Allelopathic effects of dried and composted *Pistia stratiotes* and *Lyngbya wollei* on rice and sorghum growth

Odiney Alvarez, Timothy A. Lang, Jehangir H. Bhadha, Mihai C. Giurcanu, and Samira H. Daroub

Invasive aquatic plant species interfere with farm canals' function and cause negative environmental impacts in the Everglades Agricultural Area in south Florida. *Pistia stratiotes* (WL) [water lettuce] and *Lyngbya wollei* (FC) [filamentous cyanobacteria] are two common plant species of floating aquatic vegetation (FAV) prevalent in the area and several management approaches such as harvesting and field incorporation have been implemented for their control. Our goal was to investigate the use of these species as soil amendments. Past studies have shown allelochemicals and inhibitory effects of these species on plant growth under controlled laboratory settings; however, environmental conditions may influence their allelopathic activity when applied to the soil. In this study, a split-pot experiment was conducted to compare and evaluate the effects of dried and composted WL and FC applied on rice and sorghum grown on muck and sandy soils. Evaluation of rice root dry weight (RDW) showed that dried FC applied in sandy soils resulted in significantly less RDW compared to dried WL and composted WL and FC applied in muck soils, which may indicate a negative allelopathic effect of dried FC when incorporated in sandy soils for rice growth. In contrast, no negative effect was caused by the amendments on sorghum growth; moreover, greater RDW was observed when dried WL was applied in sandy soils compared to muck soils, suggesting the opportunity to use dried WL as an amendment in coarse-textured soils to grow sorghum. The allelopathic effects of dried and composted FAV varied by soil type, environmental conditions and crops.

Growth, Yield, and Nitrogen Accumulation by Sesame (*Sesamum indicum*L.) grown in North Central Florida.

Authors: Annie Couch, George Hochmuth, Diane Rowland, and Jerry Bennett

Sesame has the potential to be a new agronomic crop for Florida with important drought tolerant and nematode resistant properties. However, because commercial production in FL began in 2012, little is known about the crop's phenology, physiology, nutrient uptake patterns in this semi-tropical environment. Research was initiated at the University of Florida's Plant Science Research and Education Unit in Citra, Florida to evaluate six commercial varieties and six experimental varieties for physiological plant characteristics such as yield, leaf area index (LAI), root growth, and dry matter accumulation. Root architecture will be evaluated *in situ* using minirhizotron imaging throughout the season. In addition, the amount of nitrogen accumulated in sesame during the 2013 and 2014 growing seasons will be quantified using total Kjeldahl nitrogen (TKN) for the above ground biomass of one experimental and three commercial sesame varieties at five times during the growing season. TKN will also be measured for the below ground biomass for two of the three commercial varieties. Soil samples will be taken throughout the season to determine the available nitrogen in the soil. A nitrogen budget will be completed based on the data collected.

Obtaining Model Input Parameters for Predicting Phosphorus Leaching using PLEASE Model

B Dari, V D Nair and R Mylavarapu

Florida sandy soils are susceptible to phosphorus (P) loss from an agricultural or animal production system into nearby water bodies via surface or subsurface pathways. Leaching is a predominant mode of P transport from these soils. Chemical equilibrium models often use the P bonding strength (Langmuir K_L) or the Freundlich coefficient (K_F) to predict P release from a soil. If K_L or K_F can be obtained from an oxalate or a soil test solution, it would offer an easy means of obtaining "K" for modeling. **P**hosphorus **LEA**ching from **S**oil to **E**nvironment (PLEASE) is a simple P loss predictive model based on P sorption mechanism in a soil and its potential movement into surface water. Our objective was to relate the P saturation ratio (PSR) to isotherm parameters based on the hypothesis that K_L or K_F will be related to the PSR as determined from P, Fe and Al concentrations in an oxalate solution. Isotherms were constructed on soil samples collected from A, E and Bt horizons of a manure-impacted dairy sprayfield and K_L and K_F values were computed. All soils were analyzed for P, Fe and Al in an oxalate extract. Results indicated that there is a relationship between PSR and Langmuir K_L or Freundlich K_F suggesting that it might be possible to obtain these "K" values from P, Fe and Al in an oxalate solution for input into the PLEASE Model. The Model uses P adsorption parameters, precipitation, soil test phosphorus and groundwater height as inputs to predict loss of P. Performance of PLEASE model might be comparable with other reliable methods for estimating P loss from an agricultural system into surface water.

The Contributions of Nitrogen and Irrigation Management in Reducing the Risk of N Leaching in Florida Potato Production

Amanda Desormeaux and George Hochmuth

“Abstract. Potato (*Solanum tuberosum L.)* production in Florida is characterized by coarse textured soils with low water and nutrient holding capacities and nitrogen (N) loss can have a negative impact on water sustainability. We hypothesized that the use of polymer-coated urea at the UF/IFAS recommended rate, as well as a reduced rate, would reduce the risk of N leaching without reducing yield and that keeping the available soil water below field capacity would reduce the risk of N leaching by providing a soil water reservoir for rainfall. We used three sprinkler irrigation treatments (Irr1: 75% field capacity, Irr2: 100% field capacity, Irr3: 125% field capacity) and three N treatments (N1 “reduced”: 196 kg N ha^{-1} polymer-coated urea, N2: 224 kg N ha^{-1} polymer-coated urea, N3 “grower”: 224 kg N ha^{-1} liquid urea/ammonium nitrate mixture). Treatments were arranged in a completely randomized, factorial design with three replications. All polymer-coated urea was applied and incorporated immediately prior to planting; 10% of N was applied pre-plant for N3, with the remainder split evenly at emergence and 44 days after planting. Drainage lysimeters were buried under each plot and N leaching was calculated from leachate volume and N concentration. There was no interaction between irrigation and N treatments. Irrigation treatments had no significant effect on nitrate leaching and there were no significant differences in yield between irrigation and N treatments. N treatments had a significant effect on nitrate leaching, with N1 resulting in significantly lower N leaching and no reduction in yield.”

Nutrient Cycling in Upper St. Johns River Conservation Area Wetlands

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The Upper St. Johns River Basin is one of ten major watersheds within the St. Johns River Water Management District. Appropriate management of wetlands in the Upper Basin has direct implications on downstream water quality and is vital to achieving the District's core missions of flood protection, water supply, water quality, and protection of natural systems. Understanding factors which affect nutrient flux and storage in the soils and vegetation of these wetlands is necessary to make informed water management decisions. The University of Florida and the St Johns River Water Management District are currently working on a multi-year project to study the effects of water level, dominant vegetation, and other factors on nutrient cycling and soil subsidence in Blue Cypress Marsh Conservation Area, Ft Drum Marsh Conservation Area, and St Johns Marsh Conservation Area. In order to get a more complete picture of soil subsidence and nutrient storage, data on litter decomposition is currently being collected. Productivity measurements and the role of litter decomposition in differing vegetation dominated sites will be assessed to determine the carbon inputs to the system, as well as the impact on nitrogen and phosphorus cycles.

Feasibility of using nitric oxide donors for removing biofilms from industrial surfaces

Ian A Durie, Charles Chen, Max Teplitski, Massimiliano Marvasi

Within industrial settings biofilm build-up is generally reduced with mechanical brushing or the use of highly toxic and corrosive chemicals, both approaches also require significant amounts of water and are not very effective at disrupting microbial biofilms and especially removing pathogens. As the use of recycled and reused waters increases, issues with controlling biofilms will only increase in due time because of increased microbial loads in various re-used waters. Therefore, novel methods for disrupting microbial biofilms are needed. With this study, we tested the effectiveness of applications of nitric oxide donor molecules for dispersing biofilms. The NO donor molsidomine was tested on *Salmonella* preformed biofilms at different temperatures on polypropylene, polystyrene and stainless steel. To test the effectiveness of nitric oxide donor molecules, we treated biofilms formed by the GFP-labeled *Salmonella* strain in plastic plates or in stainless steel tubes with varying concentrations of nitric oxide donors. Of the tested nitric oxide donors, molsidomine was particularly effective at dispersing biofilms formed on polypropylene. It was most effective at 4 and 22°C, inducing dispersal of ~50% of biofilms formed by *Salmonella* 14028 and the cocktail of six *Salmonella* outbreak strains after incubation of 6 hours. Molsidomine was also a good dispersant of the *Salmonella* biofilm formed on stainless steel. Interestingly, the compounds were most effective at the picomolar concentrations, thus indicating their potential effectiveness in industrial applications.

ABSTRACT FOR 2013 SWSD RESEARCH FORUM - POSTER PRESENTATION

Evaluating agricultural irrigation water salinity and implications of water conservation practices on future water management decisions in the Tri-County Agricultural Area, Northeast Florida

Authors: Eunice Eshun and Mark Clark

Potatoes are the major irrigated crop in the Tri-County Agricultural Area (TCAA) located in the Putnam, Flagler and St. Johns counties in northeast Florida. Increasing salinity concentrations in irrigation water within the TCAA has been of growing concern for several decades now. The source of elevated salts in the groundwater of this region is not explicitly understood, but is generally the result of vertical saltwater intrusion through a semipermeable confinement layer between the saline rich Lower Floridan Aquifer and the Upper Floridan Aquifer. There is a need to improve our understanding of spatial and temporal salinity issues in the TCAA in an effort to inform future water management decisions. This research therefore has the following objectives: To survey irrigation wells in the TCAA to determine the extent of salinity issues now and contrast them with a survey of wells conducted by the St. Johns River Water Management District in the mid 1970's. To evaluate the efficiency of alternative irrigation practices to reduce agricultural water use in the TCAA. To identify how policies related to urban and agricultural water supply allocation are impacting water conservation activities in the TCAA. To predict with model simulation, the scaled up implications of various water management alternatives related to water conservation and whether the conserved volume should be reallocated in the region or retained in the aquifer. It is expected that results from this study will provide some of the additional information needed by decision makers to influence future sustainable water management in the TCAA.

Evaluation of nitrogen management strategies for impacts on nitrate leaching and quality of St. Augustinegrass turfgrass

Authors: Rajendra Gautam & George Hochmuth

Nitrogen (N) application is important for maintaining the aesthetic quality of turf. However, frequent arguments about the possible chances of water pollution through nitrate-nitrogen (NO_3-N) have focused attention on N application in turf. This research was conducted, over three years, at Citra, Florida to determine an environmentally friendly approach to N management in St. Augustinegrass. Ten fertilizer treatments were laid out in randomized complete-block design. Drainage lysimeters were installed to collect leachate and the leachates were analyzed for NO_3-N concentration. The NO_3-N leaching loads were similar among fertilizer treatments and also not different from the control (average 2.1 $kg.ha^{-1}.yr^{-1}$). However, there was significant seasonal variation in leaching load. More than 90 percent of the total nitrate (6.3 $kg.ha^{-1}$) leached in three years, occurred in the first four months of the experiment, during turfgrass establishment. Thereafter, the seasonal loads were consistently lower (average 0.082 $kg.ha^{-1}$) and were not affected by fertilizer treatment. The quality of the grass was affected by fertilizer treatment and time of the year. Higher fertilizer rates resulted in greater turfgrass quality. Better quality was observed during the August-September period, however, the quality with all treatments declined with time over the three-year experimental period. The results indicated that fertilization is necessary to maintain the quality of the grass. Healthy turfgrass is effective at taking up N fertilizer and fertilization programs were not associated with NO_3-N leaching. There were numerous fertilization strategies involving source and timing that resulted in acceptable turfgrass quality while minimizing the loss of N.

List of any abbreviations

$kg.ha^{-1}$: Kilograms per hectare

$kg.ha^{-1}.yr^{-1}$: Kilograms per hectare per year

N: Nitrogen

NO_3-N: Nitrate Nitrogen

The Role of soft rot bacteria in the Proliferation of Salmonella in Tomatoes

Andree George, Jason T. Noel, and Max Teplitski
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In tomatoes infected with *Pectobacterium (*a soft rot plant pathogen)*, Salmonella* can grow to numbers 10 fold higher than in intact tomatoes without *Pectobacterium*. There are three hypotheses under investigation which may adequately explain this phenomenon. The first hypothesis is that pectinolytic activities increase nutrient availability allowing for increased growth of *Salmonella*. The second hypothesis is that increased pH due to rotting reduces the acid stress on *Salmonella* which may allow it to grow to higher final densities. Lastly, we also tested whether cell-to-cell signaling between *Salmonella* and *Pectobacterium* promotes increased proliferation of *Salmonella* within soft rots. Experiments conducted with a mutant of the metabolic repressor KdgR, indicated an increase in growth when non-functional. This phenotype is seen in tomatoes co-infected with *Pectobacterium* but not in tomatoes infected with the phytopathogen *Xanthomonas*. The role of *Pectobacterium* in this outcome is not yet clear, leading us to the second hypothesis. The co-inoculation experiment compares the fitness of type strain *Salmonella enterica* sv Typhimurium 14028 with the mutants that lack genes which function in the acid tolerance response (ATR) or the use of PGA monomers. *Pectobacterium* is inoculated into half of the tomatoes along with the co-infections and the differences resulting from the different environments are recorded. Rotting by *Pectobacterium* tends to increase fruit pH, which should allow the mutants to be more competitive due to a decrease of acid stress. Furthermore, this same process should make PGA subunits more readily available.

Poster abstract:

Title: Children's exposure to As from CCA wood staircases

Authors: Julia "Ky" Gress, Dr. Lena Ma, Dr. Jay Lessl

Abstract: Chromated copper arsenate (CCA) is a water-soluble wood preservative that was used to pressure treat lumber for residential use in the construction of fences, decks, play sets, picnic tables and exterior staircases. Leaching of arsenic from CCA wood commonly results in the contamination of soil surrounding structures to levels higher than the Florida Soil Clean-up Target Level for industrial sites. Dislodgeable arsenic (DA) forms on the surface of the wood and is transferred to hands upon contact. Concern about potential elevated cancer risks in children contacting CCA wood on playgrounds and at home led to a withdrawal of CCA wood for use in residential settings in 2004. With a usable life of 20-40 years, much of the CCA wood used in home construction is still in use today and serves as a continual source of arsenic exposure. CCA currently has many agricultural and industrial applications and is used globally.

This study evaluated the contamination of soil surrounding 2-story CCA wood staircases located in the front yard of 4 apartment complexes in north central Florida. Concentrations of bioaccessible soil As were determined using the SBRC/SBET protocol. Quantities of DA were measured through wipe sampling of objects stored under the staircases and on staircase hand railings and steps. These values were used to predict potential cancer risks associated with ingestion of soil and DA by children playing on and around the staircases at these complexes and is compared to USEPA estimates.

ISOLATION AND IDENTIFICATION OF GLYPHOSATE DEGRADING MICROORGANISMS IN THE FLORIDA EVERGLADES AND BELIZE PEATLANDS

A. Gupta, E. Morrison, A. Ogram

Soil and Water Science, University of Florida, Gainesville, FL

In wetland areas where phosphorus (P) is limiting, microorganisms have developed various mechanisms in order to access alternate sources of P. Phosphonates may be one such alternative source of P. Glyphosate is a commonly used phosphonate and is a component of the commercial herbicide RoundUp™. The chemistry of phosphonates is highlighted by a very strong C-P bond that makes the P difficult to access. However, microorganisms have been found in marine systems that are capable of using phosphonates as a source of P. However, the abundance of phosphonate degraders has been little studied in wetland soils and the phylogeny and physiology of these species are as of yet poorly documented. Our experiment utilized glyphosate as the sole source of P in growth medium inoculated with soils from two P-limited wetlands: the Florida Everglades and a Belize wetland subject to experimental P enrichment. These cultures were then systematically enriched and plated on solid medium to isolate microorganisms capable of using glyphosate as a sole source of P In order to separate fungal and bacterial carriers of *phnD,* a gene associated with phosphonate metabolism, colonies were streaked out on separate plates containing antibiotic and antifungal media. After purification of colonies, PCR was used to verify the presence of the aforementioned *phnD* gene in both fungal and bacterial colonies. We are now in the final stages of sequencing and analyzing the phylogeny of these isolates. This is of particular interest because of the implication of interconnected ancestry. Additionally, the ability of microorganisms to break the C-P bond of phosphonates may have important implications for the degradation of common herbicides in the environment, and may provide P-limited systems with an alternate source of P.

Methanotrophic activity in subtropical freshwater wetlands: Influence of nutrients and methane availability

F Hinz, K Inglett, P.W. Inglett and K.R. Reddy

An important regulator of methane (CH_4) emissions from freshwater wetlands is microbially mediated methane oxidation. A wide distribution of methanotrophs is reported in all soil systems including those of wetland soils. The two main classes of aerobic methanotrophs are the Type I and Type II methanotrophs. Several factors affect the distribution of these organisms in soils, including the availability of methane and nutrients. In the Florida Everglades, the dominant type of methanotrophs has been shown to shift in the soils along the nutrient gradient. The objective of this study is to determine the distribution and kinetics of methane oxidation in these soils of contrasting nutrient availability. A laboratory manipulation study is currently being performed using surface soils collected from both eutrophic and pristine sites. Soil incubations will be prepared in triplicate and held under varying CH_4 concentrations. Potential methane oxidation rates will be determined by measuring the loss of CH_4 using gas chromatography. Soil physiochemical parameters will be related to the observed methane oxidation rates. Changes in the abundance of Type I and Type II methanotrophs will be monitored with PLFA biomarkers for Type I and Type II methanotrophs (16:1ω8 and 18:1ω8, respectively). Correlations with the methane oxidation rates will be investigated to determine the way in which nutrient and methane availability impact the methanotrophic population.

Sedimentary δ^{15}N signal represents the labile rather than bulk nitrogen pool

Yuanyuan Huang, Stefan Gerber

Human activities have doubled the preindustrial inputs of reactive nitrogen into the earth ecosystems and increased the uncertainties in future nitrogen cycles. Stable nitrogen isotope values (δ^{15}N) in lake sediments have long been considered as a promising integrator of nitrogen cycles at ecosystem scale over centuries. However, we don't know whether the signal is an effective representative of the whole ecosystem nitrogen pool. We make use of sedimentary record data from 25 lakes in remote northern hemisphere and built a process based model framework to test the robustness of using δ^{15}N as a whole ecosystem integrator. We assume the ecosystems are in steady states before industrialization. For post-industrialization, with changing amount of nitrogen inputs and δ^{15}N, we set up models in 4 scenarios considering different responses of losses out of the ecosystems. Our modeling results over 25 lakes suggest coherently that it is unlikely for the signal to be a uniform representative of the overall N pool in the ecosystem. Instead, a constant or changing labile pool fits into the observations more robustly. Our systematic analysis points to the limits of sedimentary δ^{15}N as an integrator over the bulk nitrogen pool and caution must be taken when reconstruct nitrogen cycling from sedimentary δ^{15}N data.

Florida Wildfires during the Holocene Climatic Optimum

The Holocene climatic optimum (HCO) is one of the most recent cases of global warming available in geologic records. Paleodata show that there were complex responses from the biosphere as a result of this warming event. In Florida, a series of shifts in pollen abundances of *Quercus* and *Pinus* are observed over the last 60,000 years. Fire is believed to have played a major role in these shifts but has yet to be analyzed or correlated with Florida's pollen history. Fire frequency, as calculated from a dynamic global vegetation model, was approximately 20% greater during the HCO compared to pre-industrial values. Here, we use macroscopic charcoal as a fire proxy in Newnans Lake to empirically determine if the number of fire events increased during the HCO. A 3.9m core from Newnans Lake averaged about 3.5 charcoal particles per cm^3. We found that at a depth interval between 300-380cm the number of charcoal particles per cm^3 doubled. Our next steps are to perform analysis of pollen abundances and date the core based on 14C to find indications of a wildfire-vegetation shift during the HCO. Our results will help to determine the interdependencies of fire and vegetation composition under future scenarios of global warming.

Abbreviations: HCO=Holocene Climatic Optimum

Authors: Kalindhi Larios, Stefan Gerber, Mark Brenner, Francis Putz

Imidacloprid Fate and Transport in Florida Flatwoods Soils during Control of the Asian Citrus Psyllid

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ABSTRACT

The Asian citrus psyllid (ACP) *Diaphorina citri* Kuwayama is the primary vector of citrus greening disease. Imidacloprid (IMD) is a pesticide used to control ACP. IMD s*orption* and *degradation* studies in Immokalee Fine Sand soils showed a weakly-sorbed (K_{OC} 230) and persistent insecticide ($t_{1/2}$ 0.9-2.3 years) with high potential for leaching in SW Florida Flatwoods. *Field experiments* in young non-bearing 'Hamlin' orange trees were conducted during 4 growing seasons between 2011 and 2013. IMD and Br^- tracer were soil-drenched in the root zone (PA), and in a control zone without roots (NPA). IMD concentrations (µg g $soil^{-1}$) as a function of time were higher in the NPA than PA due to *plant uptake*. *Br^- tracer* leached out of PA about 1 to 2 weeks after application. IMD *leached out* of PA about 3 to 4 weeks after application during summer, and about 6 to 8 weeks after application during spring. Nonetheless, there was an effective *systemic control* of ACP at about 2 weeks after application, where treated trees showed consistently lower ACP adults and immatures infestation compared to untreated trees. This trend continued for at least 8 weeks. A method to analyze IMD from *citrus tissue* (ng g^{-1}) was developed using HPLC-MS/MS detection, and the data are in close agreement with our findings in soils and ACP counts. Close monitoring of irrigation and rainfall is very important to avoid IMD leaching problems in SW Florida Flatwoods soils, and to ensure proper systemic control of the ACP.

Improving Algal Harvesting Methods: Cultivation of Filamentous Algae Spheroids

Tommie Brent Lovato[1] and Ann C. Wilkie[2]
[1] Biology (CALS), University Scholar
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Harvesting is a key challenge in the algal bioremediation of wastewaters and simultaneous production of biomass for renewable fuels. Energy-intensive centrifugation is required to harvest the suspended microalgae that are most commonly used in the remediation process. By cultivating filamentous algae for biofuels and remediation, harvesting techniques that take advantage of their unique morphology and an observed ability to form spheroids under certain mixing conditions can be implemented. Algae of several filamentous genera (*Rhizoclonium*, *Cladophora*, *Pithophora*) and a polyculture were tested for their potential to form spheroids, which can be cultivated in suspension and harvested by straining. Results showed that all genera cultivated could be induced by orbital mixing after homogenization by blending to form spheroids of approximately 10 mm in diameter. Additional experiments with homogenized *Rhizoclonium* in an airlift reactor yielded larger spheroids, with an average of 15 mm diameter observed. The results of both experiments indicated that the shape of the flask in conjunction with the volume of the media used might have integral roles in forming the spheroids. The ability of filamentous algae to form spheroids has significant potential to improve the efficiency of algae biomass harvesting.

Effects of different land uses on base-flow nitrogen concentrations on the main campus of University of Florida

Authors: Jiexuan Luo, Dr. George Hochmuth, Dr. Mark Clark

Export of nitrogen (N) from different watersheds across the United States is receiving increasing attention due to the impairment of water quality in streams. Researchers have indicated that different land uses exerted a substantial influence on the water quality. A nitrogen budget based on different land uses is being developed to quantify the N inputs and outputs in base flow at the University of Florida in Gainesville, FL. Unlike large watersheds in other studies that involve mixed land uses with a dominating land use, this study focuses on several small sub-basins, each with a single land use. This approach eliminates the effects from mixed land uses by identifying the specific storm drainage system. Land uses have been classified in this study based on the different practices: urban with reclaimed water irrigation, urban without irrigation and recreation with fertilization. The hypothesis in this study is that the recreational land use with fertilization and irrigation will result in the greatest N loads in the runoff, and should receive priority attention for nutrient management in the university in the future. Water samples and flow volume measurements are being taken in both urban study areas and the recreational study area with fertilization. Flow in the recreational study area without fertilization will be estimated based on the other recreational study area The results showed that runoff from the fertilized recreational area can contain nitrate-N concentrations up to 23.9 mg/L with an average of 14.9 mg/L , the average nitrate-N concentration from the urban with reclaimed water irrigation was 1.03 mg/L, the nitrate-N concentration in the runoff from the urban without irrigation was 0.5 mg/L. The estimated load from the urban with reclaimed water irrigation is 6.4g/day, urban without irrigation is 0.14g/day, recreational land use is 13.8g/day.

THE RESPONSE OF MICROBIAL COMMUNITIES TO SHIFTING NUTRIENT LIMITATIONS IN THE FLORIDA EVERGLADES

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The Everglades is a naturally oligotrophic system that has been subject to phosphorus (P) enrichment from the Everglades Agricultural Area to the north. Resultant shifts in vegetation communities, enzymatic activities, and nutrient cycling have been documented between impacted and unimpacted sites, and indicate a shift from the natural P-limitation at unimpacted sites to nitrogen (N) limitation at impacted sites. Alleviation of P-limitation and shifts to N-limitation resulted in changes in the composition of functional genes within microbial communities. Through Geochip 3.0 microarray analysis, a suite of functional genes responsible for C cycling, P cycling, and N cycling were found in varying abundances between sites. The ratios of selected gene abundances along the gradient were found to be consistent with the shifts in nutrient limitation. Further work is being conducted to better understand the dynamics of phosphorus-cycling genes at these sites. Microarray analysis found genes for exopolyphosphatase, polyphosphate kinase and phytase along the gradient. Additionally, genes for high substrate affinity phosphatase (*phoX*) and genes associated with C-P lyase (*phnD*) were found along the gradient as well, through PCR and transcriptomic techniques. By coupling microarray analyses with transcriptomics, we hope to provide a more comprehensive picture of the response of microbial communities to shifting nutrient limitations in peat-based systems such as the Everglades.

Managing Expectations: Creating a community based stormwater pond nutrient management program

Authors: Charles Nealis, Mark Clark, Paul Monaghan

Stormwater basins and ponds are often used in developed landscapes to attenuate increased rainfall runoff and mitigate for increased contaminate loads. However, in many communities stormwater ponds are perceived as lakes and homes adjacent to ponds are often marketed at a premium as "lake-front" property. Homeowner expectations and aesthetic demands for these "lakes" are therefore different and drive management decisions in the ponds that often include the use of algaecides and herbicides to suppress excess plant growth responding to elevated nutrient inputs from the watershed. Suppressing the biological response often allows homeowner expectations to be met, but can reduce nutrient retention mechanisms within the pond resulting in nutrient release downstream. New management strategies and tools are necessary to address homeowner expectations while minimizing downstream impacts. To develop these strategies a better understanding of homeowner expectations and tolerance thresholds of plant growth is required as well as an understanding of the biogeochemical relationship between nutrient stimulus and biological response in stormwater ponds. To develop this relationship and assess homeowner expectations of ponds, a large development in west central Florida (Lakewood Ranch) was selected as a case study. Thirty six ponds were or will be sampled in May, July, August and September 2013 for water column nitrogen (NH_3-N, NO_x-N, TKN), phosphorous (Ortho-P, TP), and chlorophyll-a concentrations. Pond biological characteristics including filamentous algae coverage, SAV coverage, littoral zone characteristics and shoreline characteristics will also assessed. A subset of 12 ponds exhibiting a range of water quality conditions found in the initial 36 ponds will then be sampled for 8 additional months. To associate pond conditions to expectations, a survey will be conducted with residents to identify thresholds of biological responses in the ponds considered acceptable by residents. Biological response thresholds will then be linked to nutrient levels within the ponds, creating a numeric nutrient target that is compatible with homeowner preference of biological response with little or no herbicide suppression. Research findings will improve managers' ability to identify water quality conditions that would result in undesirable biological conditions in ponds thereby focusing management decisions on appropriate nutrient sources controls while minimizing the need for herbicide treatments and maintaining pond function to minimize downstream release of nutrients.

Effect of Temperature and Fertilization Method on Soil Respiration and Fate of Maize Carbon in Cropland Soils of Northeast China

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Abstract:
Temperature and nutrient availability are two key factors regulating the long-term storage of soil carbon (C). We tested the importance of these two factors on the decomposition of soil C and added maize straw in a one-year incubation experiment at two temperatures (18^{o}C and 25^{o}C) for two agricultural mollisols (black and brown soils) which been fertilized either conventionally or through manure amendment. Soil respiration rates were significantly affected by soil type, fertilization type, and temperature (P<0.001). There were also significant interactions between soil type and fertilization, and fertilization and temperature, while there was no significant interaction between soil type and temperature, and soil type, fertilization and temperature during the first month. During the second month, significant effects were observed for only soil type, fertilization and the interactive effect of soil type and fertilization. For temperature sensitivity (Q_{10} values), during the first month there were significant effects (P<0.01) of soil type and fertilization, while there was no significant interactive effect from the interactive factor between soil type and fertilization. These effects were diminished during the second month of the experiment, there was no significant effect from the factors of soil type, fertilization and the interactive factor between soil type and fertilization method. Temperature sensitivity (Q_{10} values) differed between the two soil types with black soils showing a declining trend in during the first two months, while brown soil had higher Q_{10} values in no-manure treatments. The data from this study will help better understand C emissions due to temperature variation in agricultural soils receiving manure amendments.

Effect of soil type, fertilization and temperature on soil respiration during the first month (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, NS: Not significant)

Parameters	CO2-C respiration rate
Soil type	***
Fertilization	***
Temperature	***
Type*Fertil	***
Type*Temp	NS
Fertil*Temp	***
Type*Fertil*Temp	NS

Effect of soil type, fertilization and temperature on soil respiration during the second month (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, NS: Not significant)

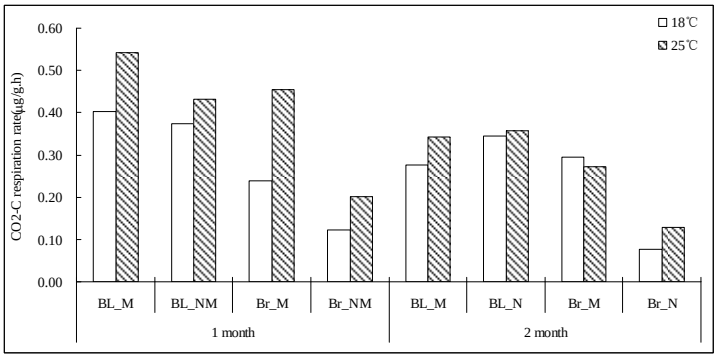
Parameters	CO2-C respiration rate
Soil type	***
Fertilization	***
Temperature	NS
Type*Fertil	***
Type*Temp	NS
Fertil*Temp	NS
Type*Fertil*Temp	NS

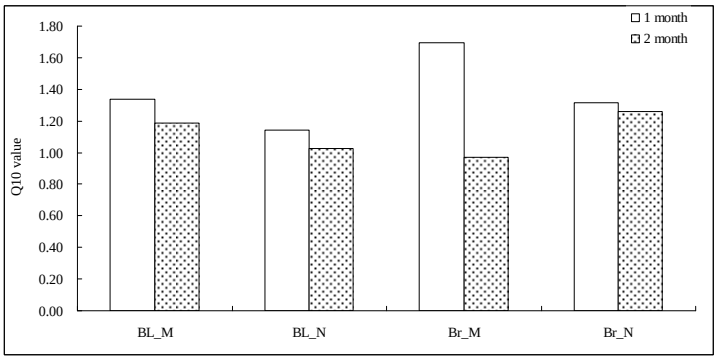
Effect of soil type and fertilization on Q10 value during the first month (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, NS: Not significant)

Parameters	Q10 value
Soil type	**
Fertilization	**
Type*Fertil	NS

Effect of soil type and fertilization on Q10 value during the second month (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, NS: Not significant)

Parameters	Q10 value
Soil type	NS
Fertilization	NS
Type*Fertil	NS





CO2-C respiration rate

Q10 value

Title: **A comparison of analytical laboratory and optical in situ methods for the measurement of nitrate in north Florida water bodies**

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Assessing the impact of nutrient concentrations on aquatic ecosystems requires an in depth understanding of dynamic biogeochemical cycles that are often a challenge to monitor at the high spatial and temporal resolution necessary to understand these complex processes. Traditional sampling approaches involving discrete samples and laboratory analyses can be constrained by analytical costs, field time, and logistical details that can fail to accurately capture both spatial and temporal changes. Optical in situ instruments may provide the opportunity to continuously monitor a variety of water quality parameters at a high spatial or temporal resolution. This work explores the suitability of a Submersible Ultraviolet Nitrate Analyzer (SUNA) produced by Satlantic, to accurately assess in situ nitrate concentration in several freshwater systems in north Florida. The SUNA was deployed to measure nitrate at five different water bodies selected to represent a range of watershed land uses and water chemistry in the region. In situ nitrate measurements were compared to standard laboratory methods to evaluate the effectiveness of the SUNA's operation. Other optical sensors were used to measure the spectral properties of absorbance, fluorescence, and turbidity (scatter) in the same Florida water bodies. Data from these additional sensors were collected to quantify possible interferences that may affect SUNA performance. In addition, data from the SUNA and other sensors are being used to infer information about the quality and quantity of aqueous constituents besides nitrate. A better understanding of the capabilities and possible limitations of these relatively new analytical instruments will allow researchers to more effectively investigate biogeochemical processes and nutrient transport and enhance decision-making to protect our water bodies.

Incorporating microbial physiology into soil organic carbon (SOC) decomposition models

Authors: Debjani Sihi, S. Gerber, K Sharma Inglett, and P. W. Inglett

Models that predict SOC decomposition based on microbial physiology suggest that an increasing temperature stimulates microbial and extracellular enzyme activity and thus increase SOC loss. However, attenuation of SOC mineralization rate could result from thermal acclimation in microbial physiological properties to warming, which is not investigated in detail in contemporary SOC decomposition models. We tested a series of mathematical models to understand the interdependencies of enzyme activity, dissolved organic C (DOC) production and consumption, and microbial (MBC) growth in order to get stable solutions for C pools (SOC, DOC, and MBC). In our model, a substrate (SOC) is converted to DOC and taken up by the microbial biomass. Microbes influence this flow by the ingestion of DOC and by production of extracellular enzymes that solubilize SOC into DOC. Using a single pool for microorganisms, we find that microbial processing of SOC is not limited by enzyme concentration, but rather enzyme activity. The MBC pool is directly proportional to the production of DOC and inversely related to the coefficient that affects the production of metabolic by-products (CO_2 and CH_4). Our analytical solutions suggest that we need to consider the responses of microbial physiology to warming in order to analyze the resulting rates of decomposition. In a next step, we will combine our solutions to measures of kinetic parameters (V_{max} and K_m) of extracellular enzymes and MBC to estimate SOC processing in upland and wetland system as a result of climate warming.

Soil Carbon Storage and Persistence Across a Chronosequence of Management Intensive Grazing Dairies, an Emerging Land Use Practice in East Central Georgia.

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A comprehensive understanding of carbon dynamics and climate change is critical as population grows and fertile land becomes increasingly scarce. Management intensive Grazing Dairies (MiGD) are expanding on row crop fields across the southeastern US, and generally result in a substantial and rapid increase in soil carbon. Thus far, the soil C accumulation rate has been 7.4 Mg C ha^{-1} yr^{-1} and persists for at least the first 6 years of conversion. Here we assess the persistence of this accumulated soil carbon by measuring CO_2 loss from a set of controlled soil column irrigation experiments. Column experiments were designed by placing replicated (n=3) intact A soil horizons across an MiGD chronosequence, and into 10 cm I.D. ABS cores fitted with a draining end-cap containing a glass fiber filter (Whatman GF/D) and 5 cm length of acid-washed pre-combusted glass wool to aid in drainage. Cores were irrigated weekly with simulated rainwater based on hourly precipitation totals from a nearby weather station. Results from this experiment will help address the extent to which these MiGDs retain soil carbon over longer timescales, an important dimension of the future growth of MiGDs and consequently improve understanding of carbon dynamics in the SE region. The scalability of this project should make it beneficial for future study of land use changes on the carbon cycle across the SE.

SbIII and SbVuptake and efflux by *Pteris vittata* and *Pteris ensiformis*

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Abstract

- **Despite being chemical analogs, antimony (Sb) and arsenic (As) are taken up and translocated differently in plants.**
- **As-hyperaccumulator *Pteris vittata* (PV) reduces AsV to AsIII before translocating it to the fronds whereas Sb is mainly accumulated in the roots.**
- **This study compared Sbuptake by *P. vittata* and *Pteris ensiformis* (PE; non As-hyperaccumulator).**
- ***P. vittata* took up more SbIII than SbV, with Sb being mainly accumulated in the roots.**
- **Sb speciation in the roots was determined after extraction using citric acid, which recovered 73-104% of the total Sb.**
- **There was 62-71% SbIII in PV roots compared to 81-82% in PE roots.**
- **Since only ~20 and 17% of the root Sb was effluxed into the media by PE and PV, Sb efflux was not a main detoxification mechanism.**
- **PV can be applied to phytostabilize Sb-contaminated soils as it accumulates Sb in the roots with limited efflux.**

Characterization of Soil Organic Nitrogen Pools in Subtropical Wetlands

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A large proportion of bioavailable nitrogen (N) to biological communities is in the form of soil organic N (SON). Although approximately 95% of soil N is in the organic form, SON pools are not well characterized. This study compares SON pools along an existing phosphorus (P) gradient in the Water Conservation Area 2A (WCA-2A), Florida Everglades. Anthropogenic drainage, channelization, and nutrient loading in the WCA-2A have resulted in changes in soil nutrient concentrations (specifically P) and shifts in vegetation communities. We hypothesize that N/P ratios will decrease with increasing P enrichment; however, the proportions of labile and nonlabile organic N pools will remain the same throughout the P gradient. To test this hypothesis, floc-soil cores were obtained from enriched, intermediate, and unenriched P sites and separated into floc (unconsolidated detrital material) and 10 cm soil increments up to 30 cm. Gross soil organic N pools were determined by the diffusion method, with modification, to separate N pools into total hydrolyzable N, NH_4-N, amino sugar N, amino acid N, and acid insoluble N. In conjunction with gross soil organic N pools, use of mass spectrometry resulted in qualitative identification of specific organic N compounds. Results suggest P enrichment has led to an increase in acid hydrolyzable (labile) N. The shift towards labile N with P enrichment may affect the overall SON pool and source of N to biological communities, resulting in changes in ecosystem structure and function. Further research will include nuclear magnetic resonance to quantitatively characterize functional SON groups.

Sugarcane (*saccharum officinarum*) water use in Florida's sandy soil with subsurface drip irrigation

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Sugarcane (*saccharum officinarum*) production in Florida is the fourth largest commodity with approximately 14 million sugarcane metric tons per year. Understanding of proper irrigation management in sandy soils is crucial due to the increasingly stringent water management required by the state government given the expected increase of sugarcane planted area. Drip irrigation is an alternative worthy of consideration for sugarcane production to promote higher water use efficiency compared with current seepage irrigation practices. Root distribution enhanced by uniform water distribution play an important role in crop water uptake. A drip irrigation study is been conducted at a commercial sugarcane planting with three different emitter spacing (31 cm, 46 cm, and, 61 cm). Water uptake was measured using the stem-heat balance method (Dyanamax Inc., Houston, Texas, USA) on four stalks per treatment for a period of 19 d in June and July 2013. Leaf area was greater in the 31 cm spacing ($P < 0.05$) and no differences were found between 46 cm and 61 cm spacing. Total water use was 80% higher in the smaller emitter spacing (31 cm) than the largest spacing (61 cm) treatments. Significant differences ($P < 0.05$) were found in average daily water use in the following order 31 cm> 46 cm> 61 cm. The water uptake peak during the day was recorded from 12 pm to 6 pm for all treatments. Better water uptake in the smaller spacing can be ascribed to larger leaf area, and similar water and root distribution in the irrigated zone.

Key words: N/A

The interaction between *Phytophthora spp.* and *Candidatus* Liberibacter *spp.* damage to citrus fibrous root

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Phytophthora nicotianae (P. n.) causes the most serious soil-borne disease of citrus worldwide. *P. n*. affects tree health by damaging fibrous roots, which reduces water and nutrient uptake and depletes carbohydrate status of the tree. Populations of P. n. are considered damaging to fibrous roots when density exceeds 10-20 propagules per cubic centimeter of rhizosphere soil. In 2010 and 2011, unprecedented *Phytophthora* populations were reported from Syngenta's statewide soil propagule survey coincident with acceleration in spread and incidence of Huanglongbing (HLB). HLB caused by the phloem-limited bacterium *Candidatus* Liberibacter asiaticus (Las), infects all parts of the tree including structural and fibrous roots. Greater fibrous root loss after inoculation with P. n. for Las positive seedlings compared to non-infected plants demonstrates that the damage caused by the interaction between these two pathogens exceeds that of *Phytophthora* alone, with a much greater portion of the fibrous root damage caused by *Las*. Higher *Phytophthora* infection of roots following *Las* infection suggests that HLB breaks down the rootstock's tolerance/resistance to P. n. Utilizing starch and sucrose status of the roots as a measure of root vitality indicates that the trophic interaction between these two root-infecting pathogens is complex. Differences between two rootstock varieties indicates the interaction of P.n. with Las may vary with rootstock tolerance to *Phytophthora*.

Impacts of Land Use Change on Soil Carbon and Microbial Activities in Subtropical Grassland Ecosystems

Sutie Xu, Julius B. Adewopo, Maria L. Silveira, and Kanika S. Inglett

Abstract

Soil organic carbon (SOC) plays an important role in ecosystem C cycling. Land use management can impact plant and microbial communities, and, therefore, it can also have major effects on SOC stocks. The objective of this study was to investigate the long-term impacts of land use intensification on SOC and microbial community in subtropical grasslands. The experiments were conducted on three land uses in south-central Florida: native rangeland, pine - bahiagrass (*Paspalum notatum*) silvopasture, and improved bahiagrass pastures. All collocated experiment sites exhibited the same topography, soil type, and climate conditions. Soil samples were collected from the 0 to 90 cm depth during the summer and from the 0 to 20cm depth during the winter. Data showed that native rangeland has smaller SOC stocks than silvopasture and improved pasture. Conversion of native rangelands into improved pastures promoted C accumulation in the particulate organic matter (POM) pool. Similarly, microbial activity and potentially mineralizable N concentrations at the 0 to 10 cm depth increased as intensification. Results suggested that proper grassland management practices such as fertilization and grazing management can promote the microbial activity and enhance soil C accumulation in subtropical ecosystems.

Light reflection visualization to determine solute diffusion into clay

Minjune Yang, Michael D. Annable, and James W. Jawitz

Light reflection visualization (LRV) experiments were performed to investigate solute diffusion in low-permeability porous media using a well-controlled two-dimensional flow chamber with a domain composed of two layers (one sand and one clay). Two different dye tracers (Brilliant Blue FCF and Ponceau 4R) and clay domains (kaolinite and montmorillonite) were used. The images obtained through the LRV technique were processed to monitor two-dimensional concentration distributions in the low-permeability zone by applying calibration curves that related light intensity to equilibrium concentrations for each dye tracer in the clay. One-dimensional experimentally-measured LRV concentration profiles in the clay were found to be in very good agreement with those predicted from a one-dimensional analytical solution, with coefficient of efficiency values that exceeded 0.97. The retardation factors (R) for both dyes were relatively large, leading to slow diffusive penetration into the clays. At a relative concentration $C/C_0 = 0.1$, Brilliant Blue FCF in kaolinite (R = 11) diffused approximately 10 mm after 21 days of source loading, and Ponceau 4R in montmorillonite (R = 7) diffused approximately 12 mm after 23 days of source loading. The LRV experimentally-measured two-dimensional concentration profiles in the clay were also well described by a simple analytical solution. The results from this study demonstrate that the LRV approach is an attractive non-invasive tool to investigate the concentration distribution of dye tracers in clays in laboratory experiments.