Short-Term Impacts of Litter Quality on Soil Carbon Accumulation

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Soil organic matter (SOM) comprises all organic carbon containing substances in the soil including plant and microbial derived materials in various stages of decomposition. Depending on the degree of association with the soil particles, SOM can partitioned into different fractions such as light-free fraction (LF), particulate organic matter (POM), and mineral-associated C (C-min).The objective of this study was to evaluate the impacts of litter quality on litter decomposition and SOM dynamics. Treatments consited of bare soil (control), and soil incubated with bahiagrass *(Paspalum notatum),* perennial peanut *(Arachis pintoi),* or saw palmetto *(Serenoa repens).* Litter materials were chosen to represent a wide range of chemical composition. Results showed that total SOC and N remain relatively constant during the 90-d incubation (13.1 g C kg^{-1} and 1.2 g N kg^{-1} soil). Despite the differences in decomposition rates, no differences in SOC responses were observed among the various litter materials. At the end of the 90-d incubation, LF increased from 6.3 g C kg^{-1} soil (initial) to 12.7 g C kg^{-1} soil (90 d). Conversely, during the same period, C-min decreased from 6.4 g C kg^{-1} soil (initial) to 2.38 g C kg^{-1} soil (90 d) . These results suggested destabilization of protected SOM likely occurred in response to litter addition.

OPTIMIZATION OF PHOSPHORUS REQUIREMENT AND YIELD PREDICTION IN BUSH BEANS USING ARTIFICIAL NEURAL NETWORK

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ABSTRACT: This study is being conducted in a greenhouse using *blue lake* variety of bush beans, where 6 different phosphorus rates were compared against a control, replicated four times. Soil and tissue samples as well plant height were collected in each pot at 30 days and 60 days after planting (DAP). Data were tested by ANOVA with subsequent Tukey's multiple comparison tests to determine which treatment were significantly different by least significant difference (LSD) at the 5% level. Pearson product moment correlation coefficients were calculated to examine the relations among the variables. The results showed that the lowest production was verified using 90 P_2O_5 lbs/Acre. The increase in P rates correlated positively with the level of P in the plant, but there was no significant difference in production from the rate of 108 lbs/acre when compared to higher P rates. Based on the Mehlich3 interpretation, the recommendation of 120 lbs/Acre was appropriate to optimum yields in bush beans. The results are consistent and artificial neural networks can be used in the prediction of bean yields. The data obtained will be used to predict yields by testing different architectures of neural networks. This study is ongoing and will continue to evaluate P in soil and tissue samples as well yield from the bush beans and other crops.

Abbreviation:

ANOVA: Analysis of variance;
DAP: days after planting;
lbs: pounds;
LSD: least significant difference
P: phosphorus;
P_2O_5: phosphate

Use of biosolids in reducing phosphorus loss from Florida agricultural soils

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Alternate sources of phosphorus (P) fertilizer are needed to secure the potential supply shortage of global P reserves. Biosolids, a by-product of municipal wastewater treatment, is an attractive source of slow-release fertilizer P but there are concerns that biosolids are being over-applied on grazing lands in central and south Florida, and thereby impacting water resources. A five-month column experiment was conducted in a greenhouse with two Florida soils, a Spodosol (Myakka) and an Ultisol (Orangeburg) and six different P sources (triple super phosphate or TSP, struvite, Class AA1 and Class AA2 biosolids, Class B biosolids, and biochar made from Class B biosolids). The soil P storage and release patterns in the two soils were determined. A P-loss risk assessment, based on a threshold P saturation ratio (PSR; a molar ratio of Mehlich-3 extractable P to [Fe+Al], beyond which P release increases sharply) was determined. The soil P storage capacity (SPSC) was calculated using the threshold PSR to assess potential environmental P-loss risk. Mehlich-3 P, Fe and Al, and water soluble P (WSP) at a 1:10 soil: solution ratio was analyzed at experiment termination (20 weeks). The amount of releasable P was lower in columns receiving biosolids than the two inorganic P fertilizers (TSP and struvite) and P loss from struvite was lower than from TSP. The soils receiving Class B biosolids retained more P than soils receiving Class AA biosolids or biochar made from Class B biosolids, regardless of soil type. This study confirms that release of P from agricultural soil can be reduced by substituting biosolids and other recoverable P (biosolids-derived biochars and struvite from wastewater treatment) for conventional P fertilizers. Increasing their use may help reduce reliance on global P reserves.

Fluoride enhanced arsenate and phosphate uptake in fern plant *Pteris ensiformis*

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Arsenic (As) and fluoride (F) are often associated in shallow aquifers around the world. Their co-occurrence has been reported in many countries including India, Bangladesh, Pakistan, China, Cambodia, Korea, Mexico and Vietnam, potentially jeopardizing the health of millions of people. In India alone, 66 million people suffer from fluorosis and 70.4 million people are potentially at risk of arsenicosis. The World Health Organization sets the guideline values for As and F in drinking water at 10 μg/L and 1.5 mg/L. To assess the impact of F on As uptake in plants, we selected a non-As hyperaccumulator *Pteris ensiformis.* Our study revealed that F increased As uptake by *P. ensiformis* at 0.1 mM F and 0.05 mM As. However, F had no influence on arsenic speciation in the root, leaf and rachis where arsenate (AsV) was predominant. In the rhizome, slight decrease in AsV from 79 to 54-65%% was observed. In addition, F also increased phosphate (P) uptake by *P. ensiformis*. The presence of F alleviated As stress as shown by lower TBARS levels in plant tissues. The study helps to better understand the basic mechanism underlying the phenomenon of co-uptake of As and F in plants.

Pteris vittata reduced arsenic uptake by lettuce in an As-contaminated soil

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Abstract

Leaching of arsenic (As) from chromated copper arsenate (CCA)-treated wood may elevate soil As levels. Thus, an environmental concern arises regarding As accumulation in vegetables grown in these soils. In this study, a greenhouse experiment was conducted to 1) investigate if As-hyperaccumulator *P. vittata* can reduce As uptake by lettuce from a soil collected from areas adjacent to CCA-treated utility poles and 2) examine the effects of soil amendments on plant As accumulation. *P. vittata* was grown for 150 days with hardwood biochar (BC), activated carbon (AC) and spent coffee grounds (CG) in a pot experiment. Lettuce was grown in the soils afterwards for 55 d followed by measurements of plant biomass, soil As concentration, and plant As uptake. The presence of *P. vittata* reduced As content in lettuce from 39.8 to 25.9 mg kg^{-1}, 35% reduction. The amendment was also effective in reducing lettuce As uptake by 22-35%, with AC being most effective, followed by BS and CG. Our data showed that both *P. vittata* and soil amendment were effective in reducing As uptake by lettuce.

Predicting optimum N requirement for irrigated field corn in sandy soils of north-central Florida

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Abstract

Efficient uptake of fertilizer N by corn is important in increasing farm profit and minimizing negative impacts to the environment. The fertilizer recommendation provides a guideline for optimum N management. However, the recommendations should be constantly updated to account for the changes in N requirement of new crop varieties, and management factors that affect the N uptake efficiency of the crop. A replicated field trial was conducted near citra, in north-central, Florida to 1) determine if the current N recommendation is on-target to produce optimum corn yield, and, 2) determine if manure application can reduce the requirement for fertilizer N. Treatments included seven N rates from 0 to 420 lbs/acre and two poultry manure rates (0 and 2 ton/acre). The treatments were arranged in a 7×2 factorial design with four replications. Greater corn yield was obtained when the N rate as a mixture of urea and ammonium nitrate was increased from current recommended rate (210 lbs/acre) to a higher rate (280 lbs/acre). Corn yield data were modeled with linear plateau, quadratic plateau, quadratic, and logistic equations. All four models showed high coefficient of determination (>0.92). The optimum N rates as predicted by linear plateau, quadratic, and logistic models were higher than the current recommended rate. Therefore, a reasonable N recommendation should be 250 lbs/acre. Growers can reduce N fertilizer amount if poultry manure is applied in conjugation with chemical fertilizer. Multi-locational trials may be necessary for changing current recommendation.

Abbreviations:
N: nitrogen
Lbs: Pound

Title: Sustainable Agriculture Research in Everglades Agricultural Area

Personnel: Raju Khatiwada, Jay Capasso, Samantha Brody, Jehangir Bhadha

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Abstract

The Soil, Water and Nutrient Management Laboratory at UF/IFAS-Everglades Research & Education Center in Belle Glade is committed towards working in the field of sustainable agriculture and environmental quality in and around South Florida. Soil sustainability, water quality, and phosphorus (P) management are topics of major concern in the Everglades Agricultural Area (EAA). We have a multidisciplinary team of scientists working on research related to (i) Benefits of cultivating flooded rice; (ii) Application of aquatic vegetation as biofilter for phosphorus; and (iii) Exploring agronomic utility of organic amendments and biochar. During the summer, more than 50,000 acres of fallow sugarcane land in the EAA is available for rice production. With no P fertilizer applied, field trials on flooded rice showed improved outflow P concentrations by nearly 40% as a result of particulate setting and plant P uptake; and harvested whole grain rice can effectively remove P from a rice field per growing season. Aquatic vegetation like *chara*, and *southern naiad* are capable of utilizing N and P from the water and act as an important sink for phyto-removal of excess nutrients. In parts of the EAA where soils are sandy, the application of using locally derived organic amendments as potential P fertilizer has gained interest over the past few years. The use of local agricultural and urban organic residues as amendments in sandy soils provides options to enhance soil properties and improve yields. Future projects include evaluation of soil fertility and crop nutrient requirement for vegetables grown on depleted soils.

SWSD 2016 Forum ABSTRACT

Title: Pesticides Sorption Kinetics, Equilibria, and Column Transport Using Fertilizer Mixtures in Soils from Florida and Nigeria

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Pesticides soil sorption kinetics (SK) and equilibria (SE) are measured in solutions containing one pesticide and various supporting electrolytes (e.g.: $CaCl_2$, KCl). Since soil solutions have complex mixtures in the field, our objective was to compare SK-SE data obtained from single-pesticide mixtures and complex mixtures of pesticides and nutrients. Atrazine, Imidacloprid, Imidacloprid urea, and Pentafluorobenzoic acid (non-sorbed tracer) were dissolved in a fertilizer mixture containing 8 mM NH_4NO_3, KH_2PO_4, and KCl (Mix#1). Also, single-pesticide mixtures were prepared in 8 mM KCl (Mix#2). We used three surface soils: Candler sand and Immokalee fine sand (Florida), and Tulluwa upland (Nigeria). Pesticides SK and SE data in Mix#1 and Mix#2 were similar across soils. SE was reached before 24 hours and followed the Freundlich model. SK data were described by one-site nonequilibrium (OSNE) or two-site nonequilibrium (TSNE) models. Results suggest that these pesticides did not interact in solution and/or did not compete for the same sorption sites on soil surfaces. Pesticide breakthrough curves (BTCs) were analyzed in soil columns at steady-saturated water flow. Pulse-inputs using Mix#1 showed that the tracer's BTCs were described by the convective-dispersive model. The pesticides' BTCs showed nonequilibrium transport described by either OSNE or TSNE transport models. Tulluwa showed the lowest sorption capacity, followed by Candler and Immokalee, a trend explained by the soil organic matter content. Imidacloprid-urea was less sorbed than Imidacloprid across soils, and Atrazine showed the highest sorption. SK and SE obtained from either mixture could be used for modeling sorption and transport processes when pesticides and nutrients exist in the soil solution simultaneously.

Determination of Fomesafen in Soil using Hybrid Extraction techniques and LC/MS-MS Analysis

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The herbicide fomesafen is applied pre-emergence and/or post-emergence for the control of broadleaf weeds, grasses and sedges in vegetable crop production. Development of a rapid and effective analytical method for fomesafen is crucial for understanding its fate in soil. In this study, a hybrid liquid-liquid partitioning/solid phase extraction (SPE) methodology was developed and validated for the determination and confirmation of fomesafen in soil using liquid chromatography coupled to electrospray ionization tandem mass spectrometry (LC-MS/MS). Briefly, 10 g of soil were extracted by shaking with 20 mL of water /methylene chloride (v/v=1:1) containing 1% acetic acid for 60 mins. Afterwards, the extract was centrifuged at 5000 rpm for 20 min. A 2 mL aliquot of the methylene chloride phase was then taken and passed through a pre-conditioned SampliQ silica SPE cartridge for cleanup. Residues of fomesafen were eluted from the SPE cartridge with 10 mL of ethyl acetate. The eluent was exchanged with 1 mL of methanol, and then sonicated for 15 min, followed by vortexing for 1 min at room temperature. Fomesafen was quantified by LC-MS/MS with multiple reaction monitoring (MRM) in negative ion mode. Chromatographic separation was achieved with an Eclipse XDB-C18 column (4.6 x 100 mm, 3.5 um), using a mixture of methanol and water (v/v=95:5) containing 0.1% formic acid. The method demonstrated a good linear correlation (R^2 > 0.99) with standard solutions ranging from 2 to 400 ng/mL, excellent precision (RSD <10%) and recoveries (from 75% to 100%). The limit of detection (LOD) was 10 ng/g.

Identifying hot spots and moments of denitrification and nitrogen transformation in the Silver Spring springshed, USA

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Abstract

Silver Springs is the largest of Florida's first magnitude springs and also likely the largest limestone spring in the United States. Land use in the springshed has shifted to more urban/agricultural over the past 50 years, and with this change, nitrate levels in ground and surface water have also increased. Denitrification is an important pathway of springshed nitrate removal, so we conducted this study of spatial and temporal patterns of denitrification and nitrogen transformation by measuring the dissolved gases (e.g., dissolved N_2, Ar, N_2O, CH_4) in the main vents (East and West) and ground water from 61 wells during dry and wet seasons around the Silver Spring springshed. Principal component analysis based on the geochemical properties showed that the West and East vent reflected the land use of forests and wetlands, and of agriculture and urban, respectively. Dissolved CH_4 and N_2O in the ground water ranged from 0 to 106 µM, and 0 to 2.0 µM, respectively. For the spring vents, significantly higher dissolved N_2O (0.11 ± 0.04 µM) was observed in the East compared to the West vent (0.07 ± 0.03 µM). High dissolved N_2O corresponded with high dissolved oxygen and nitrate, and low ammonium concentration indicating that N_2O is most likely produced from nitrification processes. On the other hand, high dissolved N_2 and dissolved N_2:Ar ratio, and low dissolved N_2O appeared in the West vent, forests and wetlands sites, indicating areas of high denitrification. Temporally, significantly higher dissolved N_2O and CH_4 in the ground water were observed in the dry and wet season, respectively ($P < 0.05$). Higher dissolved N_2 and N_2:Ar ratios of the ground water were observed in the wet season for all the 61 wells, suggesting a potential hot moment of denitrification in the wet season. No clear seasonal patterns of dissolved N_2 and N_2O were observed for the spring vents.

Bioenergy Recovery Scheme for Industrial Starch Crop and Associated Co-products

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Strategic and sustainable agricultural practices not only require innovative crop selection that will produce maximum yields with minimal resources, but also a zero-waste mentality. In order to maximize both soil and land potential, every ounce of biomass within a crop should contribute to food, fuel or restoration of soil fertility. The sweetpotato crop produces starchy roots and nutritious green tops that are both valuable end-products in regards to food or fuel. From a bioenergy perspective, even damaged or diseased roots have significant value through methane recovery. The objectives of this research were to evaluate the bioenergy potential of the products/co-products associated with an industrial sweetpotato crop (CX-1) and develop a bioenergy recovery scheme based on agronomic yields. The ethanol yield was determined for the roots and methane yields were determined for three co-products, namely the aerial vines, culls, and stillage (byproduct of ethanol production). Methanogenic batch assays conducted in triplicate at 35˚C for 40 days revealed methane yields (L of methane per kg of volatile solids added) of 305 ± 9 (vines), 364 ± 7 (culls), and 446 ± 6 (stillage). Results showed that one acre of CX-1 sweetpotatoes has the potential to produce nearly 250 gallons of ethanol and nearly 50,000 MJ from methane gas. While 20-40% of the energy would be necessary for the cultivation, transport and conversion of sweetpotato into ethanol (range dependent on conversion efficiencies), the remaining 60-80% represents excess energy that could be used for other purposes such as direct heat and/or electricity.

Navigating environmental fellowships: What is out there and tips for success

Anna Normand, Soil and Water Sciences, University of Florida

Environmental fellowships provide unique professional opportunities and financial independence. They can range from purely academic to extending beyond to the policy sphere. And ultimately they connect outstanding professionals and open networking opportunities. But what relevant fellowships are out there for environmental graduate students? What are the criteria to apply? And what is the secret to be awarded a fellowship as the pool of applicants just seems to rise? This poster outlines major fellowship opportunities particularly relevant to environmental graduate students including eligibility requirements, application materials, and tenure and benefits. In addition, the poster provides key tips for personal statements – the bread and butter of fellowship applications. Overall the purpose of the poster is to get environmental graduate students at UF interested in pursuing fellowships with key tips for a successful application.

Assessment of flow paths and confluences for saltwater intrusion in a deltaic river network

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ABSTRACT

Saltwater intrusion is a serious issue in estuarine deltas all over the world because of rapid urban sprawl and water shortage. Therefore, detecting the major flow paths or locations at risk of saltwater intrusion in estuarine ecosystems is important for mitigating saltwater intrusion. In this paper, we introduce a centrality index, the betweenness centrality (*BC*), to address this problem. Using the *BC* as the weighted attribute of the river network, we identify the critical confluences for saltwater intrusion and detect the preferential flow paths for saltwater intrusion through the least cost path algorithm from graph theory approach. Moreover, we analyze the responses of the *BC* values of confluences calculated in the river network to salinity. Our results show that the major flow paths and critical confluences for saltwater intrusion in a deltaic river network can be represented by the least cost paths and the *BC* values of confluences, respectively. In addition, a significant positive correlation between the *BC* values of confluences and salinity is determined in the Pearl River Delta. Changes in the salinity can produce significant variation in the *BC* values of confluences. Therefore, freshwater can be diverted into these major flow paths and critical confluences to improve river network management under saltwater intrusion.

SCREENING OF POTASSIUM SOLUBILIZING BACTERIA: A SUSTAINABLE APPROACH FOR K-DEFICIENT SOILS IN PAKISTAN

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ABSTRACT

Potassium (K), an essential plant nutrient is required in relatively large amounts to sustain plant growth and development. Soil K availability relies heavily on the use of chemical fertilizers, which could negatively impact the economic and environmental sustainability. Most of the applied K fertilizer is bound to minerals and thus becomes unavailable for plant. With the introduction of high-yielding crop varieties and the progressive intensification of sustainable agriculture, most soils are generally depleted in the K reserve at a rapid rate. Moreover, due to imbalanced fertilizer application, K-deficiency is becoming one of the major constraints in crop production in Pakistan. There is growing need to use sustainable resources to improve agricultural productivity. K-solubilizing bacteria (KSB) can serve as a promising biological approach to improve plant K uptake, thus reducing the use of chemical fertilizer. These KSBs can be used as inoculants to convert insoluble soil K into plant available form. These bacteria meet the plant K requirement and maintain sufficient solubilized K in soils through a variety of acidic metabolites. A wide range of bacteria have been reported to release soluble K from K-bearing minerals in soils. These KSB dissolve K, Al and Si from insoluble K-bearing minerals by either directly dissolving mineral K or via chelating Si to release K into the solution. The objective of this research is to isolate bacteria from K-deficient soils following purification, screening and identification by using 16sRNA gene sequencing and test their ability to solubilize K from insoluble soil minerals.

Organic Phosphorus Forms in Wetland Soils
by Nuclear Magnetic Resonance (NMR) Spectroscopy

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Solution ^{31}P Nuclear Magnetic Resonance (NMR) spectroscopy is now used for characterizing organic forms of phosphorus (P) in soils and sediments. Limited information is available on adaptation of this method for high organic matter and low P soils such as those encountered in the Everglades. In this study we have examined various optimization methods including P extraction methods and NMR acquisition parameters to improve the identification of organic P forms. Based on previously published reports, we have made several refinements in standardizing this technique for use in wetland systems. We used soil samples from three sites: Ordway Preserve site, Gainesville, FL; Everglades Water Conservation Area-2A (interior unimpacted site); and Everglades Stormwater Treatment Area -2.

Our results showed that pretreatments of soil sample such as air drying and freeze drying had minimal effect on delineation of organic P functional groups as determined by NMR analysis. Air drying of samples at 35ºC appeared to be a suitable option for reducing sample heterogeneity. Although, oven drying of soils at 70ºC improved both organic P extraction efficiency (NaOH- EDTA) and NMR spectra, it was likely that relative proportion of P forms might have been altered. Fresh samples exhibited low efficiency in P extraction and resulted in unreliable NMR spectra. Soil to solution (NaOH-EDTA) ratios of 1:20 or 1:40 were found to be suitable for obtaining reliable spectra. For low P soils, concentration of solutions before loading into NMR tubes improved overall NMR spectra. Organic P functional groups such as phosphonates, phosphomonoesters, phosphodiesters, polyphosphates and pyrophosphates were identified and quantified during the analysis. All functional groups were present in soil samples from Ordway Preserve sites and STA-2, while only monoesters and low levels of diesters were recorded in soil samples from WCA due to low P concentration in the soil.

The Response of Sediments and Dissolved Organic Matter to Rapid Rainfall in the Santa Maria da Vitoria Watershed, Espírito Santo, BR

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The Santa Maria da Vitória River (SMV) supplies over 30% of the water for the greater Vitória, Espírito Santo, BR metropolitan area, which has a population of roughly 1.6 million people. The availability of clean freshwater is severely limited during periods of heavy rainfall because water sanitation facilities are “clogged” by high sediment discharge. The discharge of suspended sediments and dissolved organic matter (DOM) was examined in the SMV and its tributary, the Mangaraí River, at a 3 hour frequency during heavy storm flows from October 2013 to May 2015. Bulk isotopic analyses were used to determine potential sediment sources and whether specific landscape/land use features were functionalized during periods of high runoff. Likewise, time of flight mass spectrometry (GC-ToF-MS) was used to identify a broad suite of DOM compounds that responded positively with river discharge in an effort to determine the influence of land use on the delivery of dissolved components to the river. Suspended sediment concentrations increased by as much as 70 times during peak river discharge relative to base flow several days earlier with similar increases in particulate organic carbon and nitrogen observed. Results from this study and previous field measurements were integrated into a coupled hydrology-sediment transport model, DHSVM, to predict the affects of land use change on sediment and water fluxes. For example, a 25% conversion of Atlantic forest to agricultural plots yielded a 25% increase in both river discharge and sediment fluxes.