



IMPACT REPORT

2025 RESEARCH & EXTENSION



TABLE OF CONTENTS

- 2 Messages from the Directors**
- 4 About the UOG Land Grant System**
- 5 UOG Extension Service**
- 6 UOG agInnovation Research Center**
- 7 Agricultural Experiment Stations**
- 8 4-H, Youth, Families & Community Development**
- 10** 4-H summer programs prepare Guam youth for higher education and STEM careers
- 12** 4-H entomology camps are changing how Guam youth view insects
- 14** Family resiliency workshops build healthy aging, financial literacy, and generational empathy in Guam
- 16** Household survey in Guam updates crucial data for economic planning
- 18 Food, Nutrition, Health & Wellness**
- 20** Feral swine sausage study finds Guam consumers accept wild pork when USDA inspection is assured
- 22** Dragon fruit value-added products help reduce food waste and support Guam agriculture
- 24** Diabetes prevention program and health-focused text messaging fill voids in Guam's public health education
- 26** Farm-stress program expands farmer access to needed resources
- 28 Natural Resource Management, Invasive Species Management & Landscape Resiliency**
- 30** Biosecurity and biocontrol efforts reduce risk of coconut rhinoceros beetle spread from Guam
- 33** First-time catalog of native plant traits to aid in forest restoration for Guam
- 36** Bioactive benefits of Guam-grown noni fruit unveiled
- 38** Guam study finds soursop leaves are potent with bioactive compounds
- 40** Thermal imaging by drone delivers new information on Guam's aquifer
- 42** UOG Drone Corps equips Guam agencies to gather geospatial data in-house
- 44** Ready-to-use native seed mixes to aid in efficient post-disturbance forest restoration in Guam
- 46** Seed germination study reveals best method to propagate a declining native Guam tree
- 48** First report of newly invasive banana lace bug in Guam
- 50** Guam researchers document data on newly established hog plum beetle to facilitate management
- 52 Sustainable Food & Agricultural Systems**
- 54** Drone mapping project seeks to inform conservation on private farms in Guam
- 56** Public outreach initiative grows consumer confidence in Guam-grown tilapia
- 58** Hotel-farm compost partnership in Guam demonstrates circular food system
- 60** Nursery and lab upgrades strengthen plant disease research and workforce training in Guam
- 62** Cross-training builds Guam's capacity to teach residents about home food production
- 64** Backyard poultry workshops help Guam residents build food security
- 66** Seedless watermelon variety trial identifies top-performer for Guam
- 68** Banana variety trial identifies high-yielding, low-input varieties for Guam
- 70 UOG Land Grant Faculty**
- 72 New Faculty**

Cover image: Adult banana lace bugs, a newly invasive crop pest in Guam. *Photo by Alfred Daniel Johnson.* **Image (right):** Sweet potatoes harvested at UOG's agricultural experiment station in Yigo. *Photo by Antonio Joyce.*





MESSAGE FROM THE DIRECTOR

Buenas yan Håfa Adai!

In 2025, the College of Natural & Applied Sciences at the University of Guam continued to advance its Land Grant mission through research, extension, and instruction. Our faculty, staff, students, and partners worked together to address Guam's priorities in agriculture, food and nutrition, natural resources, health, youth development, and community resilience.

Throughout the year, UOG Land Grant:

- expanded hands-on learning opportunities for youth and families;
- strengthened health and wellness education;
- supported farmers and local food production; and
- advanced research in biosecurity, environmental stewardship, and sustainable agriculture.

Our teams also developed practical tools, technologies, and locally relevant recommendations to help improve food security, protect Guam's natural resources, and strengthen the knowledge and skills of our island workforce and communities.

This work also reflects our continued commitment to building local capacity. Through workshops, field demonstrations, applied research, workforce training, and community partnerships, we helped residents and organizations gain the knowledge and skills needed to respond to emerging challenges. By connecting university expertise with community experience, UOG Land Grant continues to create solutions that are practical, culturally relevant, and responsive to the needs of Guam and the broader Micronesian region.

These accomplishments reflect the value of collaboration and the importance of science grounded in Guam's unique conditions, cultures, and needs. They were made possible through the dedication

of our employees and students and through strong partnerships with government agencies, community organizations, farmers, families, and residents across the island and region.

We are proud to share the 2025 UOG Land Grant Impact Report, which highlights the people, programs, and partnerships that continue to turn research into practical benefits for our community.

Si Yu'os Ma'åse',

Rachael T. Leon Guerrero, Ph.D., RDN

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Director, UOG Land Grant
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MESSAGE FROM THE ASSOCIATE DIRECTOR OF RESEARCH

Greetings! This past year brought significant changes in national research priorities across the funding landscape, creating a dynamic environment for all Land Grant universities. In response, UOG Land Grant refined its focus to critical issue areas that better align with these emerging national priorities while remaining firmly committed to the needs of Guam and the broader Micronesian region. The result is a research enterprise that continues to deliver science that is relevant, responsive, and impactful.



At the heart of UOG Land Grant's research are our dedicated staff and some of the region's leading scientists and mathematicians. The expertise of our research faculty spans both basic and applied research, enabling them to address complex challenges. Equally important is our commitment to developing the next generation of scientists and professionals. Through hands-on research experiences, internships, and mentoring, Land Grant faculty are preparing students to become future leaders in STEM disciplines.

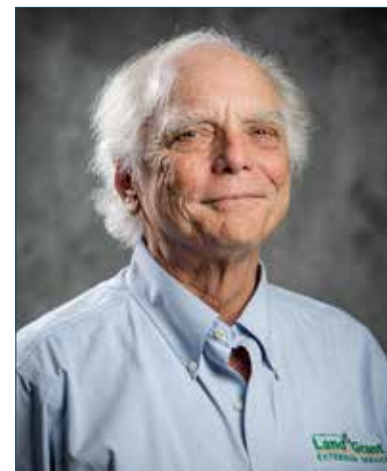
Looking ahead, we will continue to adapt to an evolving research landscape while remaining committed to science that strengthens our food systems, protects our natural resources, supports economic opportunity, and helps build a more resilient future for our region.

Frank A. Camacho, Ph.D.

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MESSAGE FROM THE ASSOCIATE DIRECTOR OF EXTENSION

Welcome! The heart of UOG Land Grant Extension Service are our dedicated faculty and professional staff who work every day to connect university knowledge with our community. Extension begins by listening. We identify local needs, build partnerships, secure resources, and deliver practical, research-based programs that improve the lives of Guam residents.



Food security continues to be a central theme in our work, helping residents produce, prepare, and wisely use local foods. This year, agriculture and nutrition professionals worked together to deliver Garden-to-Table workshops, cooking classes, and diabetes prevention programs that taught participants how to grow and prepare nutritious foods using locally available crops. We also explored innovative opportunities to increase local food supplies, from backyard poultry production to evaluating feral swine as a safe, locally sourced protein source through the development of value-added products.

Our commitment to youth is reflected in our expanding 4-H programs, where STEM, food preparation and preservation, agriculture, culture, and life skills come together through hands-on learning experiences that help prepare Guam's future leaders. At the same time, our community development team helped complete Guam's Household Income & Expenditure Survey, providing insight to understand community needs and important data to update economic indicators.

We also strengthened our own capacity through cross-training that broadened our ability to teach home food production, gardening, and other practical skills to more island residents. Together, these efforts demonstrate the power of Extension to create meaningful and lasting benefits for the people of our region.

L. Robert Barber Jr., Ph.D.

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UOG LAND GRANT SYSTEM

The University of Guam is one of 112 federally designated Land Grant universities. The UOG Land Grant units, housed within the College of Natural & Applied Sciences, work to generate and share knowledge in two areas that are relevant and applicable to every community member – living well from the land and in the home.

The Land Grant priorities include topics in agriculture, food and nutrition, natural resources, and family and consumer sciences. We explore and promote these topics through a research division, an extension (community outreach) division, and an academic instruction division.



INSTRUCTION



EXTENSION



RESEARCH



ABOUT THE UOG EXTENSION SERVICE

The **UOG Extension Service** of the University of Guam Land Grant works directly with Guam residents, delivering practical, research-based information and informal education. Our priority focus areas include:

- agriculture
- food and nutrition
- natural resources
- family and consumer sciences
- youth development

UOG Extension offers community-level workshops, trainings, demonstrations, and educational materials as well as one-on-one support and technical support.

UOG Extension is one of 112 extension units nationwide that make up the national Cooperative Extension System. Extension work is funded both through the local government and the National Institute of Food & Agriculture of the U.S. Department of Agriculture.



EXTENSION



RESEARCH



ABOUT THE AGINNOVATION RESEARCH CENTER

The **agInnovation Research Center** of the University of Guam Land Grant works to advance knowledge and investigate improvements for Western Pacific communities in the following areas:

- sustainable tropical agriculture production
- agricultural systems
- food science
- nutrition and health
- environmental stewardship
- energy and bioproducts
- climate resilience
- youth, family, and community resilience.

Our research is conducted on three agricultural experiment stations, which each have a different soil type common in Guam, as well as in the Guam Aquaculture Development & Training Center in Fadian, and in 10 on-campus research labs.

Affiliation and funding

The UOG agInnovation Research Center is an affiliate of agInnovation – the national parent organization for agricultural experiment stations at Land Grant universities in every state and territory. These stations, comprising 13,000 scientists nationwide, are federally funded through the Hatch, Multistate Hatch, and McIntire Stennis programs administered by the National Institute of Food & Agriculture of the U.S. Department of Agriculture.



OUR AGRICULTURAL EXPERIMENT STATIONS



Inalåhan Research & Education Center

Est. 1975

10.6 acres

The Inalåhan experiment station is the center's smallest station, representing the least common soil type in Guam. Bottomland, or strandline, soil is found in between the northern limestone soils and the southern volcanic soils of Guam and is deep, slow-draining, and silty or sandy in composition.

The station has a small plantation of 12 banana varieties, including some of the most popular varieties in Guam, used as a source of planting material for farmers and to teach students about plant propagation.



Ija Research & Education Center

Est. 1978

65 acres

With only rolling hills of red clay and wilderness in sight from the property, Ija station supports projects exploring agriculture techniques for sloping, erosion-prone, and predominantly clay soil.

Ija station also has an orchard of mango trees that provides a valuable opportunity for improving mango fruit production on the island. The orchard includes 29 varieties from major mango-producing regions of the world and includes many of the most successful varieties in international commerce.



Yigo Research & Education Center

Est. 1986

47 acres

The Yigo station is located in the northern part of Guam on the soil type that covers approximately 30 percent of the island. The porous limestone in the north of Guam quickly absorbs water, and the shallow, "cobbly clay" soil tends to lack a good nutrient balance.

This makes the station ideal for research projects looking to make efficient and economical use of nutrients, such as the use of biochar and organic waste compost as soil amendments.

CRITICAL ISSUE AREA #1:

4-H, YOUTH FAMILIES, AND COMMUNITY DEVELOPMENT

As an isolated tropical island territory, Guam presents unique social and economic challenges that make capacity-building and education critical. In line with NIFA's goal of growing a skilled, inclusive agricultural workforce, UOG Land Grant focuses on empowering citizens of all ages to work together to improve their quality of life and social welfare.



28

4-H CAMPS



200+

CAMP PARTICIPANTS



265

FIELD TRIP PARTICIPANTS
(HEAD START AND
MILITARY YOUTH)



151

STEM SATURDAY
PARTICIPANTS



1263

TOTAL YOUTH
ENGAGEMENT

Newspaper Columns

- Aug. 4, 2025: "More months, more benefits: Breastfeeding builds a healthier future for the Marianas" by Tanisha F. Aflague and Dareon Rios
- Sept. 29, 2025: "Guam 4-H is ready to grow" by Dareon Rios
- Oct. 6, 2025: "Healthy habits start at home: Protect Guam's children through diet and lifestyle" by Rachael Leon Guerrero
- Dec. 15, 2025: "Breastfeeding: The gift that keeps on giving for our island families" by Lenora Matanane

4-H Enrichment Camps in 2025

- April 17: 4-H Life Skills Spring Break Camp for the Department of Youth Affairs
- June 2-6: Crime Scene Investigation
- June 2-6: Level Up Game Development
- June 2-6: Imagination Art Explorers
- June 2-6: Think Like a Mathematician
- June 9-13: Mission: Move!
- June 9-13: Microbit Masters
- June 9-13: Sew, Stitch, and Fun in the Kitchen
- June 9-13: Financial Literacy
- June 16-20: Wisdom of Our Ancestors
- June 30-July 3: Kids in the Kitchen: Food Drying
- June 30-July 3: Insects: Good, Bad, and Ugly
- June 30-July 3: Sustainable Ag for the Next Generation
- June 30-July 3: Crime Scene Investigation
- June 30-July 3: Crazy Chemistry
- July 7-July 11: Imagination Art Explorers
- July 7-July 11: Crazy Chemistry
- July 7-July 11: Microbit Adventures
- July 7-July 11: Mini Math Explorers
- July 7-July 11: Insects: Good, Bad, and Ugly
- July 14-July 18: Imagination Art Explorers
- July 14-July 18: Crazy Chemistry
- July 14-July 18: Kids in the Kitchen: Food Drying
- July 14-July 18: Smarts Snacks Lab Explorers
- July 14-July 18: Beats & Bytes with Python
- July 14-July 18: Exploring the Art of Math
- July 22-Aug. 1: Junior Fisheries



4-H SUMMER PROGRAMS PREPARE GUAM YOUTH FOR HIGHER EDUCATION AND STEM CAREERS

Relevance: Guam has an ongoing need for structured, high-quality youth programming that supports academic enrichment, workforce readiness, and positive youth development during the summer months. At the same time, the island faces workforce shortages and a need to cultivate local talent in STEM, agriculture, and other high-demand fields.

Limited access to enrichment opportunities affects Guam's youth and their families, while the broader community is impacted when young people lack opportunities to develop transferable skills such as communication, teamwork, critical thinking, and problem-solving.

Response: The Guam 4-H Summer Enrichment Program under University of Guam Land Grant addressed these needs in the summer of 2025 with culturally relevant, hands-on learning experiences.

Using the National 4-H Beyond Ready initiative as a first-time model, the camps placed a strong emphasis on workforce readiness, career exploration, and connections to higher education through expert-led instruction. By having university faculty and community subject-matter experts from multiple fields central to each summer camp, the program took an innovative interdisciplinary approach to developing and teaching locally relevant curricula.

The camps served youth ages 5-18 at university and community locations. Participants engaged in hands-on activities in mathematics, forensic science, chemistry, computer science, financial literacy, traditional navigation, creative arts, sewing, food drying, healthy snack making, sustainable agriculture, fisheries, and entomology while building leadership skills, teamwork skills, and self-confidence.

Results: The program delivered 25 workshops across 13 content areas, engaged more than 200 youth, connected participants with 14 university faculty members, and mentored 10 college interns and

eight high school interns.

Preliminary evaluations found increased content knowledge and overwhelmingly positive feedback from youth and families. Parents reported gains in confidence, curiosity, independence and social engagement, with many children continuing the summer camp activities at home. Surveys also showed strong interest in the coding, sports, cooking, and food science camps.

Researchers are continuing to analyze post-program data on workforce-ready skills, career awareness, higher education interest, and future 4-H participation, with final evaluation results expected during the next reporting cycle.

Next Steps: Future efforts for the Guam 4-H program include developing take-home learning opportunities, strengthening long-term evaluation methods, deepening partnerships with industry and educational organizations, and exploring year-round Beyond Ready programming and youth leadership pathways.



200+ YOUTH ENGAGED



14 FACULTY LEADERS



25 WORKSHOPS



13 SUBJECT AREAS



18 STUDENT INTERNS

Project Leads: Dareon Rios, M.S. | riosd@triton.uog.edu
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Kate Moots, Ph.D. | kmoots@triton.uog.edu

Project Title: 4-H Summer Enrichment Program

Timeframe: June-August 2025

Funding Source: Smith-Lever Capacity Grant, USDA



Photo by Conrad Calma



Youth outcomes reported by parents:



Increased confidence



Increased curiosity



More independence



Improved social engagement

4-H ENTOMOLOGY CAMPS ARE CHANGING HOW GUAM YOUTH VIEW INSECTS

Relevance: Early exposure to entomology is critical for fostering curiosity, scientific literacy, and environmental stewardship among youth living in vulnerable island ecosystems, such as Guam. Insects make up the majority of terrestrial biodiversity and serve essential roles as pollinators, decomposers, predators, parasitoids, and indicators of ecosystem health. Despite their ecological importance, insects are often misunderstood or feared, particularly by children.

An insect-focused summer camp addressed the need to strengthen STEM education while helping youth better understand the ecological importance of insects and other arthropods. By introducing children and teens to insect science through hands-on, inquiry-based learning, the project encouraged environmental awareness and explored pathways into careers in entomology and the biological sciences.

Response: The Guam 4-H Program teamed up with UOG Land Grant's extension entomologist, Dr. Alfred Daniel Johnson, to deliver three separate entomology-focused programs for youth in 2025. These included two week-long teen camps, serving approximately 20 youth participants, and one parent-child field trip serving 33 parents and teachers and 28 children ages 3 to 5 from low-income or disadvantaged backgrounds.

Teen participants completed an immersive curriculum that combined classroom instruction with field collection, insect trapping, specimen preservation, microscopy, and scientific observation. Youth collected insects and other arthropods, learned preservation and insect pinning techniques, identified spiders using eye arrangement keys, visited the University of Guam insect collection, produced scientific illustrations, and learned



Insect collecting



Preservation and pinning



Spider and insect identification

Helping participants understand that fewer than 1% of insect species are considered pests was one of the program's most significant outcomes.

to identify 10 major insect orders. Activities also introduced students to insect mimicry, biodiversity, and the Greek and Latin roots used in scientific names.

For younger children, the experience included age-appropriate tactile learning experiences using approximately 100 live blue-banded king crow butterflies and live Hawaiian garden spiders under close supervision. Parents and teachers participated alongside children, reinforcing learning beyond the classroom.

Results: Participants responded enthusiastically to the hands-on learning experience. Teens demonstrated strong retention of insect taxonomy through quizzes, reported increased confidence in identifying insects and spiders, and expressed greater interest in biology and environmental science careers. Parents and educators reported that children continued discussing insects at home and school, indicating sustained engagement beyond the program.

One of the program's most significant outcomes was helping participants understand that fewer than 1% of insect species are considered pests, reframing insects from organisms to fear into essential components of Guam's ecosystems. By building appreciation for biodiversity and increasing scientific literacy at an early age, the program helped to strengthen the future pipeline of STEM students, environmental stewards, and biological science professionals in Guam.

Looking Ahead: Future plans include developing take-home entomology kits and educational materials, including long-term insect monitoring and citizen-science projects. The program also



plans to create mentorship pathways, connecting interested youth with University of Guam research laboratories and extension programs.

Program Lead: Alfred Daniel Johnson, Ph.D.
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Contributors: Dareon Rios, M.S.
Elaine de Leon, M.S.

Project Title: 4-H Summer Enrichment Camp: Insects – The Good, the Bad, and the Ugly

Timeframe: January–December 2025

Funding Source: Smith-Lever Capacity Grant, USDA



Main image: Guam youth capture insects outside with nets during the entomology-focused 4-H Summer Camp in June 2025. **Inset image:** A boy holds a butterfly on a field trip to the University of Guam in October 2025. Photos by Conrad Calmaa

FAMILY RESILIENCY WORKSHOPS BUILD HEALTHY AGING, FINANCIAL LITERACY, AND GENERATIONAL EMPATHY IN GUAM

Relevance: As Guam’s modern landscape evolves, families are navigating challenges that span the generations, including caring for aging family members, increasing rates of age-related illnesses, financial pressures, the need to prepare young adults for financial success, and the need for greater emergency preparedness.

These issues are an important community-wide priority. Helping older adults remain healthy and independent can reduce future caregiving demands on families, and preparing younger generations with financial knowledge and healthy lifestyle habits will contribute not only to their personal success, but to the success and productivity of the larger community. Building resilience in the family to handle challenges and changes also requires developing a better understanding of one another across generations.

Response: The Family Resiliency team under the University of Guam Land Grant Extension Service has been working with the Guam Department of Public Health & Social Services, the Mayors’ Council of Guam, and other community partners to deliver practical, evidence-based, community-centered education opportunities designed to strengthen family resilience across the lifespan.

In FY 2025, the program focused on three areas:

- **Healthy aging:** A nine-lesson “Keys to Embracing Aging” curriculum paired with healthy cooking demonstrations was delivered to 49 adults, providing 147 contact hours, at senior centers and the university campus.
- **Youth perspective on aging:** The “Walk in My Shoes: 4-H Aging Awareness Project” curriculum engaged 41 youth over 164 contact hours at public schools and summer camps, helping participants understand positive aging and develop empathy across generations.

Program	Participants	Contact Hours	Locations
Keys to Embracing Healthy Aging	49 adults	147	Senior centers, university campus
Walk in My Shoes: 4-H Aging Awareness	41 youth	164	Public schools, summer camps
Teen Financial Literacy	82 youth	328	Youth shelters, after-school programs

- **Financial literacy:** Lessons in budgeting, saving, and long-term financial planning were delivered to 82 youth and young adults over 328 contact hours at youth shelters and after-school programs.

The workshops emphasized hands-on learning. Participants completed a 30-day health improvement challenge and received learning enhancers, including home emergency toolkits, to encourage continued preparedness and healthy behaviors beyond the classroom.

Results: Combined, the program reached a total of 172 participants through 639 total contact hours across Guam.

- Among healthy aging participants, 85% reported a better understanding of how daily choices influence long-term health, identifying brain health, stress management, and financial preparedness as important components.
- Among “Walk in My Shoes” participants, 88% said they better understood how their current behaviors will affect future well-being, while 90% reported the program provided practical information they could use immediately.
- Of the youth financial literacy participants, 95% found the information highly relevant, and 91% said the materials significantly improved their understanding of financial issues.

Together, these outcomes suggest the programming is helping Guam families build knowledge and skills that may improve health, financial stability, and emergency preparedness and reduce future caregiving burdens.

Next Steps: The Keys to Embracing Aging and Walk in My Shoes curriculums will continue in the coming year, and the youth financial literacy program will further expand to include topics requested by the participants, including taxes, investing, retirement savings, and banking tools. The Family Resiliency Program will also expand its partnership with the Guam Department of Public Health & Social Services to include Bingocize® – a health promotion program combining Bingo, exercise, and wellness.

Project Lead: Tim de La Cruz, Ph.D. | delacruz237@triton.uog.edu
Contributors: Clarissa Barcinas
Elaine De Leon, M.S.
Project Title: Empowering Generations: Na Fitme I Familia-Ta/Family Resiliency Program
Timeframe: Oct. 1, 2024–Sept. 30, 2025
Funding Source: Smith-Lever Capacity Grant, USDA

Photos by Conrad Calma



HOUSEHOLD SURVEY IN GUAM UPDATES CRUCIAL DATA FOR ECONOMIC PLANNING

Relevance: The Household Income & Expenditures Survey (HIES) is a critical tool for updating Guam's core economic indicators, particularly the Consumer Price Index (CPI) and Gross Domestic Product (GDP). The last HIES was conducted in 2005, meaning data on household income, product costs, and consumer spending behavior was more than 20 years out of date.

The CPI is used to track inflation and inform key decisions about wages, minimum wage adjustments, subsidies, housing programs, and public services. Outdated data can distort economic policy, such as legislative bills to adjust the island's minimum wage, underscoring the importance of maintaining up-to-date and accurate cost-of-living metrics.

In addition to informing public-sector programs, the CPI and GDP guide private-sector planning and provide figures to help businesses align their strategies with actual consumer spending trends.

Response: To ensure high-quality, representative data collection, the Guam Bureau of Statistics & Plans partnered with the University of Guam Land Grant's community development team, which specializes in community engagement and project implementation.

The HIES team adopted several tactics to survey 1,000 random households for a representative sample of Guam's population:

- **Advanced as well as grassroots engagement:** The team transitioned from paper survey forms used in the past to tablet-based surveys, increasing data accuracy and processing speed. The team also conducted traditional face-to-face interviews.
- **Diverse selection:** To ensure a diverse pool of respondents, the households to be surveyed were pre-selected using utility maps.
- **Plan B:** In the event the selected households were not reachable or declined, the survey team had publicized a "HIES Check" webpage, where residents could enter their address to see if they'd been

The use of tablet-based surveys, village mayor partnerships, and incentives boosted participation in the 2023 Guam Household Income & Expenditures Survey from prior years.

selected. If they hadn't, they could choose to opt in as an alternate.

- **Incentives:** The team solicited gas and grocery certificates that were used as incentives for completing the survey. Additional incentives were offered for completing both the survey and the two-week expenditure diary.
- **Collaboration with mayors:** The team met individually with village mayors to secure their assistance in publicizing the survey and to improve public trust and encourage participation. The mayors were also provided an easy-to-use publicity toolkit with pre-made flyers and announcements for various communication channels.

Results: In the University of Guam's role, the survey team collected 716 accurate household survey cases and 700 detailed expenditure diaries, providing a solid statistical foundation for data analysis and the latest insights into residents' spending. The final survey results have been used to rebase Guam's CPI and will now contribute to more accurate economic measures for informed policy and planning decisions.

In addition to the statistical benefits, this survey effort supported the university's community engagement agenda by encouraging residents to engage with and take part in their community.

Project Lead:	Peter Barcinas, M.S. pbarcina@triton.uog.edu
Project Team:	Benjamin Raetilmwai (University of Guam) April Trinidad (Guam Bureau of Statistics & Plans)
Project Title:	Guam Household Income & Expenditures Survey (HIES)
Timeframe:	May 2023–January 2025
Funding Source:	Office of Insular Affairs, U.S. Department of the Interior



Photo by Jackie Hanson

CRITICAL ISSUE AREA #2:

FOOD, NUTRITION, HEALTH & WELLNESS

One of the most fundamental needs of communities is access to nutritious food and the knowledge to make healthy lifestyle choices. Recognizing that nutrition and wellness are influenced by numerous interconnected factors, this critical issue area takes a comprehensive approach that integrates education, policy development, lifestyle intervention, local food production, and food safety in order to reduce diet-related diseases, improve quality of life, and foster sustainable food systems that benefit both producers and consumers.



24

WORKSHOPS &
PRESENTATIONS



17

ARTICLES &
PUBLICATIONS



400+

WORKSHOP PARTICIPANTS

Fact Sheets & Technical Reports



Value-Added Turmeric Products You Can Make at Home

By Jian Yang
Oct. 3, 2025



Homemade Soursop Products

By Jian Yang
Nov. 20, 2025



Making Value-Added Dragon Fruit Products at Home

By Jian Yang
Dec. 31, 2025



Workshops & Events

- Jan. 6-17: *Nihi ta Fanmama'tinas* (Let's Cook): Diabetes Series
- Feb. 24-March 12: *Nihi ta Fanmama'tinas* (Let's Cook): Diabetes Series
- April 30-May 28: See What's Cooking Class for the Visually Impaired
- May 24: Home Food Processing Workshop: Breadfruit Flour
- May 27: Garden-to-Table Workshop: Chaya
- May 29: Garden-to-Table Workshop: Papaya
- June 3: Garden-to-Table Workshop: Moringa

- June 5: Garden-to-Table Workshop: Sweet Potato
- Aug. 2: Meat Processing Workshop: Sausage 101
- Aug. 4: *Kusinan* CNEP Cooking Demo: Turkey Chili with Taro
- Aug. 5: *Kusinan* CNEP Cooking Demo: Tofu Veggie Stir Fry
- Aug. 6–16: *Nihi ta Fanmama'tinas* (Let's Cook!): Diabetes Series
- Sept. 26: Value-Added Foods Workshop: Dragon Fruit
- Oct. 4–Nov. 1: Fresh & Frugal Cooking Class for Young Adults
- Oct. 8: Post-Harvest Handling and Sanitation / Processing Value-Added Products Presentations at Agricultural Symposium of Guam
- Oct. 11: Value-Added Foods Workshop: Mango Jam & Marmalade
- Oct. 11: Garden-to-Table Workshop: Eggplant
- Oct. 18: Garden-to-Table Workshop: Papaya
- Oct. 22: Garden-to-Table Workshop: Chaya
- Oct. 25: Garden-to-Table Workshop: Sweet Potato
- Nov. 17–24: Keys to Embracing Aging Workshop Series: Holiday Wellness Week
- Nov. 22: Public Sensory Evaluation: Feral Swine Sausage
- Dec. 13: Value-Added Foods Workshop: Breadfruit Flour
- Dec. 16–Jan. 6: SNAP-Ed Nutrition Education Workshop Series: Savor the Season

Newspaper Columns

- Jan. 3, 2025: "Eating local with diabetes" by Tanisha Aflague
- Feb. 3, 2025: "Red, pink, purple, or brown: Decoding the colors of raw meat" by Jeng-Hung Liu
- March 3, 2025: "An evidence-based approach to preventing Type 2 diabetes" by Shelly Blas Laguaña
- April 21, 2025: "Flour power: How to turn a backyard superfood into a year-round staple" by Jackie Hanson and Jian Yang
- May 5, 2025: "Move over spinach – chaya is the superior green in the Pacific scene" by Tanisha F. Aflague and L. Robert Barber Jr.
- May 19, 2025: "Vitamin C: The ingredient that makes Guam-grown fruits pack an exceptional punch" by Richard Singh
- June 2, 2025: "Healthy eating can help prevent colon cancer in Guam" by Rachael T. Leon Guerrero
- Aug. 18, 2025: "Boost brain health and embrace aging – your best may be yet to come" by Tim C. de La Cruz
- Sept. 1, 2025: "Feral swine meat – is it any good?" by Jeng-Hung Liu

Peer-Reviewed Publications

Aflague, T. F., Badowski, G., Bacalia, KMA, Manibusan, J.R., Dominguez, R-M, Wood, K., Hattori-Uchima, M., & **Leon Guerrero, R.T.** (2025). The association of cardiometabolic risk factors in parent-child dyads in Guam: Pacific Islands Cohort on Cardiometabolic Health study. *International Journal of Environmental Research and Public Health*, 22(4):611. <https://doi.org/10.3390/ijerph22040611>

Esquivel, M.K., Hammond, K., Delos Reyes, B.C., **Rios, D.C.**, Mian, N., de Leon, E.C., Torres, S.M., & **Aflague, T. F.** (2025). Part 1: A systematic review to describe existing cultural adaptations in lifestyle, nutrition, and physical activity programs for native Hawaiian, CHamoru, and Filipino populations. *International Journal of Environmental Research and Public Health*, 22(11):1673. <https://doi.org/10.3390/ijerph22111673>

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FERAL SWINE SAUSAGE STUDY FINDS GUAM CONSUMERS ACCEPT WILD PORK WHEN USDA INSPECTION IS ASSURED

Relevance: Feral swine are a major pest in Guam, causing agricultural losses, damaging soil and water resources, and posing public health concerns because they can carry multiple zoonotic diseases. At the same time, having locally available protein sources would help strengthen Guam's food system while making productive use of an existing natural resource.

Local livestock production has declined significantly since the 1990s, and Guam now imports most of its food. And while hunting and consuming feral swine has long been part of Guam's culture, that tradition has declined in recent years. Consumers, hunters, livestock producers, and agribusiness entrepreneurs interested in local food production all have a stake in understanding the potential of feral swine as a value-added food product.

Response: The animal sciences and meat processing team at the University of Guam Land Grant agInnovation Research Center evaluated whether feral swine meat could be successfully incorporated into processed pork products while maintaining consumer acceptance.

Two feral swine were harvested, processed, and ground to produce four chorizo sausage formulations containing 0%, 50%, 65%, and 80% feral swine meat. Building on previous research that found feral swine meat to be lean and tough, additional fat was incorporated into the sausages. Additional sausages were also prepared using imported domestic pork.

In sensory evaluation panels, participants evaluated color, juiciness, texture, greasiness, flavor, off-flavor, gaminess, and overall acceptability using a seven-point scale. Participants also completed a consumer survey examining how USDA inspection and the source of the meat influenced their willingness to purchase and consume feral swine products.

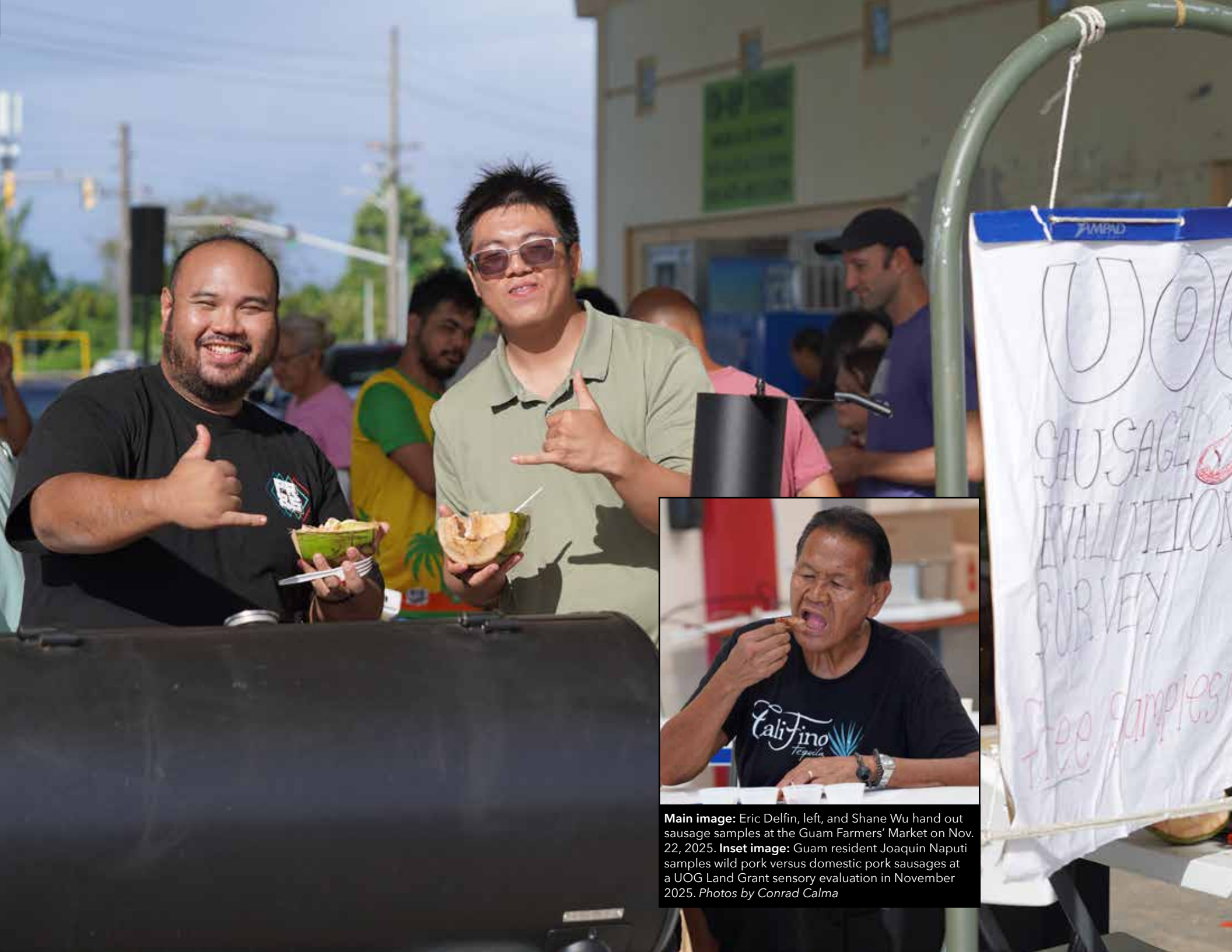
Results: A total of 84 consumer surveys were collected. Statistical analysis found no significant reported differences among the sausage formulations for any sensory attribute, indicating participants could not distinguish products containing up to 80% feral swine meat from those made entirely with domestic pork. These findings demonstrate that feral swine meat can serve as a viable local protein source for value-added products without compromising product quality when processed appropriately.

The consumer survey found that USDA inspection was the single-most influential factor affecting willingness to consume feral swine meat. Older participants generally showed greater acceptance of feral swine meat and more flexibility regarding product sourcing, suggesting that cultural familiarity may influence consumer perceptions. Younger participants placed greater emphasis on food safety assurances and USDA inspection.

This study represents the second phase of University of Guam research on feral swine meat and contributes locally relevant data on both product quality and consumer perceptions, helping inform future discussions the potential use of feral swine as a local protein source.

Next Steps: Findings will be submitted for publication in the journal Meat Science, with publication anticipated in 2027. Future research on feral swine remains possible, although current efforts are being redirected toward broader livestock production research.

Lead Researcher: Jeng-Hung Liu, Ph.D. | liuj14031@triton.uog.edu
Contributors: Dann Bilong
Eric Delfin
Adia Acda
Project Title: Feral Swine Meat Sausage and the Role of USDA Inspection Toward Consumer Preference
Funding Source: Hatch Act Capacity Grant, USDA



Main image: Eric Delfin, left, and Shane Wu hand out sausage samples at the Guam Farmers' Market on Nov. 22, 2025. **Inset image:** Guam resident Joaquin Naputi samples wild pork versus domestic pork sausages at a UOG Land Grant sensory evaluation in November 2025. Photos by Conrad Calma

VALUE-ADDED DRAGON FRUIT PRODUCTS HELP REDUCE FOOD WASTE AND SUPPORT GUAM AGRICULTURE

Relevance: Dragon fruit is an emerging crop with strong market potential in Guam because of its vibrant color and health-promoting phytochemicals. However, fresh dragon fruit is highly perishable, with a shelf life of only two to four days at room temperature. During peak harvest season, the local market can quickly become saturated, resulting in wasted fruit and lost income opportunities for growers.

Developing value-added products extends the fruit's shelf life, reduces food waste, and creates new market opportunities for local producers. The broader public can also benefit from more products in the local economy as well as practical methods for making dragon fruit products at home.

Response: To help reduce market saturation and increase the value of this locally abundant fruit, the food processing team of the University of Guam Land Grant Extension Service set out to develop a variety of value-added dragon fruit products.

The team obtained dragon fruit from local farmers and developed recipes and processes for creating dragon fruit juice, nectar, gummies, and jam. The recipes were all consumer-friendly for residents to be able to make at home. The team also conducted sensory evaluations of the products with consumers.

Community education was central to this initiative. The recipes were introduced to residents over more than five workshops across Guam – not only on making dragon fruit value-added products, but key pointers for harvesting them as well.

Results: Following laboratory testing and product development taking into account consumer preferences from sensory evaluations, the team successfully published recipes online for dragon fruit juice, nectar, gummies, and jam.

Five community workshops reached more than 100 participants, increasing knowledge of dragon fruit health benefits, post-harvest handling, and value-added processing. Participants also learned practical techniques that can be used for home food production or future business opportunities.

Benefits of value-added food products:



Extends fruit shelf-life



Reduces waste from crop surplus



New revenue stream for growers



Strengthens agricultural economy



New local products for consumers

The project provides Guam with locally developed knowledge and technology that can help reduce food waste, expand value-added food processing, and strengthen the island's agricultural economy. The results may encourage additional dragon fruit production while supporting local processing and marketing opportunities.

Next Steps: Future work with dragon fruit will include investigating the use of the fruit's natural pigment as a replacement for synthetic food colorants.

Project Lead:	Jian Yang, Ph.D. jyang@triton.uog.edu
Contributors:	Sophie Santos Kuan-Ju Chen, Ph.D.
Project Title:	Dragon Fruit Value-Added Product Development for the Project of Developing the Economic Sustainability and Viability of Value-Added Products on Guam
Timeframe:	September 2022–December 2025
Funding Source:	National Institute of Food & Agriculture, USDA (Sustainable Agriculture Research & Education Grant, G134-23-W9216)



Published
Bulletin



December 2025



(Clockwise from top left) Dragon fruit nectar, dragon fruit jam, and dragon fruit gummy candies.



DIABETES PREVENTION PROGRAM AND HEALTH-FOCUSED TEXT MESSAGING FILL VOIDS IN GUAM'S PUBLIC HEALTH EDUCATION

Relevance: The Western Pacific region, including Guam, has the highest prevalence of diabetes and impaired glucose tolerance (prediabetes) among adults ages 20–79 in the world. Prediabetes can be reversed to prevent diabetes, and a 2013 study in the journal *Diabetes Research & Clinical Practice* revealed that 50% of people with diabetes in Guam expressed their desire to have preventive services. To date, there is only one Centers for Disease Control-recognized PreventT2 program available in Guam by an insurance company.

Limited health literacy is associated with poorer diabetes self-management, glycemic control, and management of related health conditions. Only 12% of U.S. adults have proficient health literacy skills. Research published in *Health Literacy Research & Practice Journal* found that text messaging may be an engaging and beneficial education medium for adults with Type 2 diabetes, regardless of health literacy status. Although most Guam residents own cell phones, no text messaging health promotion programs were previously available on the island.

Response: The University of Guam Land Grant Extension Service addressed these needs through two complementary initiatives:

- TEXTension, a text-based health messaging program, and
- CDC's Prevent T2 Diabetes Prevention Program.

Through TEXTension, extension staff planned out a year's worth of health education messages paired with engaging infographics, delivered on a monthly or twice monthly basis. The messages take a preventative health approach on a wide range of topics – including how to boost fruit and vegetable intake, examples of meals that satisfy the Diabetes Plate method using locally popular and available produce, gardening tips, ways to protect your eye and liver health, tips for boosting cognitive function, tips for improving hydration, and more.

The Prevent T2 program was carried out over the course of the year using the CDC's curriculum, enhanced by expertise from partner community organizations. Participants attended 26 one-hour sessions and also had weekly check-ins with trained lifestyle coaches.

The team brought the curriculum to youth in the community as well through hands-on diabetes prevention workshops emphasizing sugar reduction, healthy beverage choices, grocery budgeting, and physical activity promotion.

Results: TEXTension enrollment reached 130 participants over 12 months. In 2025, the program delivered 20 educational messages in addition to announcements about health-focused events and opportunities.

The Prevent T2 program enrolled 11 participants over two cohorts. Every engaged participant met or exceeded the CDC recommendation of at least 150 minutes of weekly physical activity, some having begun the program with zero physical activity. Some participants averaged more than 500 minutes each week. Half of the participants have lost weight, with the top participant losing 5% body weight, and two participants lowering their hemoglobin A1C by 0.2%. The diabetes prevention workshops reached 214 youth throughout 2025.

These results demonstrate an interest in the local population for health and diabetes management education and support programs. The programs also showed that culturally adapted diabetes prevention programming can successfully engage Guam residents and improve health behaviors. The project also contributes Guam-specific data to national CDC diabetes prevention efforts in a region with the world's highest diabetes and prediabetes prevalence.

Project Lead: Shelly Blas Laguana, Ph.D. | mlaguana@triton.uog.edu
Contributors: Elaine De Leon, M.S.
Ilesha Ibanez
Project Title: Health Literacy Through Prevent T2 and TEXTension
Timeframe: October 2024–September 2025
Funding Source: Smith-Lever Capacity Grant, USDA

Photo by Conrad Calma

Healthy choices: Beverages

- When choosing beverages in a healthy dietary pattern, both the calories and nutrients that they provide are important considerations.
- Beverages that are **calorie-free**—water—or that contribute **fewer calories** than full-fat milk, such as fat-free and low-fat milk, should be the primary beverages.
- Coffee, tea, and flavored milk are acceptable choices, but the most nutrient-dense beverages include low-fat milk and cream.



Reported improvements from Prevent T2:

-  Weight loss
-  Increased endurance
-  Better breathing
-  Enhanced energy
-  Improved muscle mass

FARM-STRESS PROGRAM EXPANDS FARMER ACCESS TO NEEDED RESOURCES

Relevance: Surveys conducted between 2021 and 2023 among farmers and agricultural workers across Micronesia identified key challenges and stressors that affect their ability to carry out their work. Among respondents, 23% of agricultural producers and 53% of agricultural workers expressed interest in career and vocational support, while 47% of agricultural workers identified limited access to medical care as a significant source of stress.

Across Micronesia, agricultural producers, workers, and their families are disproportionately affected by stress. Those working in agriculture face economic uncertainty and extreme weather events and are subject to significant physical demands yet don't often have the resources available to support them in these challenges. When agricultural producers are struggling, the food security of the broader community is impacted as well.

Response: Since the Farmer Focus Project was launched in 2021 under UOG Land Grant, it has developed its programming around three priorities: resource sharing, intercultural collaboration, and capacity building. The program is the first in the region to integrate behavioral health into agricultural outreach and workforce development.

The focus for the program in the past year has been on broadening vocational opportunity project activities and expanding resources and tools to address the lack of access to medical as well as behavioral health care.

In 2025, the team:

- hosted expert-led workshops across Guam focusing on succession planning, agribusiness development, agricultural infrastructure, and agritourism opportunities;
- brought a Farmer Focus Workshop to the U.S.-affiliated island



- nation of Palau, with approximately 55 farmers, agricultural professionals, and educators attending sessions on behavioral health, agricultural stress, and professional networking;
- partnered with the National Taipei University of Nursing & Health Sciences to co-host its second Health Seminar Series alongside the UOG School of Health;
 - hosted its largest yet annual Farmer Focus Conference in Guam, with approximately 300 attendees and sessions on agribusiness, food security, sustainable agriculture, international collaboration, and workforce development.

Results: The Farmer Focus Project in 2025 engaged more than 600 farmers, agricultural workers, students, educators, industry professionals, and community members of Micronesia. Information gathered through the project contributes to the national efforts of the Western Regional Agricultural Stress Assistance Program. The project continues to demonstrate that agricultural sustainability,



Producers of Sunny Grow Inc., a new shipping container-based hydroponics farm operation in Guam, attending the 2025 Regional Farmer Focus Conference held in Guam in October 2025. Photo by Jackie Hanson

behavioral health, and workforce development and can be more effectively addressed through regional partnerships and community engagement.

Next Steps: In 2026, the team plans to expand regional collaboration by bringing the next Farmer Focus Conference to the island of Chuuk in the Federated States of Micronesia. It will also establish a new partnership with the Guam Department of Public Health & Social Services to deliver a third Health Seminar Series.

Project Lead: Kuan-Ju Chen, Ph.D. | chenkj@triton.uog.edu
Co-Leads: Tim de La Cruz, Ph.D. (University of Guam)
 Rita Sharma, Ph.D. (University of Guam)
 KristiAnna Whitman, Ph.D. (Guam Behavioral Health & Wellness Center)
Project Title: Deepening Roots Through Expanding Agricultural Support Locally and Regionally in Asia Pacific Region
Timeframe: January 2025–December 2025
Funding Source: U.S. Department of Agriculture (Farm & Ranch Stress Assistance Network, Grant No. 2024-70028-43273)



Extension faculty and staff from Palau Community College, the University of Guam, and Washington State University, which oversees the Western Regional Agricultural Stress Assistance Program, touring poultry houses as part of the Farmer Focus Workshops in Palau in June 2025.



Franklin Sablan delivers a Farm Succession Planning Workshop in January 2025.

CRITICAL ISSUE AREA #3:

NATURAL RESOURCE AND INVASIVE SPECIES MANAGEMENT AND LANDSCAPE RESILIENCY

Guam and the broader Micronesian region are home to fragile insular ecosystems that face mounting pressures from powerful typhoons, prolonged droughts, wildfires, invasive species, as well as human-induced habitat destruction and unsustainable land use practices. This critical issue area covers three interrelated domains: natural resource management, invasive species control, and landscape/ecosystem resilience. These efforts focus on conserving natural resources, restoring ecosystem function, and enhancing climate resilience in both urban and rural settings.



9

WORKSHOPS &
PRESENTATIONS



200+

TOTAL ENGAGEMENT



16

ARTICLES &
PUBLICATIONS



45

ORTHOMOSAIC DATASETS

Orthomosaic Datasets



Fact Sheets & Technical Reports



Gaogao (*Erythrina variegata var. orientalis*)

By Jacob Concepcion, Brian Anderson, Xavier Reyes, and Joseph Tuquero
June 17, 2025



Banana Lace Bug

By Alfred Daniel Johnson and Robert F. Bevacqua
Sept. 23, 2025



Mango Seed Weevil

By Alfred Daniel Johnson and Robert F. Bevacqua
Dec. 4, 2025



Workshops & Events

- Jan. 29: Coastal GeoTools 2.0: Post-Mawar Recovery Presentation
- April 7: STEM Watershed Workshop at CIS Conference
- June 21: Kurason I Sengsong Drone Mapping Demonstration
- July 13-18: UOG and University of Hawaii SDAV Drone Workshop
- July 23: Insect Biodiversity Conservation Presentation
- Sept. 5: SAFNR Seminar: Why Study Insects?
- Sept. 12: GIS Training Workshop for Guam Department of Agriculture
- Nov. 19: Global GreenSTEM for Guam Department of Education Teachers
- Dec. 18: Propagation & Pest Management of Wild Endangered Trees of Guam with Guam Department of Agriculture

Newspaper Columns

- March 31, 2025: "Make your Arbor Day tree plantings a success" by Roland Quituqua
- April 7, 2025: "3 native plants to add beauty and benefit to your landscape" by Joseph Tuquero and Jackie Hanson
- June 16, 2025: "The little things that run the world" by Alfred Daniel Johnson
- July 21, 2025: "Trim the risk: Tips for proactive, pre-typhoon tree management" by Roland Quituqua
- Sept. 15, 2025: "Da'ok oil: Guam's 'green gold' with big potential" by Sahena Ferdosh
- Sept. 18, 2025: "What's turning your lawn brown? Meet the armyworm" by Alfred Daniel Johnson
- Oct. 20, 2025: "A web of misconceptions: Unraveling myths about Guam's spiders" by Alfred Daniel Johnson
- Nov. 3, 2025: "Spot the symptoms: Tips for diagnosing plant diseases in your garden" by Glenn F. Dulla

Peer-Reviewed Publications

Arabesky, V., **Johnson, A. D.**, Rozenberg, T., Lubin, Y., Segoli, M., & Mowery, M. A. (2025). Maternal care thwarts parasitoids in the invasive brown widow spider (*Latrodectus geometricus*). *Proceedings of the Royal Society B: Biological Sciences*, 292(2046), 20242735. <https://doi.org/10.1098/rspb.2024.2735>

Ferdosh, S., Rahim, N.A, Azmi, N.S.A., Ibrahim, M.A.B., & Zaidul, I.S.M. (2025). Extraction of bioactive compounds and evaluation of antioxidant activity from *Senna alata* Linn leaves using subcritical carbon dioxide Soxhlet and conventional methods. *The Natural Products Journal*, 15(8), E250724232281. <https://www.eurekaselect.com/article/141914>

Ferdosh, S., Bari, N., Wu, B., Sarker, M. (2025). Supercritical fluid extraction of phenolics from *Anisophyllea disticha* (Jack) Baill. and evaluation of their antioxidant activities. *The Natural Products Journal*, 15(2):1-11. <https://www.eurekaselect.com/article/132367>

Mia, M. A. R., Ahmed, Q. U., **Ferdosh, S.**, Islam, M. S., Samdani, M. S., & Sarker, M.Z I. (2025). Antidiabetic potential of *Phaleria macrocarpa* fruit liquid CO₂ extract: Bioactivity, cytotoxicity, phytochemicals, and molecular targets. *Phytomedicine Plus*, 100814. <https://www.sciencedirect.com/science/article/pii/S2667031325000867>

Valerio, C. K. U., & **Ferdosh, S.** (2025). A review of extraction techniques of bioactive compounds and pharmacological properties of Guam's invasive vine – *Antigonon leptopus*. *Applied Sciences*, 15(10), 5625. <https://www.mdpi.com/2076-3417/15/10/5625>



A banana leaf roller larvae eating a banana leaf. Photo by Alfred Daniel Johnson

BIOSECURITY AND BIOCONTROL EFFORTS REDUCE RISK OF COCONUT RHINOCEROS BEETLE SPREAD FROM GUAM

Relevance: First detected in Guam in 2007, the coconut rhinoceros beetle (CRB) is now established across the island. With Guam serving as a major transportation hub for Micronesia, the risk of this invasive species spreading throughout the Pacific is high. The beetle can kill coconut palms within just a few years – trees that are essential to island ecosystems, cultural practices, and local economies by way of tourism and agricultural products. Replacement costs can reach thousands of dollars per tree.

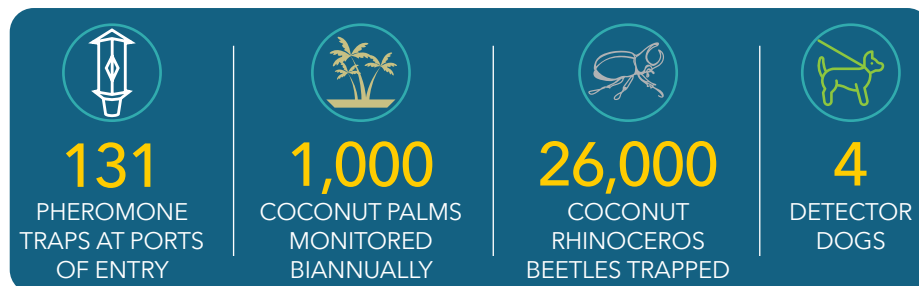
Guam's neighboring Pacific islands – many still free of CRB – face significant risk through cargo transport and travel pathways. Preventing further spread is critical to protecting regional food security, biodiversity, tourism, and cultural heritage.

Response: The agInnovation Research Center under UOG Land Grant partnered with the Guam Department of Agriculture to coordinate a multi-pronged control strategy. Their goal was twofold: 1) suppress local beetle populations and 2) prevent their accidental transport.

Key components of the plan included:

- The implementation of an integrated pest management (IPM) and biosecurity program at Guam's ports of entry. This ongoing effort includes a routine inspection of outbound cargo using specially trained detector dogs – the first program of its kind in the world for CRB detection.
- Regular monitoring of a network of 131 pheromone traps at airport and seaport facilities.
- Deployment of fungal biological control agents (*Metarhizium majus*) in breeding sites and application of injectable pesticide treatments to coconut palms in high-risk areas.
- Monitoring feeding damage on more than 1,000 coconut trees biannually.

Additionally, advanced population genetics research is underway



to identify beetle strains and evaluate the potential for viral biocontrol using *Oryctes rhinoceros nudivirus*.

Results: Since 2020, the program has removed more than 26,000 adult beetles through trapping efforts alone. Detector dog teams are actively inspecting cargo and have successfully identified and intercepted some CRB in transit.

Combining fungal biocontrol and pesticide treatments has demonstrated suppression of beetle populations in targeted areas compared to untreated areas – with three to sixfold reduction in trap catches – along with improved coconut palm health. The program has also established standardized monitoring and damage assessment protocols that can be replicated elsewhere.

The genetic research has already provided important insights, including evidence that Guam's CRB populations have not spread to other Pacific islands, reinforcing the importance and effectiveness of local containment efforts.

Next Steps: Ongoing work will expand population genetics surveillance, refine biological control strategies based on genetic findings, and further strengthen detector dog capacity. The team is also working closely with professionals in the region to share knowledge and build coordinated Pacific-wide biosecurity systems.

Published



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October 2024



(From left) Elizabeth Alexander, Tristen Lizama, and Garrett Certeza, handlers with the Guam Invasive Species Detector Dog Program at the Port Authority of Guam. *Photo by Antonio Joyce*



Project Lead: Glenn Dulla, Ph.D. | dullag@triton.uog.edu
Contributors: Guam Department of Agriculture Biosecurity Division
Research Corporation of the University of Guam
Myrmex Pty. Ltd.
Project Title: Integrated Pest Management and Biosecurity
Interdiction of Coconut Rhinoceros Beetle at Guam's
Ports of Entry
Timeframe: September 2020–Present
Funding Sources: Animal & Plant Health Inspection Service, USDA (Plant
Protection Act §7721)
U.S. Forest Service, USDA
Office of Insular Affairs, U.S. Department of the Interior
(Coral Reef & Natural Resources Initiative and the
Technical Assistance Program)

Photo by Antonio Joyce

FIRST-TIME CATALOG OF NATIVE PLANT TRAITS TO AID IN FOREST RESTORATION FOR GUAM

Relevance: With more than 600 species of plants and 100 species of trees, the tropical forests in Guam are a vital part of the island's ecosystem, supporting traditional practices and providing critical habitats for native, endemic, and endangered species.

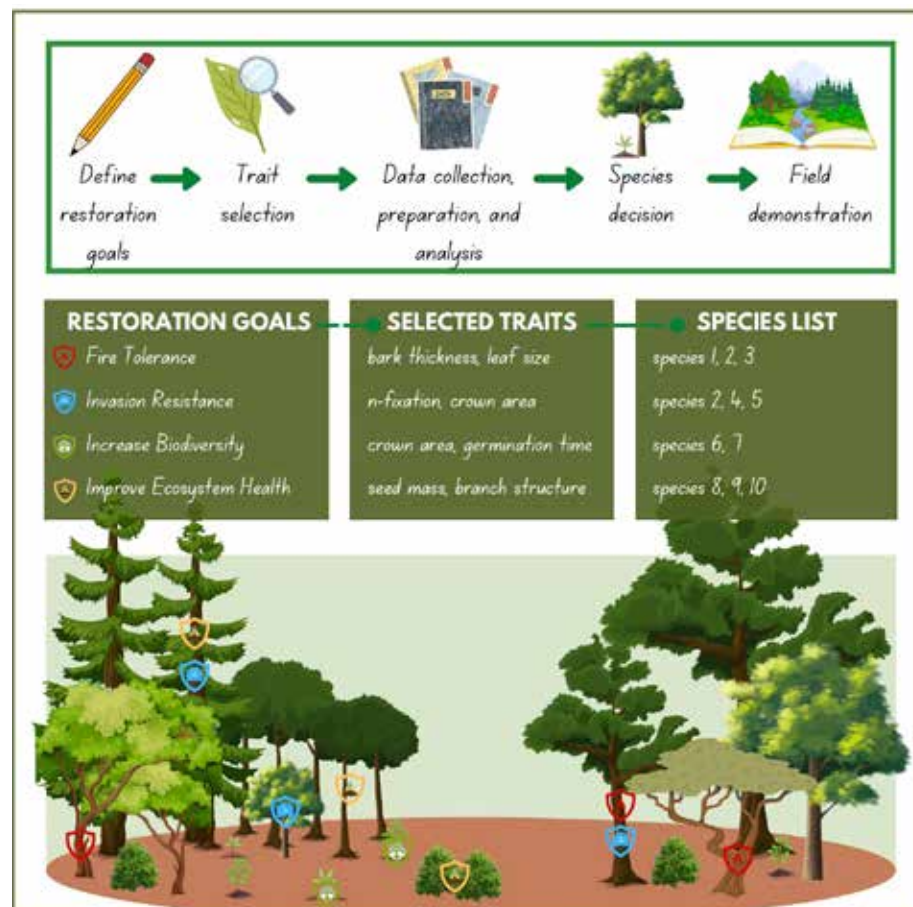
The influx of materials and equipment associated with the military buildup in Guam creates opportunities for invasive species to establish and impact forest health. Abiotic disturbances, such as typhoons, drought, and wildfires, also contribute to the spread of invasive species and alter forest composition. Land disturbance in the uplands leads to a decline in coral reef health downstream as well.

While land managers have often used certain restoration species to fill certain niches, a more scientific approach is needed. It is also increasingly urgent as Guam land managers need tools to more quickly combat a changing climate, introduced species, and reduced biodiversity. The health of Guam's forests affects not only the ecosystems, but also the human communities reliant on these natural resources.

Response: In a first-time attempt, researchers at the U.S. Forest Service Institute of Pacific Island Forestry, the University of Hawaii at Hilo, Guam's Division of Forestry, and the University of Guam Land Grant's agInnovation Research Center and supported by the Pacific Island Climate Adaptation Science Center are working to catalog the functional traits of Guam's native plant species, such as leaf area, bark characteristics, wood density, growth rate, shade tolerance, and nitrogen fixation. This can then be used to identify plants and trees equipped to face certain challenges – for example, trees with thick bark, dense wood, and quick regeneration for fire-prone areas.

This innovative approach was first tested in Hawaii using many non-native species. In Guam, the approach is mainly focusing on native or

More than 50 native plant species in Guam were identified for a first-of-its-kind database that matches plant traits to specific restoration challenges such as wildfire, erosion, invasive species, and biodiversity loss.





Non-native acacia trees, visible on the slope ridges, were planted in Guam 30 years ago and have helped stabilize the slopes and allow for the establishment of a mixture of native species seen below them. An approach moving forward will look to use native plant species in forest restoration that have functional traits for the environmental challenges of an area.



Land management representatives from numerous agencies and organizations in Guam add sticky notes to a blackboard to develop a list of key forest restoration challenges for Guam.

naturalized species, such as noni (*ladda*), to replace the non-native acacia forests that were planted in the past for forest restoration. The eventual goal is to be able to introduce a diverse mix of native species that are naturally equipped to withstand the challenges of a specific area.

Results: The research team led a workshop with more than 40 local land and forestry managers to identify the common challenges in reforesting degraded landscapes. Among the key ecological challenges they came up with were wildfires, erosion, degraded soils, invasive species, ungulates, and loss of biodiversity, among others. They also worked together to determine desirable traits in plants that could address those needs, and then identified more than 50 native species with those traits. These species will form the basis of a functional traits database for Guam.

Next Steps: In the coming year, researchers will test the functional traits and publish a list of resilient species and an analysis of how they interact with resources. This will then serve as a guide for



Research ecologist Susan Cordell of the USDA Forest Service's Institute of Pacific Islands Forestry leads the "Using a Functional Trait Approach for Designing and Implementing Resilient Landscapes in Guam" workshop at the University of Guam in early 2026.

land managers in choosing the most appropriate trees for an area. They will also determine effective species combinations for a demonstration restoration plot, which is expected to be established near the end of 2026. It will be monitored over the next 10 years to evaluate its resilience to disturbances. What results from this research in Guam could serve as a model for other similar island environments.

Lead Researcher: Susan Cordell (U.S. Forest Service, USDA) | susan.cordell@usda.gov
Research Team: Rebecca Ostertag (University of Hawaii Hilo) | Christine Fejeran (Guam Department of Agriculture) | Kyla Tuazon (ORISE Scholar) | Rachel Jolley (Univ. of Guam) | jolleyr@triton.uog.edu | Romina King (Univ. of Guam)
Project Title: Using a Functional Trait Approach for Designing and Implementing Resilient Landscapes in Guam
Timeframe: August 2024–July 2027
Funding Source: Pacific Islands Climate Adaptation Science Center, U.S. Geological Survey (Award No. G19AC00087)

BIOACTIVE BENEFITS OF GUAM-GROWN NONI FRUIT UNVEILED

Relevance: The *Morinda citrifolia* species, known locally as noni, grows abundantly and natively across the island of Guam. The wild plant can be found in both the northern limestone and southern volcanic regions of the island, yet it remains among many native Guam plants under-documented for potential natural medicinal resources.

Noni juice and other noni products are imported and marketed in Guam for the fruit's medicinal properties, as many studies globally have confirmed the fruit's bioactive components. But the specific bioactive compounds and their properties can vary based on species, maturity, climate, soil, and general environment. The noni grown in Guam's tropical climate could have unique variations.

Noni has been documented growing in a range of environments – from plains, to humid forests, to sandy coasts, rocky areas, and areas of volcanic lava flow, according to a 2019 review (Almeida et al.) of the fruit published in Comprehensive Reviews in Food Science & Food Safety. The tree's adaptability to diverse areas and its success in Guam presents an opportunity for scientific study. With localized research on its benefits, Guam can seize opportunities to develop value-added agricultural products and participate in a growing global market for plant-based therapeutics.

Response: Natural product researcher Dr. Sahena Ferdosh of the agInnovation Research Center under UOG Land Grant sought to characterize the total phenolic content and antioxidant, anticancer, and antibacterial properties of Guam's noni fruit. Her research team collected, cleaned, deseeded, and freeze-dried fruits that were growing wild alongside other native plants on the limestone in Northern Guam.

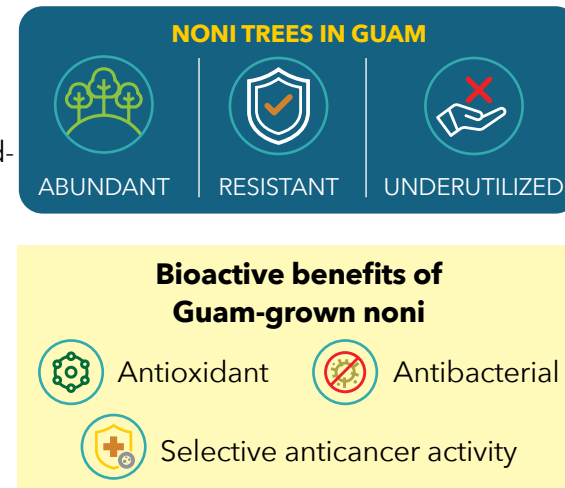
They then created crude extracts from the fruit that were tested for total phenolic content and bioactive properties. Another test looked for bacterial inhibition against *Escherichia coli*, which can cause severe

gastrointestinal illness in humans, and *Staphylococcus epidermidis*, which is the leading cause of bloodstream infections. Another evaluated noni's cytotoxicity, specifically its capacity to kill human colorectal cancer cells as well as non-cancerous cells.

Results: The biological testing confirmed that the fruit pulp of Guam-grown noni contains bioactive compounds capable of combating oxidative stress and free-radical activity. The extracts also inhibited the microbial growth of both *Escherichia coli* and *Staphylococcus epidermidis* bacterial strains. Notably, one fraction demonstrated strong and statistically significant cytotoxicity against cancer cells while showing lower toxicity toward non-cancerous cells, indicating potential for targeted therapeutic applications.

The study also determined that the Soxhlet method of extraction, at a temperature of about 78 degrees Celsius for ethanol and 65 Celsius for methanol, extracted a higher usable yield compared to maceration. Overall, this research contributes critical local data on a globally studied plant, emphasizing how environmental conditions influence medicinal properties.

Next Steps: Future research will compare conventional methods of extraction with green methods to improve sustainability and efficiency and further profiling the fruit's phytochemical composition. A manuscript detailing these findings and the potential commercial application of Guam-grown noni fruit is in preparation for journal publication.





Lead Researcher: Sahena Ferdosh, Ph.D. | ferdoshs@triton.uog.edu
Contributor: Merry Ann Ocampo (research assistant and NextGen COMPASS intern)
Project Title: Extraction and Bioactive Properties of Noni (*Morinda citrifolia*) Fruits
Timeframe: September 2024–August 2025
Funding Source: Pacific Island Partnership for Cancer Health Equity, National Cancer Institute (Pre-Pilot Project V, Grant No. 2U54CA143728)

Photo by Jessica Muyco

GUAM STUDY FINDS SOURSOP LEAVES ARE POTENT WITH BIOACTIVE COMPOUNDS

Relevance: Traditional plant-based knowledge in Guam was once central to community health but has declined as reliance on imported medicine increased. A great variety of local plant could continue to have pharmaceutical use today yet remained untested and unexplored for beneficial properties.

One opportunity lies in *Annona muricata* L., or soursop, a plant widely grown in Guam. While the fruit is commercially valued for consumption, its leaves are typically discarded despite longstanding use in traditional medicine across tropical regions for conditions such as inflammation, hypertension, and infections. Farmers, researchers, and the broader community stand to benefit from scientific validation of these underused plant materials, which could support affordable, locally sourced health solutions.

Response: The Natural Products Lab of the UOG Land Grant agInnovation Research Center investigated the bioactive potential of local soursop leaves. Researchers harvested fresh leaves and cleaned, air-dried, and pulverized them. They then performed extractions using two different solvents to see which would maximize the yield of bioactive components. One solvent was methanol, which is a more efficient extractor but unsuitable for products intended for human consumption, and the other was ethanol, which is food-grade and generally considered safer. The resulting extracts were analyzed for total phenolic content, antioxidant capacity, and antibacterial activity against *Escherichia coli* and *Staphylococcus epidermidis*.

Results: The findings revealed that solvent choice significantly influenced both composition and effectiveness of the extracts. The methanolic extracts produced the highest total phenolic content and demonstrated the strongest antioxidant activity and free-radical scavenging ability.

Often discarded as agricultural waste, soursop leaves show strong antioxidant and antibacterial activity, revealing untapped health and economic value.

Both methanolic and ethanolic extracts exhibited antibacterial activity against the tested organisms; however, the extracts using ethanol showed stronger inhibition overall, particularly against *S. epidermidis*. The leaf extracts of both proved to be more effective against Gram-positive *S. epidermidis*, which have fewer barriers preventing bioactive substances from entering the cell, than Gram-negative strains like *E. coli*.

Key bioactive compounds were identified, including alkaloids, acetogenins, and phenolics – substances widely associated with therapeutic effects. These results provide scientific evidence supporting the traditional use of soursop leaves and demonstrate their potential for applications in nutraceutical, pharmaceutical, and agricultural industries.

The identified bioactive compounds could support the development of several products, including:

- dietary supplements designed for antioxidant support
- topical creams or ointments for skin health or minor antimicrobial applications
- herbal teas and functional beverages with wellness benefits
- natural food preservatives that help reduce microbial growth and oxidative spoilage.

In agriculture, these compounds may also be explored as natural antimicrobial or plant-protection agents.



A soursop fruit (*Annona muricata* L.) in Guam.

Next Steps: Further clinical studies would be necessary to confirm safety, dosage, and effectiveness before specific medical claims can be made. Ongoing work will additionally focus on refining extraction methods and further characterizing the compounds responsible for the observed antioxidant and antibacterial activities. A manuscript on the study's findings is in preparation be submitted for journal publication.

Lead Researcher: Sahena Ferdosh, Ph.D. | ferdoshs@triton.uog.edu
Contributors: Jessica Muyco (USDA NextGen Intern)
Project Title: Valorization of Soursop Leaves (*Annona muricata*) as a Potent Source of Bioactive Compounds
Timeframe: October 2024-December 2025
Funding Source: U.S. Department of Agriculture (NextGen Subaward, Grant No. 61-1F-233425-P5)

THERMAL IMAGING BY DRONE DELIVERS NEW INFORMATION ON GUAM'S AQUIFER

Relevance: The Northern Guam Lens Aquifer provides approximately 90% of Guam's drinking water, making it one of the island's most critical natural resources. However, to accurately manage this supply requires detailed data on how water enters, moves through, and exits the aquifer system. While rainfall and distribution from production wells are relatively well-documented, gaps remain in understanding evapotranspiration and coastal discharge – two key components of the water budget. This data gap exists due to several factors, including monitoring equipment costs and limits to land access.

During droughts or periods of rapid development, it is difficult to predict water availability and implement timely conservation measures without accurate data. Water resource managers, researchers, policymakers, farmers, and residents all depend on this information to ensure a sustainable potable water supply, especially as Guam faces population growth and ongoing military expansion.

Response: A multidisciplinary research team at the University of Guam combined their expertise to get a more detailed picture of the aquifer's water budget. From May to July 2025, they used drones attached with high-quality thermal sensors, geographic information system applications, and on-the-ground and in-water loggers to conduct surveys along Guam's west and northwest coasts.

Using thermal imagery from the drones and water-quality measurements such as pH, temperature, conductivity, and salinity along the coast, the team was able to map water entry points into the aquifer, internal water transport, and freshwater discharge locations on the reefs. They then developed advanced 2D and 3D computer models to simulate how groundwater mixes with seawater under varying tidal and wave conditions and how landforms and geologic structures affect groundwater flow.

Guam's aquifer supplies about 90% of the island's drinking water, yet key data gaps limit accurate monitoring.

Results: While the data collection will continue for at least one more year, the project has already produced high-resolution orthomosaic maps and preliminary hydraulic models. These will be assessed and used to update and finalize models of coastal discharge. The resulting products can provide potentially breakthrough understandings of Guam's aquifer to be referenced by water resource managers and researchers and assist in effective planning for groundwater production and aquifer protection.

Impact and Next Steps: This research is laying the foundation for more accurate and comprehensive water resource management in Guam. By filling critical data gaps, the project supports better decision-making for sustainable groundwater use, environmental protection, and climate resilience.

Next steps include refining measurements, expanding data collection, and contributing to the development of a centralized geospatial data hub for water resources. The approach also has regional significance, offering a model for other islands with karst aquifers, including the Northern Mariana Islands.

Lead Researchers: Romina P. King, Ph.D. | roking@triton.uog.edu
John Jenson, Ph.D.

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Research Team: Yuming Wen, Ph.D.

Myeong-Ho Yeo, Ph.D.

Jose Edgardo Aban, Ph.D.

Project Title: *Hånom Fresko yan Acho' Tåsi* (Freshwater and Coral)

Timeframe: October 2021–September 2025

Funding Source: National Aeronautics & Space Administration (NASA Guam EPSCoR grant, award No. 80NSSC21M0324)



NASA Guam EPSCoR research associate Kat Delos Angeles (left) assists fellow research associate and University of Guam Drone Corps lead remote pilot Jonelle Sayama with programming a drone flight mission during a field mapping activity. *Photos by Keanno Fausto*

UOG DRONE CORPS EQUIPS GUAM AGENCIES TO GATHER GEOSPATIAL DATA IN-HOUSE

Relevance: Across Guam and Micronesia, demand for high-resolution environmental data is rapidly increasing due to climate-related challenges such as coral bleaching, wildfires, and extreme weather events. Drones offer a cost-effective and efficient way to collect this data, particularly in remote or environmentally sensitive areas where traditional methods are difficult or resource intensive.

Historically, the University of Guam Drone Corps helped meet this need by partnering with local agencies and providing trained student pilots to conduct aerial surveys. However, as reliance on drone-based data has grown, agencies have expressed a need for in-house expertise to conduct their own surveys quickly and independently. The number of certified drone pilots nationwide has more than doubled since 2020, reflecting the rapid expansion of this field.

The need affects environmental managers, researchers, students, and island communities alike, all of whom depend on accurate data for decision-making related to conservation, agriculture, and disaster response.

Response: In response, the UOG Drone Corps, an initiative under the University of Guam Land Grant's agInnovation Research Center, expanded its fifth cohort in 2025 to include not only students but also university staff and natural resource professionals for the first time. The program combined classroom instruction with hands-on training to prepare participants for FAA Part 107 remote pilot certification.

Participants completed a structured training pipeline that included aviation knowledge coursework, flight simulations, and supervised field missions. Training was conducted in partnership with local drone service provider 2cofly and took place across multiple sites, including the University of Guam campus, the university's Triton Farm, and other environmentally significant locations.



The program also introduced advanced sensor technologies, including LiDAR and gas-sensing payloads, enabling participants to collect specialized data for applications such as vegetation analysis, terrain mapping, and environmental monitoring.

Results: The fifth cohort produced 13 newly certified FAA remote pilots, achieving a 100% pass rate. Since its inception in 2021, the Drone Corps has now trained a total of 55 certified pilots. Participants conducted real-world mapping missions, producing high-resolution orthomosaic imagery to support agricultural planning, environmental monitoring, and research initiatives.

By embedding trained pilots within local agencies, the program has significantly expanded Guam's capacity to collect and analyze geospatial data in-house, reducing reliance on external support and improving response times for environmental challenges.

The UOG Drone Corps represents a first-of-its-kind model at the university, integrating workforce development, research, and advanced technology training. Its expansion strengthens Guam's ability to respond to environmental threats while building a skilled, locally based workforce.

Natalie Scott, a UOG Drone Corps graduate who works as a reef restoration biologist with the Guam Coral Reef Initiative said,



Left: UOG Drone Corps member Melanie Mendiola practices hand launching a drone alongside flight instructor John Borja at the University of Guam Triton Farm. **Right:** UOG Drone Corps members Melanie Mendiola and Kâna Sgambelluri create a polygon of the University of Guam campus on Google Earth during a training module. *Photos by Keanno Fausto*

“Obtaining my FAA Part 107 certification and learning how to operate drones has increased my team’s capacity to perform large-scale, high-quality surveys of Guam’s shallow reef flat environments, watersheds, and coastal habitats. Capturing drone imagery allows us to quickly collect data on marine and terrestrial habitats and issues like coral bleaching, algae blooms, ship groundings, erosion, and runoff, supporting Guam Coral Reef Initiative’s ridge-to-reef approach.”

Next Steps: Next steps include expanding training opportunities across Micronesia, supporting partner institutions in developing their own drone programs, and building a regional network of certified pilots. These efforts will further enhance collaboration, data sharing, and resilience across island communities.

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Research Team: John Borja (University of Guam)
 Keanno Fausto (University of Guam)
 Javier Garrido (2cofly)
 Deyan Lee (2cofly)
 Participating agency and university partners

Project Title: UOG Drone Corps Pilot-Licensing Program

Timeframe: May 2025-May 2026

Funding Sources: NASA Guam Space Grant (Award No. 80NSSC20M0039)
 NASA Guam EPSCoR (Award No. 80NSSC22M0052)
 Pacific Islands Climate Adaptation Science Center (Award No. G19AC00087)

READY-TO-USE NATIVE SEED MIXES TO AID IN EFFICIENT POST-DISTURBANCE FOREST RESTORATION IN GUAM

Relevance: Guam faces increasingly frequent and severe natural disturbances, including typhoons, heavy rainfall, and recurring wildfires. Typhoon Mawar in 2023 highlighted the island's vulnerability to weather extremes associated with El Niño–Southern Oscillation cycles and climate change. Meanwhile, human-caused wildfires burn nearly 5% of Guam's land each year, contributing to soil erosion, habitat loss, flash flooding, degraded water quality, reduced groundwater storage, and sedimentation that damages coral reefs.

These disturbances threaten native habitats that support more than 30 federally listed species and that protect water supplies, infrastructure, and military readiness. Post-disturbance restoration protocols are needed to enable resource managers to respond more quickly and effectively after fires and storms. These protocols would benefit public lands by reducing soil erosion, protecting water quality and storage, restoring forests, and conserving reef biodiversity.

Response: Researchers at the University of Guam Land Grant's agInnovation Research Center and UOG Sea Grant combined their expertise to develop and test rapid restoration methods following wildfires and typhoons. In this research phase of their project, they are identifying native plant species that can be stored long term, germinate quickly, and produce dense root systems capable of stabilizing soils. Because many tropical seeds are difficult to store, determining which native sedges remain viable over time will fill a critical knowledge gap.

The team is collecting various species of native sedges and shrubs and conducting germination trials under different seed storage conditions. Species that perform well will be propagated for seed harvest and storage so they are readily available when disturbances occur. Researchers will also evaluate hydroseeding mixtures and erosion blankets using native species and will collaborate with landscapers to test hydroseeding techniques that can be applied in remote areas.

Because many tropical seeds are difficult to store, determining which native sedges remain viable over time will fill a critical knowledge gap.

Results: The project is still in its early stages, but the researchers hope to identify native species suitable for long-term seed storage and develop effective native seed mixes and soil stabilization techniques for post-disturbance restoration. The goal is to have a native seed mix identified by summer 2027.

The project could establish Guam's first protocols for immediate post-disturbance soil stabilization using native seeds, reducing erosion during the critical period before tree seedlings become established. The findings will help guide the Guam Department of Agriculture's future restoration efforts and could create new economic opportunities for local growers who propagate and harvest native seeds for restoration projects.

Next Steps: Following the germination and seed storage research, the researchers will begin hydroseeding and soil stabilization trials and will work with the Guam Department of Agriculture Forestry Program to develop restoration protocols. Publication of this research is anticipated after sufficient data has been collected.

Researchers:	Rachel Jolley, Ph.D. rachel.jolley@triton.uog.edu Else Demeulenaere, Ph.D.
Project Title:	Creating Protocols for Safeguarding Ecosystem Services Post-Disturbances
Timeframe:	June 2024–May 2027
Funding Source:	U.S. Department of Defense Readiness & Environmental Protection Integration Program (Grant No. CF#2024-22467)



Erosion plumes show where water is directed during runoff events. Identifying these plumes and building check dams will reduce soil erosion.



Identification of native sedges, such as *Schoenus punctatus*, provides seed sources for germination and storage testing.



Erosion control blankets not only stabilize soil, but provide microclimates for seed germination. Here, a split-plot design is used to test soil erosion and seedling establishment with and without soil erosion blankets.

SEED GERMINATION STUDY REVEALS BEST METHOD TO PROPAGATE A DECLINING NATIVE GUAM TREE

Relevance: The *Erythrina variegata* species, a native tree of Guam commonly known as tiger's claw or Indian coral tree and known in the native Chamorro language as *gaogao*, is in rapid decline. While no population estimates are currently available, the decline is widely recognized by those familiar with the species. The loss of *gaogao* is both an ecological and cultural concern because the tree provides food for native birds and fruit bats, and its plant materials are a major ingredient in several traditional herbal medicines of the native Chamorro population.

The decline affects the people of Guam, including traditional healers, ornamental plant growers, forestry professionals, horticulturists, and others working to conserve native plants. Exploring ways to successfully propagate this tree, while also increasing public awareness of the tree's importance and decline, can help restore local populations and preserve Guam's native ecosystems and cultural heritage.

Response: A horticulturist with the University of Guam Land Grant's Native Plant Education Program teamed up with research assistants from the university's Center for Island Sustainability to find a mature *gaogao* tree, collect seeds, and evaluate multiple seed germination treatments to determine the most effective propagation method.

The research compared the well-established seed treatment methods of seed scarification, water-soaking seeds, and untreated seeds through germination trials. This provided a first-time learning opportunity for three research assistants at UOG's Center for Island Sustainability to conduct these propagation techniques as part of native plant conservation efforts.

Results: The seed scarification method produced the strongest results, achieving a 100% germination rate with uniform germination timing. Untreated seeds did not germinate during the 1.5-month

Treatment	Average days to germination	Germination rate
Untreated seeds	0	0%
Water-soaking	8	30%
Seed scarification	8	100%

observation period, while water-soaked seeds achieved a 30% germination rate. The findings demonstrate that manipulating the seed coat can dramatically improve *gaogao* germination.

These results, which have been published as a user-friendly fact sheet on the online UOG Land Grant publications library, provide a practical method to help residents and conservation workers to produce healthy seedlings for landscaping, restoration projects, and outplanting. Increasing successful propagation of *gaogao* can contribute to the restoration of Guam's native forests, urban landscapes, and agroforestry systems while preserving native plant genetics and increasing species-specific genetic diversity.

Next Steps: Future research will evaluate different water-soaking durations to determine whether germination rates can be improved by seed soaking and with less labor than is needed for scarification. Additional future efforts include outplanting *gaogao* seedlings in forests, urban landscapes, and agroforestry systems as well as investigating management strategies for the tree's major pest, the *Erythrina* gall wasp.

Lead Researcher: Joseph Tuquero, M.S. | tuqueroj@triton.uog.edu
Contributors: Jacob Concepcion
Xavier Reyes
Brian Anderson
Project Title: Gaogao Seed Germination Study
Timeframe: February-May 2025
Funding Source: Smith-Lever Capacity Grant, USDA

Published
Fact Sheet



June 2025



Main image: An *Erythrina variegata* tree. Photo sourced from Adobe Stock.
Inset image: Gaogao seedlings transplanted from flats into individual pots.
Photo by Jacob Concepcion

FIRST REPORT OF NEWLY INVASIVE BANANA LACE BUG IN GUAM

Relevance: The banana lace bug (*Stephanitis typica*) is a newly invasive sap-sucking pest threatening banana production in Guam. Bananas are the island's most important fruit crop, with 126,528 pounds grown by nearly 300 banana farmers in 2023. Feeding on the leaves by the nymphs and adults causes leaf chlorosis, reduces photosynthesis, stresses plants, and can reduce fruit yield and quality. The insect has also been reported as a vector of wilt disease in coconut.

Because *S. typica* is a recent invader, limited local information is available for growers on how to identify, monitor, and manage the pest or understand the role of naturally occurring predators. Improving that knowledge is critical to protecting Guam's banana production in a sustainable manner.

Response: Researchers with the University of Guam Land Grant conducted islandwide field surveys to establish baseline information on the invasive banana lace bug and its associated natural enemies. The team evaluated banana leaves from south- and north-facing orientations across row-planted and randomly planted production systems to assess lace bug abundance and document the diversity of natural enemies present.

The team also worked directly with growers through field visits and outreach, improving early detection and accurate identification of infestations. Extension materials, including a fact sheet and field diagnostic resources, were developed and distributed to growers, backyard gardeners, and extension personnel to help distinguish banana lace bug damage from nutrient deficiencies and plant diseases.

Results: The project produced the first report of *S. typica* and its associated natural enemies in Guam. Following the release of extension materials, grower inquiries increased, indicating growing awareness and demand for locally relevant pest management information.

The field surveys found significantly higher lace bug populations on south-facing leaves than on north-facing leaves, demonstrating that canopy orientation and local environmental conditions

influence infestation levels. The report also documents a native theridiid spider preying on banana lace bugs, along with a chalcid egg parasitoid and an entomopathogenic fungus.

These findings allow the development of targeted, site-specific integrated pest management recommendations that could reduce reliance on broad-spectrum insecticides. They also provide important baseline information for future comparison.

Next Steps: Researchers will continue monitoring seasonal population dynamics, evaluate cultural and biological control strategies compatible with integrated pest management, assess the role of native natural enemies and habitat management, and expand outreach through workshops, field demonstrations, and research and extension publications.

Findings also will be presented at the 2026 Entomological Society of America Annual Conference, followed by submission of a manuscript to the Journal of Insect Science.

Impact of lace bug on banana plants:



Reduces photosynthesis



Stresses plants



Reduces fruit yield and quality

Lead Researcher: Alfred Daniel Johnson, Ph.D.

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Contributors: Anastasha Wallace (NextGen COMPASS Intern)

Robert F. Bevacqua, Ph.D.

Project Title: The New Invasive Banana Lace Bug and Its Natural Enemies

Timeframe: May–Present

Funding Source: Smith-Lever Capacity Grant, USDA



September 2025



Top: A chalcid egg parasitoid that was found attacking eggs of banana lace bug. **Bottom:** A *Theridiidae* spider feeding on adult banana lace bug. **Right:** Adult banana lace mugs mating on the underside of a banana leaf.
Photos by Alfred Daniel Johnson



GUAM RESEARCHERS DOCUMENT DATA ON NEWLY ESTABLISHED BEETLE TO FACILITATE MANAGEMENT

Relevance: Guam's hog plum (*Spondias* spp. or *singuelas*) trees are threatened by the invasive sineguelas leaf beetle (*Podontia quatuordecimpunctata*), first detected in Guam in 2024. Adults and larvae feed on young leaves and shoots, causing defoliation, reduced tree vigor, and potential declines in fruit production.

Because the pest is newly established and has not been reported on other Micronesian islands, documenting its biology, distribution, and natural enemies is critical for early detection, sustainable management, and regional biosecurity. This information would benefit growers, homeowners, land managers, and neighboring islands by helping limit the beetle's spread and protect agricultural resources.

Response: The University of Guam Land Grant Extension Service established baseline information on the beetle by documenting its distribution, life cycle, feeding damage, host associations, and natural enemies. Field surveys were conducted in the villages of Yigo, Dededo, Mangilao, Ija, and Inalåhan and included assessments of more than 300 shoots to identify feeding patterns and document all life stages.

Researchers also collected pupal chambers to identify natural enemies and began laboratory studies on the predatory stink bug *Eocanthecona furcellata* as a potential biological control agent. The project also partnered with the Guam Department of Agriculture to increase public awareness and supported media coverage in a local newspaper and television station.

Results: The project produced Guam's first comprehensive biological and ecological data on the sineguelas leaf beetle. Researchers documented the complete life cycle as well as larval defensive adaptations, preferred feeding locations, and *E. furcellata* as a

promising biological control agent. The findings provide the foundation for integrated pest management while increasing public awareness, strengthening invasive pest monitoring, and providing science-based guidance for growers, residents, and government agencies. Ongoing research is evaluating whether *E. furcellata* can be mass-reared for sustainable biological control.

Next Steps: Researchers will continue evaluating *E. furcellata* as a biological control agent and refine laboratory rearing techniques to assess its potential for augmentative releases across Guam. Following two field seasons of data collection, the team plans to publish its findings in the Journal of Pacific Science and present results at scientific conferences to support regional invasive species management.

Damages caused by sineguelas leaf beetle:



Defoliation



Reduced tree vigor



Potential declines in fruit production

Lead Researcher: Alfred Daniel Johnson, Ph.D. |

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Contributors:

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Jehan Dela Cruz

Matthew Leon Guerrero

Project Title:

Sineguelas Leaf Beetle (*Podontia quatuordecimpunctata*)

Invasion: Biology, Impact Assessment, and Development of Sustainable Management Strategies for Guam

Timeframe:

June 2025–Present

Funding Source:

Smith-Lever Capacity Grant, USDA



Healthy hog plum leaf compared with leaves damaged by sineguelas leaf beetle feeding.



A nymph of beneficial predator, *Eocanthecona furcellata*, attacking a sineguelas leaf beetle larva.



An adult sineguelas leaf beetle (*Podontia quatuordecimpunctata*). Photos by Alfred Daniel Johnson

CRITICAL ISSUE AREA #4:

SUSTAINABLE FOOD AND AGRICULTURAL SYSTEMS

Ensuring a sustainable and resilient agricultural sector in Guam is essential for food security. It is also a strategic imperative for economic development and community and family wellness. This critical area addresses four interlinked issues:

- sustainable agricultural production;
- plant, animal, and aquatic pest management;
- market expansion for local agricultural products; and
- emerging issues and innovative technologies.



34

WORKSHOPS & PRESENTATIONS



21

ARTICLES & PUBLICATIONS



1000+

TOTAL ENGAGEMENT

Fact Sheets & Technical Reports



Swine Welfare Essentials: Heat Stress, Nutrient Needs, and Data Collection

By Jeng-Hung Liu
April 1, 2025



Poultry Welfare Essentials: Heat Stress, Nutrient Needs, and Data Collection

By Jeng-Hung Liu
April 1, 2025



2023 Guam Census of Agriculture

Facilitated by Peter Barcinas
April 1, 2025



Chicken Tractors (Revised)

By Ilene Quituga, Justin Santos, Mark Acosta, Jose Rodriguez, and L. Robert Barber
April 9, 2025



'Fiji' Banana

By Robert F. Bevacqua
April 25, 2025



'Saba' Banana

By Robert F. Bevacqua
April 25, 2025



Chaya

By Rennie Glen Taiwerpal, L. Robert Barber, Tanisha F. Aflague, Rita Barcinas, and Mark Acosta
May 5, 2025



Comparative Stress Assessment of Mango Cultivars at Ija Research & Education Center, Guam

By Richard Singh, Adriann Alfons, William Minami, Aryanna Sanele, and Benjamin Snaer
Dec. 1, 2025



Workshops & Events

- Jan. 18: Farm Succession Planning Workshop
- Jan. 22-23: Spring 2025 Farmer Focus Welcome Back Outreach Event
- Jan. 25: Field Day: Banana Harvesting & Handling
- Feb. 8: Field Day: Seedless Watermelon Variety Trial
- Feb. 12 and 20: Irrigation and Micro-Irrigation Workshop for UOG CIS Plant Nursery
- March 4: Horticulture Workshop at Business & Technology Charter School
- March 15-May 28: Feral Swine Perimeter Fence Program for Southern Farmers
- April 7, 9, 12: Backyard Egg Production Workshops
- April 8, 17: Five Future Farmers: Yield Production Monitoring Workshop
- April 7: Sustainable Agriculture & Agricultural Educational Resources for Teachers Presentation at Educators Summit
- April 8: Banana and Papaya Farm Tour at Educators Summit
- April 11: Sustainable Banana Production Presentation at CIS Conference
- April 26: Soil & Water Stewardship Week Demonstrations
- May 8: Agriculture & Fisheries Professional Development Training for SBDC
- May 10: Field Day: Banana Varieties & Propagation
- May 28-29: Farmer Focus Workshop in Palau
- June 21: Horticulture Lab Black Pepper Production Forum
- July 23: Economic Benefits of Soil Conservation Practices Presentation at Educator's Symposium
- July 23: Online Agricultural Resources for Teachers Presentation at Educator's Symposium
- Aug. 11-15: Principles of Gardening Workshop Series for Extension Professionals
- Aug. 23, 26, 29: Farmer Focus Health Seminars
- Sept. 13: Live Poultry Processing Workshop
- Sept. 25: Farmer Focus/I'Pinangon Suicide Prevention Outreach
- Sept. 26: Innovations in Agricultural Research Workshop: Climate Change and Guam
- Oct. 11: SAFNR Seminar: UOG Horticulture Program
- Oct. 24: SAFNR Seminar: Field Trials - Dos, Don'ts,

and Dollars

- Oct. 25: New Specialty Crop Workshop: Roselle Hibiscus
- Oct. 29-31: Regional Farmer Focus Conference in Guam
- Oct. 29: Sustainable Banana Production Presentation at Farmer Focus Conference
- Oct. 29: Integrated Crop Management Presentation at Farmer Focus Conference
- Oct. 29: Sustainable Insect Management Presentation at Farmer Focus Conference
- Nov. 20: Banana Propagation Workshop for Air Force
- Nov. 22: Agricultural Economics of Subsistence Farming Presentation at AgriNet 2025
- Dec. 14: Advanced Mango Grafting for Farmers
- Dec. 16: Sheet Mulching Workshop: Turn Your Lawn into a Productive Garden

Newspaper Columns

- Jan. 20, 2025: "A sweet opportunity: Seedless watermelon could help diversify Guam's agricultural commodities" by Robert F. Bevacqua
- Feb. 17, 2025: "From carbon capture to crop growth: How biochar benefits both the planet and our farmers" by Mohammad H. Golabi
- March 17, 2025: "From pests to partners: Navigating backyard gardening with feral chickens" by L. Robert Barber
- July 7, 2025: "How to rein in your dragon fruit: Maximize the potential of this rising tropical fruit" by Jian Yang
- Nov. 17, 2025: "It's avocado flowering season - what to do now for a good harvest later" by Jesse P. Bamba
- Dec. 1, 2025: "A crucial part of Guam's food security is right underneath our feet" by Christianah Oladoye

Peer-Reviewed Publications

Delfin, M. M. & **Marutani, M.** (2025). Studies on phytochemistry and antioxidant capacity of nine *Hibiscus sabdariffa* accessions. *HortScience*, 60(6), 832-840. <https://doi.org/10.21273/HORTSCI18483-25>

Fernandez, M., Noda, H., Takayama, K., & **Marutani, M.** (2025). Genetic diversity of cultivated and wild *Capsicum* accessions from Guam and Tinian using MIG-seq. *HortScience*, 60(4), 578-586. <https://doi.org/10.21273/hortsci18396-24>

Lu, Z., Wang, J., Jiang, D., Wang, Y., & **Jiang, H. G.** (2025). A practical and effective *Artemia* hatching method to eliminate covert mortality nodavirus (CMNV). *Aquaculture Journal*, 5(1), 5. <https://doi.org/10.3390/aquacj5010005>

Mabry, T., Klever, J., **Oladoye, C.**, Nowatzki, T., Bing, J., Sethi, A., Price, M. and Liu, L. (2025). Field efficacy, adult emergence, and yield evaluation of the corn rootworm transgenic events in Vorceed™ Enlist® Corn and SmartStax® PRO Hybrid Corn against corn rootworms (Coleoptera: Chrysomelidae). *Crop Protection*. 198. <https://doi.org/10.1016/j.cropro.2025.107371>

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DRONE MAPPING PROJECT INFORMS CONSERVATION ON PRIVATE FARMS IN GUAM

Relevance: Southern Guam faces increasing pressure from development, invasive species, and wildfire risk. At the same time, farmers, agricultural producers, and conservation partners have limited access to current spatial data needed for conservation planning on private agricultural lands. Many producers also lack affordable tools to assess the conditions of their land, identify resource concerns, and document conservation needs.

These challenges contribute to soil degradation, deforestation, and threats to long-term agricultural productivity. The threat of lost agricultural land also affects Guam's food security. Because Guam remains heavily dependent on imported food, strengthening local agriculture and improving stewardship of working lands can help support a more resilient and sustainable food system for the island.

Response: To address these challenges, the agInnovation Research Center under UOG Land Grant and the Southern Guam Soil & Water Conservation District partnered with multiple government agencies to form the Guåhan Sentinel Landscape Partnership. The team used uncrewed aerial vehicles (UAVs), or drones, to provide farmers and conservation partners with site-specific information about agricultural lands. For many participating producers, this is the first time their properties have been surveyed using drone technology.

Remote pilot Andrea Velasquez is conducting drone missions for properties registered with SGSWCD. The project produces three mapping products:

- high-resolution RGB maps that provide detailed overhead views of properties
- Normalized Difference Vegetation Index (NDVI) maps that assess vegetation health and density
- LiDAR-based maps that provide topographic information.

These tools help producers evaluate farming conditions, identify conservation opportunities, improve soil management, and support landscape preservation. The project also strengthens collaboration among farmers, private landowners, local agencies, federal partners, and conservation programs.

Drone maps help farmers:



assess farming conditions



identify conservation opportunities



improve soil management



support landscape preservation

Results: To date, drone surveys have mapped 26 properties registered with the Southern Guam Soil & Water Conservation District. The project will be ongoing through 2026. The resulting maps provide a growing inventory of working lands and private properties with existing conservation efforts or strong potential for future conservation practices.



26

AGRICULTURAL
PROPERTIES MAPPED

A post-project evaluation will determine how effectively these mapping products improved producers' understanding of land conditions, agricultural potential, and conservation opportunities.

Next Steps: This project could serve as a model for using drone technology to support agriculture and natural resource management in small island communities. Future efforts may include developing a geospatial database that tracks soil health, vegetation density, land characteristics, and agricultural capacity across Guam's working lands.



Main image: Remote pilot Andrea Velasquez operates a drone equipped with a gas detection sensor over a crop field in southern Guam on May 2025. *Photo by Keanno Fausto.*
Inset image: An orthomosaic map of a Guam farm. *Image used with permission from property owner Marcela Takai*

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Project Title: Guåhan Sentinel Landscape Partnership - Private Landowner & Producer Network (Task 3)

Timeframe: December 2022-2026

Funding Sources: U.S. Department of Defense (Readiness & Environmental Protection Integration Program); U.S. Department of Agriculture; National Association of Conservation Districts, U.S. Department of the Interior (Grant No. HQ00342020012)

PUBLIC OUTREACH GROWS CONSUMER CONFIDENCE IN GUAM-GROWN TILAPIA

Relevance: Guam imports nearly all of its seafood, leaving families vulnerable to rising prices and supply disruptions from global crises, such as during the COVID-19 pandemic. While local aquaculture offers a practical solution, small producers face strong competition from low-cost imports and limited consumer awareness of locally raised seafood.

These challenges affect both local producers and consumers. Farmers need more viable markets for locally produced fish, while residents presently have limited access to fresh, locally sourced seafood. Salt-tolerant tilapia raised in seawater offers a climate-resilient production option well-suited to island environments. Improving consumer awareness and demand for local aquaculture products can strengthen Guam's food security and reduce dependence on imported foods.

Response: From 2024–2025, the Guam Aquaculture & Development Training Center under the UOG Land Grant agInnovation Research Center led a coordinated public outreach and marketing effort to connect retailers, chefs, and students with locally grown red tilapia.

This project focused on helping Guam residents see, taste, and trust locally grown seafood, specifically salt-tolerant red tilapia raised in seawater in Guam.

Efforts included:

- **Direct public outreach** at farmers markets and agricultural events, where residents could see and learn where the fish were raised.
- **Introducing fresh tilapia in grocery stores**, offering consumers a high-quality, locally sourced alternative to imported frozen fish.
- **Partnering with major hotels and restaurants** to feature Guam-grown tilapia in signature dishes at high-profile events.
- **Supplying fish for culinary competitions** with student chefs, building awareness in the next generation of chefs of the quality and possibility of locally raised fish.

"It doesn't just compete with salmon or snapper — it was better. ... The flavor was so mild and buttery, and the texture could not have been better. I just don't think we have ever eaten better cooked fish."

- **Hands-on training** in aquaculture production and sustainable fish production with University of Guam students.

Results: Thousands of residents encountered Guam-grown red tilapia over the course of this initiative, building greater consumer awareness of and confidence in local seafood.

The effort also demonstrated to local producers and prospective producers that Guam-grown fish can compete with imports based on quality, freshness, and local identity. One Guam resident commented, "It doesn't just compete with salmon or snapper — it was better. ... The flavor was so mild and buttery, and the texture could not have been better. I just don't think we have ever eaten better cooked fish."

In the process of raising the fish, university students gained practical experience in aquaculture production and sustainable food systems as future careers. Additionally, partnerships with chefs and culinary students helped reposition tilapia from a low-cost commodity to a premium local product.

Next Steps: This effort demonstrated how local aquaculture can reduce dependence on imports, shorten supply chains, and keep food dollars within Guam's economy. Growing interest from regional partners in culturing this strain of red tilapia, including from Northern Marianas College and the Guam Farmers' Cooperative Association, suggests strong potential for expansion. Future efforts may focus on expanding production, increasing consumer access, and supporting adoption throughout the Pacific region.



Steamed Guam-raised red tilapia prepared by student chefs for a hotel conference in Guam. *Photo by Conrad Calma*



A fried red tilapia dish prepared by chefs at the Hyatt Regency Guam.



Saltwater-raised red tilapia growing at the Guam Aquaculture & Development Training Center of the UOG Land Grant agInnovation Research Center.

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Project Title: Marketing, Trade, and Management of Aquaculture and Fishery Resources (Multi-State Research Project)
Timeframe: January 2025–December 2025
Funding Source: U.S. Department of Agriculture (Multi-State Research Project: Marketing, Trade, and Management of Aquaculture and Fishery Resources, Grant No. GUA 956)

HOTEL-FARM COMPOST PARTNERSHIP DEMONSTRATES CIRCULAR FOOD SYSTEM

Relevance: The island of Guam, a tropical destination in the Western Pacific for Korean and Japanese tourists, sees close to five times the number of tourists annually as its local population. The island also sees a high level of food waste – with its largest hotels featuring multiple restaurants each, alongside many other standalone food service operations, and no systems or infrastructure in place to separate organic materials from other trash. This means a majority of food waste ends up in the landfill, which is a limited resource on the small island.

The disposal of food waste comes at a cost to these businesses. Additionally, while organic matter is going to waste and taking valuable space in the landfill, farmers in Guam are challenged by poor soil quality, often relying on costly, imported synthetic fertilizers to amend soil nutrients.

Response: Triton Farm, a demonstration farm for sustainable agriculture under the University of Guam Land Grant’s agInnovation Research Center, partnered with the Hyatt Regency Guam – a popular venue for tourists and locals alike – to establish a regular food waste collection and composting program. The initiative was timely as the island leaders and residents are looking to prioritize waste reduction, sustainability, and local food system resilience.

Over the course of the year, the Hyatt kitchen staff separated approved organic materials – fruit, vegetable, and eggshell scraps – into collection bins. Triton Farm staff then collected the bins from the hotel six to eight times each month and transported it to the farm, where it was incorporated into compost windrows. Once the compost reached maturity, it was applied to Triton Farm production areas to improve soil health. Several bins of finished compost were also returned to the Hyatt to support the hotel’s on-site vegetable garden.

Results: Throughout 2025, the partnership not only diverted 45,326

The year-long hotel-farm partnership diverted 45,326 pounds of food waste from Guam’s landfill while creating nutrient-rich compost to improve soil health.

pounds of food waste from Guam landfills, but also created a locally produced soil amendment for crop-growing areas at Triton Farm and in the Hyatt Regency Guam’s on-site vegetable garden. The compost added organic matter to the soil and appeared to improve soil structure, moisture retention, and the overall condition of the planting areas.

In the process, the composting site also provided a demonstration for farm visitors of how to compost on a larger scale and how to create a fully circular system – something that is not widely practiced in Guam. The model could be replicated throughout the region, with other food service businesses and farms partnering to support each other. Hyatt Chef Mirko Agostini said he was very pleased with the outcome and suggests that other hotels look into similar partnerships.

Next Steps: The next step for this project could be to evaluate the quality of the compost by monitoring nutrient content, organic matter levels, and microbial activity of the soils to which it was applied. Researchers could also compare the growth and yields of the crops that received the compost versus those that received standard soil management practices.



Right: University of Guam Triton Farm staff add a bin of eggshells and fruit and vegetable scraps from a local hotel to the compost windrows at the university's demonstration farm. *Photo by Jackie Hanson* **Left:** UOG Triton Farm staff Francis Taijeron demonstrates turning a compost windrow using a tractor-pulled compost turner. *Photo by Conrad Calma*



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Project Title:	Hyatt-Triton Farm Food Waste Composting Partnership
Timeframe:	January-December 2025
Funding Source:	Hatch Act Capacity Grant, USDA



NURSERY AND LAB UPGRADES STRENGTHEN PLANT DISEASE RESEARCH AND WORKFORCE TRAINING IN GUAM

Relevance: Guam and the broader Micronesian region are increasingly vulnerable to plant diseases, invasive pathogens, and climate-related stressors that threaten food crops and natural ecosystems. Despite these growing risks, the University of Guam previously lacked the infrastructure needed to safely conduct modern plant pathology research, particularly work involving quarantine pathogens or controlled experimental conditions.

Limited nursery space also restricted student training, research projects, and extension activities, creating a bottleneck in developing local expertise. As a Land Grant institution serving the region, the University of Guam plays a critical role in supporting farmers, diagnosing plant diseases, and responding to agricultural threats. Strengthening this capacity is essential for improving food security, reducing reliance on off-island diagnostics, and preparing a skilled local workforce.

Response: A project within University of Guam Land Grant's agInnovation Research Center addressed these challenges through targeted investments in laboratory and nursery infrastructure. New equipment – including a biosafety cabinet and environmental growth chambers – was installed to support sterile culture work, pathogen handling, and controlled experiments.

In parallel, the project expanded outdoor facilities through the construction of four dedicated hoop houses built on a concrete pad and secured with cyclone fencing. These nursery spaces are located near instructional areas, allowing seamless integration into teaching, research, and extension programs.

For the first time, these upgrades enable faculty and students to safely conduct advanced plant pathology work, including studies

New lab and nursery infrastructure now enables advanced plant disease research and hands-on student training previously not possible in Guam.

involving quarantine pathogens and transgenic materials under appropriate biosafety conditions.

Results: The project has modernized plant pathology capabilities at the University of Guam, creating a functional, safe, and flexible environment for both research and education. Expanded nursery facilities now support multiple courses, student-led projects, and demonstration activities.

Student participation in plant disease diagnostics and applied research has increased, with improved access to hands-on training opportunities. The upgraded facilities have also strengthened the capacity of the UOG Plant Health Clinic to provide timely diagnostic services to local farmers and agricultural stakeholders.

These improvements represent a major step forward in building Guam's ability to detect, manage, and prevent plant health threats locally. By enhancing research and training capacity, this project contributes directly to agricultural resilience, biosecurity, and workforce development in Guam and the wider Micronesian region.

Impact and Next Steps: Next steps include integrating the new facilities into undergraduate and graduate curricula, expanding diagnostic services, and developing new research collaborations and funding opportunities focused on invasive species and plant health. The infrastructure established through this project will support long-term advancements in agriculture and biosecurity well beyond the grant period.



Main image: A lab assistant place a papaya seedling in a new Conviron plant growth chamber in the UOG Plant Pathology Lab. **Inset image:** A class of agriculture students holds watermelons they grew in the new hoop house nursery facility outside the agriculture college of the University of Guam. *Photos by Antonio Joyce*



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Project Title: Improvement of Plant Pathology Research Laboratory and Student Nursery Facilities at the University of Guam
Timeframe: January 2024–December 2026
Funding Source: U.S. Department of Agriculture's National Institute of Food & Agriculture (Agriculture & Food Science Facilities & Equipment Program for Insular Areas)



CROSS-TRAINING BUILDS GUAM'S CAPACITY TO TEACH RESIDENTS ABOUT HOME FOOD PRODUCTION

Relevance: Guam's heavy dependence on imported food makes the island vulnerable to supply chain disruptions. An estimated 80% to 90% of fruits and vegetables consumed in Guam are imported, and fresh produce shortages can occur within days when shipping is interrupted. Rising transportation costs and inflation have further increased food prices, while local production supplies only a small portion of demand.

Many extension programs under the University of Guam Land Grant targeting residents and youth now include gardening and food production, but many educators outside of agriculture, such as those in 4-H and in family and consumer science programs, have limited training in tropical, small-scale food production systems. Cross-training these educators would have a multiplier effect in university's ability to deliver practical, locally relevant gardening education to even more residents and sectors of the community.

Response: Extension experts with the University of Guam Land Grant developed and piloted a five-day, 20-hour "Principles of Gardening" workshop to cross-train non-agriculture extension staff and new agriculture faculty. The curriculum condensed more than 100 hours of existing Guam sustainable agriculture materials into an intensive, hands-on course focused on tropical subsistence and small-farm gardening.

The training combined classroom instruction with field demonstrations covering soil health, sheet mulching, container gardening, plant propagation, drip irrigation, raised beds, composting, chicken tractor systems, and low-toxicity pest management.

This represented UOG Land Grant Extension's first formal cross-disciplinary agriculture training and its first structured effort to standardize tropical gardening, permaculture, and agroforestry practices across extension programs.

This first-time cross-training effort among extension educators will create a multiplier effect, with each trainer now able to teach hundreds more residents annually about home food production.

Results: Attendance averaged 13 to 16 participants per day, primarily extension professionals. Participants reported gaining practical skills in soil building, container gardening, propagation, drip irrigation, composting, and pest management. Post-training surveys indicated they plan to apply these skills in home gardens, school and 4-H programs, community workshops, and extension demonstration sites.

Over the next 12 months, the team will track how many new gardening programs, demonstration sites, and community gardens are established, along with the number of youth and residents reached.

By equipping educators who can each reach hundreds of residents annually, the training creates lasting internal capacity that could increase local food production knowledge, reduce household food costs, and improve Guam's resilience during future food supply disruptions.

Next Steps: The team plans to develop teaching kits and standardized materials that can assist in the efficient training of new faculty, staff, and partners moving forward. The training will also be expanded to community leaders and volunteers, and advanced training modules will be offered throughout the year. Lastly, the team plans to establish demonstration gardens at extension sites and will be publishing fact sheets and an outcomes report for USDA reporting channels.



University of Guam extension agent Mark Acosta demonstrates how to soak a large quantity of cardboard for use as a weed barrier when sheet mulching a garden plot.
Photo by Conrad Calma

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Project Title: Principles of Gardening for New and Non-Agriculture
Extension Professionals Pilot Training

Timeframe: Aug. 11-15, 2025

Funding Sources: Western Sustainable Agriculture Research & Education
(Grants: Training New Extension Agents in Sustainable
Agriculture for the Territory of Guam; Guam 3-Year State
Professional Development Program Plan FY 2024-2026)

BACKYARD POULTRY WORKSHOPS HELP GUAM FAMILIES BUILD FOOD SECURITY

Relevance: Guam imports approximately 85% to 90% of its food, leaving island families vulnerable to supply chain disruptions, high prices, and limited local protein production. Eggs and poultry are among the most accessible livestock options for households seeking greater food security, yet many residents lack practical knowledge of chick care, housing, waste management, food safety, and humane processing.

Educating residents on backyard egg and poultry production would build practical agricultural skills throughout the community, strengthening Guam's food resilience and reducing the island's dependence on imported food.

Response: The University of Guam Land Grant Extension Service developed a Backyard Egg & Poultry Production Workshop Series to help families safely start and manage small backyard flocks. The program targeted beginning producers, families, and homesteaders interested in producing eggs and meat for personal consumption.

Extension agents developed and delivered a four-hour chick and egg production workshop. Participants – 120 in total – learned about day-old chick care, adult hen management, housing design, deep-litter systems, composting, mulch reuse, fresh egg food safety, and small-scale production systems, including chicken tractors. Upon completing the workshop, they received two Buff Orpington chicks to establish their home flocks.

Four months later, the agents delivered a poultry harvesting and food safety workshop for 25 participants. They learned USDA-aligned humane harvesting, processing, sanitation and HACCP practices through hands-on demonstrations of scalding, defeathering, evisceration, cleaning and safe food preparation, including cooking and smoking techniques.

Results: Survey data showed most of the registrants attended to learn



how to produce food for their households rather than for commercial purposes, highlighting strong community interest in improving household food security. Ninety-five percent of the participants surveyed rated the workshop's usefulness as excellent, while 92% rated the quality of workshop materials as excellent.

Participants reported plans to raise their chicks into egg-laying hens, build coops and chicken tractors, implement deep-litter composting systems, reduce household egg purchases and improve sanitation and food safety practices. Many cited the hands-on demonstrations, coop tours, and practical, low-cost housing solutions as the most valuable parts of the training.

As a result, dozens of households initiated backyard poultry production, increasing local capacity to produce eggs and meat while adopting composting and nutrient recycling practices. By coupling chick distribution with applied training, the project equipped families with practical skills to produce protein at home and strengthened Guam's food security, sustainability, and community resilience.

Next Steps: Future efforts could include advanced poultry management workshops, additional training in poultry health and disease prevention, ongoing technical assistance for participants, and follow-up evaluations to measure long-term adoption, food production, and household impacts.



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Timeframe: April-September 2025
Funding Source: Western Sustainable Agriculture Research & Education (Guam 3-Year State Professional Development Program Plan FY 2024-2026, Project No. WGU24-001)

Guam resident Minerva Hermosilla cleans feathers and internal organs from a chicken carcass during a September 2025 workshop that taught residents the complete process of slaughtering and processing a chicken. *Photo by Conrad Calma*

SEEDLESS WATERMELON VARIETY TRIAL IDENTIFIES TOP PERFORMER FOR GUAM

Relevance: Seedless watermelon is a highly in-demand fruit for its convenience and health benefits. On the island of Guam, it has the added appeal of being a hydrating and refreshing fruit in the year-round tropical climate. While watermelons are grown in Guam, there is no local production of seedless watermelons – all are imported from Mexico and the U.S. mainland.

Consumer demand, combined with a growing preference to buy local, presents an opportunity for Guam farmers to diversify their crop production and to help the island reduce its reliance on imports and revive Guam’s melon industry. When compared to traditional melons, seedless fruits are smaller in size and lighter in weight, but have the benefit of producing more fruit per vine and having a longer harvest period.

Local farmers and consumers both stand to benefit from expanding production of a high-value crop that could strengthen Guam’s food security and create new income opportunities.

Response: A UOG Land Grant horticulturist evaluated four seedless watermelon varieties from Johnny’s Selected Seeds during a field trial at UOG’s agricultural experiment station in the village of Inalåhan. The varieties included ‘Cracker Jack,’ ‘Tropical Sunshine,’ ‘Century Star’ and ‘Ocelot.’ The standard variety ‘Empire No. 2’ served as the pollenizer.

A once-over harvest was conducted in February, 85 days after seeds were started. Researchers chose a single harvest because of increasing weed and insect pest pressure. The harvest coincided with a Watermelon Field Day extension event attended by about 40 farmers and gardeners. The participants helped harvest the melons, record fruit number and weight, measure sweetness using refractometers and compare varieties through taste evaluations. This participatory approach allowed growers to personally evaluate

varieties under Guam conditions while generating research data.

Results: The evaluations of the Field Day participants revealed that ‘Tropical Sunshine’ was identified as the top-performing seedless watermelon variety. It produced the most fruit per plant, had the highest sugar concentration, and was selected as the best-tasting variety by field day participants.

An unusual characteristic of this variety is its yellow flesh, raising an important question about whether Guam consumers, who traditionally purchase red-fleshed watermelons, will embrace a yellow-fleshed variety.

The findings provide growers with research-based guidance on seedless watermelon production and identify a promising variety for local cultivation. If adopted, seedless watermelon production could reduce dependence on imported fruit, diversify farm operations, and create new market opportunities for Guam producers. The results of the study have been published as a UOG Land Grant extension guide to support future production decisions.

Benefits of growing seedless watermelon



Consumer demand



More fruit per vine



Long shelf-life



Longer harvesting period

Best performer: ‘Tropical Sunshine’



Most fruit per plant



Highest sugar concentration



Best-tasting

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Contributors: Henin Zhea Pamintuan (NextGen COMPASS Intern)
Project Title: Seedless Watermelon Variety Trial
Timeframe: January 2024–June 2025
Funding Source: Smith-Lever Capacity Grant, USDA

Published
Guide



October 2024



Main image: UOG extension horticulturist Robert F. Bevacqua cuts into a yellow-fleshed seedless watermelon variety called 'Tropical Sunshine.'
Inset image: Community members help harvest and evaluate seedless watermelons at a Watermelon Field Day extension event on Feb. 8, 2025, at UOG's agricultural experiment station in Inalāhan. *Photos by Jackie Hanson*



BANANA VARIETY TRIAL IDENTIFIES HIGH-YIELDING, LOW-INPUT VARIETIES FOR GUAM

Relevance: Bananas (*Musa spp.*) are Guam’s No. 1 farm crop, with 126,528 pounds grown by nearly 300 banana farmers in 2023. Most local bananas are grown on diversified farms of less than 2 acres and are vulnerable to invasive insect pests and diseases. As a result, most bananas found in Guam grocery stores are imported from Ecuador. For locally grown bananas, consumers in Guam prefer two dessert banana varieties – ‘Manila’ and ‘Macao’ – but these are slow-growing and very susceptible to diseases.

Improving banana production with varieties better suited to the conditions would benefit Guam residents by improving availability of a favorite fruit and improving food security for the island. As production costs rise and pest pressures increase, farmers need sustainable production systems that maintain yields while reducing dependence on commercial agricultural inputs.

Response: Researchers from UOG Land Grant established a field variety trial to identify high-yielding banana cultivars that were naturally adapted to Guam’s growing conditions and could be grown using sustainable, low-input practices.

They evaluated five varieties: ‘Blue Java,’ ‘Fiji,’ ‘Macao,’ ‘Manila,’ and ‘Saba.’ The demonstration planting was managed without plowing or tillage, pesticides, or commercial fertilizers. Instead, compost was applied at a rate of 90 tons per acre as a replacement for commercial fertilizer, and the practice of corm trimming was used to help prevent insect pests and diseases from entering new plantings.

Results: The study found that ‘Fiji’ and ‘Saba’ would be ideal for expanded production in Guam due to their highly marketable qualities, favorable yields, and ability to be sustainably produced in Guam’s conditions without the use of pesticides. ‘Fiji’ proved

	Bunch weight	Hands per bunch	Days to flower	Days from flower to harvest	Days from planting to harvest
Saba	32 lbs.	8	245	107	352
Fiji	28 lbs.	8	209	89	298
Manila	14 lbs.	5	281	73	354
Blue Java	11 lbs.	6	264	136	382
Macao	10 lbs.	5	324	69	393

quick-to-produce and tolerant of diseases, while ‘Saba’ exhibited vigorous growth, robust fruit size, disease resistance, and tolerance to adverse conditions, such as drought and flooding. A sturdier plant, it could also be used as a windbreak for other crops.

The study demonstrated that these varieties can be successfully grown using zero-tillage practices and without pesticides or commercial fertilizers. The study also confirmed that corm trimming is an effective method for reducing the introduction of insect pests and diseases into new plantings.

The findings have been published in a UOG Land Grant technical report available at the QR code on the opposite page. These publications will deliver research-based recommendations that can improve productivity, lower input costs, and strengthen sustainable banana production in Guam and other tropical island production systems.

Next Steps: The variety trial plot will continue to be maintained as a demonstration site and a source of planting material for Guam farmers. It will also support university outreach and education on sustainable banana production practices.



Main image: Five different varieties of bananas planted for a variety trial on the University of Guam Land Grant's agricultural experiment station in Inalåhan. **Inset image:** Trimming banana plants down to the corm, as shown here, is an effective technique to be used when planting to prevent the transfer of insect pests and most diseases.

Banana (Aga') Variety Trial									
Variety									
Row 1	Fiji	Saba	(Mortality)	Saba	Fiji	Manila	Blue Java	Manila	
Row 2	Manila	Saba	Fiji	Manila	Saba	Manila	Saba	Manila	
Row 3	Manila	Blue Java	Manila	Saba	Manila	Saba	Manila	Saba	
Row 4	(Mortality)	Fiji	Manila	Manila	Saba	Saba	Saba	Fiji	
Row 5	Fiji	(Mortality)	Manila	Manila	Saba	Saba	Saba	Fiji	

Technical Report



April 2026



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Timeframe: January 2024–June 2025
Funding Source: Smith-Lever Capacity Grant, USDA

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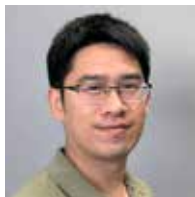
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NEW FACULTY



Lenora Matanane, M.S., RDN, L.D.

Extension Agent II/Instructor of Nutrition

Lenora Matanane joined the UOG Land Grant Extension Service in March 2025 as an extension agent in nutrition. She is a registered dietitian nutritionist and has served as adjunct faculty since 2017 teaching various courses in the nutrition track.

Her areas of focus will include sports nutrition for active youth and well-trained athletes, community education as the incoming coordinator for the Expanded Food & Nutrition Education Program, food resource management, and chronic disease management/prevention. Matanane holds a master's in nutritional sciences and a bachelor's in food science and human nutrition from the University of Hawai'i at Manoa.



Christianah Oladoye, Ph.D.

Assistant Professor of Soil Fertility & Plant Nutrition

Dr. Christianah Oladoye joined the UOG Land Grant agInnovation Research Center in October 2025.

Her research will look at how cover crops, mycorrhizal fungi, compost, biochar, and soil amendments affect nutrient cycling and availability, soil health, and conservation over time. Combining greenhouse, laboratory, experimental field, and on-farm studies, she aims to develop improved research and extension programs that foster precision farming and holistic nutrient management, minimize nutrient loss, and maximize financial returns for growers.

She holds a doctorate in plant and environmental science from Clemson University (S.C.).



Bindu Poudel-Ward, Ph.D.

Extension Agent III/Assistant Professor of Plant Pathology

Dr. Bindu Poudel-Ward joined the UOG Land Grant Extension Service in August 2025.

With extensive training in molecular biology/virology, her extension work will focus on plant disease diagnosis. She will also conduct field trials and plant health related research, implementing the information and technology generated the scientific community to help manage plant disease on farmers' fields.

She holds a doctorate in plant and environmental science from Clemson University (S.C.).

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