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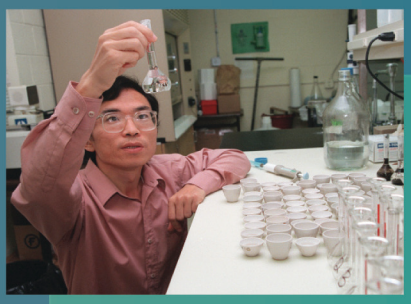

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ABSTRACTS

Oral Presentations

J.W. Reitz Union Auditorium

Influence of Site and Litter Quality on Phosphorus Forms During Leaf Litter Decay in a Subtropical Wetland Marsh.

A.W Cheesman* , P.W. Inglett, B.L. Turner, and K.R. Reddy

The pivotal role of detrital cycling in the phosphorus dynamics of wetlands has long been appreciated, yet changes in the forms of phosphorus during decomposition remain unknown. We used alkaline extraction and solution ^31 P nuclear magnetic resonance (NMR) spectroscopy to follow the of the chemical nature of phosphorus during the decomposition of litter from cattail (Typha spp.) and sawgrass (Cladium jamaicense Crantz) within nutrient impacted and nonimpacted portions of a freshwater marsh (Water Conservation 2A, Florida). The phosphorus composition differed between species and between litter from nutrient enriched and unenriched sites. However, these differences were over-ridden during the course of the study (450 days) by the impact of decomposition and the nutrient status of the site where decomposition occurred. Litter decomposed in the nonimpacted site lost phosphorus to the oligotrophic environment, while at the impacted site clear sequestration of phosphorus occurred, as indicated by the presence of distinct organic (DNA, phospholipids and various monoesters) as well as inorganic (pyrophosphate) groups. Our results provide insight, not only into the forms and rates of phosphorus transformations during the decomposition of organic material in wetlands but also sheds light on the potential stability of those forms under a given range of ambient conditions

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Effect of Green Roof Growing Media and Plant types on Water Retention and Nutrient Loading in Urban Stormwater Runoff in the Subtropics, Gainesville, Florida.

Sylvia Lang, Mark Clark, Samira Daroub

Green roofs are known to reduce rooftop runoff, however little information exists regarding their effect on water quality in the sub-tropics. This study aimed to: 1) determine the optimal growing medium-plant type combination and 2) characterize the effect of green roofs on stormwater hydrology, for the sub-tropics. Three growing media types (UCF, Building Logics and Hydrotech), and four plant types (perennials, runners, succulents and bare medium) were tested for stormwater retention and nutrient loading in a mesocosm experiment in Gainesville, FL. Water retention rates among the 12 plant-growing medium combinations ranged from a low of 24% for Building Logics-no vegetation to a maximum of 83% for UCF-perennials in the 24-week study period. The plant-growing medium combination with the highest TP load was Hydrotech-bare media (3300 mg P m^{-2}) and the lowest was UCF-runners (140 mg P m^{-2}); Hydrotech-succulents had the highest nitrate load (38,000 ± 357 mg m^{-2}) and UCF-bare media had the lowest (4.5 ± 0.9 mg m^{-2}). The initial selection of growing medium type was found to be the most important factor when designing a green roof for minimum nutrient loading and maximum water retention. Results of the green roof monitoring at two extremes of the sub-tropical climate, showed that the mean water retention in small rain events (<0.42 cm) of 79% ± 20% was significantly greater ($p<0.05$) than retention during medium (0.42cm - 0.83cm) and large events (>0.83 cm), 43% and 26%, respectively. There were significant differences in the reduction of the peak intensity among the different size rain events, but none in extension of runoff duration.

Predicting Effects of Management Alternatives on Spatio-Temporal Dynamics of Phosphorus Using a Reactive Transport Model in a Large Subtropical Constructed Wetland of South Florida

Rajendra Paudel[1], Andrew I. James[2], James W. Jawitz[1]

A spatially distributed model was developed to simulate coupled hydrologic and phosphorus (P) biogeochemical processes in one of the treatment cells (i.e., Cell 4) of Stormwater Treatment Area 1 West, and predict the effects of various feasible management alternatives on spatial and temporal dynamics of total P (TP). The P reactive transport model was coupled with Regional Simulation Model developed by the South Florida Water Management District. Internal hydrology and transport processes were calibrated against measured tracer concentrations, and subsequently validated against outflow discharge and spatial chloride concentration data from Cell 4. The calibration and validation of the P model was performed against time series water column TP concentration profiles measured at the outlet structure. Results show that the model's predictions are generally in good agreement with field measurements of outlet TP concentrations (calibration RMSE = 10.5 □g L^{-1}; validation RMSE = 15.6 □g L^{-1}). The TP uptake rate coefficient for open water, channels/ditches which were primarily oriented parallel to the flow direction at Cell 4, and remaining dense SAV areas were estimated to be 0.2 day^{-1}, and 0.4 day^{-1}, respectively. Similarly, the release rate coefficient from soil to overlying water column for the entire Cell 4 system was estimated to be 1.97×10^{-4} day^{-1}. Several scenarios such as smoothing short-circuiting channels/ditches, and changes in external hydraulic and TP loadings were modeled with careful characterization. Furthermore, we investigated the long-term (i.e., 24 years) impacts on soil and water column TP dynamics under current and reduced load conditions. Scenario testing results revealed that the removing effects of channels and ditches can significantly improve the P treatment effectiveness of the wetland (i.e., increased by 24%). Assuming that the inflow TP loads were eliminated after 6-year (1995-2000) historic loading, the model predicted that the annual average concentrations at outlet structure would still be 6.5 □g L^{-1} after 18 years. Sensitivity analyses indicate that the most critical model input factors include flow resistance parameters, initial soil TP content, and P cycling parameters.

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Assessing linkages between soil chemical properties and microbial functions by applying multivariate analytical methods

Rongzhong Ye, Alan L. Wright, and K.R. Reddy

The Histosols of Everglades Agricultural Area were drained in early 1900s and converted to agricultural production, which subsequently altered soil properties. The objectives of this study were to determine how historic land use patterns altered soil chemical properties and how their discriminations regulate microbial community structure and function. Soil was collected from sugarcane, cypress, and uncultivated sites. Cluster analysis and discriminant analysis were applied to determine differences in soil chemistry and microbial community structure and function, while principal components analysis was used to reduce variables. Canonical correlation analysis evaluated dependent relationships between soil chemical and microbial parameters. Soils with different management were perfectly clustered into their own groups, which was highly distinguished by labile inorganic P and total P. Discriminations on integrated soil microbial characteristics were notable. Microbial biomass C and N, community-level physiological profile components, and potentially mineralizable N contributed most to such differentiations. Canonical correlations between soil chemical and microbial indexes were significant on both canonical variates ($R_1 = 0.91$, $p = 0.0006$; $R_2 = 0.65$, $p = 0.03$). Cumulatively, 63% of the variances in microbial indexes were explained by chemical canonical variates. Agricultural management, especially historic P fertilization, altered soil nutrient availability and consequently modified the microbial community structure and function. Land use changes should consider the role of labile P on the functioning of microbial communities and their control of nutrient cycling.

ABSTRACTS

Poster Presentations

East & West Galleries, J.W. Reitz Union

POSTER PRESENTATIONS | JUDGED ENTRIES

Soil Nutrient Storages in the Stormwater Treatment Areas of the Everglades Basin.

Rupesh Bhomia[1], K.R. Reddy[1], Mike Korvela[2], and D. Ivanoff[2]

Stormwater Treatment Areas (STAs) are constructed to reduce phosphorus (P) loads to the Everglades Protection Area (EPA). Six STAs (45,000 acres) were strategically located to reduce P loads to EPA. These STAs have been in operation for varying time periods ranging from 4 to 15 years and are differentiated into cells having emergent and submerged aquatic vegetation. We have used the existing soil chemical data collected by the South Florida Water Management District to determine the capacity of STAs to store P, nitrogen (N), carbon (C). Relationship between C and N storages relative to P was explored for samples collected during water Year 2007 (May, 2006 – April, 2007). The range of C sequestration with respect to P varied from 444 g C/ g P (STA-5, 9 years) to 594 g C/ g P (STA-2, 8 years) in the floc and top 10 cm soil layer. The range of N sequestration with respect to P varied from 46 g N/ g P (STA-1W, 13 years) to 31 g N/ g P (STA-1E, 3 years) in the floc and top 10 cm soil layer. Surface soil accretion represents only recently accreted material and does not represent total accretion since its operation, especially in STAs operated for longer periods. However, in the recently constructed STAs, the 10 cm soil layer may represent historical TP and TC storage. Understanding the rate of soil accretion and identifying factors responsible for long term stability of this sequestered material forms the next step of this research activity.

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Differences in Metal Extractability between Bh and Bt Horizons: Implications for Environmental Assessments

Debolina Chakraborty, Vimala D. Nair and Willie G. Harris

With excessive use of fertilizers soil phosphorus (P) in agricultural lands has increased leading to eutrophication of surface water. Environmental risk of P loss from soils can be calculated from P saturation ratio (PSR), the molar ratio of [P] to [Fe+Al]. P moves from surface horizon and is retained in Bh and Bt horizons. In acidic soils, Fe and Al oxides play vital roles in P sorption and thus in P retention. Al and Fe content in soils can be determined in Mehlich 1(M1), Mehlich 3(M3) and Oxalate(Ox) extractions. The main objective of this study was to evaluate the efficacy of Ox, M3 and M1 for Fe and Al extractions from Bh and Bt horizons. Several Spodosol and Ultisol sites from Florida were sampled by horizon. Soils were analyzed for Fe and Al in M1, M3 and Ox solutions at 1:4, 1:8 and 1:50 soil:solution ratios, respectively. M3 has very poor Fe extraction efficiency compared to Ox for both the horizons. M3 has greater affinity for Al in Bt horizons likely due to presence of NH_4F in the extractant. In spite of having complexing agent (EDTA) and F^-, M3 is inefficient in extracting metals which is complexed with organic matter as in Bh horizons. Ox is more efficient in dissolving organically bound Al from Bh horizons. Soil compositional differences between Bh and Bt horizons result in different metal release characteristics. For estimating retention capacity accurately it may be preferable to use Ox for Bh and M3 for Bt horizons respectively.

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Watershed Nitrogen and Phosphorus Removal Using Algal Turf Technology: A Pilot Study of Processes and Potential Enhancements for use in the Santa Fe River, FL.

K.C. Dinkins[1,2], M.W. Clark[1], P.W. Inglett[1]

The Algal Turf Scrubber® (ATS™) is a commercially available water treatment technology for reducing nutrient concentration and loads in large-scale applications such as lake, river and stormwater systems. In simplest terms, an ATS™ is a sloped floway, designed for the growth of attached algae which is harvested for nutrient removal. This current study will focus on identifying processes affecting algal growth and N and P removal within ATS™ Pilot units receiving Santa Fe River source water at Boston Farms. During Phase I, algal grow-in rates and species composition, as well as inflow/outflow changes in water quality will be monitored. Phase II will follow stabilization of the algal turf community and include spatial and temporal monitoring of algal nutrient composition and water quality characteristics, to identify major processes driving nutrient removal along the floway. Based on results from Phase I and II, a third phase of the study will involve manipulations of one floway to better optimize nutrient removal. The findings from this work will be used to evaluate efficacy of the ATS™ technology for nitrate and phosphorus reduction in the watershed to help meet Total Maximum Daily Load requirements for surface waters.

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Aquatic Nitrogen Fixation: Patterns, Rates and Controls in a Shallow, Subtropical Lake

Moshe Doron[1], J. Hendrickson[2], E. Phlips[1], A. V. Ogram[1], P. W. Inglett[1]

Shallow eutrophic lakes are frequently sources of nutrients to downstream ecosystems. Biological N_2 fixation is one of the key processes affecting lake nitrogen (N) export, but little is known about the factors affecting this process in relation to algal blooms, particularly in subtropical systems. In this project, we investigated the spatial and temporal patterns of nitrogenase activity and diazotrophic community composition in relation to water quality parameters of a large, shallow, subtropical lake (Lake George, Florida, USA). We hypothesized that environmental conditions affecting N and phosphorus (P) concentration, would have an impact on the diazotrophic community (biomass, abundance and composition) and can be used as an estimated portion of lake N budget. We measured nitrogenase activity (via acetylene reduction) from April, 2008 to September, 2008 to assess the potential linkages between diazotrophic community composition (using *nif*D), size (microscopy), function and nutrient availability. Nitrogenase activity ranged from 3 to 95 nmol h^{-1} L^{-1} during the seasonal period, and an overall positive influence of light was observed. Nitrogenase activity was positively correlated with variables such as, dissolved NH_4^+, chlorophyll-a, BOD, DO, DIN:DRP ratio ($P < 0.05$, n=14-19), while a negative correlation was found with nitrate /or nitrite ($P < 0.005$, n=16). Preliminary analysis of *nif*D clone libraries suggests that the dominant genotypes cluster within the filamentous heterocyst order Nostocales, yet principle component analysis indicated significant variation in their genotypes composition (clades level) based on dates and sites. Microscopy revealed a community shift after a bloom event that was followed by a later bloom. The seasonal patterns show that these blooms are episodic, possibly with the availability of P relative to N (as nitrate), and potentially result in a release of the fixed N into the environment as NH_4^+. Studies are ongoing to investigate the seasonal phylogenetic patterns in more detail.

BOD: biological oxygen demand
DIN:DRP :dissolved inorganic N:dissolved reactive P ratio
DO: dissolved oxygen

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Utilizing Native Algae for Biotreatment and Biofuel Production

Scott J. Edmundson[1] and Ann C. Wilkie[2]

The intentional and optimized use of native photosynthetic protists – algae – for the treatment of eutrophied water resources and production of biofuels is an invaluable and underutilized method of waste remediation. Sewage and agricultural wastes are ubiquitous and abundant resources. Treatment of these high-nutrient resources by algae for the generation of biofuels is a novel approach in the production of bioenergy, and can be applied in any locale with human waste impacts. Residual biomass generated from algal photosynthesis can be applied as a soil amendment and slow-release fertilizer for agricultural and horticultural crops. Furthermore, algae can be integrated with anaerobic digestion to increase both the energy produced and treatment effectiveness. In order to accelerate the achievement of ecosystem and water resource sustainability, native photosynthetic algae should be evaluated for remediation effectiveness and biofuel potential. This study identifies several indigenous, wild-type algae with potential applicability in nutrient remediation and biofuel production. Algal production integrated into existing wastewater treatment facilities could improve the energy efficiency and final water quality of waste treatment systems, while lowering greenhouse gas emissions and producing carbon neutral fuel.

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Ca-WTRs Amendment to Stabilize Copper in Acidic Sandy Soils

Jinghua Fan, Zhenli He, P. J. Stoffella, and Lena Ma

Copper (Cu) accumulation in agricultural soils has been accelerated, particularly under fruit production due to repeated application of Cu-containing fungicides. Laboratory incubation and analysis were conducted to determine the effect of calcium based water treatment residuals (Ca- WTRs) application on Cu availability in acidic sandy soils under citrus production in south Florida. Two soils (an Alfisol: fine loamy siliceous hyperthermic Typic Glossaqualfs and a Spodosol: sandy siliceous hyperthermic Alfic Haplaquods) used in the incubation study were collected from two citrus groves in the Indian River area of south Florida. Ca-WTRs were applied at the rates of 0, 5, 10, 20 g kg^{-1} soil to the Alfisol soil and 0, 5, 50, 100 g kg^{-1} soil to the Spodosol soil based on the soil pH level. There were two levels of soil Cu in this study: the original soil with or without enriched with 400g kg^{-1} Cu in the form of $CuNO_3$. At the intervals of 0, 1, 3, 7, 14, 28, 42, 70 d of incubation, subsamples of the incubated soil were collected for analyses of pH, electrical conductivity (EC), dissolved organic carbon (DOC), and extractable Cu determined by (i) 0.01 M $CaCl_2$; (ii) 1M ammonium acetate (NH_4OAc); and (iii) Mehlich-3. At the end of incubation (70 d), soils were also analyzed for Cu fractionation into exchangeable, carbonate-bound, organically bound, oxides-bound, and residual fraction. Labile Cu in the WTRs amended soils decreased gradually during the 70 days incubation time. Labile Cu fractions such as exchangeable and carbonate-bound Cu decreased, while stable Cu fractions such as oxides-bound and residual Cu increased by WTRs amendment. For soil amended with the WTRs at the application rate of 0.5% exchangeable Cu was reduced by more than 63%, as compared with the control (soils without WTRs). For both soils that were enriched with 400g kg^{-1} Cu, WTRs amendment reduced exchangeable Cu in the soil by more than 92%. These results indicate that Ca-WTRs has great potential in stabilizing soil Cu, and therefore, reducing Cu leaching loss and phytotoxicity in acidic sandy soils under citrus production.

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Carbon Pool Dynamics in a Phosphorus-Impacted Wetland (Everglades, FL)

Gardner, L.M.*, K.R. Reddy, T.Z. Osborne, and S. Newman

Wetlands function as a major sink of carbon, but also release C through microbial respiration. Human disturbances, such as hydrologic changes and nutrient additions, often increase the rate at which wetland C is released to the atmosphere. In water conservation area 2A (WCA-2A), a managed hydrologic unit within the Everglades, a historically P-limited wetland is receiving high concentrations of P. The goal of this study was to determine if anaerobic respiration and the character of the C pools differed between eutrophic (P-impacted) areas and oligotrophic (unimpacted) areas of the wetland. Results indicate oligotrophic soils (0-10cm) store the most TC (μ=3341g C m^{-2}) and organic C represents >97% of the TC at all sites. Anaerobic CO_2 and CH_4 production was significantly greater in the oligotrophic detritus than all other sites ($p<0.05$). The mass of C lost to anaerobic respiration annually represents between 32% (oligotrophic detritus) and 2% (oligotrophic soil) of the TC pool, with turn-over rates from anaerobic respiration between 4 and 67 years, respectively. Neither CO_2 nor CH_4 production was correlated with TP, but CO_2 was positively correlated with liable OC ($p<0.001$). On average, 73% of the anaerobic C produced was as CO_2-C, and 27% as CH_4-C. Overall, the TC pool of the soil is significantly larger and more stable than that of the detritus. TP no longer appears to drive anaerobic respiration, but rather liable C availability. As a result, oligotrophic detritus (characterized by periphyton) has the highest rate of C production and the fastest C turn-over rate.

Characterization of arsenic-resistant rhizosphere bacteria associated with arsenic hyperaccumulator *Pteris vittata* L.

Piyasa Ghosh [1], Bala Rathinasabapathi[2] and Lena Ma[1]

Chinese Brake fern *Pteris vittata* has an unusual ability to hyperaccumulate arsenic, which makes it useful for phytoremediation of arsenic-contaminated soil and water. Since rhizosphere bacteria may influence arsenic uptake and nutrient uptake of the fern, our study is focused on the isolation and characterization of arsenic-resistant bacteria. Rhizosphere soil from naturally growing *P. vittata* were evaluated. They were collected from four sites in Florida, an arsenic-contaminated site (Site As), feed store (Site FS), Archer (Site Ar), Rainbow Springs (Site RS) and a dolomite mining site crystal quarry (Site CQ). The soils when incubated with nutrient medium and 1 mM of arsenate (AsV) reduced AsV to arsenite (AsIII), and when incubated nutrient medium and 1 mM of AsIII oxidized AsIII to AsV, suggesting the presence of bothAsIII oxidizing and AsV reducing microflora. One isolate from site As and five from site CQ were identified by plating bacteria on modified Luria Bertani medium with 10 mM Sodium arsenate. All of these isolates were fluorescent under UV and this was promoted by AsV for one isolate. The rhizosphere bacteria isolated in this study could be of potential utility for improving nutrient and AsV uptake by the fern.

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Assessment of natural, fill, and future submerged substrates on *Halodule wrightii* transplant success in two South Florida ecosystems

Luke Gommermann[1], Larry R. Ellis[1], Todd Z. Osborne[1], Thomas K. Frazer[2]

Seagrass populations require a suite of environmental parameters for their growth, including sufficient light, water column, and substrate characteristics. While species of seagrasses are observed growing in a broad spectrum of substrate types, studies have demonstrated contrasting survivability of transplants in treatments differing in substrate texture or organic matter content. To better understand the role these substrate characteristics have on seagrass restoration success in the coastal environments of South Florida, I compared the growth of seagrass transplants between pots containing substrates of differing textural classes and organic matter contents. These treatments were designed to represent potential fill materials for mitigation efforts or natural substrates of restoration sites that may be used in future seagrass re-establishment efforts in South Florida. *Halodule wrightii* transplants, a pioneering seagrass species found throughout the Caribbean and along the southeastern coast of the United States, were utilized for this study. Preliminary results will be compared with the natural substrate and seagrass characteristics of sites near Fort Pierce, Florida and Key Largo, Florida. Additionally, substrate treatments consisting of soils and sediments facing future submergence from sea-level rise will be assessed for their capability to support *H. wrightii* transplants.

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Pre-treatment of Food Waste to Facilitate Anaerobic Digestion

Ryan E. Graunke[1] and Ann C. Wilkie[2]

Increasing fossil fuel use and waste disposal in landfills have led to a situation where society must develop sustainable energy and waste solutions. Use of synthetic fertilizers derived from fossil fuels has increased substantially, placing further demand on natural resources and the environment. Anaerobic digestion of organic waste can simultaneously alleviate these problems. Through anaerobic digestion, organic material is decomposed by microbes to produce a sustainable bioenergy (biogas) and biofertilizer for organic agriculture. Anaerobic digestion maintains overall carbon and nutrient balances by recycling these resources from waste rather than using fossil fuels and raw materials. One excellent organic feedstock for anaerobic digestion is food waste. In Florida, 1.7 million tons of food waste was produced in 2006, representing 6% of the municipal waste stream. By diverting food waste from landfills to anaerobic digestion, many problems associated with landfills will be alleviated, including methane emissions, leachate treatment, space availability, odor, and nutrient lock-up. Anaerobic digestion can also help meet Florida's 75% recycling goal. The purpose of this project is to develop methods of pre-treating food waste to facilitate anaerobic digestion. By solubilizing food waste prior to digestion, the overall process efficiency increases due to improved microbial processes. Treatment methods will be selected with particular attention to sustainability, such as enzymatic and/or bacterial treatment and mechanical grinding. The solubilized COD pre- and post-treatment will be measured to determine the effectiveness of the treatment. Treatments will be assessed for large-scale applicability and feasibility to increase the widespread adoption of food waste digestion.

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Factors Controlling Long-Term Phosphorus Removal in Six Large Constructed Treatment Wetlands in the Everglades Basin, Florida.

Jerauld, M. J.* and Jawitz, J. W.

Over the past 15 years, the South Florida Water Management District has constructed 6 treatment marshes, called Stormwater Treatment Areas (STAs), to capture the phosphorus (P) from agricultural runoff before it enters the Everglades, an oligotrophic wetland susceptible to anthropogenic eutrophication. Because of the massive investment to construct these 18,000 ha wetlands, it is important to evaluate their long-term sustainability and to identify the STA components, processes and parameters that regulate P retention. Period-of-record hydrologic and water quality data are analyzed here to evaluate the impacts of various factors on treatment performance. Outflow P concentration was jointly controlled by areal P loading rate and inflow P concentration. Phosphorus mass removal effectiveness (PMRE) was not correlated with estimated wetted area*time, depth distribution or hydraulic residence time. Water column P forms were removed differentially in the STAs, but the composition of the influent TP pool did not predict PMRE. Removal of P was well correlated with the removal of calcium (Ca) but not correlated with Ca loading. Of the wetland components currently manageable by the District, only the areal P loading rate was found to affect outflow concentrations. The highly stochastic nature of the currently available datasets is a limiting factor in the illumination of process-level P dynamics that may be necessary to explain the apparent variability.

Irrigation Scheduling Affects Root Length Density Distribution in 3 Year-Old Citrus

Davie M. Kadyampakeni

Citrus is one of the most important crops in Florida with a value of production, from recent estimates, in the range of $1.2 to $1.5 billion dollars per season. Use of microsprinkler irrigation in citrus is a common practice but use of drip is not well documented. The use of automated irrigation systems and intensive nutrient management called OHS is critical to managing citrus greening disease and to achieving increased tree growth and yield. Adequate root volume in the restricted irrigation zone under drip irrigation will be critical to implementation of this new production system. A study on 3 year-old citrus was conducted to (1) determine the effect of irrigation frequency on RLD distribution and (2) determine patterns of root length density distribution as a function of soil depth and distance from the tree. Treatments were as follows: (1) Conventional practice –irrigated weekly and dry granular fertilizer applied quarterly; (2) Drip OHS – irrigated and fertigated daily in small pulses; (3) Microsprinkler OHS – irrigated daily and fertigated weekly. The microsprinkler OHS showed that RLD was greater in the irrigated zones of the tree with increased RLD near the tree. In the drip OHS, RLD tends to be higher just below the dripper and decreases with distance away from the tree and the dripper. In all the treatments, RLD decreased with soil depth. RLD was higher in the 0-15cm than the 15-30cm horizon.
Abbreviations: OHS-Open hydroponics system, RLD-Root length density

The Impact of Vegetation Type On Denitrification Activity in the Tributary Sediments

Haryun Kim, Andy Ogram, and Ramesh K. Reddy

A woody plant has a perennial stem that is above ground and covered by a layer of thickened bark and adapted to survive from one year to the next; as a result, the stem supports continued vegetative growth above ground from one year to next. However, herbaceous vegetation type has low C:N ratio and lignin content, resulting in easily decomposition. It can be expected that the difference of vegetation type can drive the rate of litter decomposition, which can influence the level of available carbon to denitrifiers. In order to explain the impact of different vegetation type on the supply of organic carbon content to denitrifiers in the tributary sediments, the cellulase, β -glucosidase and phenolic oxidase enzyme activities were measured with sediments and litters. Our results showed that the tributary sediment surrounded by woody vegetation had lower cellulase activities in litters and sediments than the tributary sediment surrounded by herbaceous vegetation type. Generally, the herbaceous litter in grasslands has a relatively low C:N ratio since it contains more nitrogen than woody species. Therefore, higher nitrogen content of herbaceous plant could drive more active cellulase activities in the tributary sediments and litter. In case of phenol oxidase, the change of activity was observed in the sediments; however the difference was not significant. Potential denitrification activity in the tributary sediments surrounded by herbaceous vegetation was higher than that of woody vegetation system. Therefore, the difference vegetation type can determine the level of labile carbon source, which could drive the denitrification activity in tributary sediments.

Bacterial quorum sensing signaling and enhancement of coral settlement and recruitment

Cory J. Krediet[1, 2*], Ali Al-Agely[2], Koty Sharp[3], Kim B. Ritchie[2,4], Mikhail Matz[5], and Max Teplitski[2]

The settlement cue perceived by coral larvae is currently unknown. Coral larvae prefer to settle on substrates that are colonized by coralline algae or by mats (biofilms) formed by coralline algae and associated microbes. Formation and function of microbial biofilms involves quorum sensing (QS) signals (acyl homoserine lactones, AHLs). Both bacteria and eukaryotes produce vitamin signals with newly discovered functions in QS and host-microbial interactions. We tested a hypothesis that known signals commonly associated with microbial biofilms may function as settlement cues for larvae of stony corals. These settlement experiments involved short and long chain AHLs, lumichrome and riboflavin, each compound is known to function in bacterial cell-to-cell communication. Acyl homoserine lactones (AHLs) and a riboflavin derivative lumichrome are also involved in interactions between bacteria and their eukaryotic hosts. These molecules have also been shown to contribute to settlement or metamorphosis of marine organisms. Presence of AHLs, lumichrome and riboflavin in coral-associated microbes and in coralline algae was investigated. Their role in settlement was investigated using two complementary approaches. First, transgenic microbial biofilms expressing AHL-lactonase were constructed to test the consequences of AHL hydrolysis in larval settlement. Chemicals were also impregnated onto C18-bonded silica resin to simulate biologically-relevant release rates of the compounds into the medium during the settlement experiment. Three settlement experiments were carried out to date with larvae of *Acropora palmata*, *Montastraea faveolata* and *Porites astreoides*. A strong correlation between the treatments and settlement rates has yet to be elucidated. Although, the presence of bacterial biofilms led to significantly higher settlement of *P. astreoides* larvae than unconditioned treatments.

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Impact of the Arsenic Hyperaccumulator Pteris Vittata on Arsenite Oxidation in the Growth Media

Shiny Mathews

Arsenic is present in the environment in two predominant forms AsIII (arsenite) and AsV (arsenate). Both forms are taken up by the arsenic hyperaccumulator Pteris vittata. Three separate experiments were conducted to understand the effect of P. vittata on AsIII oxidation in the growth media; P. vittata grown in 1) 0.27 mM AsIII solution for 8 d under constant aeration; 2) 0.10 mM AsIII solution for 14 d under sterile condition; and 3) excised P. vittata roots sonicated in solution for 2 h which was then boiled or filtered to remove enzymatic or microbial effect before adding in solution containing 1.3 μM AsIII and 1.3 μM AsV for 8 d. Arsenic speciation was monitored in the growth media. Without P. vittata, AsIII in the growth media was stable under aeration for 8 d. With P. vittata, 60% of the AsIII was oxidized to AsV after 1 d and 100% after 2 d. It is possible that both P. vittata and microbes contributed to AsIII oxidation. Under sterile condition, no As III oxidation in the media occurred with P. vittata even after 14 d, indicating microbially-mediated AsIII oxidation in the media. Approximately 23% of the AsIII was oxidized by the excised roots after 1 h and 100% after 4d. Boiling or filter sterilization resulted in lower AsIII oxidation (~20%), supporting a predominant microbial role in AsIII oxidation in the growth media. This study demonstrated that AsIII was unstable in growth media and microbes not P. vittata were primarily responsible for AsIII oxidation in the growth media.

Effect of Peat-based Substrate and Irrigation Cycles on the Residual Activity of Sodium Hypochlorite

Dustin P. Meador

Recycling of irrigation water increases water use efficiency, but can also increase the risk of disease transmission to crops. Water sanitation systems are therefore required that combine filtration, sanitizing chemicals, or other technologies such as UV light to reduce pathogen and organic load. The objective of this study was to evaluate the persistence and sanitizing power of the recommended dosage of chemical sodium hypochlorite (using Clorox® Regular-Bleach), collected as leachate during irrigation events. In Experiment 1, free chlorine concentration dropped within 30 minutes from the recommended 2 $mg \cdot L^{-1}$ to near 0 $mg \cdot L^{-1}$ following addition of 0.2 grams (dry weight) of a [70% peat-30%perlite] substrate to 1L of chlorinated water, and total chlorine dropped from 2 $mg \cdot L^{-1}$ to 0.3 $mg \cdot L^{-1}$. Initial solution ORP (730mV) and pH (8.3) decreased with addition of increasing amounts of peat-perlite. In Experiment 2, 500 mL of 2 or 4 $mg.L^{-1}$ free chlorine solution was top-irrigated onto the peat-perlite substrate in 15-cm-diameter (1225 mL) azalea pots. Free and total chlorine concentrations were measured close to zero in the 155 mL of leachate collected from the bottom of the pot. In Experiment 3, chlorine solution was applied through subirrigation events to 15-cm-diameter pots containing peat-perlite. Approximately 25% of the irrigation solution was absorbed by pots, and the concentration in the collection tank dropped from an initial 2 $mg.L^{-1}$ to 1.2 $mg \cdot L^{-1}$ free chlorine in the first subirrigation cycle, dropping to 0.3 $mg \cdot L^{-1}$ with a second irrigation cycle. With each subirrigation cycle, there was an increase in both chemical oxygen demand (14.4 to 45.7 $mg \cdot L^{-1}$ from irrigation cycle 0 to 3) and total suspended solids (0 to 18.3 $mg \cdot L^{-1}$). Results emphasize the rapid decrease in chlorine efficacy with increasing organic load, and the need for both filtration and real time monitoring of chlorine concentration or ORP.

Interactive Effects of Temperature and Vegetation Type on Greenhouse Gas Production in Wetland Soils

Cassandra Medvedeff

Carbon-based greenhouse gas emissions (CH_4 & CO_2) from wetlands are an increasing concern in the context of global climate change, however little is known about the interactive effect of increasing temperature and vegetation types in the process of C gas production. In this study, soils from two sites dominated by *Cladium* or *Panicum* vegetation were incubated from 5 - 35°C for 60 days to quantify the effect of temperature change on peat decomposition and gas production. Similar to other studies, higher temperatures resulted in higher levels of extractable organic C (OC), and increased rates of CH_4 and CO_2 production for both vegetation types. At the highest temperatures, however, *Cladium* soils had higher extractable OC levels and faster CH_4 production rates when compared to *Panicum* soils after 60 days. Despite having lower CH_4 production, Q_{10} values revealed *Panicum* soil CH_4 production was more sensitive to temperature changes. Regardless of vegetation type microbial enzyme activity (peptidase) was negatively correlated with temperature suggesting nitrogen availability may have been involved in the response at higher temperatures. Results of this study indicate the effect of temperature on CH_4 production is more strongly dependent on vegetation type, than was previously thought. This finding has implications both for understanding gaseous C production in high temperature tropical and subtropical wetlands, as well as for predictions of greenhouse gas emission rates based on present and future temperature patterns.

Phosphorus Movement in South Florida Sugarcane Field

Augustine Muwamba

Advisers: Dr. Kelly T.Morgan and Dr. Peter Nkedi-Kizza

Sugarcane requires nutrients which are made available through soil retention and supplemental fertilizer application. Manipulation of water table depths is the most common irrigation and drainage management practice during crop growth. Two 30-acre commercial sugarcane fields in south Florida with two dominant mineral soils, Immokalee fine sand (Spodosol) and Margate fine sand (Entisol), are being used for the study. Manipulations of water table depths can cause movement of P to subsurface water resulting in eutrophication. One goal of this study is to determine lateral P movement to the perimeter ditches and subsurface waters when water reaches the spodic (Bh) horizon and/or limestone of the Spodosol and Entisol soils. The objectives of the study involve; Identification of spatial variability at the field level using soil properties (e.g. organic carbon, pH and total P), monitor P movement and sorption behavior in the soil horizons both in the field and the laboratory, and determine P uptake by the sugarcane crop. Spatial variability studies help to determine P movement according to the distribution of soil properties. Patterns of P concentration in soil horizons collected from the field and sorption/desorption isotherms determined in laboratory will be used to evaluate potential for P movement to surface water. Spatial variability of the fields has been identified using kriged maps indicating significant differences with 30 cm depth increments and high heterogeneity for some soil properties. Preliminary P sorption isotherms for the A horizon have been developed and will be compared with field data collected starting later this year.

Effects of Grazing by Large Herbivores on Soil Phosphorus Forms in Savannah Ecosystem, Kenya

Lucy Ngatia*[,1], Ben Turner[2,] K. R. Reddy [1], T.J. Njoka[3] C.K.K. Gachene[3]

The objective of the study was to investigate labile and non labile P pools of two savannah soils (in black cotton soils and red sandy loams) influenced by the grazing effects of large herbivores. Soil samples were obtained from experimental plots which included: (1) glades versus bushland (2) grazing in the glade and bush (3) control with no grazing. Herbivore exclusion had been practiced for 11 years in the black cotton soils and 8 years in the red sandy loams. Glades are former cattle kraals (boma) which were abandoned for several decades, while bushland is a natural area with shrubs and grasses. Both glades and bushland are currently being grazed by livestock and wild animals. Soil samples (0-10cm) obtained from these plots were analyzed for labile P (resin P, NaHCO3 extractable organic and inorganic P), non labile P (NaOH extractable organic and inorganic P, HCL extractable inorganic P) and total P. Glade and bushland were significantly different at P=0.05 in respect to all P forms. The glades contained 798 mg/kg total P of which 37% was labile P and 59% was non labile P. While the total P in the bushland was 152 mg/kg of which 13% was labile P and 52% was non labile P.

Grazing in the glades led to a positive P forms trend and vice versa for the bushland. In black cotton soils grazed glade plots total P was 808 mg/kg of which 33% was labile P and 58% was non labile P. While in the control all the P forms decreased, the total P was 641mg/kg with 38% being labile P and 66% being non labile P.

In the red sandy loams grazed bushland plots total P was 128.1 mg/kg of which labile and non labile P was 15% and 66% respectively. While in the control all the P forms increased, the total P was 177mg/kg of which labile and non labile P was 15% and 54% respectively.

Frequency of relocation and abandonment of the livestock kraals should be reviewed in order to increase the size of the area with high quality forage and low predation risk.

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Effects of Prescribed Fire on Soil Chemistry of the Pine Rockland in South Florida

Chung Nguyen[1], Yuncong Li[1], James Snyder[2], Rafael Carpena[3], Bruce Schaffer[4], Nick Comerford[5]

Pine Rockland in South Florida is a nutrient-poor ecosystem. Maintaining low nutrient availability in Pine Rockland is necessary for native plants to compete with exotic plants. Prescribed fire is a potential management tool to keep Pine Rockland in a poor-nutrient condition. We hypothesize that prescribed fire will reduce availability of P and other nutrients in calcareous soils under the pine rockland forest. This research was conducted to determine changes on soil pH, CEC, SOM, N, P, K, Mn, Cu, Zn, and Fe after a prescribed fire. This research was carried out both with laboratory incubation and in field burning. In the field, we monitored changes of above components in a two-year period after a fire. In the laboratory, we incubated soil samples in a six-month period. The laboratory incubation included four burning temperatures, three soil moistures, and two levels of fuel loading. Preliminary results will be presented.

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[3] Department of Agricultural and Biological Engineering;
[4] Tropical Research and Education Center;
[5] North Florida Research and Education Center, University of Florida

Anaerobic Digestion for Sustainable Development

Taylor Norrell[1] and Ann C. Wilkie[2]

Anaerobic digestion is the breakdown of organic material by anaerobic bacteria, decomposing it into biogas and nutrient-rich slurry. The biogas is primarily composed of methane and carbon dioxide, and can be used in heating and cooking applications. The remaining slurry can be diluted and used on crops as a nutrient-rich fertilizer to promote growth and restore nutrients to the soil. Processing of human and animal waste by anaerobic digestion results in pathogen reduction, due to the pathogens' inability to compete for food in the oxygen-free conditions inside the digester. Anaerobic digesters can be built from low-cost materials, and require little to no technical knowledge for construction, operation and maintenance, making them an ideal technology to be used in rural settings. This technology has been used in developing regions to treat and manage waste, create a sustainable fuel source for heating and cooking, and create a biofertilizer for agriculture. The focus of this study is to determine the optimal conditions for anaerobic digestion with respect to temperature, pH, and feedstock loading rate and retention time. Establishing these conditions enables the user to maximize biogas production, creating sustainable energy and relieving an important need to any society. The study also sets out to create an operating manual that covers basic construction and operating parameters.

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Fluctuating Water Table Effects on Phosphorus Bioavailability and Fluxes from a Florida Spodosol

Augustine K. Obour[1], Cristiane P. Silveira[2], and Maria L. Silveira[3]

Spodosols in Florida exhibit a unique hydrology with fluctuating water table that can often reach the surface Ap horizon during the summer months. The shallow water table, sandy texture and limited soil P holding capacity facilitates P transport and subsequent environmental problems associated with water quality. We evaluated the effects of fluctuating water table on P availability and fluxes from a typical Florida Spodosol. Treatments consisted of three P rates (0, 5 and 10 kg ha^{-1}) arranged in a completely randomized design. Five suction cup lysimeters were installed in each plot at depths of 15, 30, 60, 90 and 150 cm. The top two lysimeters (15 and 30 cm depth) were located above the spodic (Bh) horizon while the remaining lysimeters (60, 90 and 150 cm) were below the Bh horizon. Two anion exchange membranes (2 x 6 cm) were inserted on each plot at 6 cm depth to determine *in-situ* phosphorus availability during the growing season. The membranes were collected bi-weekly and soluble P determined after extraction in 1 *M* NaCl solution. A pressure transducer was installed at the center of the experimental site to monitor changes in water table depth. During the 2-yr study, regardless of the P rate, leachate P in lysimeters above the Bh horizon increased with increasing water table in the months of August and September. However, leachate P in lysimeters below the Bh horizon remained relatively constant (0.02 mg L^{-1}) during the entire growing season. Similarly, soil P bioavailability for the control plots also increased from 3.2 µg cm^{-2} in June to 9.3 µg cm^{-2} in August when the water table was at the surface. Treatments that received the highest P rate (10 kg P ha^{-1}) showed greater available P in the early part of the growing season (June), however, there was no treatment effect on P availability when water table increased in August .Our results showed that the fluctuating water table conditions experienced during the summer affects P fluxes from the Bh horizon and has a significant effects on P bioavailability.

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Photointerpretation of Ridge Senescence of *Cladium jamaicense* in Water Conservation Area 3A, Florida Everglades

Tae-Goo Oh[1], Mark W. Clark[1], Todd Z. Osborne[1], Matthew J. Cohen[2]

A phenomenon described as sawgrass (*Cladium jamaicense*) die-off, senescence, or decadence has been widely observed in the Water Conservation Areas and Shark River Slough of the Florida Everglades at various times in the last 30 years. Even though our previous survey and scientific observations from other agencies have been reported, only limited quantitative data exist. A reduction in organic matter input to ridge soils due to senescence events may cause a critical change in the soil accretion rates and net primary productivity, which results in the complicate and massive efforts to restore or maintain the ridge and slough mosaic in the Everglades. Therefore, spatial and temporal information about ridge senescence is very important to predict the change of two different ecotypes. The main objectives of this study are 1) to quantify incidence of ridge senescence and the historical prevalence using chrono-sequence of ortho-rectified images and unrectified imageries from previous aerial survey, and 2) to develop the photointerpretation keys for ridge senescence. We selected 4 PSUs (2, 4, 71, and 58) in Water Conservation Area 3A and generated 200 random points in each Probabilistic Sampling Units (PSUs) using ArcGIS program. We set four major categories (ridge, slough, tree island, and disturbed) and seven subcategories (healthy, Type I senescence, Type II senescence, Type II senescence, periphyton, open water, and water lily) to cover entire Everglades area. Each point was carefully examined and counted according to categories. The results showed that 22% of points in PSU 2 indicates Type I senescence which is dominant type of ridge senescence. Also, 25.0 %, 25.5%, and 19.0% of points in PSU 4, PSU 58, and 71 represented type I senescence, respectively.

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An Evaluation of Best Management Practices at the Scale of the Potted Plant, Shallow Groundwater and Surface Water within an Agricultural Plant Nursery in the Santa Fe Watershed.

Casey Schmidt, Mark Clark

Since 1909, with the successful demonstration of the Haber-Bosch process, the triple-bond of elemental nitrogen was broken by humanity which ushered in a green revolution, that has increased food production to such an extent that it is estimated 40% of the world's population owes their life to this process. In the last few decades US fertilizer consumption has increased 20-fold and the Haber-Bosch process has now surpassed worldwide bacterial nitrogen fixation. Demands for food, biofuels and other crops will ensure that nitrogen demand will continue to increase in the future. Within aquatic ecosystems elevated nitrogen has been indicated in chlorophyll a increases, decreased water clarity, increased phytoplankton growth, species composition changes, and fish reproductive morphology modifications in freshwater springs. Best management practices within an agricultural potted plant nursery were evaluated to determine their efficacy in nitrate removal at the scale of the potted plant, the shallow groundwater and streams draining the property. Nitrate loads have been monitored below potted plants, in shallow groundwater wells and on a tributary of the Santa Fe. Modifications in irrigation duration and frequency reduced nitrate leaching below potted plants and increased plant uptake. The efficacy of experimental 'denitrification walls' will be determined at the field-scale and within experimental mesocosms to evaluate this technique as a best management practice for shallow groundwater. Continuing research will involve an evaluation of surface water denitrification enhancements as well as a watershed scale dentrification evaluation.

Hardwood Seedling Growth on Mine Spoil With and Without Topsoil Amendment

Showalter, J.M., J.A. Burger[1]

Advisor: V. Nair

The goal of many owners of reclaimed mined land is to restore the native forest for environmental, economic, and cultural reasons. However, native hardwoods often grow poorly on mined sites because they are planted in unsuitable spoils devoid of native topsoil. In a greenhouse experiment, we examined the suitability of four growth media available on mined sites in the Appalachians: forest topsoil (FT), weathered sandstone (WS), unweathered sandstone (US), and unweathered shale (UH), as well as the effects of topsoil amendment (none vs. amended), on the growth of three native hardwood species: *Fraxinus americana, Quercus rubra,* and *Liriodendron tulipifera*. A 4 x 2 x 3 factorial experiment was conducted with one-year-old seedlings. Tree growth, foliar nutrients, and soil properties were characterized. WS was most conducive to growth for *F. americana* and *Q. rubra. L. tulipifera* did not respond to treatments. Tree growth was highly correlated with mineralizable soil nitrogen and extractable soil phosphorus. Topsoil amendment significantly increased growth on UH, but not on US or WS. Topsoil increased the number of native herbaceous plants in pots and improved foliar nutrient content in *F. americana* and *L. tulipifera*. Native trees are sensitive to spoil type and certain spoil types conducive to good growth should be used during reclamation, particularly if topsoil is not applied. Topsoil improved tree growth on some spoil materials, improved tree nutrition, and helped restore native soil organisms and native herbaceous plants. Similarly, studies on Florida phosphate mined soils found that topsoil thickness affected plant establishment.

Reference: Showalter, J.M., J.A. Burger. 2009. Hardwood seedling growth on different mine spoil types with and without topsoil amendment. *Journal of Environmental Quality* (in press).

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Biodegradation of Biosolids-Borne Antimicrobial Triclosan (TCS)

Manmeet Waria, George O'Connor and Gurpal Toor

Triclosan (TCS) is an antimicrobial compound added to a variety of personal care products, including soaps, detergents and cosmetics for its sanitizing properties. Triclosan becomes a common constituent of domestic wastewater due to widespread usage of TCS containing products. Wastewater treated in treatment plants separates solids (sludge) and liquids (effluent). The effluent is discharged to surface waters and the sludge is often processed to produce biosolids. Land application of biosolids constitutes an important source of TCS to agricultural soils. The prime factor affecting TCS environmental fate is likely persistence; how long the compound is expected to remain in the environment. Numerous studies have reported TCS degradation in soils, but the fate and disposition of biosolids-borne TCS and its degradation products are largely unknown. We conducted a laboratory biodegradation study using a biosolids spiked with ^{14}C-TCS (final concentration = 41 mg kg^{-1}) amended to two soils at agronomic rates. The 18 week study included temporal sequential extractions with water, methanol, sodium hydroxide, and a final combustion step. The results indicated minimal (<0.1%) complete mineralization of ^{14}C-TCS. However, analysis of methanol extracts at 4 weeks indicated the presence of methyl-TCS, the reported major degradation product of TCS. Sequential extractions of the amended soils suggest formation of the degradation product and decreased extractability of added ^{14}C with time, which should portend increasingly lower bioavailability with time. Our study will ultimately contribute to the calculation of degradation half-life for biosolids-borne TCS.

POSTER PRESENTATIONS | NONJUDGED ENTRIES

Quorum Sensing Signaling Within the Coral Holobiont

Ali Al-Agely[1*], Cory J. Krediet[1,2], Kim B. Ritchie [1,3], and Max Teplitski[1]

Coral reefs are among the most biologically diverse yet threatened ecosystems in the world. Most coral diseases are not caused by dedicated pathogens, but rather by opportunistic pathogens. In order to overcome host defenses, pathogens need to reach a certain cell density and thus may rely on quorum sensing (QS) regulation to control gene expression during colonization and infection of the coral host. The invading pathogen must contend with the native bacteria associated with the coral host during colonization and infection. Quorum sensing signals (acyl homoserine lactones, AHLs) control surface motility (swimming/swarming), luminescence, cell adhesion, and biofilm formation. In this study, we investigated the role of quorum sensing on the coral surface environment between native coral-associated bacteria and a coral pathogen. Specifically, we tested the hypothesis that native coral-associated bacteria secrete compounds that can inhibit QS in a coral white pox pathogen, *Serratia marcescens* PDL100. Of over 300 coral-associated bacteria, nine showed strong inhibitory activity against QS-related phenotypes in the coral pathogen. Based on the *in vitro* observations that coral bacteria produce AHLs and exhibit QS, we also hypothesized that QS occurs in the surface mucus layer of corals. Although AHLs were not detected from the coral surface, chemical compounds from the surface of *Montastraea faveolata* showed inhibitory properties against the coral pathogen. Notably, decanoic acid, lauric acid, 2-undecanone and 2-octanone inhibited luminescence in known quorum sensing reporter strains. Utilizing the QS interplay on corals may elucidate biocontrol strategies to manage disease when other traditional approaches are not feasible on coral reefs.

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Sustainable Management of Invasive Aquatic Plants

Jason M. Evans[1] and Ann C. Wilkie[2]

Florida is home to large populations of invasive aquatic plants that are regarded as a threat to the natural environment, and thus are intensively managed by local, state, and federal agencies. Aquatic plant management is typically based upon use of chemical herbicides, mechanical harvest, and/or, in some cases, release of selective bio-control organisms. Although this approach has had success in reducing invasive plant populations, issues such as herbicide resistance, increased costs for petroleum-based herbicides, and regulatory mandates to mitigate aquatic nutrient burdens are together spurring a renewed interest in alternative aquatic plant management methods. A review of recent scientific studies and policy literature indicates that bioenergy production may provide an opportunity for developing sustainable management programs that profitably utilize harvested aquatic plant biomass. We present a general research plan for investigating the bioenergy potential from major aquatic invasive species such as hydrilla (*Hydrilla verticillata*), water hyacinth (*Eichhornia crassipes*), and water lettuce (*Pistia stratiotes*) within Florida. Preliminary analyses suggest that careful integration of biomass utilization with current invasive plant control programs can provide a significant source of renewable energy, and potentially result in lower overall management costs and improved environmental outcomes.

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Research for Extension application: Modeling tradeoffs between hydrology and water quality in Everglades restoration planning

H. Carl Fitz[1], S. Newman[2], S. Hagerthey[2], K. Rutchey[2], M. Cook[2], P. Linton[3], and F.H. Sklar[4]

In the northern Everglades, Water Conservation Area 1 (WCA-1) is a large impounded wetland. Largely due to a north-south land elevation gradient, the southern marshes have relatively deep water and the northern region is relatively dry. A water quality problem exists in the marshes adjacent to the canal ringing the interior perimeter of the impoundment, with nutrient and conductivity ("hard" water) intrusions from the canal. To aid in conceptual planning towards ecological restoration of this unique wetland, an ecological landscape simulation model (http://ecolandmod.ifas.ufl.edu) was used to evaluate restoration alternatives. The goals were to: 1) Explore conceptual restoration scenarios for WCA-1 that achieve more natural flow while maintaining "softwater" characteristics; 2) Integrate hydrologic and water quality Performance Measures for better decision making; 3) Evaluate management scenarios, to a) achieve Natural System Model -like depths, b) minimize the north-south hydrologic gradient, establishing a flowing system, and c) minimize chloride and phosphorus in the system. Results indicated: a) rainfall-only inputs of water were insufficient for hydrologic restoration, b) the perimeter canal accelerated northern over-drainage (indicating the need for some form of canal-plugs, berm, or backfill), and c) recirculating water from the south to the north was effective at redistributing water and maintaining a flowing system while minimizing the water quality constraints of external water sources. After evaluating a total of 19 alternatives, the "selected" alternative met both the hydrologic and water quality restoration targets, thus significantly improving the hydrologic gradient and increasing water flows, with very minimal water quality concerns.

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The symbiotic role of a regulatory protein Hfq in *S. meliloti*-legume interactions

Mengsheng Gao, Melanie Barnett, Elizabeth Creary and Max Teplitski

Symbiotic nitrogen fixation is important in agricultural and natural ecosystems. Most crop plants obtain soluble nitrogen (as form of ammonium $NH4^{+}$) from soil or added fertilizer. Rhizobia-legume symbioses contribute significant amount of fixed nitrogen to the plants and soil. Unlike chemical fertilizers, rhizobia supply the host legume with nitrogen at the right place, at the right time, in the right amount, and in an environment friendly way. The establishment and productivity of nitrogen-fixing symbioses depend on signal and nutrient exchanges between bacteria and their plant hosts. Development of microarrays and other genomic tools now offers an opportunity to further dissect gene regulation in this important biological process. Symbiotic gene regulation in *S. meliloti*, the symbiont of alfalfa, is the focus of our current research. Our recent discovery that a mutation in the rhizobial *hfq* gene, which encodes an RNA-binding protein, causes a defect in the symbiotic nitrogen assimilation suggests that Hfq mediates important post-transcriptional gene regulation in this interaction. Our goal is to define Hfq-mediated regulatory pathways. The obtained knowledge would help increase productivity of symbiotic nitrogen fixation, and reduce dependence on synthetic fertilizers.

Soil Microbial Biomass Affected by No Till System and Nitrogen Fertilization on Cover Crops

R.A. Garcia[1]; R.P. Soratto[1]; Q.R. Wang[2]; Y.C. Li[2]

Plant residues on soil surface in no till system may change soil microbial biomass, which is highly relevant for nutrient cycling and soil fertility. The objective of the study was to evaluate soil microbial biomass C and N affected by tillage systems and N fertilization. The experiment was carried out in Botucatu, São Paulo, Brazil, in an Oxisol. The treatments consisted of two tillage systems [No Till (NT) and Conventional Till CT)] and two N rates applied to cover crops (0 and 100 kg N ha^{-1}). The CT plots were tilled annually for 25 years, and N rates were applied in the last nine years. During 25 years, soybean, corn, bean and upland rice were cropped in the summer as main crops and black oat, wheat, millet, sunflower and forage sorghum were conducted in the spring as cover crops. Soils were sampled from 0-5 and 5-10 cm and soil microbial biomass C and N were evaluated by the fumigation-extraction method. No till increased microbial biomass C and N in the 0-5 cm layer by 26% and 48%, respectively, and 100 kg N ha-1applied to cover crops also affected biomass C in the 5-10 cm layer. However, tillage systems did not affect microbial biomass C down to 5-10 cm layer. On the other hand, biomass N was increased by 58% by the absence of soil disturbance in the deepest layer when the higher N dose was applied. Crop residues on soil surface increase soil microbial biomass in the superficial layers in tropical soils.

List of abbreviations: C: Carbon; N: Nitrogen; NT: No Tillage; CT: Conventional Tillage

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eExtension and eLearning in Soil and Water Sciences

B. Hoover, S. Grunwald, and K.R. Reddy

We developed an online platform called EcoLearnIT (http://ecolearnit.ifas.ufl.edu) that supports eExtension and eLearning focused on natural resources and environmental sciences, agricultural sciences, and human dimension of natural and anthropogenic ecosystems. EcoLearnIT provides authoring tools that allow researchers, instructors, and extension specialists to encapsulate research material and knowledge in form of Reusable Learning Objects (RLOs). RLOs can be reused, scaled, and shared from a central online repository in the support of instruction and extension. Each RLO supports a single learning objective and contains knowledge and assessment components. RLOs vary in size, scope and level of granularity ranging from small chunks of instruction/outreach material to a series of combined resources to provide a more complex learning experience. They are available in open-access mode and shared with a global community of Internet users. RLOs can be implemented in various digital formats including text, artwork (various graphics formats and Power Point), video, audio, and/or Flash animations to add interactive features. To mix different digital media provides an opportunity to create stimulating material that engages students, farmers and everybody else who wants to learn about a specific topic. EcoLearnIT facilitates to link extension, instruction and research and engages users with interest in environmental, agricultural and life science topics.

Type of presentation: Computer demo during poster session.

Automatic Calibration of Ontology-based Model for Simulating Water Table Fluctuations on farms in Florida Agricultural Area

Ho-Young Kwon, S.Grunwald, H. W. Beck, Y. Jung, S. Daroub, and T. A. Lang

An ontology-based simulation (OntoSim) is an unique data modeling environment where soil-plant-nutrient processes are represented as database objects and the user-defined relationships among objects are used to generate computer code (Java) for running the simulation. This new environment has been successfully applied to develop OntoSim-Sugarcane to model hydrology and phosphorus (P) dynamics of sugarcane-grown farms in the Everglades Agricultural Area (EAA).

Recently we incorporated the Shuffled Complex Evolution – Universal Algorithm (SCE-UA) as an automatic calibration algorithm into OntoSim-Sugarcane, which has shown success in finding a globally optimum objective function with more efficiency than other methods. By this coupling, site-specific model parameters can be automatically and objectively adjusted to provide the best fit between observed and simulated data for a particular site. In this study, we demonstrated the application of the SCE-UA for the purpose of analyzing water table fluctuations and drainage practices in EAA farms by optimizing site-specific parameters describing vertical and lateral water fluxes.

Utilizing a 2-year record (1995-1997) of field water tables from four EAA farms as well as SCE-UA, two parameters – lateral hydraulic conductivities of soil profiles and vertical hydraulic conductivity of underlying limestone – were automatically calibrated. Regardless of farms, the best parameter sets that minimize the objective function of daily root mean square error could be found after 5000 simulation runs. The quality of matching simulated to observed values of field water tables were further assessed by the Nash-Sutcliffe efficiency coefficient that ranged from 0.4 to 0.7. In conclusion, this coupling strengthen the capability of OntoSim-Sugarcane to model hydrologic and nutrient dynamics by objectively finding the best parameter sets so that it can be a more accurate tool in assessing water management practices and guiding recommendations to improve water quality.

Soil Extension at North Florida Research and Education Center, Quincy, FL

Cheryl L. Mackowiak, Assistant Professor, Soil Nutrient Management and Water Quality

North Florida Research and Education Center (NFREC) is a combination of three centers located at Quincy, Marianna, and Live Oak. Although my office is located at Quincy, I conduct research at Marianna and help to manage forage demonstrations at Live Oak. My 30% FTE extension effort focuses on the needs of clientele in the area of plant nutrient management, particularly of forage-based systems, and its environmental impact. This is highlighted by two programs, 1) nutrient management trends in forage sustainability and 2) forage mineral nutrient disease diagnostics. In the first area I investigate through research and extension what fertilizer/liming materials are available, what materials may be available in the future, and describe the potential benefits and pitfalls of using these products. Types of products include coal and wood derived ashes, ash/biosolid mixtures, chars, and other partially combusted wood by-products from the biofuel industry. I also have some involvement with biosolids, livestock manures, and humate product use. Additionally, it is important for me to educate clientele on recommended mineral fertilizer application rates and timing, and to suggest modifications or new management possibilities, as needed. As to the second extension program, extension calls and visits in response to questionable plant nutrient status are among the most common in forage and crop production and attract great interest among participants at field days and various workshops. In many cases weed, disease, pest, or N leaching losses are aggravated by poor or unbalanced soil fertility. Although preventative measures (proper nutrition) are strongly encouraged, I often need to assist with diagnosing a possible plant nutrient disorder. My overriding goal for this program is to help develop nutrient diagnostic guidelines that will assist county extension faculty when they are called out to a client's field. This may be accomplished partly through the creation of an on-line pictorial guide containing some of the more common symptoms found on plants grown in our soils and under our environment, along with common-sense approaches to assessing potential mineral disorders in the field.

Geospatial Soil Carbon Assessment Across Florida – Sampling Phase Complete!

D.B. Myers, S. Grunwald, N.B. Comerford, A.M. Stoppe, W.G. Harris

Soil carbon (C) is a major pool for C in the Earth's ecosystems, exceeded only by the oceanic and geologic C pools. We must better understand the quantity and flux of soil C to accurately assess their impact on global C budgets. This project aims to: (i) assess soil C concentrations and stocks across Florida using geospatial modeling, (ii) quantify correlations between soil C and environmental properties such as land-use/land-cover (LULC) and soil suborder, (iii) develop diffuse reflectance spectroscopy models to estimate soil C, and (iv) model the impact of LULC change on soil C. The project's stratified random sampling design (n=1012) is complete (March 2008 – Aug. 2009). Soil samples were collected in the top 20 cm. The design covers nearly every county in Florida and captures the most prominent combinations of LULC and soil suborder. Four primary fractions of soil C are being measured including total carbon (TC), non-hydrolysable 'recalcitrant' carbon, hot water extractable 'labile' carbon, and inorganic carbon. Total C concentration in the top 20 cm of soil ranges from 0.19% to 52.3% with a mean of 3.44% (mse = 0.28) and a median of 1.19%. Standard deviation of TC is 7.18 and the data are strongly positively skewed (4.05). The remaining lab and spectroscopy measurements are in progress. When completed this dataset will provide a comprehensive assessment of Florida's soil C stocks (top 20 cm) and combined with historical soils data gathered by the Florida Cooperative Soil Survey will enable the assessment of soil carbon change.

Phosphorus Uptake and Growth of Soybean Affected by Wheat Root Exudates

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There are 56.9 million ha of red acidic soils in China and most of them are low in bioavailable phosphorus (P). Yunnan Province in Southeastern China has 11.4 million ha of red soils, which accounts for 32% of the total farming area. The total P concentrations in these soils are approximately 0.9 g kg^{-1}, of which 26% is in the form of iron-phosphate (Fe-P) complex. The complex of Fe-P in red soils is hardly available to crops because of its low solubility. Roots of some monocot graminaceous species, such as wheat, can exude phytosiderophores under iron stress. Iron phytosiderophores can be formed via chelating to improve the P availability because the instability constant of iron phytosiderophores (3.16×10^{-33} to 5.0×10^{-34}) is over 10-fold smaller than that of Fe-P (1.3×10^{-22}).

The objective was to assess the P mobilization in an acidic soil and P uptake by soybeans by applying wheat root exudates (REs) into intercropped and monocultured soybeans. Results showed that shoot P content of intercropped soybean with REs significantly increased by 165.3% compared to that of intercropped soybean without REs. REs addition significantly increased shoot dry matter of soybeans by 52.3% in intercropping system. However, shoot dry matter and shoot P content of monocultured soybeans were not significantly different from those with and without REs. Results suggested that root exudates of monocot graminaceous species could mobilize P in acidic soils and facilitate P uptake of intercropped soybean, i.e. maize and soybean system.

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Soil and Water Science Extension Program at the Range Cattle REC

Maria Silveira

Pasturelands provide more than just grass for grazing animals. Native and improved pastures are the dominant land use in the USA and worldwide, covering nearly 130 million acres in the southern USA. Pasturelands are a major resource utilized for food production and are critical for maintaining environment sustainability. They provide important ecological services that mitigate drought and flooding, protect water and soil quality, maintain biodiversity, provide wild life habitat, and contribute to climate stability. The mission of the Soil and Water Science Extension Program at the Range Cattle REC is to promote education programs that emphasize the importance of sustainable use of soil and water resources. The major components of our mission are to enhance the productivity of beef and forage industry and to protect the natural resources associated with Florida grazing landscapes. Emphasis has been placed on developing science-based information that will help stakeholders to solve problems related to the agronomic and environmental aspects of forage and livestock production. Our extension effort is also focused on promoting the ecological benefits of well-managed cattle ranchers and rangelands to Florida's urban society. Information dissemination and technology transfer to our clientele are also promulgated through field days, tours, demonstrations, and professional development training.

Soil Carbon in Florida: Estimates Derived from Legacy Data

G.M. Vasques and S. Grunwald

Globally, soils store about 3250 Pg (petagrams = 10^{15}) of carbon (C), including wetlands and permafrost, which is about five times the biotic pool (650 Pg) and about four times the atmospheric pool, and have been indicated as a potential reservoir to sequester atmospheric C dioxide and mitigate global warming. Florida soils may have a larger sequestration potential when compared to other U.S. states due to their environmental characteristics including hydrology, climate and biomass productivity. Furthermore, there is a great demand for soil information in Florida to support environmental policy, provide input for research and education, and promote soil C as an ecosystem service. Our objective is to provide estimates of soil C stocks in Florida based on available legacy data that includes soil survey (STATSGO and SSURGO) (Natural Resources Conservation Service – NRCS) and Florida Soil Characterization (Soil and Water Science Department and NRCS) data. We compare different estimation methods, including weighted averaging, environmental correlation, and kriging (geostatistics). We also discuss the relative importance of soil taxonomic (e.g., order, drainage class) and physico-chemical (e.g., texture, hydraulic conductivity) properties, as well as land use, in relation to soil C. We present soil C maps for Florida based on data collected historically. A current soil C map for Florida is envisioned for the near future as new soil samples are being collected throughout the state.

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