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Soil Fertility and Plant Nutrition

contents

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From the Chair...

Major challenges for sustainable global agriculture and food security include: (1) meeting the food and fiber needs of a world population projected to exceed 9 billion by the year 2050, (2) decreasing the rate of soil degradation and ameliorating degraded soils to maintain soil fertility, and (3) protecting the quality of natural resources including land and water. During the past decade, implementation of Best Management Practices (BMPs), mostly in developed countries have helped to improve soil and water quality, while maintaining soil fertility and sustainable crop production. However, many soil management practices currently used around the world are clearly insufficient to effectively deal with stresses placed on resources from burgeoning populations. For sustainable land use and management, integration of the information from diverse domains (e.g. physical, biogeochemical, economic, social, cultural and demographic) at spatial and temporal scales is required to develop predictive tools across environmental, hydrologic, economic and social gradients. Soil fertility and plant nutrition is integral part of addressing these critical issues to maintain food security. Soil fertility and plant nutrition programs in Soil and Water Science Department (SWSD) are positioned to address some of these critical needs to meet diverse groups clientele in the State of Florida. In this newsletter we present a few examples of research and extension activities of SWSD faculty located both in Gainesville and the Research and Education Centers. Additional information on departmental programs can be found at: http://soils.ifas.ufl.edu.

Agroecology Graduate Concentration

Beginning in the Fall of 2012, MS students could begin taking courses toward a concentration in Agroecology in support of their majors in Soil and Water Science or Agronomy. The Agroecology concentration program is led by faculty members from Agronomy (Diane Rowland and Jerry Bennett) and Soil and Water Science (George Hochmuth) Departments. This is the first fully online Agroecology MS concentration in the country. The goal of the Agroecology concentration is to train students in agriculture through the application of ecological concepts and principles to design and manage sustainable agricultural systems. The concentration was originally designed for distance education delivery for non-thesis students because there is a documented demand in the job market for broadly trained MS graduates, many of whom are place-bound. However, the program has expanded to include both non-thesis and thesis opportunities. Currently there are 12 students from across the US and internationally enrolled in the concentration, with the first cohort set to graduate in December 2014. A mix of Agronomy (AGR) and Soil and Water Science (SWS) faculty members serve on the student committees. In 2013, the program was awarded a USDA National Needs Fellowship grant to provide an opportunity for UF students to conduct international research while continuing to take their UF required courses via Distance Education (DE). We teamed with Florida A & M University in Tallahassee to fill six Fellowships, with two of the Fellows beginning their research with the International Potato Centers, one in Peru and another in Ecuador. We are currently developing collaborations and MOUs for graduate and undergraduate programs with international institutions including ISARA-Lyon in Lyon France. We are also working on expanding collaborations in the US, for example, with Michigan State University. There is a competitive advantage for UF CALS in Agroecology in the distance-education marketplace because we have the appropriate distance education courses and the technology to deliver anywhere in the world. We are currently forming a Working Group composed of faculty from both SWS and AGR to tackle upcoming goals for expansion of the program including establishing a graduate certificate in Agroecology, developing additional international partnerships, and seeking additional grant support for the program. For more information on the Agroecology Concentration, please visit the following website: http://agronomy.ifas.ufl.edu/agroecology/index.shtml or contact George Hochmuth at: hoch@ufl.edu

Join us at…

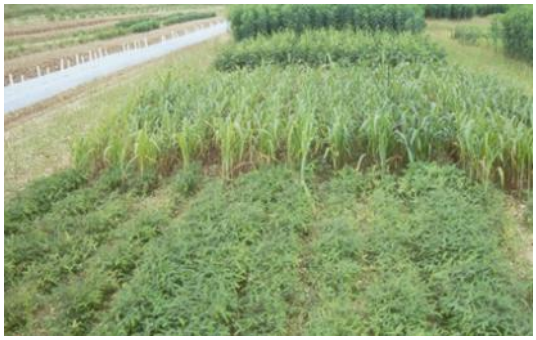
The 15th Annual Soil and Water Science Research Forum

The 15th Annual Soil and Water Science Research Forum is scheduled to be held **September 18, 2014** in Gainesville, Florida. The forum is designed to bring together representatives from state and federal agencies as well as private industry, faculty, graduate students, and prospective students interested in soil and water science. The forum will provide an opportunity for all those interested in soil and water science to interact with our students, faculty, and administrators on campus.

We look forward to your participation in the forum. If you are planning to attend, please register at http://soils.ifas.ufl.edu/research/forum. For additional information, contact James Jawitz at: Jawitz@ufl.edu.

Nutrient Management of Calcareous Soils in the Miami-Dade Area

Calcareous soils in Miami-Dade area are derived from Miami limestone. This surface rock blankets nearly all of Miami-Dade County, part of Broward County, and Monroe County (including the Florida Keys). Calcareous soils can also be found in other counties. Actually UF/IFAS Extension Soil Testing Laboratory (ESTL) received more and more soils with high pH from south and central Florida. High pH values of soils from outside Miami-Dade and Monroe counties were often caused by over liming, limestone materials brought up from deep soil depth or from construction fills, application of soil amendments with high pH, and irrigation water with high calcium carbonate. Calcareous soils in the Miami-Dade area usually contain from 30 to 95% $CaCO_3$ and pH values are in the range of 7.4-8.4. Textures of calcareous soils can be sandy, loamy or gravelly. Soil depths often range from less than 20 cm to a meter. These soils are important for production of vegetable, fruit, and ornamental plants in south Florida. To improve soil quality, management practices to utilize biosolids, composts and other soil amendments were developed to nutrient availability and improving crop yields. Another approach to improve soil quality was to introduce different types cover crops including sunn hemp (*Crotalaria juncea*) to the area. Our studies have shown vast improvement in soil quality when cover crops were used. In our program, several studies were conducted to improve fertilizer use efficiency by producing and testing new controlled release fertilizer, acidified iron fertilizer, amino acid foliar fertilizer, phosphorus solubilized bacteria, etc. Growers often ask whether they should use soil acidulents such as elemental sulfur, sulfuric acid, triosulfate salts, etc. to acidify the calcareous soil. To date no research data have been generated to establish a beneficial effect of applications of any acidic products on calcareous soils in Florida. Currently, there is also no official soil testing calibration for these calcareous soils except for P. The ESTL is using AB-DTPA as an extractant of plant available phosphorus for soils with pH above 7 and a critical limit is 10 mg P/kg. Due to long-term intensive management including high rate of applications of phosphorus fertilizers to these cropland, the soil phosphorus levels are often above 30 mg/kg and application of phosphorus fertilizers may not be necessary. Efforts are still on-going to identify a suitable soil extractant and calibrate soil testing for these soils. For additional information contact Yuncong Li at: yunli@ufl.edu.



Welcome Summer 2014 New Students!

PhD

Carla Alonso-Contes (Gerber)
Robert Andrew Kerr (Cisar)
Carlos Quintero (Cohen & Osborne)
Renita Kay Wilcox (Grunwald)

MS

Ashley Witkowski (Daroub)

BS

Keeana Baron - IS - EMANR - UFO (Curry)
Natasha Hart - IS - EMANR - UFO (Curry)
Shane Philhower - IS - EMANR - UFO (Curry)
Megan Skeen - IS - EMANR - UFO (Curry)
Curtis Taylor - IS - EMANR - UFO (Curry)

Nutrition Management for Sustainable Citrus Production

The Florida citrus industry is a significant and historical part of Florida agriculture. Currently it is fighting for survival due to the unprecedented impacts of exotic citrus diseases and pests, especially the incurable Greening Disease or Huanglongbing (HLB), vectored by the Asian Citrus Psyllid (ACP). Florida citrus has an economic impact in the state amounting to about $9 billion annually. HLB disease causes almost total loss of citrus yield by fruit drop before harvest, and the foliage shows symptoms of multiple nutrient deficiencies. Growers and scientists discovered that fortifying the HLB-affected groves with additional foliar- and ground-applied nutrients caused partial mitigation of the HLB symptoms and helped to limit yield losses. Critical nutrients targeted in this remediation effort are potassium, phosphorus, calcium, magnesium, manganese, zinc, boron and molybdenum.

Technologies that are being used in Florida to optimize the nutrition of HLB-affected trees while saving inputs like fertilizer and irrigation water are 1) variable rate technology, and 2) open hydroponics fertigation. The variable rate technology matches the correct rate of foliar or ground fertilizer with the size of the trees by scanning the tree canopies with infrared sensors and then dispensing the appropriate amount of agrochemical to the target trees. Spaces remaining when trees are removed are also sensed and not fertilized. At the CREC, we developed a patented commercial variable rate controller for this purpose, the CC-Eye-8000 Tree Sense Control System, available from Chemical Containers Inc. of Lake Wales, FL. The controller has been used in Florida citrus since 2008, and is also successfully used for tree crops in other states. A video demonstration of the CC-Eye-8000 controller is available on YouTube: http://www.youtube.com/watch?v=s5aoaGMRz7I&autoplay=1

Four year-old orange tree in central Florida showing symptoms of HLB disease, including canopy dieback, low fruit set, and fruit and leaf drop.

Open field hydroponics fertigation is a relatively new citrus production tool that was evaluated over the past 4-5 years to bring replanted young groves into production faster and with higher sustainable yields. The overarching goal is to reach and surpass the economic breakeven point, measured in years, before the grove becomes fully infected with HLB and declines. Field trials of open hydroponics combined with higher density citrus plantings, have successfully demonstrated reduced time (1-2 years less) to reach economic productivity, higher yields, and highly significant reductions in fertilizer and irrigation water requirements (up to 80% less). The decreased water and nutrient requirements also resulted in significantly lower nitrate-nitrogen losses in the leachates exiting the root zone of trees, thus underscoring the environmental as well as economic benefits.

Unfortunately HLB disease is a most persistent, systemic, incurable bacterial disease of citrus trees, and Florida citrus is currently about 75% infected. Despite the gains made through research and extension, including nutrition, the battle against HLB is far from over, and there is a real possibility that the citrus industry could be destroyed. Therefore our latest research at the CREC is exploring the intensive production of citrus for the fresh fruit market by growing trees hydroponically under insect-proof screen houses – the next level in developing sustainable horticultural solutions for the Florida citrus growers. For additional information contact Arnold Schumann at: schumaw@ufl.edu

Crop Nutrient and Water Management at the Southwest Florida Research and Education Center (SWFREC)

The emphasis of the Soil and Water Science program at the SWFREC in Immokalee has been field-scale water and nutrient cycling, nutrient transformations and crop water and nutrient uptake. Major research include 1) assessment of N, P, and K application rates and timing that have been adopted by growers to reduce environmental impact; 2) use of controlled released fertilizers; 3) development of water scheduling tools and smartphone apps improving water use efficiency using in situ data, 4) soil testing and irrigation/fertigation management BMPs to correspond with crop nutrient demand have been demonstrated to growers as methods of reducing nutrient leaching rates; and 5) in-field nutrient movement within plastic mulched beds with fluctuations in soil water content that has improved vegetable irrigation, reducing water management impact on leaching and 6) foliar nutrient applications and irrigation scheduling to reduce the impact of citrus greening disease that has devastated citrus production in Florida. Impacts of these projects have been 1) reduced nutrient applications to citrus, vegetables, and sugarcane; 2) 10 to 35% reductions in N and P applications through use of controlled release fertilizers with no adverse effect on production now adopted by approximately 80% of the sand soil sugarcane producers and 40% for the vegetable producers; 3) documentation of 20% or more water savings; 4) evaluation of Mehlich 1 and 3 on high calcium content soils with pH >7.0 for expanded soil P index; 5) demonstrated influence of seepage water depth fluctuations in reduction of soil nutrient leaching; and 6) documenting positive effects of improved grower nutrition programs in reducing the impact of citrus greening disease.

The research at SWFREC has been used to develop programmatic content on both state-wide and local scales. Management of the Florida Automated Weather Network (FAWN) program for 8 years and has led to improvements in weather data collection and the development of integrated tools to reduced water use. Work with a team of modelers in the Agricultural and Biological Engineering Department on campus to model soil water and nutrient movement that has enhanced existing crop models by improving the simulation of soil nutrient movement of a field scale. Because of these extensive research activities on effects of nutrient use and movement of nutrients below crop root zones, Kelly Morgan was named State-wide coordinator of best management practices extension programs in 2013. He also worked with FDACS to development of a state-wide grower cost-share program to provide site-specific weather data through FAWN that will be used by growers to improve irrigation scheduling potentially conserving large quantities of water. These programs will lead to grower education on improved nutrient management and reduce production agricultures impact on our limited water resources. For additional information contact Kelly Morgan at: conserv@ufl.edu

Soil and Water Science – Endowments

The SWSD established several endowments with the generous support from the Carlisle, Graetz, Polston, Robertson, and Skulnick families. Recently, the **Soil and Water Science Department Program Enhancement Fund** was established from funds by private donors in support of various departmental activities. In addition, K. Ramesh Reddy established a **Wetland Biogeochemistry Laboratory (WBL) Program Enhancement Fund** to support wetlands and aquatic systems programs in the department. We sincerely thank all our donors for their kind and generous support of soil and water science programs.

To our alumni and friends please show your support for soil and water science by selecting and making your gift to a specific area of interest. Details can be found at: http://development.ifas.ufl.edu/online_giving.html

State-wide Soil Fertility Program with Forages

From both, agronomic and environmental perspectives, soil fertility plays a major role in the sustainability of pasture and forage production systems. Pastures provide more than just grass for grazing animals. Land used for cattle production provides ecosystem services that mitigate drought and flooding, protect water and soil quality, maintain biodiversity, provide wildlife habitat, and contribute to climate stability. However, nutrients from pastures and forage production systems can become environmental hazards when mismanaged and potentially pose serious risks to the ecosystem. The fate of fertilizers applied to pasture and forage production systems is complex and is affected by several factors, including forage selection and management, fertilizer application rate, timing, fertilizer source and soil and environmental characteristics.

The soil fertility programs at Range Cattle Research and Education Center (RCREC), Ona (Maria Silveira) and North Florida Research and Education Center (NFREC), Quincy (Cheryl Mackowiak) are focused on developing nutrient management strategies that optimize fertilizer inputs necessary for sustainable forage/animal production, while protecting the environment. Our extension efforts are focused on educating target clientele on sustainable soil nutrient management and promoting the benefits of forage-based dairies and beef operations and the important roles that forage-based agriculture and grassland ecosystems play in protecting Florida's environment. For example, at the RCREC we have been evaluating different management strategies to reduce nutrient transport in nutrient-enriched soils. Projects are also focused on assessing the important role of grasslands on soil carbon sequestration and greenhouse gas mitigation. Research has shown that proper soil fertility and grazing management can promote soil carbon accumulation and improve soil quality. At the NFREC, different combinations (cocktails) of forage species are being assessed for their ability to better utilize soil nutrients and water, as compared to monocultures on nutrient impacted lands (dairies) and lower input (pasture) systems. In addition, incorporating a short-rotation (2 years) of a perennial (sod-forming) grass enhances soil carbon and water holding capacity more than crop rotations using conservation tillage practices, alone. After 5 to 6 years, this system has shown water savings of over 50% and it has doubled surface soil carbon (from < 1 to nearly 2 %). For additional information contact Maria Silveria at: mlas@ufl.edu or Cheryl Mackowiak at: echo13@ufl.edu

Congratulations! Spring 2014 Graduates

PhD

Julius Adewopo (Silveira & Gerber)

MS

Stephanie Hinrichs (Osborne)
Jose Villalobos Leandro (Morgan)

Minors

Julie Baniszewski – SLS (Bonczek)
Charles Greivell – SLS (Bonczek)
Janelle Guzman – SLS (Bonczek)
Laura McCann – SLS (Bonczek)
Daniel Mills – SLS (Bonczek)

BS

Autumn Sporleder – IS-EMANR (Curry)
Margiet Canler – IS-EMANR (Curry)
Simon Sokolof-Kemp – IS-EMANR (Curry & White)
Ashely Witkowski – IS-EMANR (Curry & White)

Minors

Olivia Olin – SLS (Bonczek)
William Ruffier – SLS (Bonczek)
Simon Sokolof-Kemp – SLS (Bonczek)
Caitlin Tourangeau – SLS (Bonczek)
Julie Wood – SLS (Bonczek)

Todd Osborne joins SWSD faculty

Todd Osborne was hired as Assistant Professor of Estuarine Biogeochemistry and is located at the UF-Whitney Laboratory in St. Augustine, Florida. Osborne's tenure is in the Soil and Water Science Department (SWSD). He completed his undergraduate degree at Georgia Tech and graduate degrees at UF with MS in Environmental Engineering Sciences and PhD in Soil and Water Science. Prior to this appointment, Osborne worked as Research Assistant Professor in SWSD and as Senior Scientist at the St. Johns River Water Management District. Estuaries lie at the nexus of freshwaters (rivers, streams, wetlands) and the ocean. These incredibly complex and ecologically important ecosystems are experiencing effects of global climate change in ways that we are only just beginning to understand. Defining the biogeochemical processes and the resulting cascade of ecological effects that climate change brings to coastal ecosystems is at the center of Osborne's research focus. Current research activities include: elemental cycling, carbon sequestration, mangrove migration, and coastal eutrophication, issues of great importance locally and globally. For additional information about research activities, contact Todd at: osbornet@ufl.edu .

Release Characteristics of Controlled Release Nutrient Sources

During the past two decades utilization of controlled release nutrient sources has increased by approximately 4.5% annually. This growth has been the result of the recognition of the potential impact these controlled release materials can have on enhanced nutrient utilization efficiency by plants and the reduced environmental impact of fertilization. Every state registers and validates the nutrient status of soluble and quick release nutrient products sold in their state by using official nationally accepted standard methods of analysis. However, due to the long term nutrient release of some controlled release materials there is no standard method for evaluating the nutrient release and labeling of controlled release materials.

In the mid-1990's Jerry Sartain was appointed an adjutant member of a controlled release task force by the Association of American Plant Food Control Officials (AAPFCO) and asked to develop a method for evaluating and validating the presence of controlled release nutrient sources. During the next several years and through much trial and error two methods for determining the release characteristics of controlled release materials were developed in his laboratory. These methods are currently being used to characterize controlled release materials and are in the process of being accepted by the AAPFCO as an official method of analysis.

The two methods involve a long-term (182 d) incubation method which establishes the release parameters of controlled release materials that can be used in conjunction with release parameters established by an accelerated laboratory extraction method (74 h) to validate the presence of a guaranteed controlled release material in a formulation. Obviously, a 182 incubation method cannot be used by a state laboratory to validate the guarantee placed on a product by a producer. However, once the release parameters of a controlled release material are known they can be used in a much shorter term extraction (74 h) to validate the presence of the guaranteed material. Thus, both methods are required in the validation process. In most cases, the release parameters of controlled release material are generated by the developer of the material prior to its commercialization. We are currently using these methodologies to investigate commercially available and experimental controlled release materials. We are also in the process of testing the methodologies for roughness and acceptance by the AAPFCO as official methods. For additional information contact Jerry Sartain at: sartain@ufl.edu

Agricultural Production on the Muck Soils of the Everglades Agricultural Area (EAA)

Some difficulties for agricultural production on the muck soils of the EAA in south Florida include soil subsidence, changes in pH, and increases in P and micronutrient fertilization rates. Management practices that minimize or retard soil subsidence could prolong the utilization of these soils under their current cropping system. One such mechanism includes seasonal flooding cycles under which soils are inundated for specific periods of time, leading to development of anoxic zones throughout the soil profile which minimize soil oxidation, and also allow for water storage in soil. However, maintenance of these high water tables should not adversely affect crop growth and yield. So the challenge is to identify flooding cycles, including the frequency and duration of flooding that would permit optimal crop production while helping to decrease soil loss through oxidation. Moreover, maintenance of higher water tables, but not flooding, would be beneficial so that more of the soil volume will be under anoxic conditions, thus decreasing soil organic matter decomposition in the anoxic subsurface zones. We are currently investigating how water table management in muck soils affects sugarcane and biofuel crop production and soil organic matter decomposition with the goal of identifying water management strategies that maximize the duration of soil inundation, which minimizes soil subsidence, while simultaneously maintaining optimal crop performance. Experiments are underway in lysimeters to test how various constant water table depths, and fluctuating flood/drain cycles to various depths, influence soil organic matter decomposition and sugarcane growth and yield. The goal is to identify water table treatments that result in enhanced soil conservation while maintaining sugarcane yields. For additional information contact Alan Wright at: alwr@ufl.edu

Faculty, Staff and Students

Congratulations to the following students for their outstanding achievements

Susanna Gomez (Daroub) received the UF/IFAS Award of Excellence for the Best Master's Student thesis

Andrew Land was selected as a member of the CALS Leadership Institute Cohort 5. The CALS Leadership Institute is a 3-semester program that encompasses personal, organizational, and global leadership development. Additionally, students will complete relative coursework, community service, be assigned a mentor, and participate in an international service and learning experience.

Christopher Weidow (Ogram) received the 2013 SWSD award for "Excellence in Graduate Studies - MS level"

Rupesh Bhomia (Reddy) received the 2013 SWSD award for "Excellence in Graduate Studies - PhD level"

Fall 2013 College of Agricultural and Life Sciences Dean's List
Jennifer Brown – IS – EMANR - UF Online
Brooke Giuliano – IS - EMANR
Ashley Witkowski – IS – EMANR - Ft. Pierce

Alumni news

Nadine Kabengi, a PhD graduate from our department (Rhue and Daroub), currently an Assistant Professor at the Departments of Geosciences and Chemistry, Georgia State University, is a recipient of the 2014 Early Career Research Program from the US Department of Energy. She received a five-year, $750,000 award from the program.