.

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The use of smartirrigation (SI) apps for irrigation scheduling increases water savings and yield of several agronomic and horticultural crops in Florida. However, none of these irrigation-scheduling apps has been tested for their impacts on nutrient distribution in Florida soils. A two season (fall 2015 and spring 2016) study was conducted to determine the effects of irrigation scheduling by an SI app on soil NO_3^--N and NH_4^+-N distributions in tomato crop. Irrigation scheduling from the SI vegetable app was applied daily at 66% SI, 100% SI, and 150% SI of the app recommended rate and compared with the University of Florida/Institute of Food and Agricultural Sciences (UF/IFAS) irrigation recommendation (100% HI). Soil nitrate (NO_3^--N) and ammonium (NH_4^+-N) concentrations were determined by taking soil samples within and below tomato rooting depths at 30, 60, and 90 days after transplanting (DAT). Compared to 100% HI, the season total irrigation water scheduled for 100% SI was 20% and 17% lower for fall and spring seasons, respectively. Soil NO_3^--N concentrations at the root zone and tomato water- and nitrogen-use efficiencies were greater for 66% SI and 100% SI compared to 100% HI and 150% SI. This study clearly demonstrates that irrigation scheduling using an SI app improved efficiencies, maintained nutrients within tomato root zone, and reduced nutrient leaching into the groundwater.

Title: Water Management Impacts to Soil Fertility in Rice Production in the Everglades Agricultural Area

Authors: Rachelle J. Berger, Maryory Orton, Jennifer A. Cooper, Timothy A. Lang, Samira H. Daroub

Abstract:

Production of flooded rice in Histosols (organic soils) has the potential to produce methane and may increase overall greenhouse gas (GHG) emissions. The Everglades Agricultural Area (EAA) has experienced substantial soil subsidence due to organic matter oxidation of the organic soils since the early 1900s agricultural production. Flooded fallow and flooded rice both have the potential to reduce soil subsidence by slowing the oxidation of soil organic matter and release of carbon dioxide (CO_2) to the atmosphere. However, prolonged flooding of these organic soils may produce methane (CH_4). We evaluated the impact of rice water management: 1) flooded, 2) alternating (one week flooded and one week drained), and 3) unflooded in comparison to dry and flooded fallows on CO_2 and CH_4 emissions, and nutrient availability and uptake. Variations were observed in soil carbon, micronutrients, macronutrients, pH, and oxidation-reduction potential in both flooded fallows and rice produced by altered water management practices. We found an increase in soil nutrients Mn and Fe observed under the flooded rice treatments. The flooded rice and two-week alternating water management treatment had the biggest impact on soil nutrients while the highest biomass and grain yield were found in the flooded rice treatment. Further research aims to determine if flooded rice production reduces the population of heterotrophic microorganisms, increases soil nutrient availability, and determines if the cultivation of rice shifts the microbial communities within the soil.

Sustainable Farming: Application of Solar Power for Irrigation on Small Farms

Lars Bjorndal[1] and Ann C. Wilkie[2]

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The movement and distribution of water is among the most important aspects of farming, and as the global population continues to increase there is a need to improve the sustainability and efficiency in this area. Smaller farms comprise a significant part of the farmland in the United States and are even more prevalent in developing nations. These farms often do not have elaborate irrigation systems and rely on gasoline-powered pumps. Unfortunately, these pumps cause a significant risk of fuel spills and create a dependence on fossil fuels. On the other hand, solar-powered appliances utilize the energy already present at farms. Sunlight is essential for growing crops, and now we have the technology to extend the energy from the sun to also power the mechanical needs of farming. This provides farmers with independence and the convenience of a more self-sustaining farm and would be a natural progression of sustainable and water-smart agriculture. To facilitate this development, a mobile system for a solar-powered electric pump was designed. The unit has a solar panel that charges a lead-acid battery which in turn powers a DC pump. Thanks to the battery, the system can store electricity, and be used on demand similarly to fossil fuel-powered alternatives. The unit was designed for and tested on a sprinkler irrigation system. However, because smaller farms may have unique water systems, the solar-powered pump can also be used to transfer water between different reservoirs or enable gravitational irrigation by pumping water to an elevated storage.

Soil Texture Analysis as a Proxy for Wave Energy

Haley Cox and Mark Clark

Coastal erosion influenced by wave energy and sea-level rise frequently results in damage to property and infrastructure. “Living,” or vegetated, shorelines, relative to seawalls and other types of armoring, are an alternative stabilization approach that can reduce damage and slow erosion while providing a variety of ecosystem services. For a living shoreline to be effective, it will have to reduce wave energy. To assess the wave dissipation benefit without the resources to measure wave energy directly, our objective was to test the use of soil texture analysis as a proxy for wave energy. Using laser diffraction particle size analysis, we analyzed sediment on Joe Rains Beach, a 14-month old (at the time of sampling) living shoreline project in Cedar Key, FL. We hypothesized that within each of the soil textural classes examined, median particle size would be smaller in the living shoreline transects when compared to the beach reference transect. In addition, we predicted that the percent silt fraction would be higher in the living shoreline. Results indicated no significant change in percent silt or sand content across all observed transects and zones. However, there is evidence that the median particle diameter of silt and sand has significantly decreased along portions of both living shoreline transects. Although this approach provided limited verification of wave energy reduction attributable to living shoreline implementation, we believe this is partially due to the vegetation still becoming established and that future sampling will provide more definitive results.

Landscape-scale nitrogen budget informed by in situ measurements of nitrate attenuation

Amanda Desormeaux, School of Natural Resources and Environment, University of Florida
Michael D. Annable, ESSIE, University of Florida
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Patrick Inglett, Soil and Water Sciences Department, University of Florida
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The nitrogen (N) exported from karst springs represents the integrated effects of the inputs, transport, and attenuation factors over their entire springsheds. Evaluating how N sources are attenuated throughout the landscape is critical to further our understanding of catchment-scale N budgets. We developed a catchment-scale nitrogen budget for a mixed land-use karst springshed using a combination of in situ measurements (nitrate leaching fluxes and attenuation) and long-term records (surface N inputs and spring exports). Here we partition attenuation between the surface soil (upper 30 cm), vadose zone (below 30 cm to top of aquifer), and Floridan aquifer. We further evaluate the relative contributions of different N sources to surface loads, groundwater loads, and spring export. The in situ measurements were combined based on land use proportions to produce model estimates of whole-springshed N loading, attenuation, and export. The model predictions of N export were consistent with measured data. Spring N export was 10% of the total N inputs and we estimate that N attenuation was responsible for a total reduction of 64% in the surface soil, 19% in the vadose zone, and 6% in the aquifer during the period of investigation.

Soil and Water Conservation Generate Profits for Vulnerable Communities in Porto Alegre, Brazil.

Carlita Fiestas-Nunez[1] and Ann C. Wilkie[2]

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Many people do not dispose of used cooking oil correctly. It is poured down the sink most of the time, penetrating sewage systems and complicating sewage purification to return it to water bodies. In places lacking a sewage system, the oil directly penetrates and pollutes water streams and soil. In Porto Alegre in the South of Brazil, a female group is leading the way to recycle used cooking oil. The group belongs to the "Ilheus Ecologicos" association which represents the vulnerable community of islanders in Ilha das Flores, Porto Alegre. This female group encourages citizens to recycle used cooking oil by offering collection points at the stand where they sell artisanal soaps, which are made from used cooking oil and medicinal herbs. This microbusiness, based on the principles of *Economia Solidaria*, provides them with income to improve their livelihood (better infrastructure for their homes, access to food, to health care, etc.) For over 12 weeks, participant observation was conducted during the soap production, and market opportunities were explored to expand sales of the artisanal soap. Fifty customers were interviewed at the organic fair where the soap is sold and eight other organic fairs were visited. The market study identified three more sale outlets for the artisanal soap. This means that this environmentally-friendly microbusiness can expand, and more people will be encouraged to recycle their used cooking oil; this, in turn, will contribute to the conservation of water and soil in urban areas such as the city of Porto Alegre, Brazil.

Caleb Gravesen
24 September 2018

Author Line: Caleb Gravesen, Harmanpreet Sidhu, George O'Connor, Jonathan Judy

Retention and Release Characteristics of Biosolids-borne Azithromycin and Ciprofloxacin

Azithromycin (AZ) and Ciprofloxacin (CIP) are commonly prescribed antibiotics frequently detected in municipal biosolids at relatively high concentrations and identified by the USEPA as contaminants of emerging concern. The land application of municipal biosolids is an agronomically beneficial practice but is also a potential pathway of CIP and AZ release into the environment. Understanding retention-release behavior is crucial for assessing the environmental fate of, and risks from, land applied biosolids-borne target antibiotics; however, scarce retention-release data restrict such assessments. Furthermore, literature addressing influence of biosolids characteristics on retention-release of AZ and CIP under the same experimental conditions are largely absent, but necessary to fully ascertain mechanism governing the retention-release. The present study utilized batch equilibration to assess retention and release of a range of environmentally relevant concentrations of the target antibiotics in ten biosolids of varying characteristics. The biosolids included Class A and Class B materials and were chosen based on the physiochemical characteristics (i.e. pH, CEC, OM, and Fe and Al content and forms) expected to influence AZ and CIP retention-release. Retention was linear (R^2>0.99 (AZ) and >0.96 (CIP)) and sorption coefficients (K_d) values ranged between 52 and 370 L kg^{-1} for AZ and ranged between 430 and 2300 L kg^{-1} for CIP. Desorption also varied but was highly hysteretic with hysteresis coefficients (H) ranging between 0.01 and 0.15 for AZ, and ≤0.01 for CIP in all biosolids examined, suggesting limited bioaccessibility. Present data suggests that biosolids composition influences the retention-release of these antibiotics. Multiple linear regression analysis will allow the quantitative assessment of the influence of the studied biosolids characteristics on AZ and CIP sorption behavior.

Author Information:

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Soil Microbial Community Response to Nitrogen Management in Florida Pastures

Nitrogen management in Florida pastures is typically through mineral N applications. Increasingly, producers want to incorporate legumes to reduce their reliance on mineral N inputs and to increase pasture nutrition for their livestock. Bahiagrass, *Paspalum notatum*, (Flueggé.) is a perennial, warm-season grass that dominates Florida pastures, and requires N fertilizer applications to keep the pasture productive. If legumes are incorporated, it is typically during the cool-season as annual clovers, vetches, etc. Rhizoma peanut, *Arachis glabrata* (Benth.), may be a perennial, warm-season legume option for southern US grass pastures. A growing body of research has identified soil microbial communities as prominent features influencing production system function and response to their environment. As part of a larger study substituting an increasing proportion of mineral N fertilizer inputs with planted legumes, the soil microbial communities of replicated paddocks were surveyed. Legumes were incorporated into bahiagrass-based paddocks either as an annual, cool-season clover mix or combined with perennial, warm-season rhizoma peanut. Microbial communities in soil samples collected from the three different N management treatments were investigated, using a DNA amplicon sequence approach. Phylogenetic analysis of bacterial 16S rRNA sequences identified significant differences in the relative abundance of dominant taxa of various treatments but bacterial diversity did not significantly differ among treatments. Study results will aid in our understanding of the microbiomes associated with perennial grass-legume systems and potiential shifts in community structure in response to N fertilization management.

Fish Habitat Enhancement: Do "Living Shorelines" Improve Richness, Diversity and Abundance?

Niamh Hays, Mark Clark, Lindsey Kelly

Cedar Key's eroding shoreline, low elevation and geographic location along the Florida Coast, leave the city vulnerable to infrastructure damage caused by hurricanes and flooding. Erosion is often combatted through artificial stabilization methods such as seawalls. Alternatively, living shorelines naturally stabilize sediment and protect infrastructure by buffering wave energy, while providing ecosystem services such as improved biodiversity. In 2017, a living shoreline (LS) was implemented on a portion of Joe Rain's Beach in Cedar Key, between sections of bare "beach reference" (BR) and natural "marsh reference (MR). We hypothesized that biodiversity would improve as a result of the living shoreline, evidenced by increased diversity, abundance, and richness of fish populations. To test this, we sampled fish using baited traps deployed along each habitat type then counted and identified all individuals captured. We used statistical comparisons and descriptive ecological metrics to compare the diversity, abundance, and richness of the three habitats. The abundance observed in the LS habitat was not significantly different from that of either BR or MR sites. The LS and MR showed equal measures of species richness with three species each, while the BR had only one species. The BR had no diversity, while the MR had the greatest species diversity. Morisita's index of Community Similarity and Canberra's metric evaluating differences in species abundance indicated the LS is more similar to MR than BR. We predict that as the LS matures, fish ecological metrics of the site will become increasingly similar to that of the MR.

Abbreviations

- BR- Beach Reference
- LS- Living Shoreline
- MR- Marsh Reference

Local Phycoprospecting for Filamentous Algae

Brett Higgins[1] and Ann C. Wilkie[2]

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Algae are a crop whose high reproduction rate makes them ideal as a feedstock for bioenergy via anaerobic digestion, or as nutritional supplements. The primary benefit of algae compared to other crops is their rapid reproduction rate, which is hours instead of days or months. Additionally, algae can be grown in a wider range of areas than traditional crops and can serve multiple functions at once. For example, algae may be used to aid in wastewater remediation at the same time as the algal biomass is used to produce biofuels. Algal productivity can vary greatly based on retention time, season, nutrients, temperature, and species. Many of these factors are intrinsically tied with geographical location. As such, this study focuses on phycoprospecting for algae in the local area, with the expectation that these algae are adapted to and well suited to local conditions. Filamentous algae, in particular, are not commonly cultivated. However, they show promise as an alternative to the standard cultivation of microalgae. Filamentous algae are more easily separated from the cultivation medium in which they are grown by means of filtration and are a readily usable product. In this study, samples of indigenous algae were collected from local sites and locations recorded via photo-metadata. The samples were analyzed and filamentous algae genera identified via light microscopy. The study resulted in the acquisition of local *Oedogonium*, *Ulothrix, Hyalotheca*, *Mougeotia*, *Microspora* and *Spirogyra* cultures that can be used for future cultivation and experimentation.

Title

Carbon and nitrogen cycling in a Gainesville soil amended with dairy- and food-derived composts

Authors

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Abstract

Nutrient concentrations and availability vary substantially among composts depending on the materials and processes with which they are made. Agricultural operations compost wastes, mostly animal wastes such as manures, whereas composts produced in urban areas mainly incorporate food waste, sometimes with yard waste. Our objective was to measure how different composts affect nutrient availability and cycling, in addition to potential impacts on soil fertility and health. In a laboratory incubation, we compared CO_2 emissions and nitrogen mineralization rates between three dairy-derived composts (composted dairy manure, vermicompost made from dairy manure, and Black Kow™) and two food-derived composts (composted food waste and Ecoscraps™) on a soil from Gainesville, FL. Incubations were conducted at 24˚C and 30˚C for eight weeks, i.e. the annual and July mean soil temperature at the PSREU in Citra, respectively. The composted dairy manure and vermicompost had the highest CO_2 emissions compared to the unamended soil. Soil nitrate increased the most with composted food waste, whereas all three dairy-derived composts resulted in a decrease of nitrate compared to the unamended soil. This suggests that N was immobilized during the incubation, which is supported by the high CO_2 emissions with these amendments. Overall, the food waste compost seemed to have the highest increase in inorganic N during the eight-week incubation, suggesting a greater potential as a nutrient source than the dairy-derived composts.

Title: Evaluating Physical, Agricultural, and Social Drivers to Irrigation Water Use in Western Kansas

Authors: Susan Lamb[1], Samuel J. Smidt[1]

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Water levels across the largest U.S. groundwater resource, the High Plains Aquifer (HPA), have been declining at unsustainable rates due to agricultural irrigation use. Despite efficient irrigation techniques (designed to reduce total water use) farmers have paradoxically increased water applications due, in part, to lower operation costs. This study seeks to statistically evaluate the impact of physical and socio-political factors to better understand the predominant drivers to irrigation use or adoption across the HPA in western Kansas. The significance of these factors will be evaluated both spatially and numerically, and analyzed within the boundaries of local governance. Specifically, western Kansas is divided into five groundwater management districts; identifying the factors that statistically lead to the greatest levels of water decline will help to design management plans within each district to achieve a more sustainable future. Lessons learned from western Kansas can later be projected across the entire HPA to develop best management practices to achieve a stable water-energy-food nexus.

Title: Simulating the Tug of War between Transport and Nutrient Uptake in Low Flow Treatment Wetlands Demonstrates the need to Model Biogeochemistry

Kalindhi Larios and Stefan Gerber

Flow and transport in treatment wetlands determine the amount and rate of nutrients supplied to plants, microbes, the soil surface, and consequently affect downstream water quality. The intimate relationship between velocity, residence time (contact time), and treatment efficiency has led to an emphasis on modeling hydrology over wetland nutrient removal. However, in low flow wetland systems other processes such as diffusion, uptake, sorption, and storage in various biogeochemical compartment may become important. We tested effects of flow by contrasting a simple advection (plug and flow system), vs. a more realistic hydrologic transport model where velocity was based on probability density function. These hydrologic transport models were then coupled with either a simple first order uptake of nutrients (total phosphorus, TP) which lumps all wetland components into one parameter; or a spiraling model which describes the cycling of TP along various wetland components (water column, plants, microbes, litter, root litter, floc, recently accreted soil). Inflow TP concentration and flow data from Stormwater Treatment Area 2 Flow Way 1 were used as inputs. There were small differences in simulated outlet TP concentrations between the transport models when they were coupled with the same biogeochemistry model. We found greater differences in output when comparing across biogeochemistry models (1st order uptake, Spiraling). We conclude that modeling phosphorus biogeochemistry in the various wetland components are just as important, if not more critical than modeling hydrology in low flow wetland systems.

Water Table Variations and Carbon Dynamic in a Short Hydroperiod Sawgrass Marsh under Present and Future Conditions in a land surface model.

Yan Liao Stefan Gerber

Abstract

Representing the carbon cycle of wetlands in land surface models is challenging, because the carbon fluxes and hydrological dynamics are highly interactive, yet difficult to accurately simulate for specific locations. We modified a land surface model (CLM4.5) such that it able to simulate reasonable carbon exchange and hydrology in the Everglades, specifically in a short hydroperiod sawgrass marsh. First, the original hydrology of CLM4.5 was modified to simulate the realistic local scale seasonal inundation and the underground water table fluctuations, by allowing for lateral flow and reducing subsurface drainage. Phenology, photosynthesis related parameters were revised to better reproduce the seasonal change of leaf area index (LAI) and net ecosystem exchange (NEE). After the calibration with the current measured water table depth, CO_2 flux data and LAI, we predicted the carbon dynamic of this site under several future climate scenarios. Our results indicate the new process of hydrology have largely improved the compared to the generic model settings, and we find that 85 % of the seasonal water table variations can now be explained by the model. Both simulated LAI and NEE show a significant improvement with adjusted parameter choices. Our scenario simulations show that this marsh site can survive a projected low level of drought (T +2 or Precipitation -20%) because increased productivity offsets the enhanced soil respiration. Further precipitation reduction however will cause net carbon losses from reduced vegetation production caused by the drought stress. However, there is indication that vegetation transition to more woody species would reduce drought the response of the overall carbon balance.

Biochar Effects on Nitrogen Leaching from a Spodosol Amended with Different N Fertilizer Sources

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Abstract

Land application of biochar has been suggested as an effective strategy for reducing nutrient leaching, while providing simultaneous benefits to soil heath. However, the process controlling N dynamics in biochar-amended soils is still poorly understood, particularly when soils also receive inorganic and organic N fertilizers. A 196-d column leaching study was conducted to evaluate the effectiveness of different particle size (0.1 mm vs. ~0.5-2 mm diameter, herein referred as "powder" and "coarse" biochar, respectively) and application method (surface vs. incorporated) in controlling N leaching from soils amended with inorganic N fertilizer or biosolids. Treatments consisted of a factorial combination of three fertilizer sources (Ammonium nitrate, Class AA pelletized biosolids, and Class B cake biosolids) surface applied at an equivalent rate of 160 kg plant available N/ha. Two biochar sources produced from pine woodchip [produced at 400 °C (coarse_) and 500 °C (powder biochar)] applied at 1% soil mass (dry wt. basis) either at the soil surface or incorporated into the top 12 cm soil column. Leachate NH_4-N, NO_3-N and TKN concentrations decreased considerably within one month. Cumulative leachate NH_4-N was ~ 52% less in biosolids compared with ammonium nitrate treatments. Biochar application method had no effect on cumulative NH_4-N in the leachate. However, when powder biochar was incorporated into the soil column, cumulative leachate NO_3-N mass decreased by 47% relative to the surface applied treatments, but no difference was observed for the control (without N amended treatment). Similarly, decreases in total N concentrations from Class AA and Class B biosolids were observed when powder biochar was incorporated, however, no effect of biochar on total N concentrations were observed for the ammonium nitrate treatments. Results suggested that both biochar type and form that N is present in the soil affected the effectiveness of biochar in reducing N leaching from agricultural soils.

Keywords: biochar, biosolids, nutrient retention, Leaching.

Abstract for Soil and Water Science Forum

Comparison of Fitness and Nutrient Effects between Conventional and Sustainable Fertilizers for Subtropical Seagrass Restoration

MacDonnell, C., Bydalek, F., Thornton, A., Osborne, T., and Inglett, P.W.*

Seagrasses are in decline worldwide, and successful large-scale restoration of these ecosystems has proven difficult. Fertilization is a popular technique used to accelerate restoration, but results can be variable and result in polluting the surrounding ecosystem. A slower dissolving fertilizer may reduce nutrient pollution while still providing resources to the seagrass growth and survival. In this study, we compare struvite (magnesium ammonium phosphate), a slow release fertilizer sustainably harvested from wastewater treatment systems, with a popular, slow-release fertilizer, Osmocote^{TM} to enhance sediment nutrient availability and seagrass fitness (measured via shoot counts). A single 0.5 mg P g^{-1} DW dose of Osmocote and struvite were added to seagrass mesocosms in St. Augustine, Florida. Seagrass shoot counts and porewater total P levels have so far been analyzed. Overall, there was a significant difference between porewater TP in the Osmocote treatment vs struvite and controls ($p < 0.005$). Seagrass shoot counts were significantly higher in the struvite treatments than both the Osmocote and controls ($p < 0.02$). The relatively rapid dissolution of Osmocote in seawater conditions may pose problems to restoration efforts, especially in concentrated doses like those used in this experiment, leading to seagrass stress. Future studies will investigate seagrass tissue and sediment nutrient concentrations, effects of smaller doses, as well as applying these results in seagrass scar restoration projects.

- Faculty advisor

Title: Aginate/Glomalin Biobeads: An Initial Determination of Structural Cohesivity, Nutrient Remediation Ability, and Reapplication Viability

Authors: Kelly Mahan-Percivall (kmahanetcheverry@ufl.edu) and Jehangir H. Bhadha

Many algal species easily assimilate nutrients into “blooms” of biomass which could, ideally, be harvested for nutrient application to agricultural systems. Unfortunately, maintaining, then harvesting, free floating cultures is complicated and expensive. However, immobilizing the algae would both allow strategic placement of the culture and facilitate the harvesting of biomass. Sodium Alginate Beads (SAB’s) were selected for an immobilization medium because alginate has been used historically as a soil amendment. Unfortunately, SAB’s, lose cohesivity over time, leaching nutrients back into the system. Glomalin, a persistent organic soil protein, was used to bolster the structural integrity of the SAB’s without negatively impacting the potential for reapplication. Biobeads were constructed from solutions containing 50% sodium alginate and 50% glomalin/*Chlorella vulgaris* at ratios of 0/0%, 0/50%, 10/40%, 25/25%, and 45/5%. Thirty beads were placed in each flask of nutrient solution. Orthophosphate concentrations and bead structure data were collected every 3 days. All glomalin groups displayed a significant drop in orthophosphate concentration (an indicator of *Chlorella* viability) compared to the control, suggesting that the glomalin/alginate complex did not impact the viability of the algal cultures. The SAB’s lacking glomalin maintained a cohesivity of 10 while the glomalin infused beads fluctuated between values of 7 and 9. Although the glomalin complex did not increase the cohesive strength of the beads, the quick initial absorbance of orthophosphate by the 45/5% group suggests that there is a glomalin driven absorption factor which may achieve the desired reduction in the characteristic leaching of nutrients.

Katie McCurley and Dr. Jim Jawitz
SWSD Research Forum 2018
Land Cover and Climate as Drivers of Global Mean Annual Evapotranspiration

Land cover and climate are the primary drivers of global evapotranspiration (ET) rates. We hypothesized that we could predict average annual ET using eight different land cover types, average annual precipitation (P), average annual potential evapotranspiration (PET), and a metric of intra-annual phase synchronicity between P and PET. We used a data-driven regression-based approach to estimate global gridded average annual ET, which we classified based on hydroclimate zone (e.g., tropical). Each grid cell of P, PET, ET, and land cover proportions were hydroclimatically categorized to create separate hydroclimate zone-specific ET models across the time series (1980-2007). We then determined the relative importance of each hydroclimate model's input variables (land cover type, P, PET, or phase synchronicity) in predicting average annual ET. Overall, the results of this study generally show good performance across hydroclimate models in predicting ET ($0.50 < \text{Adj. R-sq} < 0.95$). Climate factors tend to be universally important across most hydroclimate zones, while land cover adds more predictive power to the tropical models. These results implicate the need to investigate hydroclimate zone-specific water budget impacts, and its principal drivers, given expected future climate and land cover changes.

Titles: The Developmental History of Soil Concepts

Authors: Katsutoshi Mizuta and Sabine Grunwald

Various soil concepts have emerged since the past century, with some sharing similarities. These concepts have contributed to raising the awareness of protecting limited soil resources, but not every concept has gained widespread attention by scientists. The purpose of this study is to identify the developmental history of 10 different soil concepts (1900 to present) and showcase their growth/decline. Articles containing the pre-selected soil concepts in titles, abstracts, or publication contents available on the Web of Science from 1900 to 2017 were examined. “Soil production” was the oldest among the concept found in a paper published in 1910, followed chronologically as they appeared in the literature by soil care, fertility, conservation, quality, health, protection, security, sustainability, and resilience. Most of the concepts were found in non-soil-science journals that dated earlier than soil science journals, inferring that the concepts were initially brought from non-soil science studies. The Pettitt’s test identified that all soil concepts, except for soil care and security, experienced statistical shifts in numbers of citations sometime between 1900 and 2017 ($p<0.01$). The Mann-Kendall regression models demonstrated that the eight concepts experienced significantly positive/upward shift ($p<0.01$) from the year with the shift to 2017. This suggested an overall increase in interest in soil concepts over time. Particularly, soil concepts cited over 50 times tended to keep their momentum and communal value over time in soil science research (227/250).

Algae Cultivation: Growth of the Filamentous Alga *Oedogonium* Compared to Microalgae

Rebecca O'Connell[1] and Ann C. Wilkie[2]

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As the planet faces depletion of its natural resources, alternative and sustainable energy sources are becoming increasingly sought after. Research on the growth of algae has revealed their potential for carbon capture to reduce greenhouse gas emissions and for conversion into a fuel source for bioenergy applications. Filamentous algae have attracted recent attention as an optimal species for cultivation due to their ease of harvest and dominance over other species. To determine the most suitable species for future biomass applications, a 1000-L open raceway pond was inoculated with the freshwater filamentous alga, *Oedogonium*, with the addition of CO_2. An additional two 1000-L raceway ponds with established cultures of microalgae already receiving CO_2 were used as a comparison to the growth of *Oedogonium*. The pond cultures were harvested weekly to determine culture density/growth (mg VSS/L) and harvest productivity (g VSS/m^2-day). After 3 weeks, *Oedogonium* harvest productivity exceeded both microalgal ponds at 13.7 (± 0.3) g VSS/m^2-day compared to 9.3 (± 0.6) and 9.5 (± 0.5) g VSS/m^2-day for the microalgae. Thus, *Oedogonium* could serve as a suitable species for biomass production due to its higher productivity rates when compared with microalgal growth.

Title: Let's Get Physical- Properties of Particle Interactions at the Calhoun Critical Zone Observatory

Authors: Pachon, J. C., Bacon, A. B., Richter, D. D., Billings, S. A.

Biogeochemical processes that bind soil particles influence the structure, hydrology, and elemental cycles of soils. However, representations of Aggregating Particles, APs, and Fine Earth Aggregates, FEAs, across soil profiles are limited, hindering representations of these basic physical units over soil and landscape evolution. We hypothesize that vertical gradients of organic carbon and clay in soil profiles significantly influence the physical properties of APs and FEAs. To test this hypothesis we quantify APs and FEAs in a network of highly weathered soil profiles (n=11, up to 10.7 m deep). We find that in the eluvial soil zone (A and E horizons) FEAs are abundant (91% of samples), large (median diameter ≈219 μm), composed of large APs (median diameter ≈9 μm). In the illuvial soil zone (Bt horizons) FEAs are similarly abundant (100% of samples), but are small (median diameter ≈100 μm) and composed of small APs (median diameter ≈2.89 μm). In the minimally weathered soil zone (C horizons/saprolite) FEAs are less common (23% of samples), intermediate (median diameter ≈190.16 μm), and are formed by APs with intermediate size (median diameter ≈4.93 μm). A threshold of 4-5% clay was found for FEAs formation at low organic carbon concentrations where percent clay and the proportion of FEAs are correlated (R^2=0.82). Our findings quantify biogeochemical thresholds and show that such thresholds vary coincidentally and significantly with soil formation. Our work indicates that physical representations of particle interactions can be improved by expanding concepts and analytical techniques related to soil particle aggregation.

AP = Aggregating Particles

FEA = Fine Earth Aggregates (aggregates > 2 mm)

Controls on Mineral Phosphate Dissolution Kinetics in Aquatic Systems

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Although mineral phosphate can constitute a large portion of TP in sediments, the importance of this phosphorus pool to phosphorus cycling and eutrophication has been largely unexplored. Previous studies found that AIP comprised up to 48% of TP in Lake Apopka sediments and up to 80% of TP in Lake Okeechobee. Since the release of phosphorus from apatite dissolution is thought to control productivity in many ecosystems, the weathering process of apatite minerals is critical to understanding nutrient dynamics. Given the spatial extent of geologic phosphorus near land surface across Florida, erosion and sediment transport in streams located in these regions may provide an important non-point source of phosphorus to lakes. The stability of mineral phosphate in aquatic environments depends on sediment and water chemistry, the composition of the phosphate material, and physical weathering. Complex biogeochemical processes can influence these factors, including proton-promoted and/or ligand-promoted dissolution, aqueous metal-ligand complexation, microbial acid production, and microbial metabolism. Fluorapatite dissolution in aquatic environments was studied through a bench-scale experiment with batch reactors. Constituents of interest, including SRP, F, DOC, and TN were measured over time to evaluate potential controls on dissolution and understand how physical and chemical parameters affect dissolution kinetics. Constituent flux rates were calculated to interpret which parameters significantly affect dissolution and to identify synergistic effects. Results from this study suggest that microbial metabolism may have a significant effect on dissolution kinetics. Further work to determine the potential impacts of organic acid production and characterization of phosphorus solubilizing bacteria is underway.

List of abbreviations: apatite inorganic phosphorus (AIP), dissolved organic carbon (DOC), fluoride (F), soluble reactive phosphorus (SRP), total nitrogen (TN), total phosphorus (TP)

Seasonal Carbon Fluxes in a Patterned Karst Landscape: The Implications for Basin Development and Pattern Reinforcement

Carlos Quintero, Matthew Cohen

Underlain by a carbonate platform, much of which is visible at ground surface, the patterned wetlands of Big Cypress likely play a significant role in regulating landscape development and consequently in regulating carbon fluxes in the abiotic and biotic stores. Regularly patterned landscapes, such as Big Cypress, are thought to result from feedback loops that work to regulate environmental conditions at varying scales. We hypothesize that greater subaqueous respiration at wetland feature centers has resulted in increased rates of chemical erosion and consequently is responsible for regulating water availability at these locations, resulting in a short range feedback. To better understand the variation in carbon cycling as landscape position changes we continuously sampled three wetland features along transects extending from the center of our wetlands of interest into the surrounding upland. Respiration data was collected using a LICOR LI-6400 outfitted with a soil chamber over the course of three years, sampling was completed every three months, our data is also supplemented by leaf litter trap, water level, calcite tablet and soil core data that were collected from our domes of interest during the study period. Our current results indicate that the centers of wetland features, while comparable in terms of respiration rates to the greater landscape, act as hotspots for subaqueous respiration due to the prolonged hydro-periods at those locations.

DNDC Simulation of Soil Carbon Dynamics in Subtropical Native Rangelands of Florida Requires Adjustments in both Growth and Decomposition Parameterization

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In order to predict carbon storage changes in grazing pastures, there is a need to test and analyze process-oriented models. Here, we applied the DeNitrification and DeComposition (DNDC) model to subtropical native rangelands. Our goal was to supply the model with soil physical parameters, climatic conditions and management to predict soil respiration and soil organic carbon storage. Initial simulations yielded stocks that were too high, while also having a long-term drift. We modified initial conditions, decomposition rates, vertical distributions of SOC, as well as maximum growth rates to bring model and data in better agreement. The model-data fit required faster than the model's default decomposition rate, higher than the model's intrinsic maximum growth rate, but also lower initial conditions of soil organic carbon. The results lead to a dynamic steady state when simulated out to > 200 years. We conclude that adapting DNDC to subtropical systems, the model's basic set up seems to underestimate the vigor of both growth and decomposition. Since DNDC was developed primarily and initially for temperate cropland, our analysis suggests that the transfer to warmer system – and thus possibly the application for global change applications - needs to be carefully evaluated.

Keywords: DNDC, process-oriented model, rangelands.

Abstract

Title: Stakeholder Survey of Impacts Resulting from Coastal Erosion:
User Perceptions Prior to Living Shoreline Intervention
Vitaliya Repina and Mark Clark

Coastal erosion caused by storms, sea level rise, and loss of natural barriers such as vegetation and oyster habitat can especially impact the state of Florida, compromising the environment of the shore and leaving property owners at risk for damage. Various options can be used to stabilize the shoreline; however, a living shoreline provides multiple ecological benefits including carbon sequestration, wildlife biodiversity enrichment, and wave energy dissipation. The island of Cedar Key, FL is susceptible to coastal erosion with one location in particular being G-Street. Interest in the community to implement a living shoreline on G-Street was shown through informative stakeholder workshops in 2017 and 2018. The preliminary surveys conducted in the summer of 2018 are questionnaire format with both open and closed-ended questions and were aimed at assessing the perception of both visitors and local residents of Cedar Key on the current usability, accessibility, aesthetics, protection, and environmental aspects of G-Street. Survey results showed that the majority of the population do not like the rocks, rogue structures, or the oyster and clam shells on the beach; however, they enjoy the view they have from G-Street and would add more sand to the shoreline. In addition, most people have not heard of a living shoreline and therefore could not anticipate how integration of a living shoreline would affect the shoreline. The same survey will be conducted in the future after implementation of the living shoreline to determine if and how user perceptions have changed.

Student Compost Cooperative – Reducing UF's Ecological Footprint

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Composting is a natural decomposition process in which organic wastes decompose into a nutritious soil amendment. Nutrients in organic wastes such as food scraps (primarily fruits and vegetables), as well as shredded paper and cardboard for carbon addition, can be recovered and recycled for use in agriculture, horticulture and urban gardening. When food scraps are disposed in landfills, they produce sizable amounts of harmful methane gas because they undergo anaerobic decomposition. Composting solves this issue by allowing plenty of oxygen into the system through consistent turning, which reduces methane emissions. Not only does compost enrich the soils with organic matter and improve water retention, it also significantly reduces landfill disposal of organic waste and demand for commercial fertilizers, thereby reducing society's reliance on fossil fuels and paving the path toward a sustainable future. The **Student Compost Cooperative (SCC)** is a cross-disciplinary education and outreach program established by the Soil and Water Sciences Department, UF-IFAS, that fosters sustainability and nutrient upcycling through composting and sustainable gardening. The SCC strives to popularize sustainability and composting through educational demonstrations and social media. The SCC also provides free garden plots for students at the BioEnergy and Sustainable Technology (BEST) Laboratory, and encourages them to compost their food waste and use the finished product for their own organic gardens. All students and staff are invited to participate in the SCC to make the UF campus a more sustainable community.

Estimating Isotherm Parameters from Soil Test Data across Eastern and Central United States

Amanda Rodriguez

Advisor: Vimala Nair

Determination of Langmuir isotherms and subsequent calculation of K_L, the phosphorus (P) bonding strength, and the equilibrium P concentration (EPC_0) of a soil is a tedious and time-consuming process. A protocol using simple extraction techniques has been developed for Florida sandy soils allowing the estimation of isotherm parameters without generating time- and resource-consuming isotherms. This relationship related K_L to the soil P storage capacity (SPSC), the calculations of which are based on a threshold phosphorus saturation ratio (PSR). The SPSC, a measure of the maximum amount of P a soil can hold before becoming an environmental risk is calculated as: SPSC = (0.1 – Soil PSR) * (Fe + Al) * 31 mg kg^{-1}. Phosphorus, Fe and Al are obtained in a Mehlich 3 solution, easily obtainable from a soil testing laboratory. The objective of this experiment was to expand the relationship between SPSC and isotherm parameters to soils from eastern and central United States. Surface soil samples with varying P-impact levels and textural properties ranging from sandy to silt loam were collected from six sites in eastern and central US. Isotherms were determined and SPSC calculated for all soils. The EPC_0 ranged from 1.7 to 77 mg L^{-1}. The K_L values for all soils were low for these heavily P-impacted soils compared to values previously obtained for sandy surface and subsurface soils. The next step involves looking into relationships of K_L with SPSC for minimally P-impacted surface and subsurface soils of the eastern and central US.

A Model of Soil Subsidence in a Subtropical Drained Peatland

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Peat soils store a significant amount of carbon due to slow organic matter decomposition conditions. Drainage of these peatlands and conversion into agriculture is occurring worldwide. Drainage of the Everglades Agricultural Area (EAA) soils has resulted in soil subsidence. Subsidence rates have been reduced compared to previously reported rates. Increases in mineral content, recalcitrant carbon, and higher water tables attributed to best management practices, are considered possible causes for this reduction. The objectives of this research are to apply a model of peat dynamics to the EAA using formulations from prior models, identify the different factors that affected past and current peat dynamics, and to evaluate soil subsidence rates under different future management scenarios. The model equations are based on a peat model developed by Hilbert et al. (2000). This model was expanded to account for changes due to compaction. Model parameters were obtained from historic data and from optimization processes. The model subsequently was able to predict a predrainage peat height of 2.57 m for the EAA, and a current subsidence rate of 0.65 cm yr^{-1}, and was able to represent past changes in subsidence rates which were mostly controlled by water table depth and biomass input. Results suggest that increases in biomass input to the soil, and higher water tables are among the most effective ways to reduce soil subsidence in the EAA. Therefore, soil conservation strategies in the EAA should incorporate a combination of higher average annual water tables and higher biomass inputs to the soils.

Seasonal Variations in Soil Enzyme Activities and Carbon Fractions in Sub-Tropical Grazing Lands

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Presenter: Saroop S. Sandhu (Sss67@ufl.edu)

Seasonal variations of soil microbial activity in soil profile can occur due to changes in soil moisture, temperature, root activity and organic matter return during the growing season. Yet, the effects of management practices in sub-tropical grazing lands on microbial processes during different seasons is not well established. Therefore, the objective of this study were to i) determine the impacts of long-term management practices in grazing lands on soil carbon (C) fractions, and enzyme activity ii) to analyze the changes in enzyme activity and C fractions with depth during different seasons. The experimental site had two management systems including native rangeland (consisted of woody and non-woody perennial plants with minimal grazing and no N addition) and improved pasture (consisted of bahiagrass with continues grazing and addition of 67 kg N ha^{-1} yr^{-1}). The soil samples were collected in March and September 2017, and January and July 2018. The results indicated that the cold water extractable C (CWEC), hot water extractable C (HWEC) and acid extractable C (AEC) were consistently higher during all seasons except January in improved pasture probably due to manure addition and higher turnover rate of bahiagrass. Moreover, the ratio of labile C (CWEC, HWEC, and AEC) to residual C (RC) was higher in September compared to January and July indicating the availability of more labile C. Similar seasonal patterns were observed for the activity of C acquiring enzymes β-Glucosidase (BGA), Cellobiohydrolase (CBH) where the activity was higher in September (warm and wet) and lowest in January (cold and relatively dry), and was consistently higher in improved pasture compared to native rangeland during all seasons. Further, the ratio of labile to residual C was higher in surface horizon (A1) due to the addition of root exudates and manure in improved pastures and decreased with depth where it was lowest in spodic horizon (Bh). Thus a similar trend of higher enzyme activity was observed in surface horizon compared to sub-surface horizon. Pearson correlation analysis indicated that the HWEC was highly correlated with enzyme activity of BGA ($r = 0.77$), CBH ($r = 0.73$), microbial biomass C ($r = 0.84$) and showed that availability of labile substrate drive the microbial activity in grazing lands. Overall, results indicate that the microbial activity is affected by the availability and nature of substrate which varies with environmental condition and management practices in sub-tropical grazing lands.

Influence of Rootstock, Propagation Method, and Soil Type on Citrus Rhizosphere Composition

John M Santiago, Ute Albrecht, Sarah L Strauss

Rootstocks are important for tree crops due to their influence on vigor, fruit quality, harvestable yield, resistance to pests, and tolerance against environmental conditions. The demand for alternative propagation methods, such as stem cuttings and tissue culturing, has increased due to the lack of seed tree available in recently developed rootstocks. Differences in root conditions between propagation methods may influence the composition of the rhizosphere. Although it is recognized that rhizosphere microbial composition can significantly impact plant growth and nutrient uptake, the developmental process of rhizosphere microbial communities is still not well understood. The purpose of this study is to determine the influence of propagation methods, rootstock genotype, and soil type on citrus microbial community development. It is hypothesized that the rootstock rhizosphere propagated by cuttings will be more diverse compared to those propagated by tissue culture and seed, as seed coats are sterilized before planting and tissue culture plants are generated in a sterile environment. It is hypothesized that rootstocks grown in soils with greater soil organic matter will have a more abundant rhizosphere community. The research is being conducted through two projects. A greenhouse experiment will determine the impact of soil type on rhizosphere development. To examine the influence of genotype on the rhizosphere composition, the microbial community composition of three citrus rootstock genotypes, each propagated by seed, stem cuttings, and tissue culture, will be assessed. Rhizosphere DNA is being extracted and sequenced using Illumina high-throughput amplicon sequencing, and data will be analyzed using QIIME2 and R.

DNA-Based Methods used to explore the root and soil microbiome in Sod-Based Rotation System

Neetika Thakur, Chih-Ming Hsu, Zane Grabau, Lesley Schumacher, David Wright, Ian Small, Hui-Ling Liao

ABSTRACT

Sod-based rotations (SBR) are applicable to a wide range of soil types, are an effective practice to control plant–parasitic nematodes and plant diseases and reduce overall pest problems. The benefits of SBR on agricultural productivity, soil health and plant disease control have been well studied. For example, incorporating bahiagrass into conventionally practiced peanut and cotton rotations has been proven to increase crop yield and improve soil properties. Peanut in the bahiagrass rotation had improved grade quality characteristics. Even though cotton yield did not increase, cotton plant growth was improved with a larger root biomass in the bahiagrass rotation compared with the conventional rotation. It is likely that SBR can benefit the belowground biodiversity and subsequently improve microbial-driven soil nutrients and disease resistance of crop plants. However, how does SBR affect the belowground activities are largely unknown and will be investigated in this study. Here, we will apply next generation sequencing approach to study the biodiversity of soil microbial community underlying SBR system vs. conventional system. We collected the soil and cotton root samples from the experimental sites located at the North Florida Research and Education Center in Quincy, Florida on a Dothan sandy loam (fine, loamy siliceous, thermic Plinthic Kandiudults). Before 1999, the field had been in a conventional tillage/winter cover cropping sequence for several years. The rotation plots were established in 2000 and consisted of bahiagrass rotation with peanut and a conventional cotton-peanut rotation. The cropping sequence for the bahiagrass rotation was cotton in the first year followed by bahiagrass for two consecutive years and peanut in the fourth year. The conventional rotation consisted of growing peanut in the first year, cotton for the two years followed by peanut in the fourth year. We will present the methodology used for soil and root DNA extraction, DNA quantification, 1-step-PCR amplicon library constructions that target fungal ITS and bacterial 16S. The community structures of fungi and bacteria will be investigated using illumina Miseq 300-PE followed by Qiime 2 pipelines.

Boron (B) uptake and availability in citrus on a sandy Entisol

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Abstract

Florida sandy soils, particularly, Entisols are low in B and occasionally have B deficiency for citrus. Boron deficiency appears to exacerbate citrus greening (Huanglongbing (HLB)) disease which restricts nutrient uptake. A study was set-up at Citrus Research and Education Center (CREC), Lake Alfred, Florida, on a Candler fine sand to determine the availability and uptake of B in high density citrus (~450 trees per acre) of HLB-affected trees. Boron was applied at 1.12 kg ha^{-1} in three splits, at IFAS recommended rate, and at 2x the recommended rate using foliar and soil application methods. Soil samples were taken from soil surface to 60 cm depth at an increment of 15 cm within the irrigated zone (30- and 60 cm away from the tree row) and non-irrigated zone (90 cm perpendicular to the tree row). Soil samples were analyzed for B using Mehlich III extraction method and analyzed by ICP-MS. Tissue B concentration was determined by acid digestion and analyzed on ICP. The result show that soil B concentration using IFAS recommendation rate 1x and soil application method is significantly high ($p<0.05$) compared to foliar B application at single or double rate of application. The upper soil depth of 15 cm has significant high ($P<0.05$) concentration of B compared to the lower depth up to 60 cm. The leaf tissue B concentration for soil applied rate 1x is higher than that of foliar applied either at single or double rate. Thus, B uptake for HLB-affected citrus on sandy Entisols is controlled by availability in the upper 15cm of the soil.

Perception, Beliefs and Values of Soil and its Health.

R. Kay Kastner-Wilcox[1], Sabine Grunwald[1], Monika Ardelt[1] and Tracy Irani[1]

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Soil degradation, like many of society's 'wicked' problems, share similar characteristics; they are global, complex, difficult to resolve and interconnected across environmental, social, cultural and political spheres, and present a risk to society. Few studies have explored the social-psychological perception, beliefs and values of individuals to soil and its degradation despite the increased interest to assess soil health and soil security from a soil science perspective.

This study investigated the social-psychological perception, beliefs and values of individuals to soil, its value, health and degradation. A stratified survey of individuals residing throughout the urban–rural gradient of greater Miami, Florida, USA (N=247) was conducted to assess how individuals view soil, its health and degradation, as well as their knowledge, emotional connection and experiences with soil. Our findings suggest that social norms are positively correlated to knowledge and affects, and biospheric and socio-altruistic values are negatively correlated to affect and social norms. Knowledge, affect, and social norms are negatively correlated to the perception of risk while biospheric and socio-altruistic values are positively correlated. Experiences with the natural environment (e.g., planting vegetation, visiting a farm) were not correlated to any variables that were included in the study. Additionally, in ranking a list of "global environmental challenges" from most to least important, human health and well-being was ranked as most important, followed by water quality, clean air and stable climate, sufficient food, protection of biodiversity, sufficient energy resources with healthy soils ranked last among the most important issues confronting society.

Abstract Title:

Application of Bagasse for Sugarcane Production on Sandy Soils in South Florida

Authors:

Nan Xu, Jehangir Bhadha, Raju Khatiwada, Stewart Swanson, Rao Mylavarapu

Abstract: (250 words limit)

Bagasse is an agricultural by-product derived from the sugarcane milling process. Exploring sustainable ways of reusing this product offers options to enhance soil properties, improve crop yields, while reducing waste. In South Florida, approximately 90,000 acres of sugarcane production is done on sandy soils that has <3% organic matter. This study aims at evaluating the short and long-term effects of bagasse application for sugarcane production on these sandy soils. The experimental trial was conducted on a commercial sugarcane farm. Three bagasse application treatments with different rates, 2-inch bagasse (85 ton/ha), 4-inch bagasse (170 ton/ha), 4-inch bagasse plus an extra nitrogen application of 150 lbs/acre ammonium nitrite, were compared to a control that received no bagasse application. Several soil properties including soil pH, bulk density (BD), maximum water holding capacity (MWHC), organic matter content (OM), cation exchange capacity (CEC), active carbon, and nutrient contents were evaluated. Results indicate that bagasse application can have a positive short-term effect on OM accumulation in the soils; resulting in higher MWHC and lower BD, which is favorable for crop growth. While extractable plant-available nutrient concentrations increased in the soils, on-going monitoring work will assess its long-term effect on soil health. Over the next three years, changes in soil quality and microbial activity will be monitored and compared to sugarcane yields. Results shall provide a better understanding of the short and long-term effects on soil health using bagasse as a soil amendment in South Florida. These findings could be useful in planning best treatment programs using bagasse for commercial sugarcane production, and potentially reducing fertilizer applications.

Temporal trend in water salinity of the Suwannee River estuary and the effects of freshwater supply and sea level rise.

Zhou J., Deitch M., Grunwald S., and P., Bill

Abstract

Saline water intrusion has been observed along the Florida coast line, which has caused encroachment of coastal wetlands (mangrove forests) inland. This intrusion is attributed to the reduction of freshwater supply to the estuary and sea level rise. The objective of this study was to (1) assess the temporal trend (1982 to 2017) in water salinity in the Suwannee River estuary, and (2) investigate the effects sea level rise on water salinity. We used a compiled water quality dataset consisting of salinity, date and depth of sampling from the Florida Department of Agriculture and Consumer Services (FDACS) and the UF School of Natural Resources and the Environment (SNRE). We selected a subset of 66 sampling stations that had been consistently sampled at monthly intervals. Daily discharge data were from the USGS streamflow station on the Suwannee River near Wilcox, FL (02323500) and daily mean sea level data from NOAA station 8727520 at Cedar Key. The water quality, discharge, and sea level rise data were not collocated because they stemmed from different sources in this synergy project. Temporal trends in salinity were analyzed using the Kendall test. After using the LOWESS smoothing function to adjust for the impact of freshwater discharge, the effect of sea level rise on salinity was investigated by multiple linear regression models. Our results showed that 41 sampling stations (out of 66) had a significant ($p<0.05$) temporal trend in salinity, among them 5 were negative and 36 were positive. The data also showed a significant positive temporal trend in the mean salinity of the estuary. However in contrast to our expectation, the correlation between sea level and salinity was not significant. Possible explanations for this result include: 1) the Suwannee River estuary water salinity has not been significantly affected by sea level rise over the study period; 2) the effect of sea level rise on water salinity of the Suwannee estuary is covered by other factors. We suggest that to reveal the sea level rise effect on estuary salinity, a specified monitoring scheme need to be developed so that water samples are collocated with meteorological data over sufficient duration.