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Application Summary

Competition Details

Competition Title:	2024 Research Opportunity Seed Fund
Category:	
Cycle:	
Submission Deadline:	02/29/2024 5:00 PM

Application Information

Application Title:	DRPD-ROSF2024: A novel approach to quantifying the in-field flight of small invasive species using a new harmonic radar system and AI-based behavioral models
Application ID:	2997
Submission Date:	02/26/2024 3:29 PM

Personal Details

College Approval:	No
PI First Name:	Norman
PI Last Name:	Leppla
Application Title:	DRPD-ROSF2024: A novel approach to quantifying the in-field flight of small invasive species using a new harmonic radar system and AI-based behavioral models
PI College and Department:	College of Agriculture and Life Sciences, Entomology and Nematology Department
PI Title(s):	Professor and Program Director, IPM
Submitting by Proxy:	Yes
Contact Person:	No
Amount of Co-PIs:	4
Co-PI First and Last Name:	Tan F. Wong, Jasmeet Judge, Isaac L. Esquivel, Marcelo O. Wallau
Co-PI College and Department:	College of Engineering, Electrical and Computer Engineering Department; College of Agriculture and Life Sciences, Department of Agricultural and Biological Engineering; College of Agriculture and Life Sciences, Entomology and Nematology Department; College of Agriculture and Life Sciences, Agronomy Departments
Co-PI Email:	twong@ufl.edu, jasmeet@ufl.edu, esquivel@ufl.edu, mwallau@ufl.edu
Co-PI Title(s):	Professor of Electrical and Computing Engineering, Professor of Agricultural and Biological Engineering, Assistant Professor of Entomology, Assistant Professor of Agronomy
Additional Email Addresses for Notifications/Email Addresses for notifications:	ncleppla@ufl.edu,twong@ufl.edu,jasmeet@ufl.edu,esquivel@ufl.edu,mwallau@ufl.edu,andrew.short@ufl.edu, dcadams@ufl.edu,
Topic Area 1:	Biology
Optional: Topic Area 2:	Physical Science

Cover Page ROSF 2024

Title: DRPD-ROSF2024: A novel approach to quantifying the in-field flight of small invasive species using a new harmonic radar system and AI-based behavioral models

PI: Norman C. Leppla, ncleppla@ufl.edu, Entomology and Nematology Department, College of Agriculture, ncleppla@ufl.edu

Co-PIs/Co-Investigators:

Tan Wong, Electrical and Computer Engineering Department, College of Engineering

Jasmeet Judge, Agricultural and Biological Engineering, College of Agriculture

Isaac Esquivel, Entomology and Nematology Department, North Florida Research and Education Center, College of Agriculture

Marcelo Wallau, Agronomy Department, College of Agriculture

Project Start Date: (July 1st, 2024)

Total Budget Requested: ($98,747)

Please check all that are applicable:

☐This proposal/parts of this proposal have been submitted for funding through other seed programs at UF (CTSI, UF Informatics Institute, UF Biodiversity Institute, MBI, Water Institute, Cancer Center etc.) The proposal/parts of this proposal:

☐Are currently under consideration for funding

☒ Is the proposal multidisciplinary?

☐Has the proposal been previously submitted for ROSF funding? If yes, please include previous ROSF reviews and the Review Resubmission materials in the application Appendix (see RFP FAQ for requirements)

☒ Is this a new collaboration? If yes, describe your plans for collaboration; if no, discuss what is new and unique about your continued collaboration. (describe in section 7)

☒ Does the proposal have potential for return on investment? (describe in section 5)

Abstract:

The proposed project is an unprecedented opportunity to quantify the movement of pest and beneficial insects and other small organisms. A main goal of the project is to use a new harmonic radar system to automate the collection of a sufficient amount of validated experimental data to facilitate the development of AI-based behavioral models for the target organisms. The new prototype system could become the first commercially available harmonic radar for a wide range of important applications. Initially, we will demonstrate its effectiveness by tracking the movement of a small parasitoid wasp, *Larra bicolor*, that attacks invasive *Neoscapteriscus spp*. mole crickets in pastures. Mole crickets infest millions of hectares of pasture across the Southeast and cause severe damage in some areas. The harmonic radar system will enable us to identify the most attractive plants and determine the maximum distance the wasps fly from nectar plants to hunt mole crickets. Eventually, a predictive model will be generated in a subsequent project and used to design landscapes that increase wasp populations and maintain mole crickets below damage thresholds. After the system is optimized, it will have many important applications, for instance determining the frequency and duration of visits by commercial honeybees and bumblebees to certain crops and confirm their effectiveness. Capturing, tagging, releasing, and tracking invasive pests, such as the Africanized honey bee, with harmonic radar could enable them to be located and eliminated. Another application for this technology would be to track predatory insects and determine if they successfully locate and consume damaging crop pests. Additionally, it could enable early detection of invasive organisms of economic significance to human and animal health. Our project combines the knowledge and expertise of UF faculty members from Electrical and Computer Engineering, Agricultural and Biological Engineering, Entomology and Nematology, and Agronomy Departments. This is a truly multi-disciplinary team that will extend the project from component development to in-the-field application of knowledge gained and transferred to stakeholders. Moreover, two of the Co-PIs are early-career faculty members who, along with two graduate students, will receive multi-disciplinary training as next generation scientists.

Project Description:

Specific Aims/Objectives.
We intend for this initial project to be a major breakthrough in the ability to track insects and other small organisms. The three main objectives of the proposed research are to: 1) optimize a novel harmonic radar system we are constructing for tracking various invasive insect species, 2) demonstrate the ability of the system to follow a small 2.2 cm long *Larra* wasp, as a model organism, and 3) collect a sufficient amount of validated experimental data using the radar for a potential follow-up project to build unique machine learning (ML) models that predict insect movement. To track the insects, we are improving a novel harmonic radar system by increasing its portability, decreasing the size of the transponders, and exploring AI and ML to process the captured radar data. The novel harmonic radar system can enable scientists to follow highly mobile species to determine the ecological services they provide, such as pollination or biological control of pests, as well as spatial responses to climate change, other changes in their habitats, and reductions in biodiversity. It also will make it possible to track social insects, such as native and invasive hornets (Gill and Lucky 2020), to locate their nests where they can be eliminated. Moreover, it can determine how far a pest organism is able to disperse over time to invade new geographical areas and infest crops, urban environments or natural areas. Invasions occur constantly and the ML models could assist in delimiting an organism's pathway and predict its probable time of arrival. This technology would thereby facilitate monitoring and interdiction of new pests by regulatory authorities. If commercialized, the system could be used routinely to determine the size of floral resource patches needed within a landscape to support diverse pollinator populations and bolster the ecosystem services they provide. Additionally, scientists would find the equipment especially useful for studying animal behavior that involves movement over considerable distances and at night.

Background and Significance.
A resurgence of pest mole crickets has occurred recently in some areas of Florida and other southern states. There are three species of these invasive pests from South America, *Neoscapteriscus vicinus* (tawney), *N. borellii* (southern), and *N. abbreviates*(shortwinged) (Kerr et al. 2021) (Fig. 1). These mole crickets cause extensive damage to vegetable seedlings, turfgrass, and pastures. Unless they are controlled, damage estimates can reach about $14 million per year for pastures in Florida (Mhina et al. 2016) and $20 million for sod farms across the southeast. Insecticides control mole crickets effectively but are registered for use only in specific situations and are too expensive to apply over large areas. Therefore, biological control often is the preferred option for managing mole crickets in pastures and sod farms. The *Larra* wasp is highly effective in locating and parasitizing mole crickets but requires nectar from flowers as a food source (Portman et al. 2009, 2010). The best-known source is shrubby false buttonweed, an invasive plant that is restricted for planting in Florida. Consequently, an environmentally acceptable alternative nectar source must be identified, and this requires that the wasps be followed to determine which plants they utilize spatially, temporally and seasonally. The radar system will enable us to follow the wasp and determine its preferred nectar plants and how far from alternative nectar sources it will hunt mole crickets. Radar tracking of the wasp may also reveal sheltering sites and behaviors that may be exploited to make it more efficient in killing mole crickets. This type of research is not being conducted elsewhere in the U.S., so we formed a new interdisciplinary team of three entomologists, an agronomist, an agricultural engineer, and

two electrical and computer engineers. This new collaboration includes two graduate students and is already yielding novel ideas and approaches.

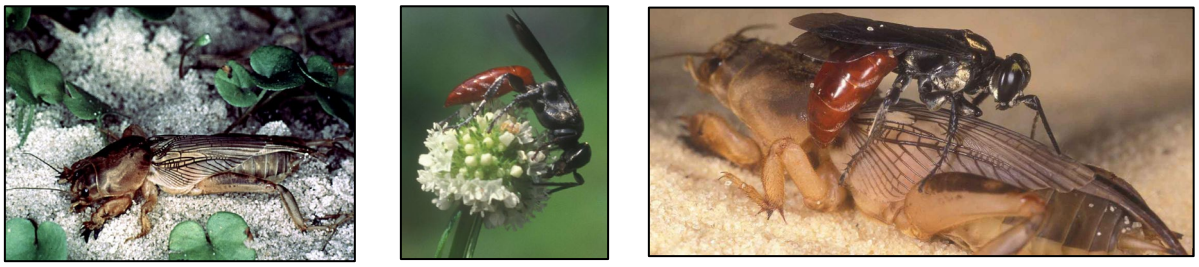

Figure 1 (L-R). Mole cricket adult, *Larra* wasp on false buttonweed, *Larra* wasp attacking a mole cricket and laying an egg.

Preliminary Data.
Research has been conducted on the *Larra* wasp by UF Entomology and Nematology Department faculty members since it was introduced into Florida in the 1980s. It is established throughout the Southeast and parasitizes up to 90% of the two main species of pest mole crickets in the laboratory (Castner 1984). However, its effectiveness in controlling mole crickets in the field is limited by the availability of nectar-producing plants. It feeds on at least 10 species of flowering plants but is often most abundant on shrubby false buttonweed, *Spermacoce verticillata* (Arevalo and Frank 2005). Partridge pea, *Chamaecrista fasciculata*, is preferred during months when it is available but is not cold tolerant. Therefore, before it was banned, we recommended shrubby false buttonweed be distributed throughout Florida to increase populations of the wasp for mole cricket control. This is no longer possible because the Florida Invasive Species Council listed the plant as a category II invasive species. Unfortunately, we have been unable to follow the movement of wasps among flowering plants to determine the best alternative nectar sources. The optimum range and spatial distribution of foraging is unknown. Based on previous research, we anticipate that the harmonic radar system will achieve a resolution of two meters in the radial direction and a few degrees in the azimuth direction (angle of horizontal change), and will be capable of operating over a duration of several hours. Some advanced signal processing will be required to continuously record the trajectory of a wasp and compare this data with a survey of the landscape and vegetation.

Innovation/Potential Impact of Research.
“Harmonic radar represents a major step forward in our capacity to study insect flight” (Riley and Smith 2002). Previous approaches to following flying insects, such as image-based tracking and radio telemetry, have limited application for insects. For example, the radio tracking equipment currently used for monitoring hornet species in North America depends on a sizable VHF transmitter that could not be carried by smaller insects (Wilson et al. 2000, Nuñez-Penichet et al. 2021, Looney et al 2023). The mass of a hornet worker ranges from 0.36 g to 1.41 g and they are about 5.08 cm long (Gill et al. 2020). Conversely, harmonic radar uses a passive lightweight transponder to double the fundamental frequency of the signal transmitted from the radar and uses it as the receiving signal to resolve the problem of ground clutters. Our unique system incorporates four main features: 1) a sturdy ground platform to provide a solid foundation and power to the radar, 2) a digital control platform responsible for signal generation, processing,

and storage, 3) transmit and receive electronically steered by phased-array antennas, and 4) a suitable horn/marine-based radar system that will serve for comparison. Commercial, off-the-shelf (COTS) parts are used when available; however, most of the antenna prototyping and design is being performed by our team. We will continually test and improve the harmonic radar system during the project.

Initially, we will use the new harmonic radar system to address the devastating mole cricket problem in pastures across Florida. All the investigators will be fully engaged in the research but with different responsibilities based on their expertise. This will enable us to learn from each other as we optimize the instrumentation while conducting entomological research. The harmonic radar system will be tested by tracking *Larra* wasps as they feed on plant nectar and search for mole crickets. The maximum distance between nectar source plants must be specified to gain full control of an infested area. The plants are to be distributed near mole crickets and in a density that maximizes feeding by the wasps. Producers will be informed about the best plants to use and how to deploy them for maintaining pest mole crickets below the economic threshold. Specific objectives include: 1) identify the best plant species to attract *Larra* wasps and enhance parasitism of the mole crickets by tracking wasps in association with the nectar plants in mole cricket habitats, 2) determine the distribution of nectar sources that maximizes the abundance and effectiveness of the wasps in managing mole crickets in pastures, and 3) measure the impacts of mole cricket biological control on pasture grass density and growth.

Approach/Research Design/Expected outcomes, Challenges, Alternative Strategies.
Our approach to tracking *Larra* wasps is to test and improve a novel harmonic radar system based on a unique ground platform (Fig. 2). This requires specialized expertise contributed by team members from the UF Electrical and Computer Engineering Department. The system consists of a telescopic mast, capable of supporting up to 250 pounds of equipment, that can extend up to 6.3 meters into the air using a hand crank. A comparable horn antenna system is being developed to aid in the calibration and fine-tuning of our azimuth and electronically steerable array (AESA) system. An X-band horn system will provide data similar to that observed in entomological publications and help in judging the benefits and costs of our AESA approach. The platform can be supported by four legs that are leveled and supported with weight to create a structure resistant to wind or wildlife. A 12V DC lithium-ion polymer battery serves as the main power source for the radar's operation; rated for 100 amp-hours, allowing the radar to operate continuously for several days. The duty cycle can be scaled down to significantly extend battery life. Additional power regulators and conditioners ensure the digital and radio-frequency (RF) equipment have clean operating power. Advancements will be made in analyzing captured radar data with more signal processing and machine learning. We also intend to extend the range of the radar by developing more advanced radar processing techniques and perhaps track multiple targets by deliberately introducing component variations in transponders. If we can develop smaller transponders, we will be able to follow smaller insects than is currently possible.

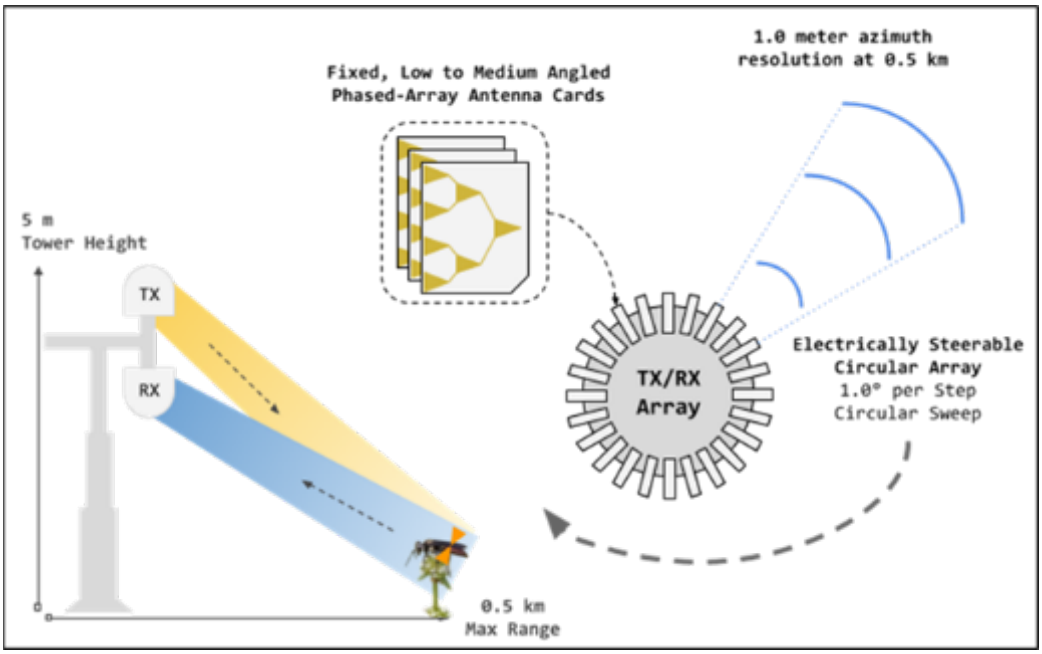

Figure 2. Harmonic radar transmits and receives radomes attached to a telescopic mast and the TX or RX array platform, composed of a phase control board and separate vertical riser cards.

The harmonic radar system will be deployed first at two sites: the Plant Science Research and Education Unit (2556 Co Hwy 318, Citra, FL 32113) and a private farm near Hawthorne both infested with mole crickets for several years. Landscapes will be designed in the pastures that will include combinations of nectar sources, such as buckwheat, sweet alyssum, and partridge pea with shrubby false buttonweed for comparison. These plants were selected based on previous observations of high attraction for *Larra* wasps and meeting the required criteria for use in pastures. The plants must be available, non-invasive, reasonably inexpensive, and capable of attracting large numbers of wasps. They also must be easy to establish in Florida agricultural areas and produce abundant flowers for long periods during mid to late summer when mole cricket activity is the highest. At both locations, areas of the pastures without nectar plants will be maintained in bahiagrass. The nectar plant seeds will be planted with a no-till drill, and bahiagrass chemically suppressed to reduce competition during establishment. The plantings will be separated by 400 meters, determined to be the estimated distance *Larra* wasps search for mole crickets (Portman et al. 2010). Linear pitfall traps will be placed five meters from each planting (Lawrence 1982). This will enable collection of mole crickets to determine the population size and wasp parasitism rates in the vicinity of the plantings. We will use the harmonic radar to track the wasps beginning when the plants start flowering and continuing each week during the study period. Wasps will be captured at or near the treatment plots and a transponder will be glued to the back of each of them before they are released and tracked for a minimum of 24 hours. Data will include at least the average maximum hunting distance of the wasps from the flowering plants, hunting and nectar foraging time each day, and time spent on the experimental nectar plants versus other plants in the area, and percent parasitism of captured mole crickets.

We will develop Kalman filter-based trajectory tracking techniques for the radar target to account for missing or corrupted radar data, a problem that is common to the proposed application scenario. We plan to use the harmonic radar to obtain data and correlate it with

information from vegetation surveys and empirical observations to build a database for training ML models that can predict wasp feeding habits, such as preferred nectar plants and how far from alternative nectar sources it will hunt mole crickets in areas with specific vegetation patterns. Researchers and producers may then be able to use these ML models to design vegetation plans for increasing wasp populations in their pastures. We also plan to capture movement data from *Larra* wasp trajectories and comparative empirical observations to train ML models that predict their movement and spread. In all, the proposed research aims to develop an optimal set of procedures and tools, including radar hardware, signal processing algorithms, and training databases for ML model development that are generally applicable to behavioral studies of flying insects and can be applied for pest prevention and management.

Timeline for Completion.
The project can be completed in two years because mole crickets are abundant in North Florida pastures from about April until December. This will enable us to optimize the harmonic radar system and obtain enough data on nectar plant utilization by *Larra* wasps and their impact on mole crickets. The budget is adequate to achieve these goals.

Year 1: (July 2024- June 2025) Establish experimental plantings of nectar plants, grow plants to flowering, test and refine the prototype harmonic radar system in the laboratory, refine the prototype, design experimental protocols, deploy the system to track *Larra* wasps in the experimental plantings, refine the system in the field, track *Larra* wasps and generate preliminary data, analyze wasp tracking data, develop data collection software, evaluate results, and refine experimental methods.

Year 2: (July 2025-June 2026) Repeat year 1 study (spring and fall mole cricket seasons), expand the study to include additional variables (e.g., light, sound, multiple *Larra* wasps, staggered planting, additional plant species, etc.), finalize data collection software, analyze data and submit the first report (June 2026), write a publication, possibly submit a patent application, prepare and apply for grants, deploy harmonic radar system to track other organisms, submit the second (final) report (August 2029).

Plans for continued support and/or return on investment:

The new harmonic radar system, as well as its antenna components, have significant technology transfer and commercialization potential. Therefore, we plan to work with the UF Innovate Office to explore patenting and marketing of the radar technology. It could be a major advancement in the capability to precisely track important insect species and observe their behavior under previously impossible conditions in the field (Woodgate et al. 2021). For example, at what distance does a nocturnal insect respond to specific wavelengths of light, what is its natural circadian rhythm, and does it avoid insecticides or traps? Are there times and conditions when pollinators, predators and parasitoids could be less affected by insecticide applications? The harmonic radar system also could be used to predict potential pathways of invasion and spread and aid in mitigating and eradicating new invasive pests that threaten agriculture and human health. For this purpose, a prototype harmonic radar tracking system was developed with improved miniaturization and range measurement (Tahir and Brooker 2011). This radar technique was configured to cover a large field of view in elevation and used to track

the yellow-legged Asian hornet, *Vespa velutina*, in Europe (Milanesio 2017, Maggiora et al. 2019). The hornet is spreading across Europe and has recently been detected in the state of Georgia. This serious pest of honey bees kills adults and consumes larvae and pupae. The estimated annual cost of controlling this hornet in Europe is $34.4 million (Alaniz et al. 2020).

Our research could attract considerable grant funding because the prototype system is unique; nothing like it is available commercially. The ROSF grant funding is needed to test and optimize the system under a variety of conditions. The next step will be to develop a much larger project for the NSF engineering core program. NSF funded a $1.1 million award in 2015-2019 for a team of computer scientists and entomologists to develop sensors and software that allowed them to classify flying insects (https://grantome.com/grant/NSF/IIS-1510741). The investigators stated that "Recent advances in sensor technology and machine learning are just beginning to enable development of advanced algorithms that will help usher in a new era of computational entomology". Similarly, our proposed radar system will enable us to automate the data collection process, based on scientific experimental design. This automated data collection approach/paradigm supports the collection of a sufficiently large volume of data required for training ML models. This may provide us a competitive advantage in pursuing grants for applying ML techniques in entomology and agricultural research.

Thus, the output of our research could open up new lines of research in tracking small invasive species. We plan to continue our collaboration for the foreseeable future and seek funding for our research from the USDA Invasive Pests and Diseases grants program (https://www.nifa.usda.gov/topics/ invasive-pests-diseases). A target will be the USDA, NIFA, CPPM, Applied Research and Development Program (ARDP) in the category of "Plant Protection Tools and Tactics – the discovery, development, and introduction of new pest management tools for use in IPM systems". Another potential source for continued external support is the USDA, Agriculture and Food Research Initiative (AFRI) Sustainable Agricultural Systems (SAS) Program. The category is "protecting yield losses from stresses, diseases, and pests". The Specialty Crop Research Initiative (SCRI) fits our work, as well. The focus priority will be "Efforts to identify and address threats from pests and diseases, including threats to specialty crop pollinators". This work also is suitable for specialty crop block grant and farm bill funding, and the NASA-Applied Science Program. Our research is appropriate for the ROSF program because it is "Guided by the philosophy that diverse partnerships across the disciplines drive groundbreaking research and winning proposals". The collaborators think that the harmonic radar system will enhance UF's research capability and create new research opportunities. We have access to different sources of funding based on our disciplines and anticipated synergy.

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Key Personnel:

Norman Leppla (Entomology and Nematology)- UF/IFAS Professor of Entomology and Program Director, IPM will serve as projector director (PD) for the project, cooperatively draft and submit the ROSF research proposal, supervise MS student William Piwowarek as co-chair of his graduate committee, with the student and other Co-PIs design the experimental landscapes

and field testing of the harmonic radar system, participate in the field work and Extension activities, maintain the IPM Laboratory and vehicles used for the project, manage the project funds, assist in preparing grant proposals, and lead preparation of reports and publications. (.05 FE)

Tan Wong (Electrical and Computer Engineering)- UF Professor of Electrical and Computer Engineering will continue to advise the engineering process of designing, assembling, testing, and calibrating the prototype harmonic radar and transponder tags, work with other Co-PIs to optimize the radar system, and develop proposals to external funding agencies. (0.02 FTE)

Jasmeet Judge (Agricultural and Biological Engineering)- UF/IFAS Professor of Microwave remote sensing and Director, Center for Remote Sensing, will provide expertise in algorithm development to help with analyzing and interpreting tracking signals. She will also collaborate with the Co-PIs to seek external funding for wider applicability of the proposed project. (0.02 FTE)

Isaac Esquivel (Entomology and Nematology)- UF/IFAS Assistant Professor of Entomology, Agroecosystems, will provide guidance for MS student Piwowarek and assist with experimental design and analysis methodology. Further, he will be involved with the other Co-PIs in bringing this information to our producer clientele. (0.03 FTE)

Marcelo Wallau (Agronomy)- UF/IFAS Assistant Professor of Agronomy and Forage Extension Specialist, will provide guidance for MS student Piwowarek, coordinate the field trials, and provide assistance in designing and maintaining the experiments. Furthermore, along with Co-PI Esquivel, be responsible for the Extension component of the project, taking the findings to stakeholders via direct communication, newsletter, related field days, and other diffusion strategies. (0.03 FTE)

David Greene (Electrical and Computer Engineering)- UF/ECE graduate student (Ph.D.) is designing and assembling the prototype harmonic radar system and will test, and calibrate the system and transponder tags. Supervised by Dr. Tan Wong, he will be responsible for delivering the radar, post-processing software, and a brief operator's manual. Time and resources permitting, David will assist with laboratory and field setup and post-processing the obtained datasets. (0.25 FTE)

William Piwowarek (Entomology and Nematology)- MS graduate student fall 2024 (currently OPS) will carry out data collection for the duration of the project, including setting up and running the experiments, performing wasp counts, collecting and surveying mole crickets, determining rates of parasitism, conducting plant surveys, and operating the harmonic radar tracking system. Following data collection, he will perform data analysis, write a master's thesis, and draft manuscripts for publication. (0.5 FTE graduate assistantship)

Budget:

a. Budget Table

Budget Item	Description	Cost
A. Personnel	Student salaries	$40,267
B. Fringe	Student fringe	4,752
Total Personnel	Salary plus fringe	45,019
C. Materials and supplies	Field tests and studies	16,000
D. Travel	Travel to two field sites	2,169
E. Tuition	Non-resident graduate tuition	35,559
	Total Project Cost	**$98,747**

b. Budget Justification

Most of the requested funding is for the salary, fringe benefits and tuition for a M.S. graduate assistantship ($80,578). Materials and supplies will be needed for minor improvements to the harmonic radar system and disposable materials for use in the field. Funding for constructing the harmonic radar system is provided by another grant. Field materials include seeds, plants, fertilizer, mole cricket trap construction, collection containers, electrical supplies, batteries, and other disposable materials ($8,000/yr x 2 yrs = $16,000). Vehicles and equipment are provided by other grants. Travel from the UF campus to Citra (26mi) and Hawthorne (20 mi) or alternative locations will be weekly from April to December (36 trips each, 3312 mi for 2 years x 0.655 = $2,169). See Key Personnel for project activities and FTEs.

Biosketch and Current and Pending Support:

a. Biosketch for PI and Co-PIs (Tan Wong, Jasmeet Judge, Marcelo Wallau, Isaac Esquivel, and Norm Leppla); Other Personnel (David Greene and Vilheim Piwowarek).
b. Current and Pending Support for PI and Co-PIs (Tan Wong, Jasmeet Judge, Marcelo Wallau, Isaac Esquivel, and Norm Leppla).

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EDUCATION

Ph.D. 1972	University of Arizona, Entomology/Biological Sciences
M.S. 1970	Arizona State University, Zoology
B.S. 1968	Arizona State University, Zoology

PROFESSIONAL EXPERIENCE

2001 - Pres.	Professor and Director, IPM Program, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida.
1999 - 2001	Professor, Department of Entomology and Nematology, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida.
1997 - 1998	Professor and Center Director, Central Florida Research and Education Center, Institute of Food and Agricultural Sciences, Univ. of Florida, Apopka, Florida.
1995 - 1996	Associate Director, National Biological Control Institute, Animal and Plant Health Inspection Service (APHIS), U.S. Department of Agriculture (USDA), Hyattsville, Maryland (GM-15).
1992 - 1994	Chief, Methods Development, Plant Protection and Quarantine, APHIS, USDA, Hyattsville, Maryland (GM-15).
1989 - 1992	Director, Methods Development, Science and Technology, APHIS, USDA, Hyattsville, Maryland (GM-15).
1988 - 1989	Research Leader, Biological Control of Pests Research Laboratory, Subtropical Agricultural Research Laboratory, Agricultural Research Service (ARS), USDA, Weslaco, Texas (GS-14).
1974 - 1988	Adjunct Associate Professor, Department of Entomology and Nematology, IFAS, University of Florida, Gainesville, Florida (Doctoral Research Faculty).
1972 - 1988	Research Entomologist, Insect Attractants, Behavior, and Basic Biology Research Laboratory, ARS, USDA, Gainesville, Florida (GS-14).

PRODUCTS

Leppla, N. C., J. H. Frank, N. Vicente and A. Pantoja. 2004. A Commercial Nematode for Mole Cricket Control. Proc. Caribbean Food Crops Society. 40:249-254.

Leppla, N. C., J. H. Frank, M. B. Adjei and N. E. Vicente. 2005. Management of Pest Mole Crickets in Florida and Puerto Rico with a Nematode and Parasitic Wasp. Florida Entomologist 90:229-233.

Adjei, M. B., G. C. Smart, Jr., J. H. Frank and N. C. Leppla. 2006. Distribution of Beneficial Nematodes for the Control of Pest Mole Crickets (Orthoptera: Gryllotalpidae) on Pasture. Florida Entomologist. 89:532-535.

Vicente N. E., J. H. Frank and N. C. Leppla. 2006. Use of beneficial nematodes against pest mole crickets in Puerto Rico, pp. 180-186. *In* H. L. Santiago and W. l. Lugo (Eds.), Food Safety and Value Added Production and Marketing in Tropical Crops, Proceedings 42nd Annual Meeting, Caribbean Food Crops Society, San Juan, PR

Portman, S. L., J. H. Frank, R. McSorley and N. C. Leppla. 2009. Fecundity of *Larra bicolor* (Hymenoptera: Crabronidae) and its Implications in Parasitoid: Host Interaction with Mole Crickets (Orthoptera: Gryllotalpidae: *Scapteriscus*) Florida Entomologist. 92:58-63.

Portman, S. L., J. H. Frank, R. McSorley and N. C. Leppla. 2010. Nectar-seeking and host-seeking by *Larra bicolor* (Hymenoptera: Crabronidae, a parasitoid of *Scapteriscus* mole crickets (Orthoptera: Gryllotalpidae). Environmental Entomology. 39:939-943.

Frank, J.H., and N. C. Leppla. 2009. Mole crickets (Orthoptera: Gryllotalpidae) and their biological control, pp. 2442-2449. *In* J. L. Capinera (Ed.), Encyclopedia of Entomology, 2nd Edition, Vol. 3 of 4. Springer. Dordrecht, The Netherlands.

Mhina, G. J., N. C. Leppla, M. H. Thomas and D. Solís. 2016. Cost effectiveness of biological control of invasive mole crickets in Florida pastures. Biological Control 100:108-115.

Kerr, C. R., N. C. Leppla, E. A. Buss and J. H. Frank. 2017. Mole Cricket IPM Guide for Florida. 3-year review of UF/IFAS EDIS IPM-206. 20 p.

Leppla, N. C. 2022. Concepts and Methods of Quality Assurance for Mass-Reared Parasitoids and Predators, Chapter 9, pp. 261-279. *In* Juan Morales Ramos, David Shapiro and Guadalupe Rojas (Eds), Mass Production of Beneficial Organisms: Invertebrates and Entomopathogens, 2nd Edition. Elsevier

SYNERGISTIC ACTIVITIES

I led the UF/IFAS Mole Cricket Task Force from 2001 until it ended in 2005. The task force was highly successful in assisting Florida ranchers and homeowners to manage pest mole crickets by using a beneficial nematode and parasitoid wasp, *Larra bicolor*.

I worked with the team and the UF Office of Technology Licensing and Becker Underwood to provide a commercial source of the patented nematode.

I directed the design, construction and modification of specialized application equipment. Taskforce members also arranged for nursery production and sales of shrubby false buttonweed, the primary plant that attracts the beneficial wasp.

I trained Extension livestock agents and clientele in the use of this biological control technology both in the field and via a series of video presentations. The outcome was a substantial increase in mole cricket biological control.

I established IPM Florida in 2001 to provide statewide, interdisciplinary and inter-unit coordination and assistance in integrated pest management to protect agriculture, communities and the environment. As the director, I serve as a primary contact for IPM in Florida and facilitate associated research, Extension and education.

BIOGRAPHICAL SKETCH FOR TAN F. WONG

(i) Professional Preparation

• Chinese University of Hong Kong	Electronics	B.Sc., 1991
• Purdue University, West Lafayette	Electrical & Computer Engineering	M.S.E.E, 1992
• Purdue University, West Lafayette	Electrical & Computer Engineering	Ph.D., 1997

(ii) Appointments

- Professor of Electrical and Computer Engineering, University of Florida (09 - present)
- Associate Professor of Electrical and Computer Engineering, University of Florida (04 - 09)
- Visiting Associate Professor, Chinese University of Hong Kong (06 – 07)
- Assistant Professor of Electrical and Computer Engineering, University of Florida (98 - 04)
- Postdoctoral Research Associate, School of Electrical & Computer Engineering, Purdue University (97 – 98)
- Research Engineer, Department of Electronics, Macquarie University, Sydney, Australia (93-95)

(iii) Publications

Five Products Most Closely Related to the Proposed Project

1) C. -Y. Wu, T. Zhang, J. Li and T. F. Wong, "Parameter Estimation in PMCW MIMO Radar Systems with Few-Bit Quantized Observations," *IEEE Transactions on Signal Processing*, vol. 70, pp. 810- 821, Jan. 2022.
2) C. -Y. Wu, J. Ren, T. F. Wong and J. Li, "Computationally Efficient Implementation of SLIM for Parameter Estimation in Few-Bit PMCW MIMO Radar Systems," *IEEE Transactions on Radar Systems*, vol. 1, pp. 339-352, June 2023.
3) J. M. Shea, C. M. Bowyer, W. E. Dixon, and T. F. Wong, "Optimizing Synchronization Times for Position Tracking of a Mobile Asset in GPS-denied Environments," in *Proc. IEEE GlobeCom*, Dec. 2022.
4) C. Bowyer, D. Greene, T. Ward, M. Menendez, J. Shea, and T. Wong, "Reinforcement Learning for Mixed Cooperative/Competitive Dynamic Spectrum Access," in *Proc. 2019 IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN),* Newark, NJ, Nov. 2019.
5) J. M. Shea and T. F. Wong, "A Deep Q-Learning Dynamic Spectrum Sharing Experiment," in *Proc. IEEE International Conference on Communications*, June 2021.

Five Other Significant Products, Whether or Not Related to the Proposed

6) E. Graves and T. F. Wong, "Inducing information stability to obtain information theoretic necessary requirements," *IEEE Transactions on Information Theory*, vol. 66, no. 2, pp. 835-864, Feb. 2020.
7) E. Graves and T. F. Wong, "Transmitting arbitrary sources with finite error over a broadcast channel with confidential communications," in *Proc. 2018 IEEE ISIT*, June 2018.
8) E. Graves and T. F. Wong, "Wiretap channel capacity: Secrecy criteria, strong converse, and phase change," in *Proc. 2017 IEEE ISIT*, June 2017.
9) R. Cao, T. F. Wong, T. Lv, H. Gao, and S. Yang, "Detecting Byzantine Attacks Without Clean Reference," *IEEE Transactions on Information Forensics and Security*, vol. 11, no. 12, pp. 2717–2731, Dec. 2016.
10) C. W. Wong, T. F. Wong, and J. M. Shea, "Secret sharing LDPC codes for the BPSK-constrained Gaussian wiretap channel," *IEEE Transactions on Information Forensics & Security*, Special Issue on Using the Physical Layer for Securing the Next Generation of Communication Systems, vol. 6, no. 3, pp. 551–564, Sep. 2011.

(iv) Synergistic Activities

Relevant Technical Activities

- Led a team, Team GatorWings, of students and professors who competed in the 2014 DARPA Spectrum Challenge and in the DARPA Spectrum Collaboration Challenge (2017-2019). GatorWings was a finalist in the 2014 DARPA Spectrum Challenge and was the winning team of the DARPA Spectrum Collaboration Challenge.

Broadening Research Participation

- Participation of the University Scholar Program at the University of Florida to supervise outstanding undergraduate students for research during summer semesters
- PI for NSF REU grants with minority student researchers

Jasmeet Judge
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University of Florida, 1741 Museum Rd., 205 Rogers Hall, Gainesville, FL 32611
Phone: 352-294-6750 Email: jasmeet@ufl.edu

EDUCATION

Stillman College, Tuscaloosa, Alabama	Physics (***Valedictorian***)	B.S 1992
University of Michigan, Ann Arbor, Michigan	Electrical Engineering	M.S. 1994
University of Michigan, Ann Arbor, Michigan	Electrical Engineering and Atmospheric, Oceanic and Space Sciences	Ph.D. 1999

PROFESSIONAL EXPERIENCE

2018-present	Professor, Agricultural and Biological Engineering Department, University of Florida, Gainesville, Florida
2008-2018	Associate Professor, Agricultural and Biological Engineering Department, University of Florida, Gainesville, Florida
2001-present	Director, Center for Remote Sensing, Agricultural and Biological Engineering Department, University of Florida, Gainesville, Florida
2001-2008	Assistant Professor, Agricultural and Biological Engineering Department, University of Florida, Gainesville, Florida
2000-2001	Postdoctoral Research Associate, School of Public and Environmental Affairs -- Indiana University, Bloomington, Indiana
1992-1999	Graduate Student Research Assistant, Electrical Engineering and Computer Sciences, University of Michigan, Ann Arbor, Michigan

PRODUCTS (Five most closely related to the proposed project)

1. Niknam, K. J. Judge, A. Roberts, A. Monsivais-Huertero, R. Moore, K. Sarabandi, and J. Wu, "A 3-D full wave model to study the impact of soybean components and structure on L-band backscatter", *IEEE Trans. Geosci Rem Sens*, *In review*, https://doi.org/10.48550/arXiv.2402.02292. 2023.
2. Roberts, A.K., K. Sarabandi, J. Wu, J. Judge, A. Monsivais-Huertero, and R. Moore, "Microwave backscatter phenomenology of corn fields at L-band using full-wave electromagnetic solver", *IEEE Trans. Geosci Rem Sens*, 10.1109/TGRS.2023.3340198, 2023.\
3. Worrall, G.[G], J. Judge, K. Boote, and A. Rangarajan, "In-season crop phenology using model-guided machine learning", Agronomy Journal, 115, pp1214-1236, doi.org/10.1002/agj2.21230, 2023
4. Judge, J., P.W. Liu, A. Monsivais-Huertero, S. Chakrabarti, T. Bongiovanni, S. Steele-Dunne, D. Preston, S. Allen, J. P. Bermejo, R. DeRoo, P. Rush, A. Colliander, and M. Cosh, "Impact of vegetation water content information on SMAP soil moisture retrievals in agricultural regions: An analysis based on SMAPVEX16-MicroWEX dataset", *Remote Sensing of Environment*, 265, doi:10.1016/j.rse.2021.112623, 2021.
5. Chakrabarti, S., Judge, J., Bongiovanni, T., Rangarajan, A. & Ranka, S. (2018). Spatial scaling using temporal correlation and ensemble learning to obtain high resolution soil moisture. IEEE Trans. Geosci. and Remote Sensing, 56(3):1238-1250. DOI: 10.1109TGRS.2017.2722236.

PRODUCTS (Five other significant products)

1. Monsivais-Huertero, A., D. E. C. Recillas, J. C. H. Sanchez, J. Judge, et al. (+14 authors), "Assessment of NASA SMAP soil moisture products for agricultural regions in central

Mexico: An analysis ased on the THEXMEX dataset", *IEEE J. Selected Topics in App Earth Obs. and Rem Sensing*, 15, doi/ 10.1109/JSTARS.2022.3165078, 2022.
2. Monsivais-Huertero, A., P.W. Liu, and J. Judge, "Phenology-based backscattering model for corn at L-band", *IEEE Trans on Geosci and Rem Sens,* 56(9)*,* pp 4989-5005, 2018.
3. Steele-Dunne, S., H. McNairn, A. Monsivais-Huertero, J. Judge , P.W. Liu, and K. Papathanassiou, "Radar Remote Sensing of Agricultural Canopies: A Review", *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing,* 10(5), pp 2249-2273, 2017
4. *GitHub repository for stakeholder training workshops*: As part of the NASA/USAID-SERVIR project [Ghana Land Use Project (GALUP)], a GitHub repository was developed to disseminate training materials for online workshops. The newly updated website is available at https://servir-wa.github.io/GALUP/ This has now been used for training in Botswana.
5. *Video for the GALUP*: Video for general audience introducing the GALUP. It is available at https://abe.ufl.edu/galup/

SYNERGISTIC ACTIVITIES

- Leadership roles at national level committees (NASA and NASEM) representing interests of the US scientists using radio frequencies for scientific uses in radio astronomy and in satellite-based earth sciences.
- Involvement of undergraduates (REU) and minority students in research experiences
- Advising women professional societies (SWE)
- Leading and conducting community-wide collaborative field experiments.
- Reviewing proposal and papers in remote sensing, crop, and hydrology related journals, federal and international agencies.

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ORCiD: 0000-0002-2242-0466
Assistant Professor and Extension Specialist
University of Florida Department of Entomology & Nematology
North Florida Research and Education Center 155 Research Rd Quincy, FL, 32351
Phone: 850-875-7146, Email: isaac.esquivel@ufl.edu

Education

Doctor of Philosophy: Entomology — May 2020
Texas A&M University — College Station, TX
Certificate in Geographic Information Systems

Bachelor of Science: Entomology — March 2014
University of California – Riverside — Riverside, CA

Specialized Training:
The Bee Course Graduate 2019 (American Museum of Natural History)

Research Appointments

University of Florida-IFAS — April 2022-Current
Department of Entomology and Nematology — (8 hrs/day, 40 hrs/wk)
North Florida Research and Education Center, Quincy, FL
Assistant Professor Agroecosystem Entomology

Alcorn State University | USDA-ARS — July 2021-Feb 2022
Mound Bayou, MS | Stoneville, MS — (8 hrs/day, 40 hrs/wk)
Post-Doctoral Research Associate

Texas A&M University — Aug 2020-July 2021
AgriLife Research and Extension Center, Corpus Christi, TX. — (8 hrs/day, 40 hrs/wk)
Post-Doctoral Research Associate

Texas A&M University — Sept 2014-Aug 2020
AgriLife Research and Extension Center, Corpus Christi, TX. — (8 hrs/day, 40 hrs/wk)
Graduate Research Assistant

Products:

1. Lua, P., Parys, K.P., Hung, J.K., Basu, P., and **Esquivel I.E**. 2023. The nutritional landscape in agroecosystems: A review on how resources and management practices can shape pollinator health in agricultural environments. *Ann. Entomol. Soc. Am 116 (5, 261-275)*
2. Brewer, M.J., John Gordy, **Isaac L. Esquivel**[1]. 2023. Advances in crop insect pest monitoring using pest population growth and geospatial data for pest risk assessment. *Fountain, M. and Pope, T. (ed.), Advances in monitoring of native and invasive insect pests of crops, Burleigh Dodds Science Publishing, 2023, Cambridge, UK (ISBN: 978 1 80146 107 8; www.bdspublishing.com)*
3. Brewer, M.J., Norman C. Elliot**, Isaac L. Esquivel**, et. al. 2022 Natural enemies, mediated by landscape and weather conditions, shape response of the sorghum agroecosystem of North America to the invasive aphid *Melanaphis sorghi*. Front. Insect. Sci. https://doi.org/10.3389/finsc.2022.830997
4. **Esquivel, I. L**[1]., M. J. Starek, S. Popescu, R.N. Coulson, M. J. Brewer. 2021. Preliminary Approach in Detecting Cotton Fleahopper Induced Damage Via Unmanned Aerial Systems and Normalized Difference Vegetation Indices. *J. Cotton Sci*. 25(2): 1-12

5. **Esquivel, I. L[1].**, K. A. Parys, R.N. Coulson, M. J. Brewer. 2021. Crop and Semi-Natural Habitat Configuration affects Diversity and Abundance of Native Bees (Hymenoptera: Anthophila) in a Large-Scale Cotton Agroecosystem. *Insects*, *12*, 601. https://doi.org/10.3390/insects12070601
6. **Esquivel, I. L[1].**, A. M. Faris, M. J. Brewer. (2021). Sugarcane aphid, *Melanaphis sacchari* (Hemiptera: Aphididae), abundance on sorghum and johnsongrass in a laboratory and field setting. Crop Prot. 148, https://doi.org/10.1016/j.cropro.2021.105715
7. **Esquivel, I. L[1].**, K. A. Parys, M. J. Brewer. (2021). Pollination by Non-Apis Bees and Potential Benefits in Self-Pollinating Crops. *Ann. Entomol. Soc. Am.* 114(2), 257-266. https://doi.org/10.1093/aesa/saaa059
8. **Esquivel, I. L[1].**, M. J. Brewer, R. N. Coulson. 2020. A native bee, *Melissodes tepaneca* (Hymenoptera: Apidae), benefits cotton production. *Insects.* 11(8), 487. https://doi.org/10.3390/insects11080487
9. Brewer, M. J., L. Deleon*, and **I. L. Esquivel[2,3,4]**. 2019. GIS-based mapping and spatial analyses applied to risk assessment and resource allocation for boll weevil detection. Ann. Entomol. Soc. Amer. 113: 71-78. https://doi.org/10.1093/aesa/saz048
10. Deleon, L., M*. J. Brewer, **I. L. Esquivel[1,2,3,4]**, and J. Halcomb. 2017. Use of a geographic information system to produce pest monitoring maps for south Texas cotton and sorghum land managers. Crop Prot. 101: 50–57. https://doi.org/10.1016/j.cropro.2017.07.016

Synergistic Activities:

Developing extension materials for pollinator education in pollinator-independent cropping systems. Many growers in the agronomic cropping system are unaware of the bee diversity in their fields and the potential reciprocal relationships between crops and bees in the system.

Worked with a large-scale commercial farming operation as a grad student from 2014 to 2020, where we introduced growers to the utility of geographic information system-based GPS devices to streamline pest insect scouting, visualization of pest occurrence maps on a field-to-field basis, and potential use of precision based insecticide applications. Without making any explicit recommendations, the farm management tested out the idea of a precision-based insecticide application.

Collaborated with faculty and students in the Geospatial Sciences department at Texas A&M Corpus Christi on potential uses of remotely sensed data from UAS to detect pest insects or other interactions in cotton and sorghum.

MARCELO OSÓRIO WALLAU

Assistant Professor, Forage Extension Specialist
Agronomy Department - University of Florida

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Gainesville, FL, 32611
PO box: 110965

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Mobile: +1-352-260-2254
Phone: +1-352-273-2216

APPOINTMENT AND SPECIALTY

ACADEMIC APPOINTMENT **2018 - PRESENT**

Assistant professor, twelve-month appointment, 70% Extension and 30% Research

PROFESSIONAL SPECIALTY

Pasture management, forage production systems, integrated crop-livestock system, farming systems design, forages for beef cattle, dairy cattle, small ruminants and horses, foraging behavior, scholarship of extension, professional development in extension.

OTHER EXPERIENCE

Farm management, livestock handling, wildlife management and control

EDUCATION

POST-DOC AGRONOMY, Forage Extension, University of Florida 2017

PH.D. ANIMAL SCIENCE, Universidade Federal do Rio Grande do Sul 2014 - 2017
Rangeland ecology and management (GPA 3.9).

M.S. AGRONOMY, University of Florida USA 2011 - 2013
Pasture production and management (GPA 3.72).
Minor in Animal Sciences, ruminant nutrition

AGRONOMY ENGINEER, Universidade Federal do Rio Grande do Sul, Brazil. 2006 - 2011
Exchange student at Texas Tech University, USA. 2009 – 2010

TEACHING AND STUDENT ADVISNG

COURSES

- AGR 6932 – Developing extension skills: special topic class on developing and delivering extension programs (2 credits, offered based on demand)

STUDENTS

- Committee chair or co-chair: 3 PhD current, 3 M.S current; 6 M.S. graduated
- Committee services: 6 PhD, 6 M.S.
- International: 6 visiting scholars, 11 participations in jury for M.S. and Ph.D
- Undergraduate advising: 12 student workers, and mentor with Plant Science program

ADDITIONAL CREDENTIALS

LANGUAGES

- Portuguese, English, Spanish, French (intermediate)

INVOLVEMENTS

- 2023-2026 American Forage and Grassland Foundation board member
- 2022-2023 Chair C6 division of Crop Sci. Soc. of America
- 2019-2021 Chair Southeastern Hay Contest (multistate)
- 2019 – 2022 UF/IFAS Plant Sci. Res. and Education Unit Advisory Council, Chair (2020 - 2021)

HONORS AND AWARDS

- 2022 University of Florida Global Fellow
- 2022 American Forage and Grassland Council Merit Award
- 2021 Extension Specialist of the Year Award by FL. Assos. County Ag. Agents (FACAA)
- 2019 Dallas Townsend Extension Award by UF/IFAS

GRANTS

PRINCIPAL INVESTIGATOR
$1,028,960 ($873,238 allocation)

CO-PRINCIPAL INVESTIGATOR
$2,455,953 ($156,718 allocation)

DONATIONS AND INDUSTRY SERVICES
$199,950

TOTAL ALLOCATION:
$1,229,906

PUBLICATIONS

PEER-REVIEWED (42)
Leading author and mentees: 21
Collaborations: 21

BOOKS (3)
Author: 2
Editor: 1

BOOK CHAPTERS (10)

CONFERENCE (83)
Abstracts: 64
Expanded abstracts/papers: 19

EXTENSION (85)
EDIS: 23
Other Ext.: 16
Trade: 46

PEER-REVIEWED JOURNAL ARTICLES (most recent)

Tsegayg, M., Z. Grabau, J. Dubeux, **M. Wallau**. 2023. Crop rotation for management of plant-parasitic nematodes in forage corn production. Agron. J. (First view Dec, 2023) https://doi.org/10.1002/agj2.21522

Wallau, M., F. Neves, N. Caram, C. Bremm, C. Pinto, J. da Trindade, J. Mezzalira and P. Carvalho. 2023. Moderate grazing intensities modulate canopy structure which maximizes short-term intake rate of heifers grazing a natural grassland. Grassland Sci.1-11 https://doi.org/10.1111/grs.12413

Felizardo, L.F., **M. Wallau** and J.R. Pereira. 2023. RPER Software: A Social Management Tool for Rapid Participatory Emancipatory Research Planning, Design and Implementation. J. Social Environ Manage. 17(10):01-28. https://doi.org/10.24857/rgsa.v17n10-003

Basen, W., J. Lai, B. Kassas and **M. Wallau**. 2023. Investigating Trends in Consumer Preferences and Willingness to Pay for Lamb and Goat Meat: A Case Study from Florida. Agribus. Int. J (Accepted)

Rush, H., J. Dubeux, L. Queiroz, **M. Wallau** and C. Wilson. 2023. Species richness and functional diversity enhance winter annual forage productivity and nutritive value. Crop Sci. (Accepted)

Rios, E.F., J.C.B Dubeux Jr., J.M.B. Vendramini, **M. Wallau**, A.J. Grossman, Y. Lopez, P. Munoz, W. Anderson, L. Baxter, K. Harris, M.S. Castillo, M.C. Saha, K. Quesenberry, A. Blount, P. Reith, and K. Kenworthy. 2023. Newell Bermudagrass: A Public Release from the USDA Cynodon Collection. J. of Plant Registrations (Accepted).

Aukema, K.D., **M.O. Wallau**, D.R. Faust, D.W. Archer, J.R. Hendrickson, S.L. Kronberg and M.A. Liebig. 2023. Soil CO2 efflux dynamics in an integrated crop-livestock system. Soil Sci. https://doi.org/10.1002/saj2.20546

Caram, N., F. Casalás, **M. O. Wallau,** P. Soca, V.D. Pillar, M. Cadenazzi and P. Boggiano. 2023. Biomass fine-scale variation is predictive of functional composition and diversity in grazed grassland. Appl. Veg Sci. 26(1)e12714 https://doi.org/10.1111/avsc.12714

Hayes, H., **M.O. Wallau**, N. Caram Fernandez, L.E. Sollenberger, K. E. Kenworthy and E. van Zanten. Early-stage evaluation of grazed tetraploid bahiagrass experimental entries. *Crop Sci.* (Accepted Jan 2023)

Harling, J., E. Rios, C. de Souza, L.E. Sollenberger, J. Dubuex and **M. Wallau**. Defoliation management affects performance of alfalfa-bermudagrass mixtures in the southeastern USA. *Agronomy J.* (Accepted Dec. 2022)

SYNERGISTIC ACTIVITIES

As an extension specialist, I am responsible for onboarding and in-service training for extension agents. I have developed novel, online, on demand training tools for Extension and NRCS, which will serve as platform for diffusion of the findings of this project. In my role, I also have great interaction with farmers, who can benefit from the results of our trials. The on-farm component of the project will serve as platform for disseminating info on mole cricket control, a frequent pest in Florida pastures, and a frequent source of consultation from agents and producers. My team and I are equipped for developing on farm work, and with tools for broad dissemination of our findings.

Further information, full CV and references:
http://agronomy.ifas.ufl.edu/faculty/marcelo-wallau/
https://orcid.org/0000-0001-9898-3399
https://www.researchgate.net/profile/Marcelo_Osorio_Wallau
https://programs.ifas.ufl.edu/forage/

David J. Greene

Professional Preparation

Institution & Year	Location	Major	Degree
University of Florida	Gainesville, FL	Electrical Engineering	Bachelor of Science, 2012
University of Florida	Gainesville, FL	Computer Engineering	Bachelor of Science, 2012
University of Florida	Gainesville, FL	Electrical & Computer	
Engineering			Master of Science, 2016

Appointments

(2012) Undergraduate Research Assistant
University of Florida - Gainesville, FL
Supervisor: Dr. Tan Wong

(2012) Undergraduate Research Assistant
University of Florida - Gainesville, FL
Supervisor: Dr. Herman Lam

(2013) Electrical Engineer
Integrated Adaptive Applications, Inc. - Gainesville, FL
Supervisor: Dr. Jian Li

(2014) Staff Researcher
Howard University - Washington, DC
Supervisor: Dr. John M.M. Anderson

(2014) Guest Researcher
U.S. Army Research Laboratory - Adelphi, MD
Supervisor: Dr. Lam Nguyen and Mr. Kenneth Ranney

(2015 - Present) Graduate Research Assistant
University of Florida - Gainesville, FL
Supervisor: Dr. Tan F. Wong and Dr. Jian Li

(2018) Visiting Researcher
University of Science and Technology - Hefei, China
Supervisor: Dr. Gang Wang (USTC) and Dr. Jian Li (UF)

Products or Publications

"Real-Time Imaging of the Ultra-Wideband Synchronous Impulse Reconstruction Radar"
David Greene, Ayotunde Odejayi, Mandoye Ndoye, and John M.M. Anderson
Department of Electrical & Computer Engineering, Howard University, Washington D.C.
2015 NVIDIA GPU Technology Conference, San Jose, CA, March 16th, 2015

"Accelerating Ground Penetrating Radar Image Reconstruction using GPUs"
David Greene and Ayotunde Odejayi
Department of Electrical & Computer Engineering, Howard University, Washington D.C.
Elsevier, Howard Research Symposium, Washington D.C., April 16th, 2015

"A GPU Accelerated Architecture for Real-Time GPR Image Reconstruction"
David Greene, Ayotunde Odejayi, Mandoye Ndoye, and John M.M. Anderson
Department of Electrical & Computer Engineering, Howard University, Washington D.C.
2015 IEEE Radar Conference (RadarCon), Arlington, VA, May 10th, 2015

"An MM-Based Algorithm for Fast L1-Regularized Least-Squares Estimation with an Application to GPR Image Reconstruction"
Mandoye Ndoye, John M.M. Anderson, and David Greene
Department of Electrical & Computer Engineering, Howard University, Washington D.C.
IEEE Transactions on Image Processing, Vol. 25, No. 5, May 2016

"Compressed Sensing in Radar Signal Processing"
A. D. Maio, Y. C. Eldar, and A. M. Haimovich
Cambridge University Press, contributing author to chapter 3:
RFI Mitigation Based on Compressive Sensing Methods for UWB Radar Imaging, 2019

Exceptional Qualifications

Founding member of Team GatorWings in the 2019 DARPA Spectrum Collaboration Challenge

- First-place winning team in the SC2 Competition Event — $2M USD 2019
- One of six winning teams in preliminary event two — $750K USD 2018
- One of ten winning teams in preliminary event one — $750K USD 2017

Presentation Awards at the 2015 Howard University Research Symposium

- "Most outstanding presentation in the area of physical sciences & engineering"
- "Best overall presentation in the graduate student category"

Winner of the 2014 NVIDIA Jetson TK1 CUDA Vision Challenge (of 50)

- Real-Time GPR Image Reconstruction using the Jetson TK1

Piwowarek, William John
Master's Student (Starting Summer 2024)
UF/IFAS Entomology and Nematology Department, Gainesville, FL
Phone: (505) 480-0278; wpiwowarek@ufl.edu

EDUCATION

B.S. 2022 University of Florida, Entomology and Nematology

WORK EXPERIENCE

2001 - Pres. OPS, UF Agronomy in Dr. Marcelo Wallau's Forage Sciences Laboratory, University of Florida, Gainesville, Florida.

2023 - Pres. Rearing and Semi-field Technician, USDA ARS under Dr. Edmund Norris and Dr. Daniel Kline

2022 - 2023 Student Assistant, UF Entomology and Nematology Department in Dr. Edwin Burgess' Medical Entomology Laboratory, University of Florida, Gainesville, Florida.

PEER REVIEWED ACCEPTED PUBLICATIONS

Piwowarek WJ, Mcduffie D, Burgess ER. Identification, seasonality, and body attachment location and nomenclature of parasitic water mites (Trombidiformes: Arrenuridae) on *Anopheles crucians* sensu lato, *Anopheles quadrimaculatus* sensu lato, and *Culex erraticus* (Diptera: Culicidae) from a North Florida botanical garden. Journal of Medical Entomology. Accepted 9 February 2024.

PUBLICATIONS IN PREPARATION

Piwowarek WJ, Garcia-Jimenez L, Rusch H, Balster R, Riley, S, Roeder E E, Wallau M. Conserving pollinators through choice of plant functional group and functional group diversity of pastures in Florida. Journal of Agriculture, Ecosystems, and Environment.

McDuffie D, Piwowarek WJ, and Burgess ER. Adult mosquito diversity and abundance in high floral and low floral microhabitats at a North Florida botanical garden. Journal of the American Mosquito Control Association.

Balster R. Piwowarek WJ, Roeder EE, Garcia-Jimenez L, Wallau M. Evaluation of vegetation cover in solar farms on enhancing pollinator habitats and land use. Journal of Agriculture, Systems, and Environment.

CURRENT & PENDING SUPPORT

Name: Norman C. Leppla

Instructions:
Who completes this template: Each project director/principal investigator (PD/PI) and other senior personnel specified in the Request for Applications (RFA). For Agriculture and Food Research Initiative (AFRI) applications, completion of this is only required for PDs/PIs and CoPDs/CoPIs.

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NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL $ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
	Active:				
Norman C. Leppla, Bahder, B.W., Daniels, J.C, Devkota, P., Diepenbrock, LM.., Lahiri, S., Martini, X., Paula-Moraes, S. Wooten, H.F., and Martin, E.	USDA, NIFA, CPPM, EIP	$889,006	2021-2024	3%	2021 Crop Protection and Pest Management Extension Implementation Project for the University of Florida
Leppla, Norman, Tan Wong, Jasmeet Judge, Isaac Esquivel, and Marcelo Wallau	UF/IFAS 2024 ISRI	$49,398	2024-2026	2%	A novel harmonic radar system for tracking invasive insect species

Leppla, Norman, Tan Wong, Jasmeet Judge, Isaac Esquivel, and Marcelo Wallau	Pending: UF 2024 ROSF	$98,747	2024-2026	5%	A novel approach to quantifying the in-field flight of small invasive species using a new harmonic radar system and AI-based behavioral models
Leppla, N.C., Adam Dale, Natalia Peres, and Brent Sellers	USDA, NIFA, CPPM, EIP	$824,254	2024-2026	3%	2024 CPPM, EIP Project for the University of Florida: Entomology and Nematology, Plant Pathology and Weed Science

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Wong	Active: NSF	$250,000	10/21 - 9/25	0.01	Collaborative Research: CNS Core: Medium: Towards Federated Learning over 5G Mobile Devices: High Efficiency, Low Latency, and Good Privacy
Sheplak, Wong, Shea	NASA	$254,992 (UF portion)	1/24 – 12/25	0.07	WIRA - Wireless Instrumentation for Rocket Applications
Wong	ARL	$300,000 (UF portion)	3/24 – 2/27	0.08	Perceptive and Reactive Autonomous Navigation in Challenging Environments
Leppla, N.C., Tan Wong, Jasmeet Judge, Isaac Esquivel, and Marcelo Wallau	UF/IFAS 2024 ISRI	$49,398	2024-2026	0.02	A novel harmonic radar system for tracking invasive insect species
	Pending:				
Wong	ARO	$177,474	2/24-1/25	0.00	RFSoC Platform for Robust Spectrum Intelligence on the Edge
Leppla, Norman, Tan Wong, Jasmeet Judge, Isaac Esquivel, and Marcelo Wallau	UF 2024 ROSF	$98,747	2024-2026	0.02	A novel approach to quantifying the in-field flight of small invasive species using a new harmonic radar system and AI-based behavioral models

This file MUST be converted to PDF prior to attachment in the electronic application package.

CURRENT AND PENDING SUPPORT

INVESTIGATOR: Jasmeet Judge

CURRENT:

Project/Proposal Title: Dataset for validating soil moisture product for NISAR in a sub-tropical agricultural region
Source of Support: NASA-SMD
Role: PI
Total Award Period:03/24 - 02/25
Amount: $136,303
Person-months Per Year Committed to the Project: 0.25 Cal

Project/Proposal Title: Theoretical modeling of dynamic vegetation in agricultural terrains for active passive microwave retrieval of soil and crop parameters
Source of Support: NASA-RST
Role: PI
Total Award Period:02/21-2/25
Amount: $412,912
Person-months Per Year Committed to the Project: 0.5 Cal

Project/Proposal Title: Integrating socio-economic and remote sensed information to characterize conflict precursors and land degradation dynamics in Ghana
Source of Support: NASA-USAID-SERVIR
Role: Co-I
Total Award Period: 1/23-12/25
Amount: $658,050
Person-months Per Year Committed to the Project: 0.5 Cal

Project/Proposal Title: Enhancing the irrigation management in vegetable farms in southeast US by developing root zone soil moisture maps in both high spatial and high temporal resolutions
Source of Support: USDA-CIG
Role: Co-I
Total Award Period: 1/21-12/26
Amount: $2,020,000
Person-months Per Year Committed to the Project: 1 Cal

Project/Proposal Title: A novel harmonic radar system for tracking invasive insect species
Source of Support: UF/IFAS 2024 ISRI
Role: CO-PI
Total Award Period: 2024-2026
Amount: $49,398
Person-months Per Year Committed to the Project: 0.02

PENDING:

Project/Proposal Title: Value-added irrigation products using time series SMAP high-resolution brightness temperatures
Source of Support: NASA-THP
Role: PI
Total Award Period: 11/24-10/27
Amount: $494,838
Person-months Per Year Committed to the Project: 1 Cal

Project/Proposal Title: Determining optimal band/polarization combination for new retrieval algorithms of crop phenology from NISAR
s
Source of Support: NASA-NISAR
Role: PI
Total Award Period: 11/24-10/27
Amount: $664,123
Person-months Per Year Committed to the Project: 1.75 Cal

Project/Proposal Title: 2024 CPPM, EIP Project for the University of Florida: Entomology and Nematology, Plant Pathology and Weed Science
Source of Support: UF 2024 ROSF
Role: CO-PI
Total Award Period: 2024-2026
Amount: $98,747
Person-months Per Year Committed to the Project: 0.02

CURRENT & PENDING SUPPORT

Name: Isaac L. Esquivel

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL $ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
	Active:				
I. Esquivel	National Peanut Board	$12, 510	Jan/23-June/24	3%	Effects of Climate and Landscape Structure on Thrips Population Dynamics and Tomato Spotted Wilt Virus Incidence Within Fields Across the Florida Pan Handle
II. Esquivel	Florida Peanut Checkoff	$11,525	Aug/23-June/24	3%	Thrips Monitoring Across the Florida Panhandle
I. Esquivel	Cotton Incorporated	$21,185	Jan/24-Dec/24	5%	Wild bee pollinators in Florida row crop agroecosystems
I. Esquivel	Cotton Incorporated	$12, 500	Jan/24-Dec/24	3%	Regional Core Project: Integrated Pest Management
Leppla, N.C., Tan Wong, Jasmeet Judge, Isaac Esquivel, and Marcelo Wallau	UF/IFAS ISRI	$49,398	2024-2025	2%	A novel harmonic radar system for tracking invasive insect species
	Pending:				
Leppla, Norman, Tan Wong, Jasmeet Judge,	UF 2024 ROSF	$98,747	2024-2026	2%	A novel approach to quantifying the in-field flight of small invasive species using a new harmonic radar

Isaac Esquivel, and Marcelo Wallau					system and AI-based behavioral models
I.Esquivel et al.	USDA-NIFA	$300,000	Jan/2024-Aug/2026	5%	New Investigator Seed Grant: Interactions Between Bees and Pollinator-Independent Crops in Southern Agroecosystems
Darwish, A. I.Esquivel, et al.	USDA-NIFA	$500,000	Jan/2024-Aug/2026	5%	Characterization of Muscadine Floral Terpenoids and Berry Aroma Volatiles to Strengthen Productivity and Marketability.

CURRENT & PENDING SUPPORT

Name: Marcelo Osorio Wallau

Instructions:
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	Active				
Matcham Wallau	FCEB	$33,905	10/2023 – 7/2024	0.5%	Impact of rate and source of Nitrogen and Potassium fertilizers on yield, nutritive value, and profitability of Bermudagrass and Bahiagrass hay production in sandy soils of North Florida
Wallau Dubeux Vendramini	FCEB	$33,496	10/2023 – 7/2024	0.5%	Maintenance and expansion of vegetatively-propagated pastures for Florida farmers
Sollenberger Wallau	FCEB	$50,040	10/2023 – 7/2024	1%	Next-Stage Screening of Bahiagrass Breeding Lines to Identify New Varieties for the Florida Cattle Industry
van Santen Dubuex Wallau	USDA NIFA	$335,698	9/2021 – 8/2026	0.5%	Fostering Resilience and Ecosystem Services in Landscapes by Integrating Diverse Perennial Circular Systems
Dubeux, Mackowiak Wallau …	FDACS	$217,787	7/2021 – 4/2025	0.5%	Enhancing cover crop adoption in integrated crop-livestock system to reduce ground water nitrates as stipulated in the attached
Wallau Dubeux Wright …	FDACS	$509,627	6/2022 – 6/2025	8%	Integrated crop-livestock systems: validating plot-scale benefits through multi-farm demonstrations
Rios Wallau Baxter…	USDA	$494,942	10/2021-12/2026	2%	Selection, Release and Dissemination of Improved Bermudagrass (Cynodon spp.) Cultivars for Yield, Nutritive Value and Stem Maggot Tolerance

Hammond Wallau Fraisse	USDA – AFRI	$298,646	10/2023 – 10/2024	3%	Heatwave atop unprecedented growing-season maximum temperature: how hot is too hot for agriculture in Florida
Leppla, Norman, Tan Wong, Jasmeet Judge, Isaac Esquivel, and Marcelo Wallau	UF/IFAS 2024 ISRI	$49,398	2024-2026	2%	A novel harmonic radar system for tracking invasive insect species
	Pending:				
Wallau	USDA – AFRI	$299,609			Ruminating over fallow ground: innovation platform as a strategy to improve adoption of climate-smart agriculture
Leppla, Norman, Tan Wong, Jasmeet Judge, Isaac Esquivel, and Marcelo Wallau	UF 2024 ROSF	$98,747	2024-2026	2%	A novel approach to quantifying the in-field flight of small invasive species using a new harmonic radar system and AI-based behavioral models