

Puerto Rico (University of Puerto Rico Mayaguez Campus) Annual Report - FY2021

Report Status: Approved as of 07/14/2022

Contributing Organizations

University of Puerto Rico Mayaguez Campus

Executive Summary

Overview

This annual report includes what the University of Puerto Rico's Agricultural Experiment Station (**PRAEXS**) and Agricultural Extension Service (**PRAES**) consider to be our most salient research and educational achievements during FY2020-2021. Puerto Rico continues recovering from the 2017 hurricanes, the 2020 earthquakes and the persistent effects of COVID-19 pandemic that have tremendously impacted all aspects of life on the island. Progress was achieved while the institution faced the challenges of rebuilding the damage suffered in vital infrastructure facilities, while researchers continued to face limitations in accessing experimentation fields and laboratories, and while Extension Agents and Educators lacked their habitual spaces and methods (face-to-face) to train their clientele due to strict COVID-19 curfews and regulations by executive order. All this was framed in the context of a worsening economic situation that continues to affect the budget assigned to the state university.

In this report we are reporting accomplishments and results from the six Critical Issues defined in the 2021-2025 approved POW which include:

1. Food Security, Plants and Animal Systems
2. Extreme Weather, Natural Resources and Environment, and Sustainable Energy
3. Food Safety, Science and Technology
4. Community, Economy and Sustainable Development
5. Family and Well-Being
6. Positive Youth Development

"**Food Security, Plants and Animal Systems**" is the critical issue that concentrates most of our research and extension projects and programs. Ten research projects were depicted in the issue's summary of progress during the year: nine highlighted in the NRS website and one final report submitted in REEport. Food Security is addressed in the PRAEXS through projects that target stakeholder's concerns regarding lack of seeds to expand plantings, availability of disease resistant cultivars and of prospective profitable new crops, best management practices for the control of pests & diseases, and on improving economic returns to livestock producers through both breeding and best management strategies.

PRAES efforts towards Food Security included the use of high tunnels technology to increase local food production by farmers and urban areas. In addition, integrated efforts among Extension Agents and Family Educators took place to improve agri-business economic and marketing strategies to increase food security in farms, homes, schools, and communities. In terms of animal production, PRAES and PRAEX personnel developed training to help local producers to increase their knowledge regarding recommended management practices and added value of small ruminant meat cuts.

Combined efforts between PRAES and PRAEX plant diagnostic clinics generated important achievements towards the control of crop pests through extensive screening of vegetative samples. Additional efforts between PRAES and PRAEX resulted in the dissemination of best practices to boost the local citrus production.

The "**Extreme Weather, Natural Resources and Environment, and Sustainable Energy**" Critical Issue is also a particularly important research program for the PRAEXS. More than 20% of our total projects contribute to this issue's progress and while the majority are sponsored by non-capacity funds, Hatch funding remains critical for leveraging additional external resources. Five research projects were highlighted that showed progress at addressing problems worsened by the impact of hurricanes, animal waste disposal practices, and

underscoring the importance of assessing and maintaining soil health and quality through best management practices. The PRAES educational activities focused on mitigating the impact of climate change on agricultural production by improving agricultural practices, supporting soil and water conservation, and encouraging composting.

Research projects in the "**Food Safety, Science and Technology**" critical issue continue to help small farmers comply with FSMA regulations that may present a challenge to their operations, while also assisting in the search for alternatives to add value to their products. The three projects highlighted offer significant achievements that also advance the educational agendas of related commodity programs in small ruminants and farinaceous crops. And although the only capacity project currently active in our "**Community, Economy and Sustainable Development**" research program was still in its initial year, prospective activities also promise to advance the marketing strategies for differentiated coffee products.

PRAES efforts towards the "**Family Well-Being**" critical issue focused in promoting family well-being, health and disease prevention, healthy eating, and the management of family resources to improve the quality of life of vulnerable populations affected by earthquakes, Covid19, and other social, economic, and environmental situations experienced in Puerto Rico. PRAES efforts concentrated in empowering communities to reach food self-sufficiency and financial independence. Achievements included the production of action plans for the development of an economic project, generate revenues from the established economic projects and the creation of new jobs.

Through the "**Positive Youth Development**" critical issue, a collection of interdisciplinary 4-H initiatives that focused in creating inclusive spaces for child and youth. Additional projects focused efforts in creating safe learning spaces, establish positive contacts, and provide opportunities and experiences for children and youth as a means to develop skills and abilities to become healthy individuals that positively contribute to our society.

Critical Issue: Community, economy & sustainable development

The educational activities developed focused on the needs of our communities, prioritizing stakeholder's inputs: the development of community enterprises. Projects that empowered communities to reach food self-sufficiency and financial independence, as a means to create vibrant communities, were developed. Achievements included the production of action plans for the development of an economic project, generation of revenues from the established economic projects and the creation of new jobs. The leadership and involvement of the trained leaders was of great benefit since they advise and participate in the community directives and government organizations helping to distribute food and developing community emergency plans for dozens of families in their respective municipalities.

A summary of the overall progress of these projects and the continued education activities related to the community self-management, economic development, and volunteers' resilient program include: participation of 119 leaders with 870 hours dedicated to volunteer work, empowerment and community self-management achieved in 24 communities, collaboration of 56 of organizations to help organizing communities, development of emergency and security plans for 44 families, among other important achievements.

At present, only a couple of Hatch projects contribute towards research in this Critical Issue and they are still in the initial stages of their fieldwork. Progress continues, however, in the planned activities of "Consumer attitudes and behavior towards differentiated products in Puerto Rico: An assessment of text, labels and quick response (QR)codes". This project seeks to increase awareness of the importance of differentiated products to farmers and stakeholders through multiple strategies to present consumers with information about the characteristics of differentiated coffee and milk products.

Critical Issue: Extreme weather, environment & sustainable energy

A series of research projects approved in the aftermath of Hurricane María addressed specific problems that arose as a result of the hurricane. In "Forestry Innovation Laboratory and Learning Institute (FILLI): Using Hurricane Maria's lessons and opportunities to support long-term sustainable forestry industry in PR" the project evaluated the use of soil and growing media amendments from vegetative debris, such as biochar and wood chips on tropical timber tree growth. Results have shown that air dried biochar from different species vary in humidity content from 50% to 10%. Also, *Albizia procera* (white siris) biochar mixed with Promix® in different concentrations showed no significant differences in basil (*Ocimum basilicum*) growth. However, the project's greatest achievement has been the development of the Forestry Innovation Laboratory and Learning Institute (FILLI). This laboratory has served as an outreach venue where the research content material is adapted to a Spanish-speaking audience to promote the production of timber trees and the use of hardwood materials. The project has gained greater reach thanks to collaboration with PRAES, with other NIFA programs such as RIIA and McIntire-Stennis and with other federal agencies such as the Forestry Service.

"Using wild bee hives to assess melliferous plants, honey bee health and honey quality", a second project borne after hurricane María, deals with the conservation, restoration and maintenance of honey bees. Since 2019, we have worked on establishing apiaries at the different locations of PRAEXS. At present, Lajas, 3 established from a total of 17 relocated; Isabela, 5 established from a total of 13 relocated; Juana Diaz, 4 established from a total of 8 relocated; Gurabo, 2 established from a total of 6 relocated; Adjuntas, 9 established from a total of 12 relocated; Corozal, 5 established from a total of 17 relocated. A beehive registration sheet was developed to make field assessments of each established beehive and to describe temporal changes of the apiary health and honey production. Field variables measured at the beehive: amount of honey, nectar, pollen, queen sightings, population size, types of queen cells, drone population, temperament of the colony. The results of this research project will increase awareness about bee conservation and importance over agricultural production areas among the general public.

In the last few years soil quality and health have been two of the most important research subjects in the PRAEXS. "Soil quality assessment among soil orders and ecological zones in Puerto Rico" was developed to directly focus on establishing quantitative parameters to distinguish soil quality among soil orders, soil series and ecological zones in the tropics. At present, soil quality parameters have been established for two soil series (Coto and Cotito) of the Oxisol order. The Coto soil has shown soil quality parameters superior to the Cotito series. Cotito soil has the limitation of being shallow and moderately alkaline while Coto soil is slightly acidic with excellent physical properties. With the results of this project, it will be possible to assess the best management practices and techniques to predict short- and long-term impact on land use, determine soil, water and air health. Among the management practices that could be recommended is the use of cover crops. Cover crops have been widely used in the US for some time but in PR only recently this practice has gained popularity. Even when this is a positive practice, we have been using plant species and planting rates and densities recommended for temperate zones. "Agroecological Practices Adapted to Extreme Weather Conditions" introduces the use of cover crops to measure the improvement in soil health of acid and eroded agricultural soils of the central region of PR. After hurricane María it became abundantly clear that we needed to take proactive steps to protect our soils of the damaging effects of extreme weather conditions. This project initiative, in conjunction with other federal agencies such as USDA-NRCS, will aid in implementing tailored soil conservation practices to conserve our soils and guarantee the income of growers in the short- and long-term.

Finally, "Towards a sustainable Hog production in PR" is the only research capacity project we currently have contributing towards energy recovery from animal waste treatment thru biological decomposition. This project has the potential of reducing the carbon footprint of small and medium size swine operations in Puerto Rico.

PRAES educational activities were focused on mitigating the impact of climate change on agricultural production by improving agricultural practices, supporting soil and water conservation, and encouraging composting. Multiple workshops covering soil sampling, soil analysis interpretation, and nutrient recommendations were provided for the agricultural agents as a means to improve their technical knowledge. Trainings on soil management and fertility were offered to farmers which included the analysis and interpretation of their farm soil samples. Collaborations between the PRAES and NRCS resulted in the dissemination of soil nutrient management information to farmers, producers, and the public. Collaborative efforts with PRAEX resulted in trainings on soil fertility and nutrient management to agricultural agents about vegetable crops (*solanaceae* and cucurbits). Workshops on watershed protection, water harvesting, and storage have been offered to farmers to increase on agricultural resilience and natural resource protection. Moreover, workshops on the developments in tropical agriculture in drought conditions was provided to individuals using the established PRAES curriculum guide "Climate Change: Impact on agricultural production and methods of adaptation". The educational activities related to soil management and conservation resulted in the adoption of practices and recommendations that have improved the conditions on more than 50 farms; 8 farmers incorporated the use of soil amendments based on soil fertility results; 11 farmers changed their fertilizer formulations to more closely coincide with the needs of the crops grown and 37 individuals adopted recommended conservation practices to effectively manage the soils on their farms. Trainings related to agricultural resilience and natural resource protection resulted in more than 20 individuals/farmers that adopted practices that will improve agricultural resilience and natural resource protection; 15 individuals implemented or improved water collection systems on their properties while one farmer adopted agroforestry practices and 5 Five farms prepared contingency plans and obtained agricultural insurance in case of natural disasters. Trainings on composting at home resulted in 5 families now composting materials from their kitchens to provide nutrients to their home gardens and 3 farmers also adopted composting practices on their farms in the reuse of crop residues.

Critical Issue: Family well-being

Socioeconomic statistics report an increase in the number of people who have lost their jobs which in turn has caused financial instability and food insecurity; uncertainty, infliction of sadness and pain; stress in interpersonal and family relationships; poor care of health conditions, and other related situations. The Healthy and Sustainable Families program aims to promote family well-being, health and disease prevention, healthy eating, and the management of family resources to improve the quality of life of vulnerable populations.

Through multiple educational strategies such as short courses, educational series, workshops, and virtual and face-to-face activities, the Family and Consumer Sciences Extension Educators, and their volunteers, achieved the programs goals. Individuals and families increased their sense of well-being through non-formal education on related topics, and the application of skills and practices to improve self-care and self-esteem, managing emotions, human relationships and positive family, healthy lifestyles, disease prevention, nutrition, food safety and food security. In addition, participants acquired acquisition of knowledge for the management of family resources to improve their economic and social condition.

Our target audience included adults, older adults, caregivers, families, and communities in rural and urban areas, residents of public housing, participants of non-profit organizations, school youth, and other low-income audiences. In summary, the benefits of the project included: the collaboration of 262 volunteers. Participants reported to improve: their family's quality of life (n=53), roles and duties as fathers, mothers, or caregivers (n=39), family strength skills such as sharing time, improving family bonds and affection, effective communication, commitment, and spirituality (n=355), skills to strengthen their personal development and well-being (n=271) and, food security through food preservation using (n=777), among other achievements.

Critical Issue: Food safety, science and technology

Our current POW depicts how part of our research and education efforts will be directed towards identifying small farmers in need of water sampling to comply with the Food Safety Modernization Act (FSMA) Produce Safety Rule, and in conducting water sampling on their farms. Work conducted last year under collaborative project "Enhancing Microbial Food Safety by Risk Analysis" took water samples of wells, surface and municipal waters in 12 farms of southwest Puerto Rico, and shared results and recommendations with the farmers. In addition, research and development of new products that could potentially add value to local farinaceous crops has been advanced by the results obtained in "Elaboration of flours, extruded products & chips based on *apio* (*Arracacia xanthorrhiza* B.) & plantain as alternatives for using local agricultural products & their marketing". This project demonstrated that *apio* can be extruded and used as a high quality snack. Finally, the project "Manufacturing and marketability of valued added products using goat milk" contributes both to this Critical Issue and to the work needed to address Animal Systems concerns in small ruminants' farms and enterprises. Under this project progress has been made on the development of *cajeta* (slow-cooked caramel sauce made of goat's milk), yogurt and a frozen dessert, and is currently focusing on performing proximate analysis of milk to make formulations suitable for manufacture of these products.

PRAES is not reporting this year.

Critical Issue: Food security, plant & animal systems

Puerto Rico continue to lose its more productive farming lands, risking our Food Security. PRAES County Agents (**CA**) and specialists provided individual assistance and training to farmers on crop and animal production, organics practice, farm management, feasibility analysis and marketing networks. In addition, PRAES Family Educators (**FE**) also delivered individual assistance and training to housewives, young people, and public about increase food security practices, like home, school and community gardens. Educational activities carried out included training on food security activities to adults and youth, home and community gardens activities and training of farmers about agricultural enterprise feasibility and marketing strategies. Training provided to small farmers about urban agriculture and high tunnels, to promote the organization of communities and farmers to increase local food production, included the participation of CA, FE and NRCS agronomists. Achievements included the training of more than 250 farmers and 100 community leaders and the establishment of 11 high tunnels incentivized by NRCS.

Small ruminant production is a viable strategy to increase local food production since they exhibit a great adaptation to tropical conditions. Educational activities that increase the public interest in small ruminants, their demand and production efficiency will help increase food security and the agricultural activity of Puerto Rico. PRAES and PRAEX personnel developed training trained producers to increase their knowledge on management practices and added value of small ruminant meat cuts. Associated with these efforts, one participating farmer opened a meat-processing plant facility to produce specialized meat cuts. Major activities employed to increase the interest of the public about small ruminants, and efficiency of production of small ruminant systems, have benefited over 200 participants.

Plant disease outbreaks in Puerto Rico cause significant losses in cash crops, fruit, and ornamentals. Coffee and vegetables production, specifically in the southern area, are currently experiencing outbreaks of fungal, bacterial, and viral origin. Diagnostic tools for plant disease are of vital importance to implement an effective management strategy. The PRAEX and PRAES Diagnostic Clinics have processed more than 1,370 vegetative samples from more than 30 different crops and ornamentals. Information dissemination has been focused on agricultural festivals, scientific meetings and interventions with farmers and communities about the different diseases and pests. These activities have encouraged more than 75 producers to adopt recommended practices related to cultural, biological, and chemical control of pests in crops.

Citrus production in PR is of paramount importance, not only for farmers but for the local markets and households. The citrus industry has been severely impacted by two important diseases, Huanglongbing (**HLB**) and Citrus Tristeza Virus (**CTV**). To overcome this, the Adjuntas Experimental Station has improved its citrus nursery facilities. PRAES efforts included training of 85 CA and 24 agronomists from the Department of Agriculture. They in turn provided training to growers and interested individuals to help disseminate good agricultural practices to enhance citrus production, training 596 individuals. As a result of PRAES educational intervention with citrus growers, producers reported to adopt practices that promote production efficiency, quality of their products by adopting practices related to sustainability, increase production and business size.

Research efforts continue to target the most important production constraints faced in crops essential to our food security and economic viability of local farming. Under "Plant Genetic Conservation and Utilization" we continue to evaluate local and introduced germplasm to identify desirable traits and genotypes with high agronomic performance. In bananas for ex., the evaluation of cvr. Monalisa (FHIA02) shows it could be an alternative if Fusarium TR4 enters the Caribbean, potentially also providing an alternative market for the population with diabetes, given its lower glycemic index than Cavendish Grande Nain. Work with legumes have been strengthened through collaborative research efforts in "Breeding Phaseolus Beans for Resilience, Sustainable Production, and Enhanced Nutritional Value" and under "Evaluation and selection of grain legumes genotypes with heat and drought tolerance in Puerto Rico". Varieties released through the former project contribute to reduce loss in yield and seed quality caused by disease, and permit more bean production during the hot and humid summer months. In the latter, several genotypes were identified that overcome drought.

New production systems offering market alternatives to farmers are also being explored in "Adaptability and Performance of Specialty Tomatoes and Asian Vegetable Varieties in Different Production Systems in Puerto Rico with Market Opportunities", while under "Facilitating Registration of Pest Management Technology for Specialty Crops and Specialty Uses" research seeks the best management tools to diminish the impact of pests and diseases particularly in minor crops. These crop protection efforts were complemented by activities developed in "Design and evaluation of protocols for early detection and management of plant pathogens". Under this project a Loop-mediated isothermal amplification (LAMP) assay for the early detection of *P. fijiensis* (responsible for Black Leaf Streak in plantains and bananas) was developed to be used in Puerto Rico and help prevent the spread of the disease.

Heat tolerant dairy cattle and enhancing lamb and beef production are major concerns for livestock production in Puerto Rico. Highlighted projects in heat tolerant dairy cattle, "Implementation of novel reproductive biotechnologies and genomics for the multiplication and commercialization of genetically superior Slick cattle" and "Characterization and relationships of growth patterns, eating behavior and health in slick and wild type (WT)- haired Puerto Rican Holstein calves and heifers" show continued progress in the depiction of Slick cattle vs WT in different parameters. Research efforts have shown greater thermoregulatory and productive capacities in these animals when compared to WT. This response has been observed in the early stages of life in these animals.

The evaluation of nutritional and management strategies aimed at improving beef and lamb production for human consumption in Puerto Rico is also a current need. In "Performance, health, carcass and meat quality, sensory attributes, and consumer preference of lambs reared under thermal stress in grazing and feedlot conditions and slaughtered at two body weights", results showed that the feeding system affected performance, carcass and cuts yield, and meat quality of crossbred lambs raised under heat stress conditions. As a result of the PRAEXS research and PRAES efforts, an increase in the offer of meat lamb cuts have been observed on the island. Research efforts to enhance beef production include the "Effect of sex, nutritional plane, and processing age on the growth efficiency, carcass composition, beef quality and economic returns of Senepol calves raised under grazing conditions" (final report in REEport). Field research trials have preliminary shown that the use of creep-feeding type supplementation enhanced the growth of pre-weaning calves, and that growth of intact males was higher than castrated ones. This practice has been adopted for beef producers on the island.

Critical Issue: Positive youth development

The recent natural disasters and the current health crisis of Puerto Rico have dramatically impacted youth's mental health and academic achievements. The lack of educational opportunities and access to healthy food, due to the closing of schools, in addition of the pre-existing economic challenges exacerbates our youth precarious situation. The Positive youth development program used interdisciplinary 4-H initiatives to integrate 4H members needs and program objectives to develop skills and abilities that promote healthy lifestyles. Examples of some of the 4H activities implemented to achieve the program goals included:

- ***Reto Agricola*** (Ag-challenge), a virtual and at-home learning initiative that connected our children and youth with experiences in agriculture.
- The ***Ruta 4-H para una vida saludable*** initiative (4H route for a healthy life), through school and community teen teaching strategies, allowed us to teach and promote healthy living lifestyles to empower youth.
- "Talent is everywhere opportunity is not", **OYE** provided new opportunities to our participants to create awareness about deaf and blind youth in the island and how 4-H can be an inclusive place with opportunities for development the talent and life skills of this

community.

- **ACCESO 4-H** activities served as a space to reflect and talk about homelessness and their impact in youth, people, and families.
- The **Bug Camp** exposed kids and youth to basic knowledge in entomology. They learned about related professional careers in entomology and the role of insects in the food production, how they increase environmental diversity, and their impact in reducing world hunger.

Virtual camps, forums, 4-H week and state conferences were activities in which youth improved their leadership skills and teamwork strategies. All the activities included advocacy, emergency preparedness, diseases prevention and other approaches like 4-H DEI objectives and SDGs, that provided knowledge and community service experiences for youth to develop skills and abilities to become healthy individuals (*i.e.*, physically, socially, mentally, and emotionally) that positively contribute to our society.

Merit and Scientific Peer Review Processes

Updates

No significant changes have yet occurred in the PRAEXS merit review process but two suggestions are being discussed and implemented to guide future changes in this process and in the way it may assess and incorporate stakeholders input: (1) a committee with participants from the PRAES, PRAEXS and CAS teaching faculty has been established to evaluate prospective changes in the way research priorities and programs are established and developed, and (2) the incorporation of research and commodity programs leaders into PRAES regional advisory committee's meetings is being evaluated as a means of putting researchers more directly in contact with the needs expressed by farming stakeholders. Results from these initiatives will be reported in future Plans of Work.

Stakeholder Input

Actions to seek stakeholder input that encouraged their participation with a brief explanation

None

Methods to identify individuals and groups and brief explanation

None

Methods for collecting stakeholder input and brief explanation

A new strategy was adopted in FY 2021 for PRAES. All the data collected from extension county advisory committees was recorded digitally through online surveys. This allows us to interrupt the stakeholder input process during COVID-19 and improved the monitoring of needs at the municipality, regional and state level. This new approach improves the collection process and participation of stakeholder input, allowing extension administrators to better distribute time and effort in the required programs.

None yet in research but please refer to the description above of alternative methods for merit review and collection of stakeholders input being evaluated

A statement of how the input will be considered and brief explanation of what you learned from your stakeholders

Stakeholder input was considered in the list of priorities selected for last year's Hatch competitive call for research proposals and for the distribution of time and effort among the PRAES Educational Programs. It also guided the search for the limited research and teaching positions opened in the CAS during this year.

Highlighted Results by Project or Program

Critical Issue

Community, economy & sustainable development

Community self-management, economic development, and volunteers' resilient projects during critical times.

Project Director

Jaime Curbelo

Organization



Development of community enterprises to create vibrant communities

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

After Hurricane Maria in 2017, the earthquakes of 2020, and covid-19, the PRAES personnel noted that more communities expressed their desire to establish or improve their community organizational structures to meet their needs. These events exposed the vulnerability of our communities on issues related to economic development, food security, and resilience. The communities realized that in order to solve their problems appropriately, they must carry out initiatives that in the past were carried out by the government. The lack of information on how to organize the community contributes to keeping people in a cycle of dependency and vulnerability. So now the PRAES faculty training's that address issues of economic development, self-management, leadership and volunteering have greater importance for our students.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The main activity that we developed focused on the needs of our communities. In fact, various stakeholders prioritized training on topics related to the development of community enterprises. Therefore, we developed projects that empowered communities to reach food self-sufficiency and financial independence, as a means to create vibrant communities. Some of the achievements included the development of action plans for the development of an economic project (14 people). Additionally, 104 people benefited directly from the economic projects and 4 new jobs were created. The community gardens established are generating a constant production of food consumed by the participants themselves and providing an additional source of income for the participants.

Briefly describe how your target audience benefited from your project's activities.

Among the projects on community economic development that we established, four stand out. The first is in the county of Aguada, which is dedicated to making biscuits and desserts for sale, as well as distributing free food to the community. At the municipality of Florida, Puerto Rico, a businesswoman has developed a project for the sale of sofrito (caribbean mix of spices and herbs) and continues to create income for her family and her community. There are three community gardens established in the municipalities of Cabo Rojo, Adjuntas, Vega Baja and Ponce that are generating additional income and food for their communities. The leadership of the trained leaders is of great benefit since they advise and participate in the community directives and government organizations helping to distribute food and developing community emergency plans for dozens of families in their respective municipality. Additional achievements recorded from follow-up visits include:

- 119 leaders actively participated in the design and development of community projects.
- 24 communities took actions to meet their needs in order to improve their quality of life through empowerment and community self-management.
- 56 government agencies or other organizations collaborated in the development and organization of the community.
- 23 communities developed an emergency and security plan.
- 44 families developed an emergency plan.
- 159 people collaborated as volunteers.

- 870 hours dedicated to volunteer work as a community leader.
- 5 communities were organized for the preservation and conservation of agricultural land and of ecological value.
- 3 communities organized for the preservation and conservation of coastal resources and other natural resources.
- 27 action plans developed and updated by community members to address a problem.
- 14 coalitions or support networks established in the community.

Briefly describe how the broader public benefited from your project's activities.

The program's goal is to provide knowledge and tools that allow our target audience to better address issues related to economic development, self-management, leadership and volunteering. By improving the economic situation of our participants, we are helping to improve their communities as well, therefore indirectly benefiting other individuals as well.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

We are proposing to organize 10 new community gardens with a USDA Natural Resources Conservation Service (NRCS) proposal. These projects are oriented towards economic development, conservation of natural resources, community organization and community food security. The grant lasts for two years in its initial community organization and construction phase. To achieve this, each community organization that adopts each PRAES community garden will assign technical personnel in agronomy and family and consumer sciences. They will use the integrated model of the 4 program areas that include food security, food safety and scientific technology, community economics for sustainable development, family well-being, and positive youth development.

Critical Issue

Extreme weather, environment & sustainable energy

Agroecological Practices Adapted to Extreme Weather Conditions

Project Director

Jose Dumas

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1025524



Agroecological Practices Adapted to Extreme Weather Conditions

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Ecosystem protection is a priority in any national initiative that addresses food security and human health and depends on soil health conservation. The rate of soil health losses depends on extrinsic conditions such as the climate and human management and intrinsic conditions such as the soil order. This project will explore the benefits of covering crops in different soils to increase the CEC and overcome problems related to soil health losses due to drought and heavy rainfall events.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We established the project in a greenhouse in the Lajas AES. Before treatments, six soil orders were collected and characterized for chemical, biological, and physical properties. The soils have been characterized in an intermediate stage before the final cycle. We selected six cover crop plants, and their adaptability to each soil type on three humidity regimes will be evaluated. Our scope is to tailor soil order, cover crop and humidity, and drought tolerance to conserve soil health during extreme weather conditions that have a valid application to tropical and subtropical regions. These activities contributed to making significant progress toward fulfilling the project's primary goal of preparing and implementing tailored soil conservation practices as corrective and preventive actions that conserve lands and guarantee the incomes of growers in the short and long term. The specific objectives addressed during this period were objectives 1 and 2.

Briefly describe how your target audience benefited from your project's activities.

Target audiences during this reporting period were six graduate students. We talked about the importance of increasing soil health and tailoring practices to specific soil order and climatic conditions. We talked about a simple method for water collection from air and injection in keyline tunnels enriched with biochar and effective microorganisms to preserve the soil quality.

Briefly describe how the broader public benefited from your project's activities.

The broader public benefited through a podcast with the master's degree graduate candidate student (Luis Rullán) and a web page created as an additional contribution of this project, which will be actualized as the project progresses.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - This project provides the opportunity for training directly to one graduate student and indirectly to five graduate students that currently work in the Agroenvironmental Laboratory at Rio Piedras. Also, five undergraduate students will be exposed to the project and have opportunities for training and professional development.

Dissemination of results (outreach activities) - The broader public benefited through a podcast with the master's degree graduate candidate student (Luis Rullán) and a web page created as additional contribution of this project, which will be actualized as the project progresses.

Other Products-Cortez, M. (Host), (2022, February 10). Proyecto de Investigación H-513. [Audio podcast episode] In Proyecto de Investigación H-513 by Luis Rullán. Production desde la eea.

[Natural resource protection amid extreme weather and natural disasters](#)

Project Director

Jaime Curbelo

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

7002484



Natural resource protection amid extreme weather and natural disasters

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Extreme weather events such as hurricanes, very intense rainstorms, and flooding, which have now become more common, are main contributors to soil erosion with its negative consequences on watersheds. As the world continues to experience the effects of climate change, no group will be impacted more than farmers, and each growing season seems to come with more challenges than the previous. Prime agricultural land is a limited resource on the island and is constantly threatened by

urbanization and soil erosion. Though Puerto Rico's agriculture is very diverse, characterized mainly by small family production units, the effects of land degradation without mitigation strategies will become insurmountable in the near future.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The activities and educational efforts in 2021 associated with the critical issue of Extreme Weather, Environment & Sustainable Energy were focused on mitigating the impact of climate change on agricultural production by improving agricultural practices, supporting soil and water conservation and encouraging composting. Though COVID-19 restrictions limited in-person trainings, efforts were made to continue the instruction and service to the farmers and other stakeholders across the island through various virtual and other means.

Virtual workshops covering soil sampling, soil analysis interpretation, and nutrient recommendations were provided for the agricultural agents that cover the municipalities in the east of the island. In addition, 18 trainings on soil management and fertility were offered with 55 farmers attending. Soils from 35 farms were sampled, analyzed and the results were discussed with farmers. Collaborations between the Agricultural Extension Service (PRAES) and NRCS resulted in the dissemination of soil nutrient management information to farmers, producers and the general public.

Two trainings on soil fertility and nutrient management in vegetable crops (solanaceae and cucurbits) were held at PRAEX in Juana Diaz, Puerto Rico. Ten agricultural agents that provide service to the municipalities in the south of Puerto Rico where the large majority of commercial vegetable crops are grown attended the training. A training on composting at home was provided for the coastal communities in Fajardo.

Educational efforts on soil erosion control have continued to increase awareness of soil protection. These include training workshops on watershed protection, water harvesting, and storage that have been offered at extension offices and in the field. Fifteen individuals were trained in the protection of water quality and conservation of watersheds near agricultural farms and individual instruction to three farmers was provided on agroforestry and the control of soil erosion in the farm.

Workshops on the developments in tropical agriculture in drought conditions was provided to 12 individuals using the established SEA curriculum guide "Climate Change: Impact on agricultural production and methods of adaptation".

Briefly describe how your target audience benefited from your project's activities.

Soil management and conservation: Soil conservation and nutrient management training resulted in the adoption of practices and recommendations that have improved the conditions on more than 50 farms. Eight farmers incorporated the use of soil amendments based on soil fertility results. Eleven farmers changed their fertilizer formulations to more closely coincide with the needs of the crops grown. Thirty-seven individuals adopted recommended conservation practices to effectively manage the soils on their farms.

Agricultural resilience and natural resource protection due to climate change: More than 20 individuals/farmers adopted practices that will improve agricultural resilience and natural resource protection in the face of climate change. Fifteen individuals implemented or improved water collection systems on their properties while one farmer adopted agroforestry practices (ground cover, wind breaks, others) to control water and wind erosion. Five farms prepared contingency plans and obtained agricultural insurance in case of natural disasters.

Composting: The training on composting at home for the communities in Fajardo resulted in five families now composting materials from their kitchens to provide nutrients to their home gardens. Three farmers also adopted composting practices on their farms in the reuse of crop residues.

Briefly describe how the broader public benefited from your project's activities.

The project's goal is to increase the use of sustainable agricultural practices that protect Puerto Rico's natural resources. The broader public benefit directly from a more sustainable local food source and indirectly from the protection of natural resources that provide raw materials, fuel, recreation, and aesthetics to the island.??

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Our main issue throughout the year was the COVID-19 restrictions that limited in-person trainings. We were able to overcome these limitations and continue the instruction and service to farmers and community members through a variety of distance-teaching efforts. We plan on continuing to incorporate virtual instruction as part of our teaching repertoire as we have found it to be very effective in reaching our target audience.

Closing Out (end date 09/07/2023)

[Using wild bee hives to assess melliferous plants, honey bee health and honey quality](#)

Project Director

Wilfredo Robles

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017580



Using wild bee hives to assess melliferous plants, honey bee health and honey quality

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

As honeybees are one of the most important pollinators for food crops, providing a suitable habitat to maintain their population is always a concern. Natural events like Hurricane María in 2017 jeopardized local honeybee population as wild melliferous plants remained scarce over period of time. Therefore it is important to understand the relationship between melliferous plants populations and wild bee hives along with bee genetics and honeybee quality.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The goal of this project lead to understand local wild honeybee populations within dry and moist ecoregions and how they may thrive after natural disasters. As there is a lack of information about genetics, melliferous plants, honey bee health and honey quality, objectives were developed along these research areas. Currently there is on-going field research being conducted to study melliferous plant phenology at two ecoregions. Specifically, wildland weed populations are surveyed targeting melliferous plant species and pollen presence at established bee hives. Moreover the genetics of honeybee at those bee hives are being compared with preserved genetic material collected before Hurricane Maria.

The main bee hive pest has been identified as *Galleria mellonella* or wax moth. Currently ongoing laboratory research searches for efficacious botanical extracts to prevent or diminish their impact on bee hives.

Briefly describe how your target audience benefited from your project's activities.

This project is targeting the agricultural sciences community related to apiculture such as beekeepers and honeybee related business. This target audience may benefit from current research outcomes as they may acquire the following information: 1- identify appropriate melliferous plant species to provide food source for honeybees, 2- broad understanding about honeybee genetics, and 3- managing target pests at the beehive using botanical extracts or low toxicity products. Such information will aid beekeepers to identify the best melliferous plants to have contiguous to beehives according to ecoregions and related flora. Similarly, genetics may provide information about desirable bee traits to improve honey production. As target pests such as *G. mellonella* may impact beehives, availability of plant-derived products may ease pest management.

Briefly describe how the broader public benefited from your project's activities.

Along with beekeepers, food production farmers may benefit as honeybee is the most important pollinator. Potentially, the outcomes of this project may serve to have beehives at those farms to improve crop production. Others like extensionists, researchers, faculty, and the State Department of Agriculture may develop educational activities to disseminate resulting information supporting honeybee conservation.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - Graduate students as well as field personnel have been trained in topics related to beehive management. Specifically, graduate students have received lab training related to pollen extraction, genetics processes and plant tissue extracts as part of their thesis work. Extensionists have acquired new professional knowledge related to beehive management. Gathered information will serve to disseminate resulted outcomes to stakeholders.

Dissemination of results (outreach activities) - Results have been disseminated by means of train-the-trainer field workshops along with live videos posted in social media. For instance, a new video related to the recovery of wild beehives was developed as an electronic resource for general public interested on honeybee conservation.

Plans for next reporting period - As honey production will increase during spring months, honey produced will be harvested and sent to the lab for analysis. Melliferous plants and beehive pests will continue to be monitored during the year to document temporal changes and population dynamics. Honeybee genetic material collected will be analyzed against available genetic material collected prior to Hurricane Maria. Results are expected to be gathered in the next reporting period.

Publications:

Poster presented at the Weed Science Society Meeting, February 2022. Title: Potential of Using Wildland Weeds for Honeybee Health in Puerto Rico. Authors: Andres Curcio, Wilfredo Robles, Fernando Gallardo and Alejandro Segarra

Virtual Oral presentation presented to Extension Service personnel from University of Florida and University of Puerto Rico, Mayagüez. Title: Using wild honeybee hives to assess melliferous plants, honeybee health and honey quality. Author: Manrique Planell.

Other Products: Activities include:

Mentoring thesis work for the following graduate students related to the project

1. Andres Curcio – thesis title “Floral and pollen pellet composition of two eco-regions in Puerto Rico and their importance for apiculture”
2. Valerie Soto – thesis title “Evaluación de extractos botánicos sobre larvas de *Galleria mellonella* (Lepidoptera: Pyralidae) bajo condiciones de laboratorio”
3. Marian Ortiz – thesis title “Asociación entre la percepción del apicultor sobre la genética de la abeja melífera en Puerto Rico y el uso de cría selectiva para la mejora de sus apiarios”

Events include:

Field day at the Agricultural Experiment Station, Adjuntas provided to Extension Agents on October 2021. Topics: Basic tools to manage beehive, Frames and Foundation, Personal Protective Equipment (veils and gloves), Feeders, Sampling, Pest Management and Inspection.

Services include: Monthly tutoring to field personnel in charge of managing established apiaries at all 6 Agricultural Experiment Stations.

Products include: Recorded video at the Agricultural Experiment Station Isabela related to the recovery of wild beehives. Video is being edited and is expected to be uploaded in the YouTube platform in April 2022. Appropriate url or link will be provided in the next report.



Soil quality assessment among soil orders and ecological zones in Puerto Rico

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Soil quality parameters vary among soil orders and the environment where the soil is located. Agricultural practices affect soil quality parameters such as organic matter content, aggregate stability, microbial activity, fertility status and if not performed correctly the soil deteriorates and its agricultural potential is reduced. Soil quality parameters in Oxisols, Ultisols, Mollisols and Vertisols are evaluated under tillage and no tillage conditions and the data collected will be used to develop a set of agricultural practices and recommendations to preserve high soil quality parameters.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The first stage of Oxisols evaluation at Isabela Agricultural Experiment Station was completed. The Coto soil shows soil quality parameters superior to the Cotito soil. Cotito soil has the limitation of being shallow and of moderately alkaline pH values. In both soils, the resistance to penetration increases at depths below the plow layer, but parameters such as aggregate stability and bulk density are not negatively affected by tillage in neither of the two soils.

The Cotito soil pH was moderately alkaline (7.5 - 7.9). When no tillage and tillage plots were compared, higher values of available P, organic matter, aggregate stability and alkaline phosphatase activity were observed in the no tillage plots. On the other hand, effective cation exchange capacity (ECEC) and dehydrogenase activity (DHA) were higher in the tillage plots.

The pH of Coto soil under tillage was slightly acidic (6.7) and for the no tillage was moderately acidic (5.2). The available P, ECEC and DHA of the soil were significantly higher in the tillage plots. On the other hand, organic matter content (MO), aggregate stability (AS), and bulk density (BD) were higher in the no tillage plots.

Coto soil is an Oxisol of excellent quality and great potential for agricultural production as long as liming practices are implemented and intensive fertilization. The excellent physical properties like high aggregate stability, and friability facilitate land preparation and tillage practices.

A soil management time frame of two years is not enough to assess the benefits of no tillage or minimum tillage cultivation. In fact, our results indicate higher bulk density values and higher resistance to penetration in the first 20 cm of the soil, under no tillage conditions.

Briefly describe how your target audience benefited from your project's activities.

Undergraduate and graduate students gained knowledge on evaluation and analysis of soil quality parameters. A broader knowledge was gained on good quality soils, on how to preserve and improve soil quality parameters, and on the capacity to provide farmers and other audience solid orientation on the subject. Leadership and decision making is a valuable gain stemming from the project.

Briefly describe how the broader public benefited from your project's activities.

The general public and other audiences will understand the benefits of soil management practices targeting the improvement of soil quality parameters and on how to preserve them. Also, knowledge on differences in soil quality among soil orders, environmental location and land use, will provide farmers and general public valuable information for effective soil use and planning.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities -Three graduate students are conducting research work in selected objectives of the project. These students have been trained in analytical techniques and procedures for the analysis of soil available nutrients, organic matter content, and enzymatic activity in soils. Once the research project is completed, the students will be properly trained on the use of major laboratory equipment for soil science research such as Nitrogen Autoanalyzer, UV spectrophotometer and Inductively Coupled Plasma (ICP).

Plans for next reporting period - A master thesis on soil quality parameters of two Oxisols from northwestern Puerto Rico will be completed. Two publications will be prepared from the results of the thesis.

Field and laboratory studies on CO₂ evolution will be conducted on Oxisols, Mollisols and Ultisols. CO₂ evolution from field studies will be correlated with laboratory data and other soil parameters like organic matter content and texture.

Dynamic soil quality parameters, such as enzymatic activity and evolution of CO₂ will continue in Oxisols, Mollisols and Ultisols.

Some educational material (guide, brochures) on soil quality parameters determination and management will be completed. These educational materials will impact the target audiences of professionals in agricultural sciences, students and farmers.

Major changes or problemse Covid 19 pandemic still is a very serious obstacle, since traveling to experimental sites is restricted by safety protocols and the support from the Agricultural Experiment Station has been reduced due to scarcity of hand labor. Also, purchasing of materials and supplies, and chemical reactants for soil analyses is taking longer periods of time, again due to safety restrictions by providers and by the university.

Although more flexibility in the restrictions for the use of laboratory facilities has been implemented, the outbreak of new COVID 19 variants raises new concerns among students, technicians and professors and frequent changes in protocols are implemented, impeding long term planning of research work.

The participation in scientific meetings and congresses has also been limited due to safety restrictions implanted by organizers and the university.

Closing Out (end date 09/07/2023)

Forestry Innovation Laboratory and Learning Institute (FILLI): Using Hurricane Maria's lessons and opportunities to support long-term sustainable

Project Director

Mario Flores-Mangual

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1016450

★ Forestry Innovation Laboratory and Learning Institute (FILLI): Using Hurricane Maria's lessons and opportunities to support long-term sustainable forestry industry in PR

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The project focused on developing research and knowledge in forest product uses and to increase forest enrichment to obtain multiple benefits in Puerto Rico. In specific, to take advantage of multiple forest products that could be obtained from vegetative wastes after hurricanes.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We were able to test biochar and mulch as part of growing medium first planting basil, and then planting trees, in particular *Tabebuia heterophylla*. In the basil experiment we tested mixes of different sources of biochar (*Pinus*, *Spathodea* and *Albizia*) with Promix as growing medium, and also included a treatment of only Promix (control). We found greater plant biomass in

the pots with mixtures of promix and pine biochar, while results in *Albizia* and control treatments were similar. *Spathodea* biochar mixed with Promix resulted in the lowest plant growth. These results are promising because they show that some Promix in growing can be substituted by some type of biochars, sometimes with greater results than with the Promix alone. We also prepared biochar from pine wood to test this year the biochar in the field as a soil amendment in reforestation efforts. We also prepared four videos last year to be included in YouTube. These videos include one that talks about the experiments related to the projects and three videos on the care and use of sawmills.

Briefly describe how your target audience benefited from your project's activities.

We are currently working with Para La Naturaleza, a NGO dedicated to the conservation and reforestation of protected ecosystems. The results on how to use biochar will directly help in possible new formulations of growing media that include a less amount of Promix. The data generated on the test of biochar in the field will help them improve their reforestation strategies. We are testing biochar as a soil amendment in highly degraded soils that are limiting the reforestation of protected areas. This information not only benefits Para La Naturaleza, but also all groups, government agencies and land owners interested in reforestation and forest products. We created videos during a training, held in Corozal on May 3 2021, on how to use and maintain a sawmill. In this training we had extensionists, forest service personnel, landowners, and arborists. We prepared three videos from this training that will be available to the general public to be added in internet platforms such as YouTube. We have trained multiple undergraduate students (12 students) on biochar production in the Soil Conservation course (Agro 4005) 2019. We have trained personnel from Para La Naturaleza on biochar production on 2020. We prepared a video on the benefits of biochar as a soil amendment and as part of growing media that will be also available on YouTube and in pages of the UPRM. For next year we are planning to present the results of field experiments using biochar as a soil amendment. From October, 2020 - September, 2021: 1. Graduate and undergraduate students that received training in forestry, agroforestry, ecological restoration and silviculture, and supported research activities related to this project include (1) six graduate students (Rey Cruz, Génesis Túa, Alejandro Marengo, Gabriel Báez, Alvin Rodríguez and Pablo Díaz) completing Thesis (AGRO 6999) for a Master's in Agronomy under the guidance of Dr. Oscar Abelleira, one graduate student (Jennifer Rivera) completing Thesis (HORT 6999) for a Master's in Horticulture under the guidance of Dr. Oscar Abelleira, and one graduate student completing a Master's Thesis in General Engineering and Materials (Yivaldo Juan) under the guidance of Dr. Oscar Suárez; (2) five graduate (Rey Cruz, Alejandro Marengo, Yivaldo Juan, Alvin Rodríguez and Pablo Díaz) and one undergraduate students (Armand Tirado) completing research activities as part of assistantships funded by the project under the guidance of Dr. Oscar Abelleira, and (3) undergraduate students enrolled in the advanced (graduate and undergraduate) course Natural Forest Management (AGRO 5010; 13 students in Spring 2021), and the undergraduate course Silviculture (AGRO 4010; 17 students in Fall 2021) that conducted research and training activities as part of field laboratories (8 hrs. per day) for at least five laboratory days per course. All undergraduate and graduate students were from minorities that included people of Hispanic/Latin American cultural and racial heritage, and women. (2). Listeners of the Night Crew radio show broadcasted by the Radio Isla WKJB 710 AM and aired on January 1, 2021, from 9-11PM. The show's evening program consisted of an interview, hosted by Padre Edwin, focused on the development and history of the Río Hondo Community Forest in Mayagüez, Puerto Rico. Interviewees included community leader Agro. Víctor González Rosas, Ms. Magaly Figueroa, Forest Stewardship Program Director in the International Institute of Tropical Forestry, USDA Forest Service, and Dr. Oscar Abelleira. The interview showcased the practical applications of the results and products of this project by a local community of residents of the wards of Malezas, Río Cristal and Río Hondo in Mayagüez, Puerto Rico, that currently co-manage forested lands under the Open Space and Community Forest Program of the USDA Forest Service. The applications include the establishment of agroforestry crops and of enrichment plantings with late-successional tree species in the community forest grounds for food security and biodiversity conservation. The show is broadcasted on the local AM broadband and vía Facebook Live (<https://www.facebook.com/thenightcrewam/>). Radio listeners of the show mostly comprise minorities that include people of Hispanic/Latin American cultural and racial heritage, and women. (3). Participants of the 1st Feria de Investigaciones de la Universidad de Puerto Rico, Mayagüez, Puerto Rico, held on March 11, 2021, in the G-Meet online platform. This online symposium showcased research conducted by graduate students of the University of Puerto Rico, Mayagüez. The symposium included talks by three graduate students under the guidance of Dr. Oscar Abelleira focused on the results of this project and potential applications. Participants consisted of about 50 graduate and undergraduate students, faculty and professionals, and were comprised mostly by minorities that included people of Hispanic/Latin American cultural and racial heritage, and women. (4). Participants of the 1er Congreso de Custodios de Terreno y Agricultores of the Centro de Conservación del Paisaje and Cafiescencia held on March 27, 2021, in the Zoom on-line platform. The first day of this three-day online congress was inaugurated by a talk by Dr. Oscar Abelleira focused on the results of this project and potential applications in secondary forests on private lands. The first day of the congress and Dr. Abelleira's talk was attended by 200 participants that included scientists, practitioners, professionals, students, government agency representatives, community leaders, non-government organizations, forest managers and landowners in Puerto Rico, U.S. Virgin Islands and 11 states in the continental U.S.A. Participants also included attendees from Bolivia, Argentina, England, Holand, Austria, Costa Rica and Dominican Republic. Participants of the event comprised mostly minorities that included people of Hispanic/Latin American cultural and racial heritage, and women. The full recording of the talk and event can be found online in the webpage at the end of the title and

citation of the talk. (5). Participants of the Encuentro “Restauración forestal: un camino a la recuperación y el bienestar” of the Catholic World Movement for Climate (MCM), Puerto Rico Chapter, held on April 21, 2021, in the Zoom online platform. The activity consisted of online talks by Ms. Magaly Figueroa, Forest Stewardship Program Director in the International Institute of Tropical Forestry, USDA Forest Service, and Dr. Oscar Abelleira. The talk of Dr. Abelleira focused on the results of this project and potential applications in secondary forests on private lands. The activity was attended by 15 participants that included community leaders, students and land owners. Participants of the event comprised minorities that included people of Hispanic/Latin American cultural and racial heritage, and women. (6). Participants of the Primer Encuentro Agro-forestal y de Conservación of Distrito Caribe de Conservación de Suelos y Agua held on May 28, 2021, in the Hacienda Vista Alegre, Ponce, Puerto Rico. The activity consisted of talks by students, faculty and professionals focused on the management of forested lands for agroforestry production and biodiversity conservation. A graduate student under the guidance of Dr. Oscar Abelleira presented a talk focused on the potential applications of the results of this project. Participants included scientists, practitioners, professionals, students, government agency representatives, community leaders, non-government organizations, forest managers and landowners. Participants of the event comprised minorities that included people of Hispanic/Latin American cultural and racial heritage, and women. (7). Participants of the "Private Forest Stewards Working Group" meetings held on a monthly basis, from summer of 2020 to date (2022), sponsored by the Forest Stewardship Program of the USDA Forest Service International Institute of Tropical Forestry. The working group consists of farmers, landowners, professionals and practitioners interested in implementing Best Management Practices (BMP) on forested lands in Puerto Rico. Dr. Oscar Abelleira has actively participated, gained insight and contributed the contents of a BMP Guide for Forests on Private Lands that is under development by Dr. Abelleira and colleagues of the Department of Agroenvironmental Sciences. The monthly meetings, which are attended by about 30 participants per date, have acted as a bi-lateral communication stream to and from the target audiences, and has helped Gauge the contents of the BMP Guide. Participants of the working group include personnel from government agencies including the Natural Resource Conservation Service (NRCS), the Department of Natural Resources of Puerto Rico (DRNA), USDA Forest Service and US Farm Service, and from the private sector including Centro para la Conservación del Paisaje Inc., Cafiescencia Inc. and Para la Naturaleza, Inc. Participants of the event comprised minorities that included people of Hispanic/Latin American cultural and racial heritage, and women. We prepared several videos last year that will be posted in the internet for the whole community. In the filming of these videos there were also public watching the presentations. The videos were edited by personnel from the Agricultural Extension Service of UPRM, and will be posted soon at YouTube. We are doing a conference this year (May 6, 2022) about the results of this and other projects of UPRM working with forest management and forest products.

Briefly describe how the broader public benefited from your project's activities.

We prepared several videos last year that will be posted in the internet for the whole community. In the filming of these videos there were also public watching the presentations. The videos were edited by personnel from the Agricultural Extension Service of UPRM, and will be posted soon at YouTube. We are also doing a conference this year (May 6, 2022) about the results of this and other projects of UPRM working with forest management and forest products. The general public has also benefitted of the multiple participations of Dr. Abelleira in activities that are both attended by target audiences but also by the broader public, for example the Primer Encuentro Agro-Forestal y de Conservación of Distrito Caribe de Conservación de Suelos y Agua held on May 28, 2021 in Hacienda Vista Alegre, Ponce, PR.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - We have trained several farm workers (at least four) in the use of the sawmill. This has been done inviting local sawmill owners, that kindly have provided their time and expertise to participate in these trainings. From these trainings we have generated videos that we hope will teach the general public on the use of sawmills. We also trained two technicians and two graduate students on the preparation of biochar. Also, the technician was trained in plant growth and tree nursery management. We also have trained multiple undergraduate students (12 students) on biochar production in the Soil Conservation course (Agro 4005) 2019. And trained personnel from Para La Naturaleza on biochar production on 2020. Also we trained a undergraduate student on biochar production, media preparation and plant growth while doing an undergraduate research. The project has also provided support for the professional development of eight graduate students and one undergraduate student under the guidance of Dr. Oscar Abelleira (see Benefits to Target Audience). The project has also provided support for the professional development of personnel of the Department of Agroenvironmental Sciences, including research associates Anthony Pérez Méndez and María del Rocío Suárez Rozo, who have collaborated closely under the supervision of Dr. Abelleira. The project has contributed to the professional development of Dr. Abelleira, and to the development of the laboratory he directs at UPRM's Finca Alzamora.

Dissemination of results (outreach activities)-We did last year an outreach activity where a local sawmill owner did trainings on sawmill maintenance and uses at Corozal, Puerto Rico on May 3, 2021. In this activity we invited local landowners, arborists, Natural Resources agents and USDA Forest Services personnel. From these trainings we have generated 3 videos that we hope will teach the general public on the use of sawmills. We also did another video the same day explaining the benefits of biochar. All four videos will be posted on YouTube for the benefit of the general public. For Thrust 2 of this research we included many outreach initiatives on the parts of “Benefits to Target Audiences” and in “Publications”.

Plans for next reporting period - I will be presenting the first results of growing media using biochar in a Forest Conference planned for May 6, 2022 as part of the Agricultural Experiment Station-UPRM. We just finished collecting data from an experiment using biochar growing media for “roble blanco” or white cedar (*Tabebuia heterophylla*). We are drying plants and roots to determine biomass. We will also send the growing for nutrient analyses. Also, we are growing now “capa prieto” or Spanish elm (*Cordia alliodora*) using the same treatments as in the white cedar experiment. We will present the results of the white cedar experiment this year. We are also going to plant in the field white cedar and Spanish elm applying to the soil different mixtures of biochar. The goal of this experiment is to find the best biochar mixture to increase plant survival and growth and improve soil quality.

Major changes or problems - The biggest problem of the Thrust 1 (biochar researches) was the initial lockdown of Covid-19 that caused the research to be behind schedule. Since these research is held between Mayaguez and Corozal, the lockdown difficulted the traveling and labor at the Corozal Station. Also, last semester we had a student strike at UPR-Mayaguez that lasted more than two months. This limited the access to laboratories, offices, and equipments (e.g. Biochar kiln) that were stored in the University Campus. Also, due to safety issues it was impossible to produce any biochar during the student strike. This biochar was going to be use for the field plantation experiment. In addition, we initially proposed to have a technician, however, we believe that a technician is no longer needed because the experiment is not as labor intensive as in the beginning of the project when we prepared biochar and mixtures for plant grow in pots. Also, we had difficulties since the original technician of the project could not visit Corozal (the technician was based in Mayaguez) due to family concerns related to the Covid-19 pandemic at the beginning of the pandemic. A technician was later hired at Corozal to work on the project, but it took some time to complete the hiring process, and at the end of the contract we decided that for the experiments it was better to continue the research with a graduate student. Therefore, now instead we have a graduate student, giving the opportunity for a student to do a thesis on the use of biochar as a soil amendment during reforestation.

Publications:

Abelleira Martínez, O.J. 2021. Floración, fructificación y germinación abundante de Cóbana Negra en terrenos del Recinto Universitario de Mayagüez luego del Huracán María: observaciones y recomendaciones. *Acta Científica* 32: 5-11.

Báez Rivera, G., R.E. Cruz Aguilar, A. Pérez Méndez, J. Rivera San Antonio, G.Z. Túa Ayala, T. Keyser, and O.J. Abelleira Martínez. 2021. Preliminary estimate of the immediate effects of Hurricane María on the tree structure and species composition of novel forests in the moist lowlands of Puerto Rico. *Acta Científica* 32: 34-100.

Lugo, A.E., Abelleira Martínez, O.J., Medina, E., Aymard, G., and Heartsill-Scalley, T. 2020. Novelty in the tropical forests of the 21st century. *Advances in Ecological Research* 62: 53-116.

Tavárez, H.S., L. Elbakidze, O.J. Abelleira Martínez, Z.M. Ramos, and N.B. Pérez. 2021. Willingness to pay for gray and green interventions to augment water supply: A Case study in rural Costa Rica. *Environmental Management*.
<https://doi.org/10.1007/s00267-02101476-9>.

Túa Ayala, G.Z. and O.J. Abelleira Martínez. 2019. Interventions for agroforestry and species restoration in novel forests of Puerto Rico: Enrichment planting success before and after Hurricane María. *Brazilian Journal of Forestry Research* 39: e201902043, Special issue, 768 p.

Rivera San-Antonio, J. 2021. Structure and species composition of the Río Hondo Community Forest in Mayagüez, Puerto Rico, before and after Hurricane María: Implications for social-ecological resilience. M.S. Thesis, College of Agricultural Sciences, University of Puerto Rico, Mayagüez, Puerto Rico.

Closing Out (end date 09/07/2023)

[Towards a sustainable hog production in Puerto Rico](#)

Project Director



Towards a sustainable hog production in Puerto Rico

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

We needed to measure on a continuous manner the methane production potential of several combinations of swine waste and carbon sources available at the farm. We developed a biochemical methane potential (BMP) test to estimate in real time the methane production potential of the mix and generate useful parameters for the design of co-digestion systems for swine waste treatment and energy recovery at the farm level. We came up with an electronic control and monitoring system that quantifies environmental parameters and BMP of up to nine separate digestors operating simultaneously in the laboratory.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The development of a BMP test for multiple co-digestates and swine waste combinations will facilitate data acquisition for more combinations of co-digestate in combination with swine waste for optimal methane production and broadening the impact of anaerobic digestion for animal waste treatment, nutrient re-utilization and energy recovery.

Briefly describe how your target audience benefited from your project's activities.

Medium and small swine farms in Puerto Rico will be able to significantly reduce the environmental impact of their operation by combining non-animal waste with other crops residues increasing the availability of rapidly utilized carbon in the decomposition and transformation of swine waste into biogas, a source of energy, that can be used back in the farm, thus reducing energy bills.

Briefly describe how the broader public benefited from your project's activities.

Energy recovery from animal waste treatment thru biological decomposition has the potential of reducing the carbon footprint of small and medium size swine operations in Puerto Rico. Furthermore, it will directly benefit the water quality of rivers and lakes downstream swine operations.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - The project provided support and training to nine undergraduate students from agricultural sciences and computer engineering and one graduate student that worked directly in the project. Computer engineering students developed electronic and computer programming for operating test beds simultaneously. Agricultural science students were trained in BMP tests and produced reports with the results generated by the tests.

Dissemination of results (outreach activities) - All results have been shared with participating swine farmers.

Plans for next reporting period - We plan to complete the specifications of a modular digester system for small and medium size swine operations in Puerto Rico, thus reducing impact of animal waste discharges into stream and recovering energy from animal waste treatment.

Other Products:

Software. A computer software was developed by participating undergraduate students from the Department of Electrical and Computer Engineering at UPRM for monitoring BMP tests and collection of methane production from nine anaerobic digestors that run simultaneously three sets of swine waste – co-digestate combinations.

Equipment. A computer-electronic interphase was built using an Arduino processor to control data acquisition of the experimental setup with nine simultaneous reactors. The computer processor executes the computer software developed by participating students, controls the experiment and monitors and stores environmental parameters of the experiment and evolution of methane throughout the BMP test. The entire computer-electronic interphase was updated with a Raspberry computer interphase.

Critical Issue

Family well-being

Healthy and Sustainable Families

Project Director

Jaime Curbelo

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

7002470



Transforming the well-being of individuals and families through non formal education

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Socioeconomic statistics report an increase in the number of people who have lost their jobs, which in turn has caused financial instability and food insecurity; uncertainty and deaths; infliction of sadness and pain; stress in interpersonal and family relationships; poor care of health conditions, and other related situations. These events caused multiple situations that affect the well-being of individuals and families in the areas of health (physical and emotional), food security, safety, nutrition, and family economic resources. The Healthy and Sustainable Families program aims to promote family well-being, health and disease prevention, healthy eating, and the management of family resources to improve the quality of life of vulnerable populations affected by earthquakes, Covid19, and other social, economic, and environmental situations experienced in Puerto Rico.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Educational experiences that helped achieve the goals and objectives were provided by Family and Consumer Sciences (FCS) Extension Educators and their volunteers. They employed multiple educational strategies such as short courses, educational series, workshops, and virtual and face-to-face activities, including advising and follow-up visits. With these multiple strategies, individuals and families increased their sense of well-being through non-formal education on related topics, and the application of skills and practices to improve self-care and self-esteem, managing emotions, human relationships and positive family, healthy lifestyles, disease prevention, nutrition, food safety and food security. In addition, participants acquired acquisition of knowledge for the management of family resources to improve their economic and social condition.

Briefly describe how your target audience benefited from your project's activities.

Notorious achievements of our project's activities include:

- 262 volunteers collaborated with individuals, families, and communities' wellbeing issues.
- 53 people made positive changes, improving their family's quality of life
- 39 people improved their roles and duties as fathers, mothers, or caregivers

- 355 people developed family strength skills such as sharing time, improving family bonds and affection, effective communication, commitment, and spirituality
- 166 people learned skills and/or adopted practices to deal and manage efficiently with tension, crisis, and family conflicts
- 159 people applied skills to identify and manage their emotions positively
- 141 people adopted practices to maintain good mental health, manage loneliness and/or loss
- 47 people acquired skills for the care of the elderly by learning about the aging process, their needs, and vulnerability
- 271 people adopted practices or skills to strengthen their personal development and well-being
- 361 people improved food resource management by planning meals, checking the pantry, and making a list before buying
- 777 people improved food security through food preservation using canning, dehydration, freezing, and Mylar bag technologies
- 185 people improved food safety practices
- 142 people have a food reserve of a minimum of 14 days to have food security in case of emergency
- 397 people adopted recommended practices for the promotion of healthy lifestyles
- 110 people adopted positive practices in managing money resources
- 34 people showed changes in behavior in managing the money resource
- 22 people improved their economic and social condition through a good management of finances

Briefly describe how the broader public benefited from your project's activities.

The activities of our project besides benefiting our targeted audience also benefited adults, older adults, caregivers, families, and communities in rural and urban areas, residents of public and private housing, participants of non-profit organizations, health prevention centers, non-4H children and youth students, and other low-income audiences.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

We will continue to create projects aimed at improving the social, economic, and environmental conditions of individuals, families, and communities holistically and synergistically. FCS Extension Educators and volunteers will continue receiving professional development and training in food safety issues through the creation of home gardens, food preservation technologies, healthy eating, and food safety for the education of individuals, families, and communities. We will continue to promote a sense of well-being in low-income audiences through health promotion, chronic disease prevention, and healthy lifestyles; positive practices of human development and family relations; and the teaching of skills for self-confidence in the management of resources and personal finances.

Critical Issue

Food safety, science and technology

Manufacturing and marketability of valued added products using goat milk

Project Director

Leyda Ponce de Leon

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1021261



Manufacturing and marketability of valued added products using goat milk

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

In Puerto Rico, goat's milk is an industry that is emerging, in order to be successful in developing this industry it's important to provide training in how to convert this milk in added value products. Due to the differences in composition, goat milk does not behave similar to cow milk. Dairy products made out of goat do not have the same organoleptical characteristics as cow's milk, thus the importance of learning how to develop dairy products using goats milk.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Two graduate students of the Food Science and Technology program were recluted to work on the development of different products using goat milk such a cajeta and yogurt. Currently, they are working on the proximal analysis of milk in order to do the proper formulations for the manufacture of these products.

An undergraduate was working on the development of a frozen dessert using goat milk.

Briefly describe how your target audience benefited from your project's activities.

Any person that wishes to produce goat milk may benefit from the research were are doing. For instance, we are obtaining data of the composition of goat milk in Puerto Rico. Milk composition may be different due to climate, nutrition, breed, thus the goat milk composition is not the same and this is valuable information that is needed to develop dairy products. Products made out of goat milk do not have the same organoleptical properties as cow's milk thus developing the proper methods to manufacture products is important.

Briefly describe how the broader public benefited from your project's activities.

The broader public may benefit because we are working on the development of different products that at the present time are not manufactured in Puerto Rico; this is a very positive activity because we are helping with the food security of the island.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities -This project will provide the opportunity for graduate students to obtain their MS degree. At this moment 2 graduates are working toward this goal. And a third student already obtained his MS last May.

This project will also provide opportunities for undergraduate students to work with the development of goat's milk products.

Once the pandemic caused by the Covid virus is resolved, workshops on the manufactured of goat milk products will be offered to dairy goat farmers.

Dissemination of results (outreach activities) - A webinar was offered last March, the activity was a complete success and we have over 250 people from Puerto Rico, Central and South America attending.

Plans for next reporting period - At this present time we have been working on developing of yogurt, cajeta and frozen dessert manufactured using goat milk, we still need to continue working on those and also we are planning to start working on aged cheese.

Major changes or problems - Major problems that we have had are related to the pandemic caused by the Coronavirus, that have caused the University to be closed and limiting the access to the lab.

Other Products-

Activities :

teaching, or mentoring.

1. 1. Survey of the consumption of goat's milk products by Puerto Ricans. This survey was conducted by Juan Arellanos, a student from the Agricultural Economics department. The results of this survey could be found on his MS thesis "Estudio del consumidor potencial del productos derivados de la leche de cabra en PR" University of Puerto Rico 2021.

2. Yadhier Diaz, an undergraduate student from the Animal Science department worked under my supervision, on the development of frozen desserts using goat milk. We worked on the formulation of a low fat product. During this time, the student learned how to do proximal analysis of goat milk, how to use the serum point method to calculate the amount of ingredients needed for the goat dessert and to determine the texture properties.

Events include:

1. A Webinar on March 24, 2021, titled "Leche de cabra", four conferences of the following topics were presented:
 - a. Characteristics of the Puerto Rican consumers of goat milk products, by Juan Arellanos
 - b. How to manufacture cajeta and other confections using goat milk by Dr. Leyda Ponce de León
 - c. Labelling of goat milk products by Dr. Maria Plaza
 - d. Marketing of goat milk products by Dr. Mirna Comas

[Elaboration of flours, extruded products and chips based on apio \(Arracacia xanthorrhiza Bancroft\) and plantain \(Musa paradisiaca L.\) as alternatives for using local agricultural products and their marketing](#)

Project Director

Rosa Chavez-Jauregui

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017621

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The aim of this proposal will be to produce flours and starch for culinary purposes and snacks (expanded extruded products and chips) from local cultivars of apio and plantain, and carry out sensory quality test and perform surveys of consumer impressions and acceptance of expanded extruded products, chips and products prepared with flours.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

1. To evaluate the properties of starch isolated from Puerto Rican apio as a strategy to increase this species' use.

Overall, arracacha starch isolated from the storage root, rootstock, and stems exhibit attractive properties and can be used as an alternative for the food industry. Rootstock starch had larger granule sizes and high paste clarity (42%) than stem (30%) and storage root (24%). Starches exhibited irregular shapes like polygonal and truncated for large and small granules. Amylose content was lower in rootstock starch (23.86%) compared to storage root (26.14%).

2. To produce flour from apio and plantain.

Apio and plantain flour shows potential for the development of new food products given its nutritional, functional and thermal properties.

3. To evaluate the quality of expanded extruded products made from apio and plantain and chips.

Our work demonstrated that apio (*Arracacia Xanthorrhiza*) can be extruded and used as a high quality snack. In the optimal process, the maximum expansion ratio (obtained at 11% of moisture and 150°C process temperature) coincided with the best texture.

Snacks were made by extrusion of pure plantain and mixture containing corn in the following plantain: 100:0, 75:25 and 87.5:12.5%, respectively. In the optimal process, the maximum expansion ratio (9.92±0.02) (obtained at 13% of moisture and 160 °C process temperature) coincided with the best texture with mixture plantain and corn (87.5:12.5%).

Briefly describe how your target audience benefited from your project's activities.

The principal target audience served by this project are scientists in the public sector working with technology for processed vegetables. Information will be delivered to the first target audience through publications, presentations in scientific meetings and informal discussions at these meetings.

Briefly describe how the broader public benefited from your project's activities.

Other important target audiences are growers, consumers of fresh products and restaurants in Puerto Rico.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - One master-level graduate student and two undergraduate students have been participating in this research during this year. Students have been able to improve their skills in the use of various laboratory equipments and in data analysis.

Plans for next reporting period - 5.) To carry out consumer perception assessments of expanded extruded products; 6.) To identify the tuber and plantain processed products with most potential market in PR.

Publications: Oral presentation:

1- Natalie N. Rivera-Agosto and Rosa N. Chávez-Jáuregui. Development of an extruded product using stem and rootstock from apio criollo (*Arracacha xanthorrhiza*). 3RD Edition of Euro-Global Conference on Food Science and Technology. Sept 30 - Oct 01, 2021, Paris, France.

2- Rosa N. Chávez-Jáuregui, Carmen Pérez-Donado, Natalie Rivera-Agosto, Fernando Pérez-Muñoz. Puerto Rican Arracacha (*Arracacha xanthorrhiza* Bancroft) starch: Physicochemical, functional and morphometric properties. The 14 SLACAE- Latin American Symposium of Food Science - "Impact of Food Science on Health and Disease. December 12-14, 2021, Campinas, São Paulo, Brasil.

Other Products: The students learned to operate the single screw extruder and learned to assemble and disassemble the equipment. They also learned to solve problems when the equipment stops working, lack of pressure or other situations that could arise in the middle of the process.

Closing Out (end date 09/07/2023)

[Enhancing Microbial Food Safety by Risk Analysis](#)

Project Director

Maria Plaza

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017722



Enhancing Microbial Food Safety by Risk Analysis

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Risk assessment of agricultural water to help farmers comply with the fresh produce safety rule..

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Agricultural water sampling for 12 farms located around the southwest region of Puerto Rico was conducted. A total of 25 water samples were collected and E.coli analysis was performed. Sampled water included: well (17 samples), surface (7 samples) and municipal water (1 sample). Results for fourteen of the well water samples showed no E.coli count or less than 1 CFU/100 mL; 2 samples collected from the cistern where well water was stored showed negative results. One well water sample showed 54.5 ml/100 mL; the head of the well was damaged and a repair was recommended. The municipal water sample showed less than 1 CFU/100 mL. For the surface water samples: 2 were negative and 5 showed E.coli counts between 6.5 and 84 CFU/100 mL.

Briefly describe how your target audience benefited from your project's activities.

Farmers that participated in this sampling project will know the quality of their water and receive recommendations for improving water quality.

Briefly describe how the broader public benefited from your project's activities.

Farmers can understand the importance of water sampling and meet the Agricultural water requirement for fresh produce.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Plans for next reporting period - Beaches from the west part of Puerto Rico (Mayaguez, Aguadilla, Cabo Rojo and Isabela) will be assessed for the presence of *Listeria monocytogenes*. *Listeria monocytogenes* is a bacteria capable of growing at a salt concentration of 10%. The presence of this microorganisms in sea water may cause listeriosis, a human illness.

Critical Issue

Food security, plant & animal systems

Facilitating Registration of Pest Management Technology for Specialty Crops and Specialty Uses

Project Director

Wilfredo Robles

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1025402



Facilitating Registration of Pest Management Technology for Specialty Crops and Specialty Uses

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Minor crops are defined by all crops grown in less than 300,000 Acres, therefore in Puerto Rico all crops fall on that category. Crop production is continuously threatened by pests and diseases that requires effective management tools to combat them. As acreage size of minor crops is low, registered pesticides is also limited which consequently promote overuse and resistance by pests and diseases. Therefore the search for alternative management tools is key to maintain crop production while ensuring food safety. Currently, new outbreaks of coffee diseases like coffee berry disease have raised serious concerns to coffee growers. The lack of fungicides to manage this disease effectively have jeopardized the coffee industry which leads to the IR-4 project to identify new tools for management. Other pests like nematodes on banana along with diseases affecting mango flowering are always a concern for growers. Although this information is typically generated at the Agricultural Experiment Station, its distribution and spread to general public requires effective educational and outreach activities pursuing accurate use of pesticides.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Over the last year, we have been attending many virtual meetings with IR-4 project representatives, researchers and stakeholders to identify such methods. As a result, new field projects have been established at the Agricultural Experiment Station to conduct field assessments of several fungicides. In a joint effort with the IR-4 team at University of Hawaii, it is expected that results from this field studies will aid to identify the best management methods along with a potential registration by EPA.

Briefly describe how your target audience benefited from your project's activities.

New pesticide registrations achieved over the last years on minor crops like coffee provide direct benefits to local farmers. This project seeks best management tools to diminish the impact of pests which consequently increases crop yields and high quality products. Searching for new biopesticides derived from botanical extracts may represent new discoveries of better pesticide molecules that ensure pollinator conservation.

Briefly describe how the broader public benefited from your project's activities.

The web-based system will benefit general public in terms of selecting best tools to manage pests in crops. Equipment calibration and safety videos are generated to ensure proper use of pesticides. Information developed by this project reinforce proper handling and safer use of pesticides.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - Personnel involved with this project attended the 2021 IR-4 Food Use Priority Setting Workshop held virtually during the month of September 2021. At the meeting, local priorities and concerns were established to identify and support registration of new pesticides for PR crops. Moreover, EPA provided with an update about new registrations and regulations related to pesticides. Throughout the year, personnel attended to many virtual trainings required by EPA for conducting GLP field trials for pesticide registration.

Dissemination of results (outreach activities) - Oral presentations and written reports have been distributed to stakeholders as outreach activities. Principal investigator have participated in public hearings to strengthen public knowledge about pesticide use. The new pesticide web-based database is being redesigned with updated information. Fields for educational videos and blogs were created in a new designed web-based system embedded into the UPRM Wordpress pages under the following link: <https://www.uprm.edu/plaguicidaspr/>

Plans for next reporting period - It is planned to keep attending IR-4 meetings and prioritized local needs of pesticides. Moreover, new information about pesticide registration will continue to be provided at the “Reunión de Empresa” by means of oral presentations and meetings with stakeholders. All IR-4 field plots located at the Agricultural Experiment Station of Adjuntas, Corozal, Isabela, Juana Diaz and Lajas will be maintained for research purposes and new pesticide assessments. The web-based system with the pesticide database will continue to be updated. New educational and fact sheets will be developed throughout the year. The entire database is being worked in Spanish language to facilitate better communication to growers.

Publications:

Robles, W. and E.L. Martinez. 2021. A case study of waterhyacinth (*Eichhornia crassipes*) control in Puerto Rico using glyphosate and hand removal. *Invasive Plant Science and Management* 14: 196-203.

Vargas, N., **W. Robles**, ML Lugo y J.P. Morales. 2020. Malezas en el cultivo de piña cv. MD-2 y su control con herbicidas y acolchado de *Spathodea campanulata*. *Journal of Agriculture University of Puerto Rico*. 104(2): 233-240

Robles, W. 2021. Avances de investigación en registro de plaguicidas en café. Reunión Empresa de Café, Estación Experimental Agrícola. May and October 2021.

Poster presented at the Weed Science Society Annual Meeting. Title: Addressing citizen concerns about glyphosate use in Puerto Rico. Author: Wilfredo Robles.

Other Products:

Activities include: Mentoring undergraduate student Sigfred Rodriguez from UPRM, Computer Engineering.

Services include: Consulting activities such as attending public hearings at municipal legislature to educate about pesticide use and safety.

Products include: Fields for educational videos and blogs were created in a new designed web-based system embedded into the UPRM Wordpress pages under the following link: <https://www.uprm.edu/plaguicidaspr/>

Research and Extension Small Ruminant Program

Project Director

Jaime Curbelo

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

7002368



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The food insecurity that characterizes our current situation has pushed us forward to find alternative strategies to increase the local food supply. Small ruminant production could be a viable strategy since they exhibit a great adaptation to tropical conditions such as heat, diseases, and forage quality requirements. Therefore, educational activities that increase the public interest in small ruminants, their demand and production efficiency will help increase food security and the agricultural activity of Puerto Rico.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Through traditional and non-traditional educational activities, PRAES and PRAEX personnel developed training based on data developed through local research. This information helped local producers to increase their knowledge regarding recommended management practices and added value of small ruminant meat cuts. Due to the various seminars offered during the past years, one participating farmer opened a meat-processing plant facility to produce these specialized meat cuts. PRAES offered over 100 educational activities associated with the following topics: biosecurity (19) animal welfare and protection (24), management records (24), nutrient utilization (26) and control of internal parasites (29).

Briefly describe how your target audience benefited from your project's activities.

From the major activities employed to increase the interest of the public about small ruminants, and efficiency of production of small ruminant systems, 207 benefited from these. From participating farmers, 1 reported to participate in the PR Department of Agriculture programs, 4 increased farm size and 2 increased their product quality. In addition:

- 2 adopted recommended practices towards biosecurity

- 2 adopted recommended practices in records and disease prevention

- 3 adopted recommended practices for the control of parasites

- 4 adopted recommended practices in animal welfare

- 2 adopted recommended practices to improve reproduction

- 2 adopted recommended practices for the management of nutrient utilization

- 5 producers are marketing specialized lamb meat cuts

Projects (H-490 and H-474) trained lamb meat producers on nutritional and management strategies aimed at improving lamb production. Research results on performance, carcass characteristics, cut yields, meat quality, and fatty acid profile of lambs raised under grazing native tropical pastures or fed with total rations have been presented to producers. In addition, recommendations on the optimum slaughter weight of lambs to produce meat have been presented to lamb meat producers.

Briefly describe how the broader public benefited from your project's activities.

All the combined PRAES and PRAEX educational activities may benefit other individuals by providing knowledge about small ruminant production that can further be a promoter for the establishment of new enterprises that generate income to families and communities. These integrated strategies among the different educational PRAES areas intend to expand the achievements of one target audience to other audiences, generating a broader impact.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Due to the integrated activities carried out among PRAES and PRAEX personnel, some of the experiences and research results have been disseminated among UPRM students, increasing the impact of this project.

Closing Out (end date 09/07/2023)

Adaptability and Performance of Specialty Tomatoes and Asian Vegetable Varieties in Different Production Systems in Puerto Rico with Market Opportunities

Project Director

Ermita Hernandez-Heredia

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017708

★ Adaptability and Performance of Specialty Tomatoes and Asian Vegetable Varieties in Different Production Systems in Puerto Rico with Market Opportunities

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Small vegetable farmers in Puerto Rico need research-based information of new specialty crops that are climate resilient on different production systems. Also, farmers and agricultural businesses need protocols to overcome post-harvest challenges of these new crops and research support to develop new value-added products that can help increase their market opportunities and boost profits.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Extension factsheets were published to extend research-based knowledge to beginner farmers interested in producing these new specialty crops. In addition, we offered two online courses where we certified nine extension agents so they can provide individual advice about new specialty crops evaluated in different regions and how to manage pest and identify new markets for these high-potential crops. This information was disseminated to other agronomists as well as to local government and federal agencies such as USDA NRCS that provide technical advice to different production systems including high tunnel production under the Ag Urban Program. We presented a virtual field day and a workshop to have a better connection between small growers and new extension personnel. All information presented was driven by the need to learn about new varieties to grow in the field under organic farming practices.

Briefly describe how your target audience benefited from your project's activities.

Extension agents benefit directly from these activities since they are the principal contact with small growers on their region, providing workshops and individual advice on the best crop to grow based on their climate and type of system. Growers benefit from the research-based knowledge of adaptable crops and management strategies, increasing farm sustainability and productivity.

Briefly describe how the broader public benefited from your project's activities.

Having extension agents with certified specialty crops knowledge can broaden the public that will benefit from such research-based activities. In the future we will increase workshops and online courses to other agronomists around the island to disseminate more information and include our last component of added-value to increase marketing strategies.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - Nine extension agents were trained with certifications of 24 hours contact that will count for professional development and their agronomist license in Puerto Rico. In addition, four undergraduate students were trained in crop management under assistantships and one of them participated as a Coop intern at the UPRM farm. One undergraduate student from the department of Computer Engineering developed and gave maintenance to the website that disseminates all the research and extension information produced from the project. One graduate student started its Master research in the Food Science and Technology program.

Dissemination of results (outreach activities) - Several extension activities such as workshops and a virtual field day presented at the vegetable and basic grains annual meeting disseminated the results to growers, extension personnel and other stakeholders. The factsheets and the online courses created to train extension agents will help to disseminate even more the information per region of the Island and help growers choose the best varieties available per region. They will also help them implement sustainable practices and in the identification of ideal markets to sell their products.

In addition, we collaborated with Dr. Myrna Comas with the project Urban Agriculture granted by USDA NRCS and provided information about specialty crops that can be produced under high tunnel production. As a result, with this collaboration a handbook guide will be created and a video will be produced to help farmers choose the best specialty crops under these production systems.

Plans for next reporting period - The next reporting period we will have 3 publications (field pocket manual and research articles). Part of these publications will be presented during the ASHS annual conference meeting and at our local vegetable annual meetings. We also have preliminary research results of the post-harvest protocols and added value evaluation that will be part of a graduate student thesis.

Major changes or problems - A one-year extension will be needed to complete objective #4 (Post Harvest and Add-Value Development). This is due to COVID 19 restrictions during last year's period.

Publications: Comas M. & Hernandez E. 2021. *Estudio Exploratorio del Mercado Potencial de Hortalizas Especiales y Asiáticas en Puerto Rico*. The Journal of Agriculture of the University of Puerto Rico. [Manuscript submitted for publication]. Agroenvironmental Science Department, University of Puerto Rico.

Hernández E. Empresa de Hortalizas UPRM. (2020, 24 de marzo). *Curso Básico I Hortalizas Especiales: Variedades* [Video]. YouTube. <https://youtu.be/l8gLoLaHB-8>

Cabrera I. Empresa de Hortalizas UPRM. (2020, 25 de marzo). *Curso Básico I Hortalizas Especiales: Plagas importantes* [Video]. YouTube. https://youtu.be/vSEB_DSrLTE

Hernández E. Empresa de Hortalizas UPRM. (2020, 14 de abril). *Curso Básico II Hortalizas Especiales: Practicas para el manejo de cultivos* [Video]. YouTube. <https://youtu.be/5OP9qGVgSiw>

Giraldo M. Empresa de Hortalizas UPRM. (2020, 15 de abril). *Curso Básico II Hortalizas Especiales: Identificación de enfermedades y su manejo* [Video]. YouTube. <https://youtu.be/-tpPwEQoYIA>

Hernández E & Pérez F. Empresa de Hortalizas UPRM. (2020, 26 de mayo). *Curso Básico III Hortalizas Especiales: Manejo Cosecha y Post Cosecha* [Video]. YouTube. <https://youtu.be/4RvN5ZB1864>

Comas M. Empresa de Hortalizas UPRM. (2020, 27 de mayo). *Curso Básico III Hortalizas Especiales: Potencial mercado de hortalizas especiales* [Video]. YouTube. <https://youtu.be/wkkuDzx5k5Q>

(11 de mayo de 2021). *Prácticas Orgánicas para el Manejo de Hortalizas Especiales en la Zona Oeste* [pdf]. Vegetable and Basic Grain Annual Industry Meeting [virtual]. University of Puerto Rico. https://www.uprm.edu/hortalizasvygranosbasicos/wp-content/uploads/sites/330/2021/05/FOLLETO-REUNION-2021_2-min.pdf

Hernández, E., & Maldonado, A. (2021). *Hoja informativa: Cebollines*. Publicación HORT 02-21. Servicio de Extensión Agrícola, Universidad de Puerto Rico. <https://www.uprm.edu/sea/mdocs-posts/hoja-informativa-cebollines/>

Hernández, E., & Maldonado, A. (2021). *Hoja informativa: Bok Choy*. Publicación HORT 01-21. Servicio de Extensión Agrícola, Universidad de Puerto Rico. <https://www.uprm.edu/sea/mdocs-posts/hoja-informativa-bok-choy/>

Empresa de Hortalizas UPRM. (2021, 11 de mayo). *Día de Campo Virtual de la Empresa de Hortalizas y Granos Básicos* [Video]. YouTube. <https://www.youtube.com/watch?v=txGuEtHbtNM>

Other Products:

? **Activities include:** conducting and analyzing experiments from field and high tunnel at three different locations. Facilitating research information and mentoring 10 beginners' growers.

? **Events include:** One virtual field day and workshops presented by extension educator at the 2021 Virtual Vegetable and Basic Grain Annual Industry Meeting. Offered two online courses on the online Moodle platform of the University of Puerto Rico; HORTES 101 (12 contact hours) and HORTES 102 (12 contact hours) to seven extension educators.

? **Products include:** 6 videos products of the two courses offered are available on YouTube channel Empresa de Hortalizas UPRM <https://www.youtube.com/channel/UCBdFstWWQin4p346Ot4xbeg>.

Characterization and relationships of growth patterns, eating behavior and health in slick and wild type- haired Puerto Rican Holstein calves and heifers

Project Director

Hector Sanchez-Rodriguez

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017581

★ Characterization and relationships of growth patterns, eating behavior and health in slick and wild type- haired Puerto Rican Holstein calves and heifers

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Previous studies have associated the slick hair coat presence with better adaptation to tropical weather, higher milk yields and smaller mature body size in Holstein cows. However, no information (or highly limited information) was available on the possible effects of hair coat length over cattle's performance at younger ages. Thus, the current study aimed to compare the growth and performance of slick and wild type- haired Holstein calves/heifers.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Sampling has continued during this year, bringing a more complete dataset as some of the evaluated heifers are getting close to parturition (progress through gestation). This will allow to evaluate the complete birth to parturition period in terms of growth, performance and health of slick and wild type- haired Puerto Rican Holsteins.

Briefly describe how your target audience benefited from your project's activities.

The target audience has benefited from the resulting several publications in scientific meetings.

Briefly describe how the broader public benefited from your project's activities.

In the future a broader public (including the scientific community and the dairy farmers) will benefit from the project results as it will provide a more complete understanding on how hair coat length may affect growth, performance and health of Puerto Rican Holsteins.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - The project has continually provided for training and professional development of 2 graduate students and a considerable amount of undergraduate students (4-6 per semester) as it has allowed them to develop their research and scientific- related skills. Moreover, the project will result in the Master in Sciences thesis of one of the graduate students.

Dissemination of results (outreach activities) -The obtained results have been disseminated as presentations in scientific meetings as stated above.

Plans for next reporting period - Sampling will continue until the evaluated heifers reach their first parturition in order to provide a complete dataset that allow for the analysis of the first stages of the growing period of slick and wild type haired- Puerto Rican Holsteins.

Major changes or problems - As stated in the previous report, sampling at a private farm was not possible due to the 2020 earthquakes and the COVID-19 pandemic. Instead, research efforts have been concentrated on the Agricultural Experiment Station dairy farm, in order to reduce the associated risks for the working students.

Publications: Conference Presentations:

Colón-Rodríguez, I., Z. Contreras-Correa, N. Cruz-González, N. Pérez-Rosario, A. Ramos-Gerena, D. Vega-Martínez, J. López-Colón, K. Domenech-Pérez, and **H. Sánchez-Rodríguez**. 2021. Evaluation of hip-height as a predictor of body weight in slick and wild type-haired Puerto Rican female Holstein calves. Abstract presented at the 2021 Sigma Xi Poster Day, celebrated virtually on May 10, 2021.

Colón-Rodríguez, I., K. Domenech-Pérez, N. M. Cruz-González, N. K. Pérez-Rosario, A. D. Ramos-Gerena, D. Y. Vega-Martínez, J. D. López-Colón and **H. L. Sánchez-Rodríguez**. 2021. Growth patterns in slick and wild type-haired Puerto Rican female Holstein calves. Abstract presented at the 2021 ADSA Annual Meeting, celebrated in Louisville, Kentucky on July 11-14, 2021.

Sánchez-Rodríguez, H. L., I. Colón-Rodríguez, N. M. Cruz-González, N. K. Pérez-Rosario, A. D. Ramos-Gerena, D. Y. Vega-Martínez, J. D. López-Colón, and K. Domenech-Pérez. 2021. Evaluation of body dimensions as predictors of body weight in slick- and wild-type-haired Puerto Rican Holstein calves. Abstract presented at the 2021 ADSA Annual Meeting, celebrated in Louisville, Kentucky on July 11-14, 2021.

Closing Out (end date 09/07/2023)

[Design and evaluation of protocols for early detection and management of plant pathogens](#)

Project Director

Merari Feliciano

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1016322



Design and evaluation of protocols for early detection and management of plant pathogens

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This research focuses on developing early detection protocols to design effective and reliable control measures. This is important to improve and increase the local food production on the island to ensure food security.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

LAMP primers were designed by targeting the pathogen's partial coding sequence (CDS) of actin. LAMP specificity and sensitivity were optimized using the DNA of *P. fijiensis* extracted from pure culture and infected plant tissue. Also, LAMP primers specificity was tested against a broad range of fungi from plantain and bananas. Six primers were successfully designed and were highly specific to *P. fijiensis* with no amplification of any other fungi evaluated. Amplification of *P. fijiensis* was optimized from raw mycelial tissue at 68°C in 20 minutes using six primers. By increasing the incubation time to 1 hour, the assay efficiently detected *P. fijiensis* DNA at a low concentration of 0.01 ng /µl. The LAMP assay was designed and optimized to be used as a tool for the early detection of *P. fijiensis* in Puerto Rico, helping to prevent the spread of the disease and further losses.

Briefly describe how your target audience benefited from your project's activities.

The LAMP assay was designed and optimized to be used as a tool for the early detection of *P. fijiensis* in Puerto Rico, helping to prevent the spread of the disease and further losses to farmers or any plantain producer. Thus, it will help farmers to improve control measures and better design of fungicide application progress.

Briefly describe how the broader public benefited from your project's activities.

The designed trial provides essential information for anyone interested in designing an early detection protocol. This test can be used for plant, animal, and human pathogens, which is very useful for multiple disciplines in science.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - Both at the field and laboratory level, the project has allowed undergraduates, graduates, and technical staff of the laboratory in training and professional development on - DNA extraction techniques - characterization of organisms at the molecular level - design of primers for LAMP assays - evaluation of pesticides under controlled conditions - validation of PCR tests.

Dissemination of results (outreach activities) - Results have been disseminated on graduate and undergraduate courses, PROC 4016 and PROC 6603. Also, the graduate student, Denisse Román, presented part of the results in the annual meeting of the "Sociedad Puertorriqueña de ciencias agrícolas" on December 3, 2021.

Plans for next reporting period - (1) Evaluate plant defense response activators' effect on experimental field plots of plantain in the Agricultural Experiment Station of Isabela. (2) Publish the developed protocols to design the *P. fijiensis* primers for Loop-Mediated Isothermal Amplification.

Major changes or problems - In the past year, we faced many challenges and significant problems that will delay the proposed work and significantly impact the expenditure rate, mainly due to COVID-19. Students lost access to the lab for several weeks due to COVID 19 measures implemented on the island. This caused the loss of experiments in progress in both the lab and the field. All these experiments began to be repeated with a delay of more than six months. Also, we faced a significant problem that caused a significant deviation from research. We are facing problems working with the pathogen *Rickettsia* and being able to design the first ones for LAMP trials. The pathogen has not been fully characterized on the island, and the sequences of genes deposited in the gene bank are highly variable. The project will be completing the primers' design based on the *sdhA* region, but validation and field tests cannot be completed as established until the pathogen is appropriately characterized.

Publications: LOOP-MEDIATED ISOTHERMAL AMPLIFICATION FOR THE DETECTION OF PSEUDOCERCOSPORA FIJIENSIS.

Denisse Román Zea and Merari Feliciano Rivera. Department of Agro-Environmental Sciences. College of Agricultural Sciences, University of Puerto Rico, Mayagüez Campus. denisse.roman@upr.edu.

Abstract: Black Leaf Streak (BLS), caused by *Pseudocercospora fijiensis*, is an economically important threat to plantain and banana production in Puerto Rico. Chemical control of BLS in intensive cropping systems costs more than 30% of crop production. Early detection of the disease is essential to taking swift measures and preventing the further spread of the disease. Loop-mediated isothermal amplification (LAMP) is a molecular technique that uses a polymerase with strand

displacement activity and four to six primers for rapid and specific amplification of the target pathogen. The objective of this research was to develop a LAMP assay to detect *P. fijiensis* in plantain and bananas. LAMP primers were designed by targeting the pathogen's partial actin coding sequence (CDS). LAMP specificity and sensitivity were optimized using the DNA of *P. fijiensis* extracted from pure culture and infected plants. Also, LAMP primers' specificity was tested against a broad range of fungi from plantain and banana. Six primers (B3, F3, BIP, FIP, LF, and LR) were successfully designed, based on the actin partial CDS, and were highly specific to *P. fijiensis* with no amplification of any other fungi. Using six primers, the amplified *P. fijiensis* was optimized from raw mycelial tissue at 68° C over 20 minutes. Increasing the incubation time to one hour, the assay efficiently detected *P. fijiensis* DNA at a low concentration of 2.5×10^{-1} ng/ μ l. LAMP assay was also optimized to detect *P. fijiensis* from infected *Musa* spp. tissue without the need to perform DNA extraction. The LAMP assay was designed and optimized to be used as a tool for the early detection of *P. fijiensis* in Puerto Rico, helping to prevent the spread of the disease and further losses.

Other Products-Two students, one graduate and one undergraduate, were weekly mentored on aspects of the project, including applying research techniques in the lab and fieldwork. Also, the graduate student Denisse Roman was trained to use the light microscope to complete the morphological characterization of *Mycosphaerella fijiensis*. All DNA sequences for each pathogen were analyzed, and LAMP primers were designed.

[Evaluation and selection of grain legumes genotypes with heat and drought tolerance in Puerto Rico](#)

Project Director

Angela Linares-Ramirez

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1016323



Evaluation and selection of grain legumes genotypes with heat and drought tolerance in Puerto Rico

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

In the fiscal year for this report the problem addressed is to investigate the effect of drought and heat, using traditional cooking procedures, on some important physicochemical and nutritional properties of common beans.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Cooking and physical properties of common bean can be affected by drought; however, some genotypes studied in this research developed attributes to overcome these effects and show acceptable quality in terms of color, dimensions, and cooking times.

Briefly describe how your target audience benefited from your project's activities.

During the past year the objective was to perform and to analyze the effect of drought on physical and cooking properties of a subset of six out of thirteen common bean genotypes grown under a non-stressed (NS) and drought-stressed experimental plots (DS) in Puerto Rico. Selected seeds used in this experiment were collected and stored at freezing temperatures. For each genotype, dimensions, color, bulk density, and true density were determined. In addition, hydration capacity, swelling capacity, cooking time, and gruel solid loss procedures were carried out. Dimensions of five out of six studied genotypes were affected by drought conditions. Pinto beans had the greatest values of length (10.85-11.90 mm), thickness (6.35-7.02 mm) and width (4.64-5.22 mm) regardless of treatment. Most of the color parameters observed for each of the six common beans genotypes were not significantly different between the NS and DS treatments. Bulk and true density values were higher in black beans genotypes compared with navy and pinto beans. There was no significant effect of drought treatment on bulk and true density, comparing the same genotype in the two studied conditions. Similarly, NS and DS treatments did not exhibit differences in porosity. However, one of the navy beans showed differences between DS treatment (38.56%) and NS treatment (35.90%) in their porosity values. High values of hydration capacity, observed in genotypes under NS treatments of black and

pinto beans, ranged from 0.21 to 0.23 g/seed and from 0.28 to 0.33 g/seed, respectively. Swelling capacity was not significantly different for black and navy beans with regard to treatments. Nevertheless, pinto beans under NS treatment exhibited greater swelling capacity (0.28 – 0.32 mL/seed) than DS treated pinto beans (0.25 - 0.28 mL/seed). In terms of cooking times, black beans genotypes had the lowest times (29.61-9.50 min) whereas navy beans had the highest values (43.17 - 26.28 min) regardless of the treatment. Although NS treatments had lower cooking times (40.61e 26.00 min) than DS treatments (43.17 - 28.39 min), it is worth mentioning that the cooking times of the navy beans exhibited shorter cooking times under the DS treatment (40.33 min) than NS treatment (43.00 min). Gruel solid loss ranged between 9.99 to-5.30 %, 8.63 to5.80 %, 8.11 to 4.06 %, for black, pinto, and navy beans, respectively.

Briefly describe how the broader public benefited from your project's activities.

Several genotypes have been identified that overcome drought. Those genotypes could be used in breeding programs in the Caribbean Basin as well as in other countries with similar drought conditions to those in the area of study.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - One undergrad student was trained in order to accomplish the objectives for this period.

Dissemination of results (outreach activities) - Results have been disseminated to the food science community in the Euro-Global Conference on Food Science and Technology held in October 2021 with an oral presentation participation, and in a more formal way, with the submission of a research paper to the Journal of Food Chemistry.

Plans for next reporting period - Research project ends in this current fiscal year.

Publications:

Pérez-Donado, C. E, Rosa N. Chávez-Jáuregui, Angela Linares-Ramírez. 2022. Effect of drought on nutritional composition, physical and cooking properties of common bean genotypes grown in Puerto Rico. Nutritional composition, physical and cooking properties of eleven common bean genotypes grown under non-stressed and drought-stressed conditions in Puerto Rico. Journal of Food Chemistry. Submitted.

Pérez-Donado, C. E, Rosa N. Chávez-Jáuregui, Angela Linares-Ramírez. 2021. Impact of drought and heat on the physical and cooking properties of six grain legume genotypes in Puerto Rico. 3rd Edition of Euro-Global Conference on Food Science and Technology Proceedings p.31.

Closing Out (end date 09/07/2023)

[Implementation of novel reproductive biotechnologies and genomics for the multiplication and commercialization of genetically superior Slick cattle](#)

Project Director

Melvin Pagan-Morales

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017600



Implementation of novel reproductive biotechnologies and genomics for the multiplication and commercialization of genetically superior Slick cattle

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

As an adaptation to climate change, special attention has been given in recent years to a few breeds of cattle segregating the slick coat mutation. In Puerto Rico, superior milk production and lower calving intervals were documented in purebred slick Holstein cattle. Therefore, this project focuses in the genomic evaluation of such unique and extremely valuable population, with the inclusion of Senepol and Senepol x Holstein presenting such phenotype, with the ultimate purpose of producing semen and embryos.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Slick cattle (Holstein, Senepol and Senepol x Holstein) were characterized using commercially available tools (genomic tests and molecular marker panels) with concurrent evaluation of production records. That provided the basis for the establishment of a state of the art animal reproduction laboratory using funds provided by the Department of Agriculture of the commonwealth of Puerto Rico. Such facilities will be used to produce semen and embryos to fulfill the ultimate project objective.

Briefly describe how your target audience benefited from your project's activities.

The project current results suggest that slick Holsteins (males and females) are genomically similar to wild type for the most important economic traits when descending from a slick dam. However, differences in type and health traits may occur if the females are compared alone.

Briefly describe how the broader public benefited from your project's activities.

Slick genotype information from our Holstein population was shared with scientist from The University of Florida resulting in a publication of a peer-reviewed article in 2021. Semen availability of genetically characterized slick animals from Puerto Rico are expected in the current year.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - Currently, there are two graduate students and one undergraduate from the Department of Animal Science of The University of Puerto Rico at Mayagüez (UPRM) working in different aspects of the project. Both graduate students are expected to complete their master degree in may 2022 and the undergraduate will continue graduate studies under our supervision and focusing in the current project objectives and ramifications of it starting in august of this year. A second undergraduate from the Department of Biology at UPRM worked in the project during the first semester 2021-22 to complete a research requirement for his application to medical school.

Dissemination of results (outreach activities) - A paper was published in Animal Genetics, a scientific journal managed by the Wiley-Blackwell on behalf of the International Society for Animal Genetics. The impact factor of Animal Genetics is 2.605.

Plans for next reporting period - During the next reporting period semen straws will be prepared from bulls selected as genetically superior within the project bovine population as determined by genomics and OPU training will be coordinated. Also, we expect to provide genotyping data of candidate genes chosen from a previous RNA sequencing experiment in which differentially expressed genes in hair follicle from slick and wild type Holsteins were identified. In that sense, reproductive tissues and uterine swabs were collected in this reporting period to evaluate gene expression by real time-RT PCR of such RNA seq. chosen candidates for further expands the biological characterization of the germplasms under study.

Major changes or problems - Due to the Covid-19 pandemics, aspects of project related to OPU training, oocytes collection and IVF for embryo production are behind schedule.

Publications: Sosa F, Carmickle AT, Jiménez-Cabán E, Ortega MS, Dikmen S, Negrón-Pérez V, Jannaman EA, Baktula A, Rincon G, Larson CC, Pagán-Morales M, Denicol AC, Sonstegard TS, Hansen PJ. Inheritance of the SLICK1 allele of PRLR in cattle. Anim Genet. 2021 Dec;52(6):887-890. doi: 10.1111/age.13145. Epub 2021 Oct 12. PMID: 34642995.

Other Products- Two master students have been enrolled in the course CIAN 6999: Thesis. Two undergraduate students were enrolled in the course CIAN 4027: Special Problem. Research objectives, reagents, materials and graduate assistantships were provided by this project. Project results are routinely presented to the students enrolled in CIAN 4019: Animal Breeding and Genetics

Networks and/or collaborations fostered by the project or activity- In this reporting period collaborating efforts and networking was experienced with scientist from The Department of Animal Science of The University of Florida at Gainesville, The University of California at Davis, The University of Missouri at Columbia, Bursa Uluda? University (Turkey), Acceligen and Zoetis.

Performance, health, carcass, meat quality, sensory attributes, & consumer preference of lambs under thermal stress in grazing and feedlot conditions & slaughtered at 2 body wghts

Project Director

Abner Rodriguez-Carias

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017675

★ Performance, health, carcass and meat quality, sensory attributes, and consumer preference of lambs reared under thermal stress in grazing and feedlot conditions and slaughter

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Feed represents the major variable cost associated with raising animals for meat production. In addition, a decrease in animal performance is associated with thermal stress. Presently, sheep production is a growing industry in different Latin American countries. However, there is an urgent need for producers to know the effect of the feeding systems on performance, health, carcass and meat quality, sensory attributes, and consumer preference of lambs reared under thermal stress and slaughtered at two body weights. Lamb meat is also catalogued as a gourmet product therefore the effect of the feeding system on meat quality of lambs slaughtered at two different body weights needs also to be determined.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Project results show that the sensory attributes, meat quality, fatty acid profile and consumer preference for lambs reared under thermal stress in grazing and feedlot conditions and slaughtered at different body weights were determined.

A webinar entitle “Lamb Meat” was conducted on May 19, 2021, with the participation of speakers from the University of Puerto Rico, and the University of Arizona. Webinar conferences are also available online in the UPRM Official Agricultural Extension Service Facebook website.

Briefly describe how your target audience benefited from your project's activities.

Results have shown an effect of the feeding system (grazing versus high grain diets) on meat quality, fatty acid profile, and sensory attributes. The body weight at slaughter within feeding system also influence meat quality, especially fatty acid profile. Puerto Rico lamb producers have adopted recommendations based on project results to enhance their operations, including animal management, carcass handling, and meat retail cuts production and marketing.

Briefly describe how the broader public benefited from your project's activities.

As a result of the webinar conferences, and the increase in local lamb meat production, an interest in the consumption of local meat-lamb, including value-added products have been noticed in Puerto Rico. Our expectation is to increase local lamb production to decrease the importation of lamb meat.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training and professional development opportunities - Two graduate students and 4 students were training during this period. One lamb producer supported our activities on a research trial.

Dissemination of results (outreach activities) - Project results and information have been disseminated using social media to reach members of the Puerto Rico Small Ruminant Production Fund, Agronomists, UPRM extension agents, students, and public.

Three research abstracts were presented in the virtual annual meeting of the American Society of Animal Science (2), and the Mexican Association of Ovine Specialists (1).

Three research abstracts were submitted for presentation at the annual meeting of the Latin American Association of Specialists in Small Ruminant and South American camelids to be held in Colombia, 2022.

Plans for next reporting period - Plans for the next period include the preparation and publication of two journal articles with the research results, and the presentation of research abstracts in national and international meetings.

Major changes or problems - Because of the current pandemic situation, we were unable to conduct presentational outreach activities during the 2020-2021 project period.

Publications:

Rodriguez, A.A., A.Rivera Serrano, S. Duckett and A. Bayne. 2021 Performance, carcass, wholesale, and retail cuts yield of lambs reared under thermal stress in grazing conditions and slaughtered at two body weights. Annual meeting American Society of Animal Science (virtual)

Rodriguez, A.A., A. Rivera Serrano, S. Duckett and A. Bayne. 2021. Meat quality and fatty acid composition of lambs reared under thermal stress in grazing conditions and slaughtered at two body weights. Annual meeting American Society of Animal Science (virtual)

Bayne Hernández, A., A Rivera Serrano, S. Duckett y A.A. Rodríguez Carías. 2021. Calidad de la carne y composición de ácidos grasos de corderos criollos alimentados en pastoreo o en confinamiento con raciones totales. Memorias. XXI Congreso Internacional de Ovinocultura (Virtual). Asociación Mexicana de Técnicos Especialistas en Ovinocultura. 140 p.

Other Products: A database of carcass characteristics, meat quality and fatty acids composition of lambs raised under tropical environments have been developed.

Results have been presented to members of the Department of Agriculture Small Ruminant Producer Fund.

Counseling and tutoring to lamb producers on feeding systems have been conducted in a regular basis.

A survey type questionnaire on lamb meat and value-added product consumption in Puerto Rico was developed.

Closing Out (end date 09/07/2023)

Plant Genetic Resources Conservation and Utilization

Project Director

Carlos Flores

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1017544



Plant Genetic Resources Conservation and Utilization

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

During the last decade, Puerto Rico met only 15% of the total food demand with local production, while 85% was imported. Great efforts have been made to increase local production, but the high cost of production related to yield, quality, resistance to pests and diseases remains and must be addressed. We are evaluating local and introduced germplasm to identify desirable traits and genotypes with high agronomic performance. We expect to identify crop genotypes with high yield, quality, as well as resistance to pests and diseases to expand production and to use nontraditional growing conditions with different varieties and species.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objective 1. Acquire and conserve genetic resources of crops and related wild species of importance to the Southern Region such as sorghum, peanut, watermelon, chili peppers, warm-season grasses, cowpea, clover, tropical/subtropical legumes, and others.

Local plant genotypes from diverse origins are being evaluated in the field and greenhouses of the Agricultural Experiment Substations of the University of Puerto Rico. Agronomic and morphological traits and fruit quality will be evaluated in different environments. All plant genotypes will be **conserved** and multiplied at the University of Puerto Rico and will be available for distribution to growers and the scientific community. We will make information on genotypes available to researchers, educators, and plant breeders in the Southern Region and worldwide in traditional and electronic formats.

During this year, an experiment comparing three yellow passionfruit accessions (*Passiflora edulis*) in Adjuntas (subtropical highland, approximately 1300 feet above sea level) was completed. There were differences in plant vigor and fruit yield among the accessions. The experiment of yellow passionfruit accessions and giant granadilla accession (*Passiflora quadrangularis*) in Lajas (semi-arid region in a valley near the southwestern coast of the island) continues. The data collected so far shows differences between the accessions of both *Passiflora* species in size of plants, vigor, and fruit production.

Forty-three *Musa* spp. genotypes were conserved and maintained at the Corozal Agricultural Experiment substation. The results of the evaluation of agronomic traits and desirable characteristics present in the banana variety Monalisa (FHIA02), not found in Cavendish cultivars, provide an alternative for banana production should *Fusarium* TR4 enter the Caribbean region. We offered farmers an alternative to produce banana with lower costs and without chemicals to control major pathogens (Phytoparasitic nematodes, Sigatoka, and *Fusarium*). In addition, our results provided an alternate market for the population with diabetes, since this variety showed a lower glycemic index than the popular banana Cavendish Grande Naine.

Evaluations of potential varieties of sweet potato (*Ipomoea batatas* L.), tanier (*Xanthosoma sagittifolium*) and white carrot (*Arracacia xanthorrhiza*) could bring alternatives to the different production regions of the Island and increase local production. Two sweet potato varieties, 04-180 and 04-006, are being evaluated under Integrated Control Management practices, in five different locations in two planting seasons with the goal of releasing new varieties. Two tanier varieties, Nazareno and segregation from Vinola, at the Isabela substation are under field evaluation with the goal of publishing the release of a new cultivar. Six white carrot varieties were collected from different regions of the Island and are under morphological, agronomic and irrigation evaluation.

A study was performed to assess the effects of: (1) Generate® (a microbial catalyst), (2) LiquiFert® (22-0-0) liquid urea (LU) at a rate of 168 kg/ha (in split applications), (3) a mixture of LU + Generate, and (4) a control, on aboveground biomass, root biomass, nutritional value, and soil parameters of cv. Mombasa forage (*Megathyrsus maximum*) in 35-d harvests during six harvests. The results showed that aboveground biomass doubled using LU (2,369 kg DM/ha) compared with the control and Generate (1100 kg DM/ha). Crude protein (CP) was 10.1% and CP index was 5.30 kg CP kg/N using LU. Neutral Detergent Fiber was 70 % for the control and around 40 % for acid detergent fiber (ADF) for any treatment. These values are extremely high when harvested at 35-d regrowth. In conclusion, LU is an excellent source of N for Mombasa, but shorter harvests may be required to improve the fiber quality of Mombasa.

A study of three citrus cultivars (Mexican lime, Fina clementine mandarin and Campbell Valencia orange) in three rootstocks (HRS 897, HRS 812 and Swingle) continues at the substation in Isabela. A study of Pera sweet orange grafted onto HRS 812 with three planting distances (18 by 8 ft, 18 by 10 ft, 18 by 12 ft) continues at the Corozal substation.

A study of F2 and F3 pigeon pea plants with indeterminate growth habit, early maturity, and insensitivity to the photoperiod was performed for selection. Also, 33 (*Phaseolus* spp.) genotypes were evaluated to identify those with higher yield and lower ashy stem blight (ASB) scores in the field. Tepary bean PI 313488 and common beans 92BG-7, SB-DT1, SEN 21, SER 16, SER 22, TARS-MST1, and XAN 176 had the higher mean seed yield values (1,077-1,300 kg ha⁻¹). Regarding ASB resistance, tepary bean PI 313488 had lower severity (mean scores ≤ 4) to *Macrophomina phaseolina* (the causal agent of ASB disease) in field

evaluations conducted at Isabela and Lajas substations, while common bean cultivars 'Bill-Z' and 'Matterhorn' at Lajas were susceptible (> 7). Likewise, newly developed black, cream, cranberry, and white common bean genotypes had partial ASB resistance (scores of 4-6) in greenhouse and field evaluations.

2. Conduct genetic characterizations and phenotypic evaluations of the conserved crops and related wild species for commercially important genetic and agronomic traits.

The molecular characterization of 29 cassava (*Manihot esculenta* Crantz) accessions conserved at Corozal substation and comparison with the global cassava gene bank at CIAT will provide us with better passport identification and more accurate tools to determine which varieties are important for further conservation and evaluation.

In the common bean, F6:7 recombinant inbred lines (RIL) were screened in two isolates of *M. phaseolina*, and single nucleotide polymorphism markers were running in these populations to identify genes/QTL which are resistant to ASB disease. This new germplasm could have desirable traits (e.g., insensitivity to photoperiod and higher ASB resistance, which will give the legume breeding programs new sources of QTL to introgress into their common bean and pigeon pea cultivars and to conduct research in genetics and molecular breeding.

3. Distribute genetic resources and associated information to researchers, educators, and plant breeders in the Southern Region and worldwide.

Two macro-tunnels were established at the Rio Piedras AES and Corozal substation using selected mother plants of banana (*Musa* spp.) to produce their own propagation material with the best production characteristics as a strategy for farmers to protect their farms from the entry of devastating diseases or pests. We needed to evaluate the sucker production during six months to be able to determine its applicability for the farmers. Also, we established a safe and accurate methodology for decontamination, pre-germination, and multiplication of propagation material of sweet potato and cassava in the greenhouse and in the field to ensure the quality of the material used each planting season and for seed distribution. Citrus accessions are protected in screened greenhouse at Adjuntas, Corozal and Isabela substations. In addition, we have rootstock collections in the field from which we collect the rootstock seeds (Isabela and Corozal).

Briefly describe how your target audience benefited from your project's activities.

A better understanding of the adaptability and performance of local accessions of vine crops in highland and lowland conditions helps growers decide which accession may be better suited for their purposes. Farmers now have an alternative with a potential new market as results presented Monalisa as a banana variety tolerant to the major pathogens, eliminating the use of chemicals for their control, and as an alternative variety for organic production. Also, farmers will have an alternative to produce propagation material on their own farms with their best material, preventing the exchange of material and the entry of devastating diseases on plantains and bananas. Root crop farmers will be able to apply simple practices for the decontamination and multiplication of their vegetative seed, ensuring a better crop that allows them to increase production and occupy a fair space in the local market. Forage results will support researchers and agricultural extension personnel of the University of Puerto Rico, Mayaguez, and the local Department of Agriculture in promoting the use of forage germplasm and maximizing yield. Common bean and pigeon pea growers in Puerto Rico who need cultivars with higher levels of resistance to diseases and optimum agronomic performance will benefit from these studies and new germplasm releases. Extension Service personnel who provide technical assistance to legume growers as well as plant breeders who need new common bean and pigeon pea germplasm with resistance to diseases and insensitivity to the photoperiod, will benefit from these studies.

Briefly describe how the broader public benefited from your project's activities.

The development of new varieties of fruit and vine crops and a description of their attributes and yield may help growers decide which varieties could be used to expand current planted areas and increase domestic production. Consumers and farmers will have access to of plantain and banana varieties produced with fewer applications of pesticides or synthetic chemicals, and having higher nutritional properties. The broader public continues buying pest-free certified citrus trees at Isabela and Adjuntas experiment substations and/or buying seeds of recommended rootstocks such as HRS-812, Swingle and Carrizo. Common bean and pigeon pea growers in Puerto Rico will benefit from new releases of cultivars with higher levels of resistance to diseases and optimum agronomic performance.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to

communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training/professional development opportunities A total of seven undergraduate and graduate students in the Agroenvironmental Science Department at UPR-Mayaguez have received funding and mentoring. Graduate student Fernando Prieto is comparing 3 accessions of yellow passionfruit in experiments towards a master's in science (MS) degree. This semester, MS student Elvin Lassalle will defend and publish his thesis: "Evaluation of the banana hybrid Mona Lisa, FHIA – 2, and its response to phytoparasitic nematodes in Puerto Rico". Undergraduate student Ashley Avilés-Noriega was able to propagate her plantain material at our greenhouse and accomplished part of her practical research at our laboratory of Phytopathology and Tissue Culture. Undergraduate Marangelie Figueroa Estronza initiated her research project with sweet potato and did part of her practical research in the field and at our laboratory of Phytopathology and Tissue Culture. MS students Shirley Alquichire and Carolyn Castillo Feliciano were partially funded with assistantships to conduct their thesis research, and they successfully completed Master of Science degrees in soils/agronomy in May and December 2021. Graduate student Roberto Vázquez Rivera presented "Breeding to improve agronomic performance in pigeon pea and resistance to ashy stem blight in common bean" for his master's thesis.

Dissemination of results -Although COVID19 pandemic restrictions did not permit conducting field days or visits of many stakeholders in the orchards, information was disseminated mainly online through formal lectures in courses at UPR-Mayaguez. The oral presentation "Evaluation of the banana hybrid Mona Lisa, FHIA – 2, and its response to phytoparasitic nematodes in Puerto Rico" was presented at the 44th annual meeting of the Puerto Rican Society of Agricultural Sciences (SOPCA by its Spanish acronym) on December 3, 2021. Workshops and demonstration-field days to extension agents and farmers will be offered during 2022. An oral presentation entitled "Integrated management practices for control of white carrot rot" was made to white carrot (*Arracacia xanthorrhiza*) farmers in Barranquitas on November 17, 2021. A manual and video of the macro-tunnels to produce propagation material of plantain and banana will be published during this period at the laboratory website, <https://www.uprm.edu/lfct>. Workshops and demonstration-field days will be offered to extension agents and farmers during 2022. Evaluation of two potential sweet potato varieties is ongoing in five localities, and two planting seasons. Publications will follow. A catalog for morphological identification of the most common sweet potato varieties grown in Puerto Rico will be published during this period at the laboratory website <https://www.uprm.edu/lfct>.

Plans for next reporting period - In 2021-2022 we will continue the experiments at Lajas experiment substation (accessions of yellow passionfruit and giant granadilla), and we will establish the experiment with Angolan melon (*Sicana odififera*). In Isabela, we will establish an experiment on giant granadilla accessions. We will initiate the multiplication of propagation material of Curare and FHIA20 varieties for establishing field evaluation experiments. The evaluation of the macro-tunnels for the production of clean and abundant propagation material for farmers' production plots. Morphological and molecular characterization of a collection of six varieties of white carrot (*Arracacia xanthorrhiza*), or apio as it is called in Puerto Rico, has been initiated. These varieties were established in December 2021 and are being assessed at a farm in Barranquitas and maintained in tissue cultures at the Phytopathology and Tissue Culture Laboratory in Rio Piedras. Experiments are ongoing to assess effects of cutting frequency and intensity on yield and quality of three Urochloa cultivars. HRS-897 and HRS 802 citrus rootstocks will be released to local farmers and the public. Evaluate one RIL population to ASB in the greenhouse, and extract DNA from plants for QTL analysis. Conduct GWA analysis in two RIL to identify resistant QTL to ASB. Release new common bean germplasm with partial resistance to *Macrophomina phaseolina*. Select F4 and F5 pigeon pea genotypes insensitive to the photoperiod and with indeterminate growth habit. Increase seeds of developed pigeon pea and common bean genotypes.

Major changes or problems - Transportation and supply problems related to the COVID19 pandemic caused long delays in receiving imported structural materials for the establishment of the experiment in Isabela (steel pipes, metal wire, wood beams). The major challenges are the scarcity of propagation material of the plantain varieties, Curare and FHIA-20, needed for agronomic evaluation. During the second semester of 2019-2020, graduate student Marangelie Figueroa Estronza initiated her research project with sweet potato but later decided not to continue with her master's studies. We had to continue the project without a graduate student. Covid 19 has made it difficult to find a student to fill in.

Publications:

1. Avilés-Noriega, Ashley. (2021). Sigatoka disease complex of *Musa* spp. in Puerto Rico and the development of a transformation vector for *Pseudocercospora fijiensis* to examine the avirulence 4 (pfavr4) effector during infection of *Musa* spp. (Master dissertation).
2. Lassalle Loperena, Elvin. (2021). "Evaluation of the banana hybrid Mona Lisa, FHIA – 2, and its response to phytoparasitic nematodes in Puerto Rico". Oral presentation at the 44th annual meeting of SOPCA, December 3, 2021.

3. Books or other non-periodical, one-time publications: Giraldo et al., "A guide for the cultivation of *Arracacia xanthorrhiza* in Puerto Rico", submitted 2021.
4. Alquchire, S. and E. Valencia. 2021. Liquid urea and microbial catalyst effects on biomass and nutritional value of cv. Mombasa. In Abst. Southern Pasture Meeting. Auburn, May 2021.
5. Viteri, D. M., & Linares, A. M. 2021. Agronomic performance of common and tepary bean genotypes and their response to ashy stem blight in Isabela and Lajas, Puerto Rico. Legume Science, e118. <https://doi.org/10.1002/leg3.118>
6. Sarmiento, L., Viteri, D. M., Linares, A. M., & Gonzalez, K. 2022. Evaluación agronómica de 15 genotipos de gandul [*Cajanus cajan* (L.) Millsp.], en Isabela y Lajas, Puerto Rico. J. Agric. Univ. P.R.: In Press.
7. Sarmiento, L. 2021. Caracterización agronómica/morfológica de genotipos de gandul [*Cajanus cajan* (L.) Millsp.] y sus niveles de tolerancia a infestaciones naturales de Heliothines (Lepidoptera: Noctuidae), y pruebas de eficacia para evaluar insecticidas en el control de larvas. Master of Science Thesis. University of Puerto Rico. May 2021.

Other Products-

(H-94 C) Graduate and undergraduate students received training in the production of clean and certified vegetative seed under laboratory and greenhouse conditions, supervised by Dr. Martha Giraldo at the Phytopathology and Tissue Culture Laboratory.

The macro-tunnel at Rio Piedras AES is being used as a demonstration and educational tool for farmers, extension agents and students.

Consulting services have been provided to farmers in the south interested in producing propagation material on their farms.

The compilation of a manual and a video on establishing a macro-tunnel for the production of propagation material of plantain and banana is in progress. It will be published during this period at the laboratory website, <https://www.uprm.edu/lfct>

(H-94 D) Advice has been provided to sweet potato, tanager and taro farmers interested in producing their own propagation material on their farms. In process is the publication of a catalog for the sweet potato most common varieties in Puerto Rico. It will be published during this period at the laboratory website, <https://www.uprm.edu/lfct>

(H-94 Q)

I. Data and research collection

-Field trials- A) In Isabela, we are evaluating three cultivars (Mexican lime, Fina clementine mandarin and Campbell Valencia oranges) in three rootstocks (HRS 897, HRS 812 and Swingle). B) In Corozal, we are evaluating Pera sweet orange grafted on HRS 812 under three planting distances (18 by 8 feet, 18 by 10 feet, 18 by 12 feet).

II. In addition, we maintained three insect protected collections at Isabela, Adjuntas and Corozal in greenhouses, each with 20 citrus varieties including lime, lemons, oranges, tangelos, grapefruits, and others. We are actively collecting data on the trees inside the Isabela location.

III. Mentoring graduate students as Co-PIs of kumquat variety and giant key lime studies. Both orchards are grafted in HRS 812 rootstock. Project H-94Q provided pest-free kumquat and giant key lime material to graduate students. Also, I served as student advisor on horticultural, irrigation and pest management practices.

Developing educational strategies to improve local food security

Project Director

Jaime Curbelo

Organization



High tunnel as an innovative technology to increase local food production

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Puerto Rico is a densely populated island that depends on net food imports (over 85%). Land dedicated to agricultural production decreased by 17% from 2012 to 2018. Recognizing the contribution of small farmers and urban agriculture to food security, a collaboration agreement was signed with the Natural Resource Conservation Service. With this project we will promote the organization of communities and farmers to adopt high tunnel as an innovation technology to promote urban agriculture and increase local food production.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

PRAES county agents, family educators and specialists provided training to small farmers about urban agriculture and high tunnels. Some of the more important educational activities carried out, including the clientele that benefited from these, were:

- 53 PRAES county agents and 4 NRCS personnel were trained in Agricultural Enterprise Planning (Planning my farm and Guide for the Agro-entrepreneur: Plan for the establishment and development of the agricultural enterprise)
- 41 PRAES county agents and 2 NRCS personnel were trained in the Puerto Rico Urban Agriculture Toolkit.
- 75 volunteers and PRAES personnel were trained in the Organization of Agricultural Communities.
- 63 volunteers and PRAES personnel were trained in the curricular guide for community gardens.
- 43 PRAES county agents were trained in Tunnel Systems: a guide for sustainable crop construction, management, and production.

Briefly describe how your target audience benefited from your project's activities.

The educational material developed in the project has been used by 28 agricultural agents to guide 282 farmers and 110 community leaders on the following issues:

- 11 high tunnels new projects were established and incentivized by NRCS
- Using the planning of my farm and guide for the agro-entrepreneur, 113 farmers were able to prepare their business plans and fulfill the requirements of the Puerto Rico Housing Department and the CDBG-DR emergency program.
- A total of 33 farmers applied to NRCS programs applied (10 farmers applied for high tunnel conservation practice and a community organization presented a proposal to Washington urban agriculture and innovative technology office)
- 8 farmers applied for loans for active acquisition or operational cost using Urban Agriculture planning materials

- 14 community leaders were trained in establishment and/or monitoring of community garden
- 1 community established high tunnels and 4 communities applied for at least one NRCS program to implement conservation practice like High tunnel and irrigation system.
- 4 educational institutions (University of Puerto Rico – Mayagüez Campus, Barranquitas Interamerican University, NUC University y E & F Development, Inc.) adopted educational material to be incorporated in their academic programs

Briefly describe how the broader public benefited from your project's activities.

The Puerto Rico NRCS developed the urban agriculture initiative in Puerto Rico and continue working with PRAES to follow the project's progress, mainly in metropolitan area where 3 PRAES county agents are actively working with these initiatives, therefore further benefiting non-targeted audiences.



Increasing food production practices in farms, homes, schools and communities

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Year by year, Puerto Rico loses its more productive farming lands and the provisions of local products for the food consumption in the Island decreases, and it inserted in a global food market. This insertion triggered the importation of approximately ninety percent (90%) of the food that Puerto Ricans consume, placing Puerto Rico in a high vulnerability food supply chain. Our main supplier is the USA, and from there to our consumers, the food travels more than 2,800 miles crossing the Caribbean Hurricane Zone. We need to increase local food production to improve our food security

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

PRAES county agents and specialists provided individual assistance and training to growers and farmers about organics practices, farm management, feasibility analysis and marketing networks. In addition, PRAES Family Educators delivered individual assistance and training to housewives, young people, and public on increase food security practices in homes, schools and communities. Some of the more relevant educational activities carried out, including the clientele that benefited from these, were:

- 26 farmers trained about agricultural enterprise feasibility analysis
- 70 farmers trained on marketing strategies
- 92 people trained in agricultural economics and agricultural enterprises while 270 received technical assistance regarding this issue.
- 764 adults participated in food security activities
- 1,333 young people participated in food security activities
- 1,382 adults participated in home and community gardens activities
- 247 young people participated in home and school gardens activities

Briefly describe how your target audience benefited from your project's activities.

From the educational activities delivered by the PRASE personnel working with the Food Security Initiative, the following achievements were accomplished:

- 20 new agricultural enterprises were established, and 13 enterprises increased their production
- 66 farmers adopted post-harvest management practices, 6 developed new products, 2 established new market channels, and 41 adopted different marketing strategies.
- 50 farmers completed an Agricultural Business Plan
- 161 farmers applied for loans and subsidies
- 54 home gardens, 2 school gardens and 3 community gardens were established
- 106 housewives adopted food baskets as part of their nutritional plan
- 102 volunteers worked on food security initiatives providing 667 of voluntary hours

Briefly describe how the broader public benefited from your project's activities.

The farmers will benefit or may benefit in the future with the creation of new enterprise, increasing local food availability. Housewives, young people and general public can increase their food security.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The COVID-19 limited the outreach activities. Limited number of local farmers have access to technology, so PRAES personnel experienced challenges to accomplish our objectives. Providing training to farmers about the use of technology for farm administration is an opportunity for improvement.

Enhancing Crop Health to Maximize Plant Production

Project Director

Jaime Curbelo

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

7002495



Providing diagnostic tools for plant diseases through PRAES and PRAEX plant diagnostic clinics

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Plant disease outbreaks in Puerto Rico cause significant losses in cash crops, fruit, and ornamentals, representing up to 50% decline in crop production. Major crops such as coffee and vegetable production, specifically in the southern area, are currently experiencing outbreaks of fungal, bacterial, and viral origin. Rapid diagnosis has prevented the geographic

expansion of several diseases in the Island. Therefore, approaches to continue providing diagnostic tools for plant disease are of vital importance to implement an effective management strategy.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Plant Diagnostic Clinic (PRPDC) in Juana Diaz, part of the Southern Plant Diagnostic Network (SPDN), and the PRAES Diagnostic Clinic (PRAESDC) have processed more than 1,370 vegetative samples from more than 30 different crops and ornamentals. For each sample or query, a report was prepared with management recommendations, emphasizing IPM practices. The economic impact of rapid and accurate reports, accompanied by the recommendations provided by PRAES and the Diagnostic Clinic personnel, has saved resources and time by reducing unnecessary use of pesticides in crop production. This was possible because of the use of standard, serological and molecular assays to identify the pathogens that cause diseases and pest identification in the plant pathology and entomology laboratories of the disease clinics.

In addition to provide plant pests diagnostics and recommendations to control these, the laboratories also provide training to farmers. Nine virtual training sessions were offered on topics related to: How to identify the most common diseases and sample handling, Phytosanitary practices in tree production nurseries, Diseases in cucurbits, IPM for black sigatoka and nematodes in bananas, IPM in citrus, IPM for flies in dairy herds, BBP and IPM for Easter, Protection of pollinators and how to attract them, and IPM in beehives. A total of 162 PRAES educational interventions about recommended practices to produce coffee, farinaceous, citrus and non-citrus fruits and vegetables, benefiting 641 individuals.

Briefly describe how your target audience benefited from your project's activities.

At the PRPDC in Juana Diaz a total of 394 serological tests were conducted for 15 different bacterial and viral pathogens. In addition, a total of 345 diagnostic reports and 16 first disease reports were entered in the National Plant Diagnostic Network (NPDN) database. Molecular methods are part of the routine analysis at the PRPDC in Juana Diaz. Candidatus Liberibacter asiaticus, Begomoviruses in soybeans and cotton were screened using the Polymerase chain reaction for a total of 134 assays. Results from the clinics were also disseminated in local and National Conferences. Clinic staff attended annual workshops hosted by the NPDN. Participation on national committees and several webinars organized by NPDN in emergent diseases increased the diagnostic capabilities of the Juana Diaz clinic in *Ralstonia solanacearum*, tomato brown rugose virus, citrus canker and seed transmitted diseases.

The diagnostic clinic of AESC participated in agricultural festivals in various municipalities around the Island. Posters and educational information were delivered to the community about the different diseases and pests, emphasizing the importance of early diagnosis of diseases and pests and the use of IPM practices to reduce the use of pesticides and associated risks to humans and the environment. Some achievements are posted at (<https://www.uprm.edu/sea/sea-del-oeste/>) and the poinsettia google site, <https://sites.google.com/upr.edu/pascuaspr/sobre-proyecto-ipm>

From the PRAES educational interventions about recommended practices in coffee, farinaceous, citrus and non-citrus fruits and vegetables:

- 42 producers reported to adopt at least a recommended practice about the cultural control of plagues in their crops
- 9 producers reported to adopt at least a recommended practice about the biological control of pest in their crops
- 104 producers reported to adopt at least a recommended practice about chemical control of pest in their crops
- 130 producers reported to adopt on or more recommended practices about integrated pest management practices for the control of pest in their crops
- A total of 8 volunteers reported to provide 16 hours of voluntary work related to pest management control.

Briefly describe how the broader public benefited from your project's activities.

Education to stakeholders of the PRPDC has been successful through constant communication using social media, site visits, and during annual meetings with the different commodity groups. We acknowledge that experienced growers and field personnel who have interacted with the Plant Diagnostic Clinics, have developed a diagnostic sense for most common diseases in the different crops.



Research and Extension strategies to enhance local citrus production

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Citrus production in Puerto Rico is of paramount importance, not only for farmers but for the local markets and households. The citrus industry has been severely impacted by two important diseases affecting citrus plants, Huanglongbing (HLB) and Citrus Tristeza Virus (CTV), reducing 50% of citrus production and acreage planted. There is a priority to produce healthy citrus plants in Puerto Rico and internationally. In Puerto Rico, citrus production in 2018 comprised 1,282 farms in an area of 4,000 acres. The demand for citrus plants in Puerto Rico has increased in the last few years due to the high prices of imported citrus oranges, lemons, and limes. Considering the impact of HLB and CTV in the citrus industry, a priority for Puerto Rico is the production of tested citrus plants free of these diseases. The PRAEX holds a citrus germplasm collection with 38 varieties and other important genetic resources for citrus production in Puerto Rico. The PRAEX at Isabela and Adjuntas propagate rootstocks of 15 commercial varieties. Also, secure certified citrus mother plants and variety propagation blocks for citrus growers and the Puerto Rico Department of Agriculture. The Citrus Foundation Blocks (CFB) of commercial citrus cultivars and the citrus germplasm collection are regularly screening vegetative samples for systemic pathogens ensuring that growers are supplied with nursery trees of the highest quality). The project also supports the testing of HLB and CTV of citrus plants from private nurseries in collaboration with the Department of Agriculture of Puerto Rico (DAPR).

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The purpose of this collaborative project is to secure the availability of tested Citrus species at the Experiment Stations for distribution to growers and the public. The Isabela Experiment Station conducted evaluation of new rootstocks with tolerance to HLB (HRS 897 and HRS 812). This is important for the citrus industry, especially for those citrus growers that need to replace old susceptible varieties with new genotypes. At the PRAEX at Corozal, a replica of the citrus collection is maintained. At Isabela (105) and Adjuntas (532) budwood of oranges, limes, mandarins, tangelo, and pomelo field collections were tested free of HLB and CTV. To increase the capacity to produce citrus plants, the Adjuntas Experimental Station has improved the citrus nursery facilities. Train the training PRAES efforts including training of 85 county agents and 24 agronomists from the Department of Agricultura were performed. This in turn has provided training to growers and interested individuals to help disseminate good agricultural practices to enhance citrus production, training a total of 596 individuals.

Briefly describe how your target audience benefited from your project's activities.

During fiscal year 2021, 45 hours of direct contact with 200 agronomists and citrus growers were generated to promote the use of healthy citrus plants. Seventy agronomists, including county agents, have also been trained in citrus production best practices. This alone will help the dissemination of the information to over 130 growers in Puerto Rico. In March 2021, extension educators participated in the annual Citrus festival in the municipality of "Las Marías" where artisans and exhibitors of products made of citrus were part of the festival with over 20,000 attendants. This event promoted citrus production, agricultural tourism, and the local economy. Extension Educators are promoting IPM practices by conducting field days to exhibit citrus orchards with the participation of more than 200 growers and extension agents. As a result of PRAES educational intervention with citrus growers:

- 16 citrus producers reported adopting at least one or more recommended practices that promote production efficiency

- 1 citrus producer reported improving the quality of their products by adopting practices related to sustainability.

- 10 citrus producers reported to increase production and 2 increased their business size.

- o A total of 10 voluntary hours were reported

Results have been disseminated to growers and stakeholders of the local industry. Most of the extension work has been reported in the extension newsletter SEA del Oeste. <https://www.uprm.edu/sea/mdocs-posts/revista-del-sea-vol-3-2020-2/>

Turism Company promoting visit to Oranges Festive <https://www.discoverpuertorico.com/regions/west/las-marias#!grid~~~random~1>

Briefly describe how the broader public benefited from your project's activities.

Field days organized by the Extension team provide management options to improve production in citrus orchards. The broader public benefited from healthy citrus plants and increased production of citrus varieties. In the future, the major benefit is to reduce the dependency of imported citrus plant materials and continue with good agricultural practices in the orchards.

Critical Issue

Positive youth development

Opportunities for youth in equity (OYE)

Project Director

Jaime Curbelo

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

7002509



4-H, an inclusive space that provides opportunities for children and youth

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Before hurricane María, 58% of our children and youth were living in poverty. The recent natural disasters and current health crisis have dramatically impacted youth's mental health and academic achievements. These exacerbated child poverty on the island and accelerated the migration of families with children. The lack of educational opportunities and access to healthy food due to the closing of schools, in addition to the preexisting economic challenges exacerbates our youth precarious situation. Loss of homes due to loss of jobs in the families, in addition to the state lockdown, increased the rate of child violence. These factors hinder child and youth development.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Our major activities incorporated interdisciplinary 4-H state initiatives that helped us to integrate 4H members' needs and program objectives at different levels (local, regional and state). The Reto Agricola was a virtual and at-home learning initiative that helped connecting our children and youth with experiences in agriculture. The Ruta 4-H para una vida saludable initiative, through school and community teen teaching strategies, allowed us to teach and promote healthy living lifestyles to empower youth. "Talent is everywhere opportunity is not", OYE provided new opportunities to our participants to create awareness about deaf and blind youth in the island and how 4-H can be an inclusive place with opportunities for development the talent and life skills of this specific group. Using a public health approach ACCESO 4-H activities served as a space to reflect and talk about homelessness and their impact in youth, people, and families. Virtual camps, forums, 4-H week and state conferences were activities in which youth improved their leadership skills and teamwork strategies. All the activities included advocacy, emergency preparedness, diseases prevention and other approaches like 4-H DEI objectives and SDGs, that provided knowledge and community service experiences for youth to develop skills and abilities to become healthy individuals (i.e., physically, socially, mentally, and emotionally) that positively contribute to our society.

Briefly describe how your target audience benefited from your project's activities.

OYE, the first initiative DEI 4-H achieved the established goals therefore a second team was selected to participate in TLEI. This team was awarded with the opportunity of developing a second project OYE+ (more than signs to strengthen OYE team; already certified ASL) with the best practices to continue eliminating the barriers that prevent the participation of deaf youth in the Puerto Rico 4H Program. This initiative raised awareness of the deaf community's needs, extended the already available educational resources, and made partnerships that generated greater community outreach. During the 2021 TLEI showcase reactions given by the participants included: "Can you share this video with the pledge? What a great resource!! Excellent, love it!!, great job, Thank you, PR! Congratulations OYE Puerto Rico, such a beautiful project and presentation!, In addition to making inclusive spaces for youth, this can also build inclusive spaces for volunteers, staff, parents, and other family members, I love the expansion of your project." [TLEI Look Book 2021.docx \(sharepoint.com\)](#).

As a result of the participation at the **Healthy Living Summit PR**, our 4-H Ambassador presented an action plan to work with homeless people. The approved plan promoted the establishment of ACCESO (access), a project for 4-H teen leaders to learn how to appropriately serve the homelessness community. Also they acquired knowledge to identify risk factors associated with increased predisposition to become homeless.

Our healthy habits initiatives, sponsored by the National 4-H Council and Walmart foundation, celebrated 12 years promoting healthy lifestyles with youth in the island. Regardless of the challenges provoked by the pandemic, we enrolled 565 participants in the Route for Healthy Living project. All the students completed the healthy living lessons curricula offered. Also, they participated in virtual activities like field trips to a community garden. 4-H teen-teachers (n=65) facilitated peer's education in school, communities and virtual learning platforms. Teen ambassadors supported the educational activities with healthy recipes videos making the learning process more "fun". A total of 361 youth adopted one or more healthy practices for their life's. [Receta #1- Tartas de Fruta- Ruta 4-H para una Vida Saludable - YouTube](#), [Receta #4-Muffins de Zanahoria y Piña- Ruta 4-H para una Vida Saludable - YouTube](#), [Receta #3- Ensalada colorida de frijoles negros- Ruta 4-H para una Vida Saludable - YouTube](#), [Receta #2- Agua con un toque especial- Ruta 4-H para una Vida Saludable - YouTube](#).

The Bug Camp exposed kids and youth to basic knowledge in entomology. They learned about related professional careers in entomology and the role of insects in food production, how they increase environmental diversity, and their impact in reducing world hunger. Two young participants demonstrated interest in pursuing an entomology career after participating in the bug camp. Of the participating students, 15 completed the camp activities including the preparation of an insect collection. In alliance with the Department of Agricultural Education, UPRM, 50 participants (from 7 a 13 years of age) completed the virtual entomology workshops. Other achievements included: reduced participants fear to insects and, learn how to control pests that impact pollinators and other beneficial insects. The program was sponsored by Corteva Agrisciences and was presented in different media reports as an innovative 4-H program. The Bug Camp had more than 3,000 online participants and 568 reproductions. <https://www.facebook.com/CortevaPuertoRico/posts/1865589960299377> and [Bug Camp Exposes Students to Different Career Opportunities | Business | theweeklyjournal.com](#)

With the **Ag Challenge** (Reto Agrícola 4-H) around 250 participants benefited from the educational activities after school, at home, or at school, to celebrate workshops and face-to-face activities. The Ag Challenge contributed to reducing the pandemic fatigue in our participants. Some efforts included school collaboration with 4-H local clubs to provide experiences for kids during pandemic restrictions.

La Plata Project, in the municipality of Aibonito, was a great example of how PRAES Family Educators, school officials, families and communities work together to create a safe space to grow and learn. The media report, created by ex-alumni 4-H, benefited our program by showing how our organization assumed leadership and provided resources to young people to encourage them to move positively during adolescent stage. <https://www.facebook.com/juventud4hpr/posts/2784512181800995>.

The National 4-H Conference, the Puerto Rico State Conference, and National 4-H week were three major activities of 2021 that provided intensive educational activities to develop leadership skills. During the National Conference, 6 delegates participated in roundtable activities and prepared a virtual meeting with PR State Commissioner in Washington DC. In the meeting, the delegates presented to the Commissioner needs and concerns about education, food insecurity and poverty situation of Puerto Rico. <https://www.facebook.com/juventud4hpr/photos/pcb.2760496290869251/2760496210869259> To address the concerns presented to the commissioner they used SDGs to create and deliver activities that promote critical thinking skills and youth commitment with sustainable ideas. Comer (eat), a recognized performance in the island, was used as a resource to promote an exchange of ideas to guarantee food access to everyone. All the facilitators and presenters in the State Conference were a 4-H Exalumni. All recognized how 4-H empowered them and invited the participants (n=75) to be a 4-H and community spokespersons. The Conference was celebrated as hybrid event <https://www.facebook.com/juventud4hpr/posts/2821968284722051>. The National 4-H week also served to expand activities

to enroll and promote 4-H projects. Through the virtual route we connected kids and youth with agriculture topics, healthy habits projects like mindfulness and art, crafts, and other youth initiatives. <https://www.facebook.com/watch?v=450784989656797> <https://www.facebook.com/watch?v=188742753388752>

Briefly describe how the broader public benefited from your project's activities.

Since the programs objectives involve the creation of safe learning spaces that promote opportunities and experiences for children and youth so they develop the appropriate skills to positively contribute to our society, every single achievement obtained will benefit the public.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Covid restrictions continue generating major challenges to deliver face to face activities. Youth experiences virtual burnout, but we maintain communication with teen leaders to create and innovate 4-H strategies. New opportunities to work are civic responsibility projects, careers exploration, urban forestation, agriculture entrepreneur. In addition, the Fondita de Jesus organization (NGOS) committed with us to create a youth and adult academy to work with homeless initiatives.

Type

Projects / Programs

Projects / Programs without a Critical Issue

0

Not Provided