

The banner features a vibrant, abstract background of green and yellow floral patterns. The text "MISA 2026" is prominently displayed in large, white, bold, sans-serif capital letters across the upper portion of the banner. Below this, the subtitle "Materials Innovation *for* Sustainable Agriculture" is written in a smaller, white, sans-serif font. The dates "October 10-11th, 2026" and the location "Orlando, FL" are centered at the bottom in the same white, sans-serif font.

MISA 2026

Materials Innovation *for* Sustainable Agriculture

**October 10-11th, 2026
Orlando, FL**

Welcome Note from the Chair

Dear Friends,

It is my great pleasure to welcome you to MISA 2026, the 11th Annual Symposium on Materials Innovation for Sustainable Agriculture.

As global agriculture faces increasing challenges from climate change, emerging plant diseases, resource limitations, and growing demands for food security, the need for innovative and sustainable agricultural solutions has never been greater. Addressing these challenges requires a collaborative effort that integrates advances in materials science, engineering, chemistry, plant biology, and data-driven technologies. Through such interdisciplinary partnerships, we can accelerate the development of practical solutions that enhance productivity, improve crop resilience, and support environmental stewardship.

Since its establishment in 2016, the UCF Materials Innovation for Sustainable Agriculture (MISA) Center has fostered collaborations among scientists, engineers, industry leaders, growers, and government agencies to develop transformative technologies for modern agriculture. Our work has advanced the development of innovative crop protection formulations, precision nutrient delivery systems, and sustainable technologies aimed at improving crop health while minimizing environmental impacts.

This year's symposium highlights several emerging areas that are shaping the future of agricultural innovation. Particular emphasis will be placed on next-generation crop protection formulations, trunk injection technologies for targeted delivery in plant systems, and strategies that accelerate lab-to-field technology translation. These research areas provide exciting opportunities to improve the efficiency, precision, and sustainability of agricultural inputs while reducing waste and environmental exposure. By bridging fundamental research with field implementation, we can deliver solutions that create measurable impact for growers and agricultural stakeholders.

Our Mission

The MISA Center remains committed to:

- Promoting interdisciplinary research that drives innovation at the intersections of materials science, chemistry and agriculture.
- Developing advanced technologies that improve crop protection, plant health, and agricultural sustainability.
- Strengthening industry-academia partnerships that facilitate technology development and commercialization.
- Supporting educational and extension activities that empower growers with science-based solutions.
- Accelerating the translation of laboratory discoveries into field-ready technologies that address real-world agricultural challenges.
- Fostering collaboration among researchers, industry leaders, government agencies, and growers to create sustainable and economically viable agricultural practices.

Over the past decade, MISA has expanded its research activities and partnerships across the United States and internationally. Our collaborative efforts continue to generate innovative solutions that address critical challenges in plant disease management, nutrient delivery, environmental sustainability, and precision

agriculture. By working closely with stakeholders throughout the innovation pipeline, we strive to ensure that scientific discoveries ultimately benefit growers and food production systems worldwide.

The goal of MISA 2026 is to provide a dynamic forum where researchers, industry partners, technology developers, students, growers, and policymakers can exchange ideas, share experiences, and build meaningful collaborations. The symposium offers a unique opportunity to discuss both scientific breakthroughs and practical implementation strategies that accelerate the adoption of innovative agricultural technologies.

We are grateful for your continued support of the MISA Center and for your participation in this year's symposium. Your engagement and partnership are essential to advancing our shared mission of developing sustainable solutions for agriculture. We look forward to insightful discussions, productive networking, and new opportunities for collaboration.

We wish you a successful symposium!



Dr. Swadeshmukul Santra

MISA Director and Program Chair

(On behalf of the MISA 2026 Organizing Committee)

MISA 2026 Symposium Program Committee

James H. Graham – University of Florida (E-mail: jhgraham@ufl.edu)
Mike Barry – TradeMark Nitrogen Inc. (E-mail: MBarry@trademarknitrogen.com)
Jorge Pereira – University of Central Florida (E-mail: Jorge.Pereira@ucf.edu)
Melissa Deinys – University of Central Florida (melissa.deinys@ucf.edu)
Everton Luiz Vieira Aguilar De Souza – University of Central Florida (E-mail: evertonluiz.aguilardesouza@ucf.edu)
Ted Molina – University of Central Florida (Ted.Molina@ucf.edu)
Deborah Penchoff – University of Central Florida (deborah@ucf.edu)
Swadeshmukul Santra – University of Central Florida (E-mail: ssantra@ucf.edu)

MISA donors

Estes Citrus Inc
TradeMark Nitrogen Inc

MISA 2026 Symposium Program

University of Central Florida
Live Oak Event Center
4115 Pyxis Lane, Orlando, FL

October 10-11, 2026

Saturday, October 10th

7:30 am – 8:00 am: Registration (Lobby area)
Breakfast (Live Oak Ballroom)

Opening Remarks

8:00 am – 8:05 am: **Dr. Swadeshmukul Santra**, Professor of Chemistry and Director of Materials Innovation for the Sustainable Agriculture (MISA) Center, University of Central Florida, USA

8:05 am – 8:15 am: **Dr. Lei Zhai**, Professor of Chemistry and Director of NanoScience Technology Center, University of Central Florida, USA

Session I: Trunk Injection for Crop Protection (Live Oak Ballroom)

Moderator: Dr. Jim Graham (University of Florida, USA)

8:15 am – 8:30 am: Session Introduction

8:30 am – 9:30 am: **Dr. Srdjan Acimovic**, Virginia Institute of Technology, VA, USA
“Keynote: Management of apple scab and fire blight using trunk injection”

9:30 am – 10:10 am: **Brandon Page**, CRAFT Foundation Inc., FL, USA
“Trunk injection technology in citrus”

10:10 am – 10:25 pm: Coffee Break

10:25 am – 11:05 pm: **Dr. Yiannis Ampatzidis**, University of Florida, SWFREC, UF/IFAS, FL, USA
“Automation in trunk injection for HLB management”

11:05 pm – 11:45 pm: **Dr. Jorge Pereira**, University of Central Florida, USA
“Innovative adjuvant technology for oxytetracycline trunk injection”

11:45 pm – 1:00 pm: **Networking lunch with Stakeholders (Live Oak Ballroom)**
(Meet 1-to-1 with NSF Program Director, Dr. Nora Savage; Moderator: Dr. Andre Gesquiere, University of Central Florida, USA)

Session II: Student/Postdoc Research Dissemination (Live Oak Ballroom)

Moderators: Giulio Diracca and Preeti Maiti (University of Central Florida, USA)

1:00 pm – 2:15 pm: **Poster Presentation (Live Oak Ballroom)**

Session III: Plant Disease Management (Live Oak Ballroom)

Moderator: Dr. Inga Meadows (Bartlett Tree Experts, Charlotte, NC, USA)

- 2:15 pm – 2:20 pm: Session Introduction
- 2:20 pm – 3:00 pm: Dr. Megan Dewdney, Citrus Research and Education Center, UF/IFAS, Lake Alfred, FL, USA
“Foliar diseases of citrus in Florida: Current management strategies and challenges”
- 3:00 pm – 3:40 pm: Dr. Sanju Kunwar, North Florida Research and Education Center, UF/IFAS, Quincy, FL, USA
“Sustainable Management of Bacterial Diseases in Specialty Crops: Challenges, Innovations, and Future Opportunities”
- 3:40 pm – 3:55 pm: Coffee Break
- 3:55 pm – 4:35 pm: Dr. Chun-Hsiang (Sean) Wang, UF/IFAS, Gainesville, FL, USA
“Alternaria Leaf Blight of Carrot in Florida: Pathogen Identity, Seed Health Management, and Fungicide Delivery”
- 4:35 pm – 5:15 pm: Melissa M. Deinys, University of Central Florida, Orlando, FL, USA
“BabyBlue and MgSuN: Advanced Copper and Cu alternatives for crop protection”
- 5:15 pm – 5:30 pm: Break

Session IV: Industry-Academia Partnership (Live Oak Ballroom)

Moderator: Everton Luiz Vieira Aguilar De Souza and Dr. Swadeshmukul Santra (University of Central Florida, USA)

- 5:30 pm – 6:10 pm: Dr. Shadia M. Ihlaseh Catalano, Genetic and Molecular Toxicology Group Leader, CORTEVA Agriscience, USA
“Pesticide Safety Assessment and Career Pathway Beyond Academia”
- 6:10 pm – 6:50 pm: Mrs. Cristina Porciuncula Krzyzaniak, Bayer, USA
“Importance of Academia-Industry Partnership Towards the Professional Development of Young STEM Scientists”
- 6:50 pm - 8:45 pm: Networking Dinner with stakeholders (Meet 1-to-1 with NSF Program Director, Dr. Nora Savage; Moderator: Dr. Andre Gesquiere, University of Central Florida, USA)
- 8:45 pm: Day 1 program adjourns

Sunday, October 11th

9:00 am – 12:00 pm: **Registration (Lobby area)**

Session V: Student Mixer (Live Oak Ballroom)

Moderators: Giulio Diracca and Preeti Maiti (University of Central Florida, USA)

9:00 am – 9:10 am: Session Introduction

9:10 am – 9:50 am: **Dr. Amit Naskar**, Oak Ridge National Lab, TN, USA
“Advanced Bioproducts from Lignin via Reactive Extrusion”

9:50 am – 10:30 am: **Dr. Andre Gesquiere**, University of Central Florida, Orlando, FL, USA
“REU Opportunities for students”

10:30 am – 11:10 am: **Dr. Andrea Bardales**, University of Central Florida, Orlando, FL, USA
“The Scientist-Entrepreneur: Calibrating Pipettes & Pitch Decks”

11:10 am – 1:00 pm: Networking lunch (meet 1-to-1 with NSF Program Director, Dr. Nora Savage)
Moderator: Dr. Andre Gesquiere, University of Central Florida, USA.

1:00 pm: **Symposium Adjourns**

Presentation (Invited) Abstracts

Saturday, October 10th

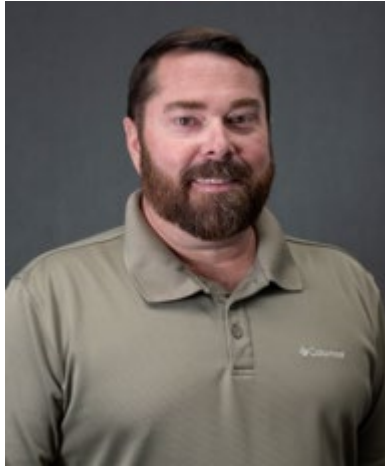
Keynote address



Dr. Srdjan Acimovic
Virginia Institute of Technology, USA

Management of apple scab and fire blight using trunk injection

Trunk injection offers an alternative approach for delivering plant-protective compounds directly into the vascular system of apple trees, potentially reducing pesticide drift, environmental exposure, and reliance on conventional foliar applications. This presentation will summarize research evaluating trunk injection for the management of two economically important apple diseases, apple scab, caused by *Venturia inaequalis*, and fire blight, caused by *Erwinia amylovora*. Studies investigated the disease control efficacy, systemic distribution, leaf and fruit residues, and persistence of injected fungicides, antibiotics, and other plant-protective compounds, as well as the influence of application timing and injection method on disease suppression. Results demonstrated that several injected compounds can move systemically within apple trees and provide disease suppression, although efficacy varies with the active ingredient, formulation, disease, injection timing, and tree physiology. Practical advantages and limitations of trunk injection, including treatment efficiency, residues, tree wounding, and feasibility for commercial orchard use, will be discussed. Collectively, this research illustrates both the potential and current limitations of trunk injection as a precision pesticide-delivery strategy for managing apple diseases.



Brandon Page
CRAFT Foundation Inc., FL, USA

Trunk injection technology in citrus

The Florida citrus industry has long been an important part of the state's economy and agricultural heritage. Over the past two decades, huanglongbing (HLB) has spread throughout every citrus-producing region of Florida, contributing to a dramatic decline in citrus production and acreage. Numerous management strategies have been evaluated to mitigate the effects of HLB, but most have provided limited or inconsistent results. More recently, oxytetracycline trunk injection has emerged as one of the most effective therapeutic tools currently available to citrus growers, with widespread adoption resulting in measurable improvements in tree health and productivity. Unlike conventional foliar or soil-applied treatments, trunk injection delivers active ingredients directly into the vascular system of the tree, improving uptake efficiency while minimizing environmental losses and off-target exposure. This presentation will review the development of trunk injection technology in citrus and discuss results from field evaluations, including effects on tree health, canopy condition, fruit yield, and fruit quality. Factors influencing treatment performance, including application timing, dosage, tree size, and treatment frequency, will also be examined. Emerging research and future opportunities for therapeutic delivery through trunk injection will be highlighted.



Dr. Yiannis Ampatzidis
University of Florida, USA

Automation in trunk injection for HLB management

Manual trunk injection of therapeutic materials in tree crops is labor-intensive, time-consuming, and costly, making large-scale implementation challenging for commercial growers. To overcome these limitations, we have developed an innovative, [automated needle-based trunk injection system](#) designed specifically for HLB-affected citrus trees. This system significantly reduces application time, achieving injections in under a minute per tree, while lowering costs. Our unique, drill-free, multi-puncture mechanism utilizes a precision needle mounted on an end effector to create injection ports, delivering the required liquid volume efficiently via a metering pump. We are now working to further develop and fully automate this technology, paving the way for scalable, high-throughput citrus treatment solutions.



Dr. Jorge Pereira
University of Central Florida, USA

Innovative adjuvant technology for oxytetracycline trunk injection

The Florida citrus industry has shrunk drastically over the past 20 years due to the advent of citrus greening disease or Huanglongbing (HLB). The disease is associated with the non-culturable pathogen *Candidatus Liberibacter asiaticus*, which is known to infect the phloem of citrus trees. Recently, Oxytetracycline (OTC) trunk injections have been shown to reduce fruit drop, increase fruit yield, mitigate disease severity, and improve fruit quality significantly. Nevertheless, OTC drawbacks include heat and photo instability, as well as requiring a pH of 1.8-2.0 to be soluble. To minimize these drawbacks, a novel adjuvant was designed to solubilize OTC at near-neutral pH for trunk injection, which also improves its compatibility with micronutrients, such as Zinc. Therefore, the compatibility of the adjuvant with OTC was studied using UV-Vis and fluorescence spectroscopy at 20°C and 37°C. The adjuvant affected the light absorption and fluorescence of the samples, demonstrating direct interaction with the molecule. Furthermore, a microbroth dilution method allowed for the identification of the Minimum Inhibitory Concentration. Finally, the adjuvant was evaluated under field conditions in Valencia and grapefruit trees with and without zinc. It was determined that the adjuvant did not impact the improvement in fruit yield provided by OTC. Moreover, the treatment with Zinc boosted fruit number and reduced HLB symptom severity. Overall, our findings suggest that utilizing the near-neutral does not reduce the benefits of OTC and enhances compatibility with zinc, which can be more beneficial than injecting OTC alone.



Megan M. Dewdney
University of Florida, USA

Foliar diseases of citrus in Florida: Current management strategies and challenges

With the warm and wet climate of Florida, foliar diseases of plants are problematic in the agriculture context, and citrus is not an exception. Historically, the most common canopy-affecting citrus diseases were caused by foliar fungi, although citrus canker, caused by a bacterium, became a huge concern. For each disease, there is a unique management strategy based on the disease cycle and other epidemiological aspects of the pathosystem. In a broad view, management is a blend of cultivar selection, horticultural practices, environmental variables, chemical control, and economics for each disease. The diseases and how the management practices for citrus black spot (*Phyllosticta citricarpa*), greasy spot (*Zasmidium citri-griseum*), citrus canker (*Xanthomonas citri* subsp. *citri*), and *Alternaria* brown spot (*Alternaria alternata*) are related to epidemiology will be discussed. Disease management challenges, illustrated by the above diseases, can be grouped into broad categories. The first type of challenge is highly susceptible hosts. Often a highly susceptible citrus cultivar will be planted because of desirable horticultural characteristics. The second type is resistance selection of the pathogen population. There is a limited number of products registered for chemical control in citrus and many of them target only a single site within pathogen physiology or pathogens can develop mechanisms to detoxify products. Selection for these beneficial traits occurs at the population level, leading to widespread resistance. The third category is trade policies. Some diseases are challenging to manage because of stringent quarantine requirements for import markets or maximum residue limits (MRL) that limit chemical choices. Finally, the economics of a management recommendation. Growers are very unlikely to adopt the best biology-based recommendations if they perceive them to be impractical or too costly to implement for the benefit.



Dr. Sanju Kunwar
University of Florida, USA

Sustainable Management of Bacterial Diseases in Specialty Crops: Challenges, Innovations, and Future Opportunities

For Florida tomato growers, bacterial diseases, specifically bacterial wilt (*Ralstonia solanacearum*) and bacterial spot (*Xanthomonas perforans*), remain among the most devastating and difficult-to-manage production constraints. While the pathogen biology and challenges posed by these diseases are distinct, their impacts are equally severe. Bacterial wilt lacks management options that provide reliable, season-long control, whereas bacterial spot management relies heavily on frequent applications of copper-based bactericides. However, the widespread emergence of copper-resistant *Xanthomonas* populations and increasing environmental and regulatory concerns threaten the long-term sustainability of these copper-based management programs. This presentation will provide an overview of the field-level realities of these two pathosystems and highlight our laboratory's ongoing efforts to develop more resilient and sustainable management strategies. We will discuss approaches that integrate resistance monitoring, cultural practices, host resistance, and soil ecology with the evaluation of novel antimicrobial compounds and biologically derived products. Particular emphasis will be placed on opportunities for advancing disease management through innovative formulation technologies, optimized delivery systems, and bio-based materials. Development of safe, effective, and economically viable solutions is essential for maximizing disease suppression while minimizing environmental impacts and improving the long-term sustainability of specialty crop production systems for Florida tomato growers.



Dr. Chun-Hsiang (Sean) Wang
University of Florida, USA

Alternaria Leaf Blight of Carrot in Florida: Pathogen Identity, Seed Health Management, and Fungicide Delivery

Alternaria leaf blight (ALB) is the important foliar disease of carrot (*Daucus carota*) in Florida, where foliage loss compromises mechanical harvest and reported yield losses reach 40–80% under high disease pressure. Although ALB management has traditionally targeted *Alternaria dauci*, Florida pathogen populations had not been examined in nearly four decades. We conducted a multilocus phylogenetic survey of 66 isolates from symptomatic foliage across four North Florida counties (2022–2026) and 18 isolates from 19 commercial seed lots. *Alternaria alternata* accounted for 95% of field isolates and also predominated among seed isolates, whereas *A. dauci* represented only 5% of field isolates. Seed lots from all four suppliers were infested at 0–47% incidence. Ten seed treatments—thiram, six OMRI-listed biological strains, Kocide 3000, and experimental copper hybrid nanomaterials—were screened in vitro against *A. alternata* conidial germination. The two candidates with the lowest EC₅₀ values were then evaluated on artificially infested seed using ISTA freeze-blotter and germination assays. Thiram reduced seed infection from 93.3% to 6.7% and the copper nanomaterial to 36.7%, without reducing germination at 1,000 ppm; biological products showed limited activity. In two-season field trials, six fungicides were delivered by tractor-mounted sprayer or solid-set overhead chemigation. Delivery method affected penthiopyrad efficacy under high disease pressure (final severity 37% vs. 56%; $P = 0.015$), whereas product selection was the dominant factor ($P < 0.0001$); OMRI-listed products did not differ from the untreated control. These results identify *A. alternata*, rather than the historically assumed *A. dauci*, as predominant in Florida field and commercial seed populations, support seed health testing and treatment, and highlight the need for effective organic-compatible seed and foliar options.



Melissa M. Deinys,
University of Central Florida, USA

BabyBlue and MgSuN: Advanced Copper and Cu alternatives for crop protection

Many of the active ingredients used in agricultural disease management have remained largely unchanged for decades. While these compounds are effective, their performance is often limited by how they are formulated and delivered. Copper-based pesticides, for example, are readily lost from plant surfaces during rainfall, while other established antimicrobial compounds face limitations in their ability to reach target tissues. Our research focuses on addressing these challenges through materials chemistry, with the goal of improving the performance of conventional agrochemicals while reducing their environmental impact. This presentation will discuss two formulations developed in our laboratory: Baby Blue and MgSUN. Baby Blue is a copper-based formulation designed to improve rain fastness and retention on plant surfaces. By limiting copper wash-off, the formulation aims to extend the duration of protection and reduce the frequency of pesticide applications. MgSUN takes a different approach, combining magnesium hydroxide nanoparticles with sodium polysulfide, a known antifungal compound whose agricultural applications are limited by poor systemic delivery. The nanoparticle component is intended to improve the delivery of sodium polysulfide, allowing its antifungal properties to be used more effectively. MgSUN has also been evaluated in mangrove disease management, including nursery and field applications, demonstrating the broader potential of this approach beyond conventional crop production. These two formulations address different limitations of traditional agrochemicals but share a common objective: improving how existing active ingredients are delivered and retained. Their development highlights the role of materials chemistry in making established agricultural treatments more effective, with potential benefits for both crop protection and environmental sustainability.



Dr. Shadia M. Ihlaseh Catalano
CORTEVA Agriscience, USA

Pesticide Safety Assessment and Career Pathway Beyond Academia

This presentation will provide an overview of agrochemicals, their role in modern agriculture, and the scientific and regulatory processes that ensure their safe use. Topics will include toxicology assessment, global regulatory requirements for pesticide registration, and the importance of Good Laboratory Practices (GLP). The session will also feature a personal career journey from academia to industry, highlighting opportunities to apply scientific expertise in safety assessment in real-world research and development company.



Dr. Cristina Porciuncula Krzyzaniak
Bayer Crop Science, USA

Importance of Academia-Industry Partnership Towards the Professional Development of Young STEM Scientists

The rapidly evolving landscape of science, technology, engineering, and mathematics (STEM) demands a workforce that is not only technically proficient but also adaptable, innovative, and industry-ready. Academia-industry partnerships play a critical role in bridging the gap between theoretical knowledge and real-world applications, providing young STEM scientists with opportunities to develop relevant skills, gain practical experience, and expand their professional networks.

Through collaborative research projects, internships, mentorship programs, and technology transfer initiatives, these partnerships foster experiential learning and expose early-career scientists to emerging trends, industry challenges, and multidisciplinary approaches to problem-solving. Such engagements enhance scientific competency, strengthen employability, and promote innovation by encouraging the translation of academic discoveries into societal and economic impact.

This presentation examines the significance of academia-industry collaboration in shaping the next generation of STEM professionals. It highlights successful partnership models, discusses key benefits and challenges, and explores strategies for creating sustainable ecosystems that support talent development, knowledge exchange, and workforce readiness. Ultimately, strengthening academia-industry partnerships is essential for cultivating a resilient and globally competitive STEM workforce capable of addressing complex challenges and driving future technological advancement.



Dr. Amit Naskar
Oak Ridge National Lab, USA

Advanced Bioproducts from Lignin via Reactive Extrusion

State-of-the-art thermoplastic polyesters derived from biomass-based monomers, including polylactic acid and polyhydroxyalkanoates, remain constrained by low heat-deflection temperature, hydrolytic instability, and poor fatigue resistance. Biomass-derived thermosets, such as lignin-formaldehyde condensates, similarly exhibit limited thermal stability and excessive brittleness. Fatty-oil-derived polyamides can provide useful toughness, yet they offer limited cost and performance advantages relative to petroleum-based analogues. Concurrent market volatility, resource scarcity, and global economic pressures have therefore created an urgent need to replace fossil-derived polymeric products with materials sourced from non-food agricultural biomass residues.

Recent advances in understanding the structure and physicochemical properties of biomass constituents, particularly lignin, have created new opportunities to address this challenge. Its ability to form covalent and physical interactions with complementary polymeric building blocks provides a chemically and functionally diverse platform for tailoring hydrophilicity, interfacial energy, and bonding capability. In this presentation, we describe the development of robust families of lignin-based multiphase polymers that can be processed and molded through reactive processing. For example, branched phenolic oligomers derived from plant biomass and dispersed in a polyethylene oxide matrix display pronounced time-dependent mechanical behavior. An initially intimate molecular mixture yields high ductility, with elongation approaching 4000%, but low strength. Subsequent matrix crystallization during several days of room-temperature annealing produces an approximately 20-fold increase in tensile strength, thereby offering a broad, tunable property set from a single mixture.

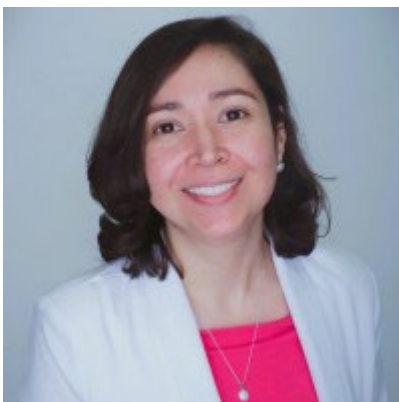
We have also developed a range of recyclable materials containing at least 50 wt% lignin whose mechanical properties are comparable to those of high-strength thermoplastic elastomers, commodity thermoplastics such as polyethylene, and engineering plastics such as acrylonitrile-butadiene-styrene (ABS). Submicron-scale dispersion of lignin within a rubbery matrix provides substantial reinforcement, which can be enhanced by lignin crosslinking through different chemistries. The principles established in these systems offer a general framework for the design of synthetic materials from other unconventional feedstocks.



Andre J. Gesquiere
University of Central Florida, USA

Undergraduate Researchers at the Frontiers of Science: NSF REU Students in Interdisciplinary Research

Undergraduate research can provide students with an opportunity to move beyond learning established concepts and become active participants in the process of scientific discovery. This seminar will highlight research from my laboratory and the ways in which NSF Research Experiences for Undergraduates (REU) students have contributed to ongoing projects in interdisciplinary areas spanning analytical science, nanotechnology, imaging, and applications in agriculture and biotechnology. The REU students are immersed in real-world scientific challenges with the aim to prepare and retain students in graduate school with continued engagement in STEM disciplines. A central component of the REU experience is the formation of a research cohort in which undergraduate students work alongside graduate students on a daily basis. Graduate students play a critical role in this environment, serving as peer mentors providing day-to-day guidance and scientific feedback on scientific reasoning and laboratory practice. This close interaction allows REU participants to develop independence while also becoming part of an active research community. Examples from REU student projects will illustrate both the scientific contributions of undergraduate researchers and the skills they develop through sustained participation in authentic research.



Dr. Andrea Bardales
University of Central Florida, USA
CEO and Founder, DNAlyte LLC.

The Scientist-Entrepreneur: Calibrating Pipettes & Pitch Decks

What happens when a scientist ventures an idea beyond the laboratory? This talk shares my personal journey from academic research in DNA nanotechnology to entrepreneurship, exploring the unexpected challenges and opportunities that arise when scientific discovery meets real-world problems.

My transition from researcher to scientist-entrepreneur began with a simple realization: developing innovative technology is only part of creating impact. Translating an idea into a product requires understanding customers, defining a meaningful problem, communicating value beyond the scientific community, building partnerships, and learning to navigate the uncertainties of commercialization. Along the way, I discovered that many skills developed at the laboratory bench-formulating hypotheses, designing experiments, analyzing data, troubleshooting failures, and iterating-are equally valuable in entrepreneurship.

Through the story of founding the startup DNAlyte, I will discuss the lessons, unexpected setbacks, and mindset shifts that accompanied my transition from pipettes to pitch decks. The talk will explore how scientists can leverage their research skills while developing new capabilities in customer discovery, business strategy, communication, and innovation.

Ultimately, entrepreneurship does not require scientists to leave their scientific identity behind. Instead, it offers another way to apply scientific curiosity and problem-solving to challenges beyond the laboratory.

Poster Abstracts

Development and evaluation of rock-phosphate-based coating for soybean seeds

Everton Luiz V A Souza,^{1,2} Melissa M. Deinys,^{1,2} Jorge Pereira¹ and Swadeshmukul Santra^{1,2}

¹NanoScience Technology Center

²Department of Chemistry

University of Central Florida, Orlando, FL 32816, USA.

Phosphorus is essential for plant growth and early seedling development. However, its limited availability in soil and the low use efficiency of conventional fertilizers make phosphorus management a persistent challenge in agriculture. Apatite-based seed coatings may provide a more targeted strategy by placing a mineral phosphorus source near developing roots, potentially reducing the need for high fertilizer application rates. This study aimed to develop a rock phosphate-rich apatite formulation and evaluate its use as a soybean (*Glycine max*) seed coating for localized phosphorus application. A suspension concentrate containing 40% (w/w) finely ground apatite-rich rock phosphate was prepared with poly(vinyl alcohol), propylene glycol, Atlox™ 4913, and a blue pigment. The mineral material and final formulation were characterized by scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM/EDS) for average particle size and to examine coating morphology, surface coverage, uniformity, and the distribution of calcium and phosphorus on coated seeds. X-ray diffraction (XRD) to determine crystallite structure and identify crystalline mineral phases. Coating retention and phosphorus loading were assessed gravimetrically and by inductively coupled plasma optical emission spectroscopy (ICP-OES), respectively. Soybean seeds were coated at formulation coating levels (FCLs) of 5, 7.5, 10, and 12.5% of seed mass. Untreated seeds and seeds treated with an apatite-free blank formulation were included as controls. Germination was evaluated for 21 days at 26 ± 1 °C under a 12 h light/12 h dark photoperiod and ranged from 80 to 100%. The 5% FCL treatment produced the highest final germination percentage (100%) and germination speed index (1.762). Mean germination time was 6.12 days for untreated seeds and ranged from 5.44 to 5.80 days for the apatite-based treatments. Although root length, shoot height, and fresh and dry biomass did not differ significantly among treatments ($p > 0.05$), the 5% FCL treatment produced the highest numerical seedling vigor index (4025), approximately 28% higher than the untreated control. Overall, the formulation placed a mineral phosphorus source directly on soybean seeds without evident adverse effects on germination or early seedling development. These findings support its further evaluation as a seed-treatment platform for future incorporation of active ingredients and beneficial microorganisms.

Controlled Release of Plant Micronutrients via Stimuli-Responsive Self-assembled Polyphenolic delivery System

Ganga Prasad Phuyal^{1,2}, Jorge Pereira¹, Melissa M. Deinys^{1,2} and Swadeshmukul Santra^{1,2,3}

¹NanoScience Technology Center

²Department of Chemistry

³Burnett School of Biomedical Sciences

University of Central Florida, Orlando, FL 32816, USA

About 2.33 billion people worldwide, accounting for about 28.9% of the global population, faced moderate to severe food insecurity in 2023, according to the Food and Agriculture Organization of the United Nations (FAO). These alarming numbers indicate that the world is still far from achieving global food security. There is an urgent need for innovative plant health management strategies to improve global food security by maximizing food production from minimal land resources. To address this global challenge, a stimuli-responsive Tannic Acid-Polyvinyl Alcohol (TA-PVA) adjuvant system that exhibits cation-dependent self-assembly was developed. This carrier was designed for efficient delivery, controlled release, and better translocation of essential micronutrients in plants. This approach has the potential to reduce the frequency of fertilizer applications and leaching. Elemental analysis confirmed that the formulation successfully encapsulates Fe, Mn, and Zn. Particle size, morphology, and ion-carrier interactions were confirmed using Scanning Electron Microscopy, Dynamic Light Scattering (DLS), Infrared spectroscopy, and X-ray Photoelectron Spectroscopy. DLS measurements revealed hydrodynamic diameters ranging from ~74 nm (Zn) and ~63 nm (Mn) to ~220 nm (Fe), demonstrating the formulation's ability to generate stable nanoscale assemblies with metal-specific size variation. The encapsulation efficiency of micronutrients in the TA-PVA carrier was determined by quantifying the unencapsulated micronutrients remaining in the supernatant using ICP-OES. The encapsulation efficiencies for Zn, Fe, and Mn were ~62%, ~79%, and ~42%, respectively. Controlled-release behavior was evaluated via dialysis experiments (0–96 h), with micronutrient concentrations quantified by ICP analysis. Greenhouse trials (foliar application) were conducted to evaluate micronutrient translocation in plants treated with and without the TA-PVA carrier. The results demonstrated enhanced micronutrient translocation in plants treated with the TA-PVA carrier. Overall, these findings show the potential of the TA-PVA carrier for delivering essential plant micronutrients, reducing the environmental impact of fertilizing programs by improving delivery efficiency.

Efficient DNA delivery and expression in plants through plasmid microparticle synthesis

Preeti Maiti^{1,2}, Jorge Pereira^{1,2}, Swadeshmukul Santra^{1,2,3}

1. Department of Chemistry, College of Science

2. Nanoscience Technology Center,

3. Burnet School of Biomedical Sciences

University of Central Florida, Orlando, FL, US

The delivery of nucleic acids through the different plant system barriers is very challenging. Therefore, nucleic acid delivery systems are necessary for transformative agriculture. Numerous nanoparticle systems have been developed as nucleic acid delivery tools. However, many of these systems are not cost-effective, are not environmentally friendly, or have a low loading capacity. So, herein, a pLMP (plasmid microparticle) has been synthesized and used for delivering it to the plants. We aim to understand whether genetic materials like plasmid DNA can be formulated into pLMP. Plasmid DNA isolated from *Escherichia coli*, was formulated into microparticles through the flash precipitation. The particles were characterized by Zeta potential, NanoDrop, SEM, and Gel electrophoresis. The surface charge of pLMP is -30mV where plasmid DNA concentrations of 50ng/ml. Compared to bare plasmid DNA, where the surface charge is -74 mV at pH 7. The stability of pLMP was tested with bare plasmid DNA kept at room temperature. The expression of the pLMP was tested by spraying the plants with pLMP and bare plasmid as a control separately. The treated plants were analyzed via confocal microscopy to evaluate the plasmid expression. The leaves treated with pLMP showed higher expression and a spread-out expression. Whereas leaves treated with bare plasmid DNA showed limited expression localized to application sites. To confirm the insertion of pLMP in the plants, the total DNA was isolated and amplified. The results showed the presence of plasmid DNA in the plants treated with pLMP. This work shows how plasmid DNA can be formulated into a microparticle. It has also been proven to be an effective method of inserting plasmid DNA in the plants, with higher expression confirming its viability. In conclusion, this method can be exploited for the application of genetic material in field conditions, due to its cost-effectiveness and greater stability.

Testing the efficacy of a novel MnS nanoformulation as a control measure against *Xylella fastidiosa*

Radhika Rani¹, Jorge Pereira², Swadeshmukul Santra^{2,3,4}, Paul A Cobine⁵, Leonardo De La Fuente¹

1. Department of Entomology and Plant Pathology, Auburn University, Auburn, AL.

2. Nano Science Technology Center, University of Central Florida, Orlando, FL.

3. Department of Chemistry, University of Central Florida, Orlando, FL.

4. Burnett School of Biomedical Sciences, University of Central Florida, Orlando, FL.

5. Department of Biological Sciences, Auburn University, Auburn, AL.

Xylella fastidiosa (Xf) is a xylem-limited bacterium with rapid evolving nature. It has an extremely broad host range with over 700 host plants. For transmission, Xf requires xylem sap-sucking insect vectors. With no cure available, disease management options are limited to controlling the vector. Here we tested the efficacy of the novel MnS nano formulation as a potential measure against two strains of Xf (AlmaEm3 and TemeculaL), both in vitro and in planta. By conducting crystal violet assays and monitoring the growth of Xf strains under varying concentrations of MnS and ZnK (Zinkicide® – a nano-ZnO based bactericide formulation), MnS was found to be more inhibitory than the previously tested ZnK, with a smaller MIC of 5-15 ppm. For the in planta experiments, a preliminary phytotoxicity assessment was carried out using the model plant tobacco, which showed no phytotoxicity even when applied at the highest dose (five applications at 400/400/400/400/1000 ppm). Mn levels were found to be higher in treated plant leaves, indicating uptake of the treatment by the plant. Disease severity assay was conducted by observing the symptoms every week, followed by bacterial and ionome quantification. We found that disease severity was significantly reduced at the highest dose applied in strain AlmaEm3-inoculated plants, while in another strain there was no significant effect. The present study suggests that MnS has potential for controlling Xf, although more testing is needed to explore its effectiveness further. A similar in planta experiment will be conducted in grapevines to assess disease severity.

Exploring the mechanism of action of MnS nanoparticles against *Xylella fastidiosa*

Jacobo Dobon¹, Lake Treen¹, Jorge Pereira³, Swadeshmukul Santra^{2,3,4}, Leonardo De La Fuente¹.

1. Department of Entomology and Plant Pathology, Auburn University, Auburn, AL.
2. Department of Chemistry, University of Central Florida, Orlando, FL.
3. Nanoscience Technology Center, University of Central Florida, Orlando, FL.
4. Burnett School of Biomedical Sciences, University of Central Florida, Orlando, FL.

Xylella fastidiosa is a xylem-limited bacterial pathogen responsible for economically important plant diseases, including Pierce's disease of grapevine. Its ability to move through plant vascular tissues and form biofilms contributes to host colonization and disease development. Nanoparticle-based treatments may offer an alternative approach to interfere with these processes due to their improved plant absorption. This study evaluated the effects of novel manganese sulfide (MnS) nanoparticles on bacterial motility and growth of *X. fastidiosa* using complementary microfluidic and solid-medium assays. First, bacterial behavior was monitored in microfluidic chambers following exposure to 50 ppm MnS nanoparticles. Preliminary observations showed that bacterial movement was completely arrested, and no biofilm formation was observed throughout the incubation period. However, bacteria recovered from the chambers subsequently grew in PW medium, suggesting that MnS exposure was bacteriostatic. Second, twitching motility was evaluated on solid PW medium. Although colonies increased in size on MnS-amended medium, preliminary observations showed lack of twitching motility (as measured by colony fringe). In a split-plate assay containing control and MnS-amended media, fringe development occurred on both sides, but expansion into the MnS-containing region rapidly ceased. These results suggest that MnS nanoparticles inhibit bacterial motility and are potentially bacteriostatic under the tested experimental conditions. Further investigation is needed to characterize the underlying mechanisms and determine the potential application of MnS-based treatments for managing *X. fastidiosa* diseases.

Lighting up citrus: Real-time fluorometric monitoring of oxytetracycline with quantum dot tattoos

Giulio Diracca^{1,2}, Melissa Deinys^{1,2}, Jorge Pereira² and Swadeshmukul Santra^{1,2,3}

1. Department of Chemistry, University of Central Florida, Orlando, FL.

2. Nanoscience Technology Center, University of Central Florida, Orlando, FL.

3. Burnett School of Biomedical Sciences, University of Central Florida, Orlando, FL.

In current citrus groves, trunk injection of oxytetracycline (OTC) is one of the few effective treatments for bacterial diseases such as huanglongbing (HLB). While a significant advancement over foliar or soil applications, producers lack any effective way to monitor OTC movement and retention in tree vasculature, limiting the ability to optimize treatment regimens and attain consistent therapeutic outcomes. To address this gap, an injectable "tattoo" proof of concept sensing platform with doped ZnS quantum dots (Qdots) was developed for in situ agrochemical sensing. Preliminary experiments demonstrated fluorescence quenching of ZnS Qdots in direct contact with OTC, establishing the basis for quantifiable sensing. In order to optimize fluorescence properties and sensitivity of OTC sensing in situ the ZnS Q dots were doped with Sr, Ca, and Mn, which provided tunable emission and stability. Quenching capabilities were measured through UV-Vis spectrophotometry. The composition of the ink was examined through dynamic light scattering (DLS) to confirm particle size distribution and colloidal stability. Tattoos applied directly to citrus bark maintained stable fluorescence and were sensitive to OTC exposure. Qdot deposition and distribution on bark microstructures were also confirmed by scanning electron microscopy (SEM). Together, these findings illustrate the potential of doped ZnS Qdot tattoos as a novel, field-deployable platform for the real-time monitoring of antibiotic flow in perennial crops.

Enhancing Biological Control of Bacterial Pathogens in Fruit Tree Crops using a Probiotic Targeted Delivery System

Melissa M. Deinys^{1,2}, Jorge Pereira¹, Giulio Diracca^{1,2}, Everton Luiz V A Souza,^{1,2} and Swadeshmukul Santra^{1,2,3}

¹NanoScience Technology Center

²Department of Chemistry

³Burnett School of Biomedical Sciences

University of Central Florida, Orlando, FL 32816, USA

Bacterial diseases continue to threaten citrus and apple production, with limited sustainable control options available to growers. Biological control agents, such as *Aureobasidium pullulans*, represent a promising alternative; however, their success depends on effective delivery, persistence, and compatibility with host plant tissues. In this study, a novel target delivery system composed of magnesium, calcium, and boron (MgCaB) was developed to preferentially deposit probiotics to sustain *A. pullulans* and mitigate plant disease. Zeta potential measurements were used to evaluate the surface charge and colloidal stability of the delivery system. Dynamic light scattering (DLS) through size exclusion filtration was conducted to determine the hydrodynamic size distribution of the particles. Furthermore, Fourier-transform infrared spectroscopy (FTIR) identified functional groups and confirmed their interactions within the formulation. Scanning electron microscopy (SEM) confirmed targeted adhesion and colonization of probiotics and *A. pullulans* on citrus leaf surfaces following application, demonstrating the delivery capacity of the formulation. Colony-forming unit (CFU) quantification further demonstrated that yeast populations persisted on treated leaves, while challenge assays with bacterial pathogens revealed a significant reduction in pathogen recovery relative to untreated controls. Together, these results indicate that the nutritional carrier enhances both the stability and protective efficacy of *A. pullulans*. This integrated micronutrient microbe delivery approach offers a dual benefit; it allows targeted delivery of beneficial biological control agents and nutritional support for host tissue health. These findings provide a foundation for scalable, field-ready biocontrol strategies that align with sustainable disease management in perennial fruit crops.

Evaluation of Nanoparticle Presence, Nitrogen Leaching, and Turf Health in (28-0-0 Substain-N) Fertilizers

Alexis Buggam³, Jorge Pereira¹, Melissa M. Deinys^{1,2}, Allison Lloyd³ and Swadeshmukul Santra^{1,2,3}

¹NanoScience Technology Center

²Department of Chemistry

³Burnett School of Biomedical Sciences

University of Central Florida, Orlando, FL 32816, USA

Nitrogen is an essential nutrient in plant growth, contributing to chlorophyll production, tissue development, uptake of other nutrients, etc. Substain-N is a slow-release nitrogen fertilizer produced by TradeMark Nitrogen. The product is primarily intended for ornamental and turf grass but can be applied to various agricultural crops. In continued partnership with TradeMark Nitrogen, members of Santra Research Group aimed to characterize and test efficiency of this product. The provided objectives were: Evaluate Substain-N for the presence of nanoparticles. Assess the nitrogen leaching potential of Substain-N and compare it to urea and another industry product. Quantify the effect of the application of Substain-N on the color, chlorophyll content, and biomass production of turfgrass. Dynamic Light Scattering (DLS) characterization was used to assess Substain-N and various Laponite-Substain-N formulations for the presence of nanoparticles; visual observation for presence of the Tyndal effect was also implemented. These techniques showed Substain-N does not possess nanoparticle characteristics. Fourier-transform infrared (FTIR) spectra of Substain-N show its most prominent peak at 1575 and 1515 cm, representative of N-H bending modes, from the numerous amine groups in its urea-triazone molecules. Application of Substain-N and similar products (UAN 32 and N-Sure) was done on sod, under greenhouse conditions. Throughout the 6-week trials collection of Nitrogen-containing water samples from lysimeters allowed for subsequent testing of nitrogen content. The slow-release nature of Substain-N was reflected in the increasing Nitrogen concentration in the leachate with time. Collection and analysis of biomass after the trial-period show Substain-N increases biomass production without causing phytotoxicity. Substain-N proved a suitable fertilizer for recently planted sod.