IMPACT

2007 IMPACT report

Research for Guam's Future

WPTRC IMPACT 2007

"The important thing is not to stop questioning."

-Albert Einstein

MISSION

Excellence in research in support of the land grant mission of discovery, learning and engagement. We excel in the areas of tropical agriculture, environmental and life sciences.

Western Pacific Tropical Research Center
College of Natural & Applied Sciences
University of Guam

WPTRC IMPACT 2007

Lee S. Yudin, Ph.D.

Greetings! It's been a great year for the Western Pacific Tropical Research Center. I believe as you read through our impact report you also will realize how important our current research activities are to the stakeholders we serve locally, regionally and internationally. This year we have highlighted some very key projects that we believe demonstrate our commitment to the diverse communities we serve. Our faculty continues to make every effort to secure grants that can be used to target important issues including the continuous onslaught of invasive species that reach our fragile island's ecosystem. Guam and its neighboring islands in Micronesia are the front doors to many invasive pests that reach our shores from abroad. If we don't try to reduce their numbers from within our shores then the potential of these pests moving into Hawaii or the US mainland is highly possible.

The small number of research faculty employed within the College of Natural and Applied Sciences places a great deal of pressure on these men and women as they confront the agricultural and environmental challenges in the region. This impact report demonstrates who we are and what we have accomplished. I personally want to thank all the contributing researchers at the Western Pacific Tropical Research Center for another strong year of both applied and basic research activities.

Lee S. Yudin, Ph.D.
University of Guam, CNAS
Dean/Director
Western Pacific Tropical Research Center

Research for Guam's Future

Greg Wiecko, Ph.D.

With the beginning of the new century, across-the-board changes in agriculture research have been spectacular. New research needs provide major challenges and major opportunities for the Western Pacific Tropical Research Center. The population of Guam is about to expand with the natural environment being subjected to even more constraints. Food safety, invasive species, as well as an increase in cargo entering our air and sea ports all lead to concerns for the natural environment.

WPTRC scientists see a great need for basic discoveries, innovations and novel applications in plant health and sustainability of the natural environment. Multi-disciplinary challenges motivate us to address important issues through collaboration with other universities, federal agencies and private companies. In 2007 we added a new research program focusing on the rapidly developing aquaculture market. Rising energy costs have stimulated more interest in our bio-fuels research.

Addressing challenges to Guam's agriculture and food industries as well as the island's natural resources is the primary function of WPTRC. As a land-grant institution of higher learning, we also combine discoveries, innovations and research applications with student training. We have dedicated researchers and educators, we address and resolve important issues and we will always strive for excellence. We continuously ask questions and try to find answers, we also ask for the support, commitment and engagement of our stakeholders.

Greg Wiecko, Ph.D.
University of Guam, CNAS
Associate Dean/Director
Western Pacific Tropical Research Center

WPTRC IMPACT 2007

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Tumon Palms Under Attack

Photo: Aubrey Moore

Adult coconut rhinoceros beetle being removed from Tumon coconut tree.

"Adult beetles bore deep into the crowns of coconuts and other palms to feed on sap."

Saving Tumon palms one coconut tree at a time is a tall order, but researchers from the University of Guam have joined forces with the Guam Department of Agriculture, local landscapers, the Guam Visitor's Bureau, and concerned citizens to stop the attacks on Tumon coconut trees. Everyone on Guam should be concerned about the invasion of the coconut rhinoceros beetle (CRB), *Oryctes rhinoceros*, as its voracious appetite puts the quintessential symbol of the tropics, coconut palms, in jeopardy.

The infestation of CRB in Tumon was discovered in mid September. The beetle was identified by Dr. Aubrey Moore, an entomologist and researcher with WPTRC, who then organized a delimiting survey to ascertain the extent of the infestation. This survey indicates that the infestation is limited to Tumon Bay and Faifai Beach, an area of approximately 1,000 acres. Given the size and extent of the infestation, it is estimated that this major pest of coconuts and other palms arrived on Guam one to two years ago.

The female coconut rhinoceros beetle burrows into rotting stumps, standing palms and decaying vegetation to lay her eggs. The total life cycle is completed in 3 to 9 months allowing for more than one generation per year. Relatively few pupae and adults have been collected to date. However, the population density of grubs feeding in rotting coconut logs and stumps is very high. As many as 140 grubs have been extracted from a one meter section of decaying coconut log. Most grubs are currently in the third and final larval stage. These will pupate and emerge as adults by the new year and are expected to cause massive damage to palms within the infested area. Dr. Moore explains why an immediate response is necessary, "Adult beetles bore deep into the crowns of coconuts and other palms to feed on sap. Trees are killed when beetles bore through the growing tip, providing breeding sites for future generations. Despite the low number of CRB adults collected to date, mortality of young palms from feeding damage has already been observed."

Dr. Moore has played and integral part in educating the community and community leaders as to the severity of the situation. He states, "This is a very real threat to Guam's economy and ecology. Without immediate action to suppress and contain the infestation, massive mortality of cultivated and wild palms is expected." The Government of Guam has responded quickly. The Department of Agriculture issued a quarantine order for the village of Tumon on October 5th, making it illegal to transport any palms, detritus that could harbor the pest, or the beetle itself from the area under quarantine. On October 25th, Governor of Guam, Felix Camacho, signed an emergency declaration concerning the CRB infestation. (continue next page)

Tumon Palms Under Attack

(continued)

Photo: Aubrey Moore

Rhinoceros beetle grubs found in decaying coconut tree.

"In order to avert massive damage to palms within the infested area in Tumon and risk of dispersal to other parts of Guam, it is imperative that the eradication project is funded and launched without further delay."

When the CRB invaded Palau starting in 1942, coconut palms were completely eradicated from some islands and overall tree mortality was about 50%. Guam is primed for a huge outbreak of CRB as there are many standing and fallen coconut logs resulting from typhoon damage which may be used as larval breeding sites. In addition, vertebrate insectivores capable of preying on CRB grubs and adults have been decimated by another invasive species on Guam, the brown tree snake. During the predicted CRB outbreak it is expected that many, if not most, palm trees on Guam will be attacked and killed. In addition, adults will be numerous and risk of accidental transport to other islands in Micronesia, Hawaii, and beyond will be high.

CRB infestations can be contained, suppressed and eradicated by removing larval breeding sites and mass trapping adults. CRB was exterminated from the 36 km2 of Niuatoputapu Island, between Samoa and Tonga using these methods. However, mass trapping coupled with sanitation during 1971 through 1974 failed to eradicate CRB on two islands in Fiji. The eradication attempt was abandoned when it was determined that there was "a low but persistent population which could not be trapped." According to Bedford 1980, "It appeared that possible results from the indefinite continuation of the trial were no longer commensurate with the costs."

During the past decade, lures containing a synthetic aggregation pheromone, ethyl 4-methyloctanote, which attracts both sexes of adult CRB, have become commercially available. These lures are 10 times more attractive than ethyl chrysanthemumate which was used in the failed Fijian mass trapping program. Traps baited with these lures can be used for detection, monitoring and population suppression.

Dr. Moore has developed a CRB eradication plan for Guam and funding requests have been submitted to federal agencies, the Government of Guam and nongovernmental organizations. Funds from several sources have been identified including a $250,000 grant from USDA-APHIS. The plan has two components: sanitation of potential breeding sites to remove immature beetles, and mass trapping with pheromone traps to remove adults. Given that most CRB currently observed are in the final larval stage, the next wave of adults is expected to emerge in early January.

Dr. Moore's major role in the eradication project will be running the trapping program for adult beetles. His team is currently in the process of manufacturing and deploying the more than 1,000 traps necessary for the project. He warns, "In order to avert massive damage to palms within the infested area in Tumon and risk of dispersal to other parts of Guam, it is imperative that the eradication project is funded and launched without further delay." WPTRC scientists like Aubrey Moore working together with local and federal agencies continue to make a difference on Guam and the impact of their work is deep and tall if you're a coconut tree.

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Advances in Cycad Biochemistry Research

Young cycad seeds such as these contain higher concentrations of steryl glucoside toxins.

Concentrations of steryl glucosides decline as cycad seeds age. These two-year-old seeds are at the appropriate stage for preparing flour.

Photos: Thomas Marler

The Guam cycad has been the focus of a long history of seed chemistry research because of the probable ingestion of toxins within these seeds when they have been consumed on Guam as flour. Upon reviewing this literature, WPTRC scientist Dr. Thomas Marler noted the absence of any publications that address the influence of plant and ecological factors on seed chemistry. To tackle this vacuum, he has partnered with neuroscientist Dr. Christopher Shaw at the University of British Columbia in Vancouver, Canada to study a group of steryl glucosides that have elicited neurodegeneration in mouse behavioral models.

The research partnership was established with a 2005 commentary and review of the relevant literature. This article discussed some of the plant and habitat factors that have been ignored during the historical studies on seed chemistry of Guam's cycad plants. Their research then set out to look at some of these factors individually.

One bothersome issue about the cycad seed chemistry literature was the failure to document seed age in the methods. To expose the severity of this oversight, the scientists determined concentration of the steryl glucosides in Guam cycad seeds from 2 months to more than 30 months in age. The results were recently published in the journal *Functional Plant Biology*, and revealed that the youngest seeds contained the greatest concentration, and the content of these chemicals declined with seed age. This research continued by studying the changes in seed chemistry when seeds are stored after removal from the plant. The rationale behind this study was that Guam's frequent typhoons cause abscission of cycad seeds, and these seeds remain on the forest floor for many months before germination occurs. The results of this study, recently published in the journal *HortScience*, revealed that up to 14 months of seed storage had no influence on concentration of the steryl glucosides. The implication is that seeds harvested from the forest floor for production of flour may have contained greater amounts of these neurotoxins than seeds harvested directly from the plants.

Their research has subsequently been expanded to include the influence of habitat on expression of these cycad chemicals. The results of this first habitat-level study, published in the journal *Micronesica*, revealed that plants in littoral habitats with relatively fewer available resources produced seeds with higher concentrations of the steryl glucosides.

The research is ongoing, and is proving of critical importance for filling a void in the literature, and also for clarifying aspects of past research that may have led to ambiguities in interpretations. Whether or not the link between cycad toxin consumption and neurodegenerative diseases on Guam is ever proven, this WPTRC research is a valuable contribution to the field of chemical ecology.

Further Reading:

Functional Plant Biology 33:857-862. 2006.
HortScience 42:626-628. 2007.
Micronesica 39:297-314. 2007.

Plant Biomechanics Being Studied in WPTRC

Photos: Thomas Marler

Leaning cycad stems produce eccentric growth on the lower side of the leaning stem. They aquire the added growth by producing extra vascular arcs (orange-tan tissue) below the youngest vascular cylinder.

"Guam's cycads are the only native gymnosperms in the region"

Allometric relationships have been studied for many woody plant species, but these relationships for arborescent species that produce pachycaulis stems have not received much attention. Pachycaulis plants produce stems that are thick at the tip, and are little-branched. Guam is home to two common plant groups that produce pachycaulis stems, papayas and cycads. WPTRC scientist Dr. Thomas Marler has partnered with Dr. Karl Niklas at Cornell University in Ithica, New York and with Dr. Jack Fisher at Fairchild Tropical Botanic Garden in Miami, Florida for the pioneering studies.

The initial study on Guam's papaya, recently published in the *American Journal of Botany*, determined the influence of domestication on allometric relations of this important species. The study confirmed that cultivated plants were shorter and thinner than wild plants on average, and that the height to first flowering was much reduced in cultivated plants. These findings were expected, since condensed stature is desirable and breeding programs have selected for these traits. The results also revealed that the scaling exponent for height versus basal stem diameter was reduced by domestication and the stem slenderness ratio exhibited a major shift in development when female plants began to flower.

The initial study conducted with Guam's cycads focused on how the soft-wooded pachycaulis cycad stem reacts to a horizontal orientation. These growth reactions, which are important for the maintenance of plant stature, have been extensively studied in other plant groups, including other gymnosperms. Guam's cycads are the only native gymnosperms in the region. Woody gymnosperm species generate reaction tissue on the lower side of a leaning stem that includes production of cells with altered shape and structure. The results of the Guam study, recently published in the *International Association of Wood Anatomists* Journal, revealed a dramatic eccentric growth reaction, which included successive new arcs of cambial tissue and resulting vascular tissue on the lower half of the leaning stem. However, all of the cells were typical cells that were devoid of any alterations in shape or structure. The results indicate cycads do not conform to the type of developmental reaction that is typical of woody gymnosperm species.

Allometric relations of maximum size individuals for a long list of species was used to compare groups of plant types, in attempts to better understand how cycads compare as a group to other taxonomic or functional plant groups. The study included two other pachycaulis groups, palms and cacti. The work was recently published in the *Annals of Botany*, and revealed that the scaling exponent and allometric constant were unique for each spes group.

This work establishes the need for continued study of the allometry and biomechanics of pachycaulis plants. For example, mechanical stimulation from mild winds is important for strengthening the stems of woody tree species, but has not been studied for pachycaulis species. The ongoing WPTRC research may improve our understanding of how Guam's cycads are so effective in withstanding typhoon force winds.

Further Reading:

America Journal of Botany 94:999-1002. 2007.
Annals of Botany 97:79-83. 2006.
IAWA Journal 27:377-382. 2006.

Sustainable Aquaculture: Dr. Gong's Passion

Dr. Hui Gong, UOG's first aquaculture researcher.

Photo courtesy of USDA.

Penaeus vannamei is an important shrimp in aquaculture production.

"Shrimp disease outbreaks remain the most profound threat to this fast growing industry..."

Isolated in the western Pacific, yet within four-hour flight time to major Asian cities, the center of world aquaculture production and major seafood markets, Guam has unique geographic advantages and great potential in playing a more significant role in aquaculture locally, regionally and even globally. The University of Guam (UOG), through the Guam Aquaculture Development and Training Center (GADTC), is striving to expand applied research to support aquaculture development in Guam and the region. In February 2007, Dr. Hui Gong became the first aquaculture research faculty to be hired by the University. Dr. Gong's background is in aquaculture nutrition, molecular biology and health management, and her long-range plans include conducting applied research in aquaculture species, initially focusing on health management, and nutrition and genetics studies in shrimp.

Careful assessment has been conducted for revitalizing GADTC for the production, maintenance, and distribution of specific pathogen free (SPF) shrimp stocks worldwide and for sustaining a viable regional shrimp aquaculture industry. Dr. Gong has been working with the team at GADTC in taking several critical initiatives, which include implementing biosecurity protocol and a routine health surveillance program, and obtaining genetically improved SPF stocks that have the greatest genetic diversity in the industry.

Shrimp disease outbreaks remain the most profound threat to this fast growing industry, and the potential for pathogenic agents to be transmitted rapidly inter-continentally through the indiscriminative movement of shrimp and other carriers is high. There are yearly reports on Guam of shrimp farmers importing post-larvae shrimp from disease-prone areas, without following proper quarantine procedures and with no surveillance monitoring program in place. Viral outbreaks cause economic losses for individual farms, but they also pose a threat to the shrimp industry island wide. With her extensive experience in health management and through continuous research efforts in optimizing culture techniques, Dr. Gong and GADTC are poised to help local shrimp farmers and government agencies in developing comprehensive health management practices in Guam and the Commonwealth of the Northern Marianas Island. This will protect the local and regional shrimp industry from disease outbreaks, establish high health status, boost self-sufficient expansion, and promote a sustainable shrimp industry.

Another important area of interest for Dr. Gong is the development of a *Penaeus vannamei* strain that can grow well with a low-protein diet and utilize plant protein efficiently. Shrimp feed is one of the most expensive production costs, accounting for 60-80% of total cost, and protein is one of the most expensive components of shrimp feed. Modern aquaculture has been criticized for increasing the pressure on marine resources for use as feed. Optimizing diet formulation to improve production performance, maximize efficiency of nutrient utilization, reduce feed cost and minimize nutrient loads in effluents, are crucial challenges for sustainable aquaculture. The significance of Dr. Gong's future research will be to improve dietary protein efficiency and reduce feed cost through genetic selection, which could contribute to cost-effective, environment-friendly and sustainable shrimp aquaculture in the region.

Biological Control in the Region

Dr. Reddy's team: Nakita Braganza, Dr. Reddy, Zerlene Cruz, Ray Gumataotao

Photo: G.V.P. Reddy

Banana borer trap redesigned by Dr. Reddy.

"The indigenous plants and animals on small islands like Guam are highly susceptible to invasive species"

Biological control of invasive species is an earth friendly way of protecting crops from harmful insects and weeds. Dr. G.V.P. Reddy and his team at WPTRC have been successfully using integrated pest management (IPM) methods to keep Guam green and the island's local food supply flourishing. Using semiochemical-based control method means, Dr. Reddy's research has been instrumental in reducing the population of invasive insects on Guam such as the sugar cane weevil, *Rhabdoscelus obscurus* (Coleoptera: Curculionidae), the banana borer, *Cosmopolites sordidus* (Coleoptera: Curculionidae) and the adult fruit-piercing moth, *Eudocima (fullonia) phalonia* (Lepidoptera: Noctuidae).

Dr. Reddy developed a semiochemical-based control method in Guam for the New Guinea sugarcane weevil, which not only attacks sugarcane but also attacks palms and ornamental plants. Bucket traps were used to monitor trends in sugarcane weevil borer populations throughout the island during cane-growing seasons. The trapping method had a great impact on the borer populations, resulting in a dramatic decrease for most of the sites. This work has been published in the *Journal of Applied Entomology* and *Micronesica.*

Dr. Reddy's team also evaluated various trap designs for capturing the banana borer, *Cosmopolites sordidus.* Recent findings indicate that ground traps significantly caught more weevils than the ramp traps developed by ChemTica Company from Costa Rica and the standard pitfall trap. Further findings indicated that the trap size of 40 × 25 cm caught significantly more weevils than the other sizes. The trap color also influenced the trap catches. These trap experiments are on-going and once the experiments are completed, Dr. Reddy will apply for a patent for the more efficient trap design that he developed. Local farmers are grateful to be part of this research and are very happy to have fewer weevils in their banana fields.

Insects are not only seen as pests to eradicate, but they can also be the biocontrol agent in controlling other invasive species. Dr. Reddy and his team have been using insects in their work on the biological control of invasive weeds, focusing on the control of ivy gourd, *Coccinia grandis* (Cucurbitaceae) and Siam weed, *Chromolaena odorata* (Asteraceae) and the giant sensitive plant, *Mimosa diplotricha* (Fabaceae).

The ivy gourd vine, *Coccinia grandis* (Violales: Cucurbitaceae), is a perennial vine and occupies over 200 acres in different parts of Guam, 60 acres in Rota and almost one third of the land area of Saipan. A biological control program has been initiated in Guam, Saipan, and Rota following the success achieved in Hawaii by introducing the natural enemies, *Acythopeus coccinae* (Coleoptera: Curculionidae), *Acythopeus burkhartorum* (Coleoptera: Curculionidae) and *Melittia oedipus* (Lepidoptera: Sesiidae). *Acythopeus coccinae* causes defoliation of *C. grandis* by the larval mining of the leaves, *A. burkhartorum* larvae cause stem and petiole galling, while caterpillars of *M. oedipus* begin feeding in young shoots, boring down through the larger stems and into the root, eventually killing the vine. Dr. Reddy's team was able to conduct host specificity tests in the Western Pacific Biocontrol Quarantine Laboratory (WPBQL) at the University of Guam and successfully obtained the release permits for all the three agents. Accordingly, all these agents have been released in Guam and Saipan and established. They expect that all three agents will remarkably reduce the ivy gourd population throughout the Marianas.

The giant sensitive weed *Mimosa diplotricha* C. Wright ex Sauvalle (Fabaceae) is a serious weed in vacant lots, roadsides, and crop lands. It has invaded most of the islands in Micronesia and South Pacific. Scientists from Australia have done exploratory work in South America and identified a natural enemy *Heteropsylla spinulosa* (Hemiptera: Psyllidae). Dr. Reddy has obtained the permit from USDA to import this natural enemy from Pohnpei. Further, the request for the permit for its field release is in review and is expected to be obtained soon.

Insects eating insects, insects eating plants, plants dependent on insects for pollination: the delicate balance of nature. The indigenous plants and animals on small islands like Guam are highly susceptible to invasive species. Through their work, Dr. Reddy and his team give nature a little boost in trying to keep a healthy balance on Guam and the region. Research for Guam's future is conducted daily by WPTRC scientists.

Ensuring Kelaguen Safety for Consumers

Photo: Jian Yang

Participant preparing beef *keleguen* at Safe *Kelaguen* Preparation workshop.

Table 1: The minimum amount of lemon for kelaguen, which will be stored or/and served at outdoors/room temperature for more than 2 hours. Consumers can select any one of three listed recommendations to prepare chicken, beef, shrimp and fish kelaguen. To kill pathogens in raw meat, chicken should be cooked to an internal temperature at 165°F and beef or shrimp should be blanched in boiling water for 1.5-2 minutes.

Recommendation		Kelaguen*			
Fresh lemon juice**	Lemon powder***	Chicken	Beef	Shrimp	Fish
½ cup	4-½ teaspoons	1.6 lb(5 c)	1.6 lb(6 c)	1.5 lb(5 c)	1.5 lb(4.5 c)
1 cup		1.1 lb(3.5 c)	1 lb(4 c)	0.8 lb(3 c)	1 lb(3 c)
	1 package or ¼ cup	2.3 lb(7 c)	2.3 lb(9 c)	2.1 lb(7.3 c)	2.1 lb(6.3 c)

*: the unit "lb" means "pound" and the unit "c" means "cup". **: the fresh lemon can be either local or commercial lemon. ***: the recommendation is based on the lemon powder "Yours Lemon Flavored Powder" from Yands Trading Co., Ltd, Japan

WPTRC Food Scientist, Dr. Jian Yang and his research assistant Dolores Lee have been conducting research on *kelaguen*, a local delicacy and fiesta favorite. *Kelaguen* is a unique, delicious and nutritious food prepared by mixing meat with lemon, onions, peppers, coconut and salt. Chicken, beef, shrimp and fish *kelaguen* are commonly consumed with rice or tortilla as an appetizer or a main dish at home. *Kelaguen* is one of the most popular dishes at parties or fiestas and is frequently served outdoors without temperature control for hours. *Kelaguen* is often prepared with raw or undercooked meat because the freshness, tenderness and delicious taste are essential attributes of *kelaguen's* sensory quality. Unfortunately, *kelaguen* is one of the leading causes of foodborne illness on Guam. During the last two decades, an average of 40 foodborne illnesses per year associated with kelaguen has been reported to the Guam Department of Public Health and Social Services. Including unreported cases, the estimated foodborne illness from *kelaguen* is above 1000 cases per year and its economic cost can be $500,000 to 5 million.

The survival of foodborne pathogens in meat during preparation and the pathogen growth while serving *kelaguen* in a tropical environment without time control are the major causes of foodborne illness. To prevent foodborne illness from *kelaguen*, the pathogens in the meat must be reduced to a safe level and the growth of pathogens must be controlled.

To prevent pathogen growth, researchers determined the pH of beef, chicken, shrimp and fish *kelaguen* and identified the minimum amount of lemon needed for *kelaguen* to be served at parties or fiestas outdoors without temperature or time control for safety. Instead of using raw or undercooked meat for *kelaguen*, recommendations for the minimum blanching time needed to kill pathogens in beef and shrimp were made. Researchers also investigated the minimum amount of time that beef must be marinated in fresh lemon juice to reduce pathogens to a safe level. In addition, consumer food handling knowledge, behaviors and attitudes toward *kelaguen* were evaluated to ensure effective *kelaguen* safety education.

Based on research results, "Safe *Kelaguen* Preparation" workshops have been conducted for general consumers including *kelaguen* retailers and vendors, school cafeteria employees, and food safety educators in the community. Food safety principles, critical control points, and recommended recipes for *kelaguen* were taught as guidelines to reduce the risk of foodborne illness. In workshops, participants not only gained food safety knowledge but also left with the intention of applying the food safety principles and recommendations toward their *kelaguen* preparation. Workshop participants were very receptive to recommendations for the amount of lemon and/or blanching time needed to prepare the meat used in *kelaguen*. "We will continue educating the public in *kelaguen* food safety procedures to decrease the incidences of foodborne illness on Guam," Says Dr. Yang. WPTRC scientists like Dr. Yang work hard at and making eating on Guam more fun, nutritious and safe.

The Ants Go Marching In

Photo courtesy of USDA

Painful blisters resulting from fire ant bites.

"..there are about 36 different species of ants on Guam."

Researchers at the Western Pacific Tropical Research Center were instrumental in collecting, identifying and coordinating eradication of an ant genus newly introduced to Guam. These tramp ants entered Guam like most tourists, through the airport, but they never intended to return home. Workers from the genus *Lepisiota frauenfeldi* were found near stored cargo containers at the Wonpat International Airport and were treated and hopefully eradicated in April with the assistance of UOG entomologists Drs. Ross Miller and Aubrey Moore. Dr. Miller states, "We verified the type of ant with scientists at the Secretariat of the Pacific Community and at the California Academy of Sciences. Then worked out that it most likely arrived on Guam from Asia." A common way for ants to arrive on island is in cargo containers, through shipments of ornamental plants or in household goods from places where the ants live.

A survey of ants on Guam conducted by Dr. Miller revealed that there are about 36 different species of ants on Guam. Although the Chamorro word for ant is *ordot*, it is thought that most of the ants on Guam have been introduced to the island accidentally. One ant, *Odontomachus simillimus* is probably a native to Guam and other Micronesian islands, and is the ant that the word *ordot* likely refers to. It has huge jaws and is a predator on termites and other small insects. Although most people think of ants as a slight annoyance at picnics, they can wreak havoc on the environment through their habit of cultivating plant pests like aphids and scale and by preying on native animals.

Dr. Miller warns that there is one kind of ant Guam especially needs to be on the lookout for, the little fire ant, *Wasmannia auropunctata*. He says, "This ant will change the quality of life on the island as we now know it if it ever establishes on Guam." The little fire ant is known for its incredibly painful and long-lasting sting. It has been living in New Caledonia for over 30 years. People there can no longer take a leisurely stroll through the jungle or down to the beach because of their fear of getting stung by this minute but powerful ant. Not only does it have a painful sting, but the little fire ant will alter the ecosystems it inhabits by killing lizards and many of the other small animals that inhabit Guam's forests and open areas.

Guam needs to stay vigilant. If the little fire ant ever entered the island, all necessary steps to eradicate this highly invasive species before it established would need to be taken. The little fire ant has been found in Hilo, Hawaii and Cairns, Australia, and is also present in Florida. This is of concern to Guam as there is a direct flight from Guam to Cairns, and a substantial flow of cargo and people from Florida and Hawaii. Islands like Guam are particularly vulnerable to invasive ants due to the low numbers of natural enemies that would keep the invaders in check. We can all play a part in keeping Guam healthy by not bringing in any plants, fruits or seeds without following all local customs and quarantine procedures.

WPTRC entomologists work with creatures small in stature, but the potential for environmental damage from these tiny terrors is great.

Soil Scientist Works to Redeem Badlands

Photo courtesy of WPTRC

Dr. Mohammad Golabli works to reduce soil erosion from badlands in southern Guam.

"The natural areas affected are integral parts of both the quality of life for residents and the viability of the tourism industry."

Water erosion is the most severe form of degradation from the standpoints of both soil resources and pollution. Eroded sediment carries away valuable soil nutrients and poses a serious threat to humans, resources, and environments downstream. This type of erosion is a serious problem in Guam. The badlands of southern Guam are a prime example. Transport of sediment out of a badland basin and into a new sedimentary system promotes a spectrum of environmental and ecological changes ranging from wetlands formation and river turbidity to coastal modification and habitat destruction. The natural areas affected are integral parts of both the quality of life for residents and the viability of the tourism industry. Both are severely altered by unchecked badlands formation.

WPTRC soil scientist Dr. Mohammad Golabi has developed an integrated approach to control the accelerated soil erosion and restoration of the land resources in southern Guam. In his research, he and his colleagues evaluated a variety of options, including the effects of Vetiver Systems on the watershed areas for controlling the sedimentation and preventing water pollution downstream, hence protecting the coral reefs.

The badlands of southern Guam are located within the confines of several of Guam's most important watersheds, including the Ugum, Fena, and La Sa Fua watersheds. The origin of badlands in southern Guam is related to annual wild and set fires, forest clearing, military action, recreational vehicles, and grazing animals. These badlands are a significant source of sediments in the La Sa Fua watershed and are currently increasing in number and size. The overall extent of the badlands is currently unknown, but their association with non-point source pollution from runoff is certainly measurable at the mouth of and within the La Sa Fua River.

Other techniques that are more relevant to farming areas include cropping systems such as conservation tillage practices (no-tillage and reduced-tillage) and planting of sunn hemp (*Crotalaria juncea*) in rotation with the maize (or corn, *Zea mays*) crop. They are intended to maintain surface cover between plantings, and the sunn hemp also serves as green manure and improves the quality of the soils under study. Plant cover intercepts and dissipates the energy of the raindrops before they strike the soil, enabling the water to reach the soil surface without damaging it. Furthermore, the resulting buildup of plant stems, roots, and organic matter act to improve soil quality.

Although many soil conservation technologies can be combined to reduce erosion rates, reduced tillage practice can play a key role in this effort by reducing soil erosion, decreasing weed pressure through maintenance of surface mulch, and enhancing soil productivity through crop residue and organic matter maintenance. The principal method of controlling rapid water runoff and the resulting soil erosion in farm areas is to maintain adequate vegetative cover on the soil surface at all times.

Dr. Golabi has designed an integrated approach to evaluate the effect of no-till and other conservation tillage practices such as crop rotation with a leguminous plant for organic matter build-up and residue management for soil rehabilitation and restoration of the badlands in southern Guam. (continue next page)

Soil Scientist Works to Redeem Badlands
(continued)

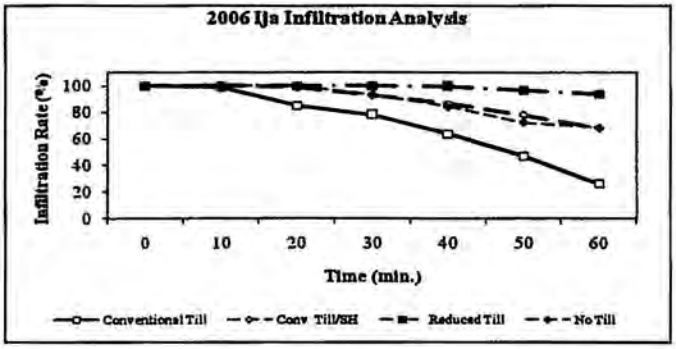
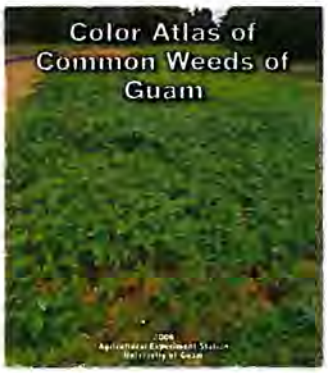


Figure 1. Infiltration (%) measured under different tillage treatments during a one-hour simulated rain event after 2006 crop harvest.

The no-tillage practices proved very effective as an erosion-control technique, as was indicated by the measured infiltration rates that were compared with the other experimental treatments (Fig 1), but the no-tillage plots produced lower crop yield and proved inefficient in productivity. These results reveal that, unless the no-tillage techniques are adopted for long-term farming, they will not be attractive to farmers for short-term practices. A useful compromise seemed to be the reduced-tillage treatment, which not only produced higher yield but also proved to be somewhat effective in reducing the runoff, hence reducing water erosion from these severely eroded soils of southern Guam. Conventional tillage accompanied by rotation with sunn hemp (a leguminous crop) also produced higher yields as well as reducing soil erosion. As a result, in both cases sunn hemp has proved valuable as green manure and its effective consequent contribution to soil organic matter

The 2005, 2006 and 2007 infiltration data showed that the no-tillage treatments were the most effective in reducing runoff and therefore protecting the soil from erosion by water. Soil research leads to improvements in planting techniques, which keeps farmers prosperous and Guam's irreplaceable reefs thriving.

Identify Your Weeds With Ease



"....a useful tool for landscapers, farmers, gardeners, and nature lovers."

Jim McConnell and Lauren Gutierrez are the authors of a colorful and comprehensive field guide to the weeds of Guam. *Color Atlas of Common Weeds of Guam* is a useful tool for landscapers, farmers, gardeners, and nature lovers. Spiral bound to allow easy access to the information on the pages and printed on special waterproof paper, this guide begs be taken into the field and used to identify unfamiliar weeds.

The first step in weed management is proper identification of the offending plant and the *Color Atlas of Common Weeds of Guam*, replete with Dr. McConnell's exceptional photographs, not only allows for easy identification, it also introduces the process of successful weed control.

The weeds are divided into three categories: Broadleaf, Vines, Sedges/Grasses and within each category the plants are listed alphabetically by Genus. Each weed is covered in two pages. The front of the page has a large photograph of the plant with smaller photos of the weed at various stages of growth and a table listing the scientific name, common name and origin. The back of the page includes a table with descriptions of vegetative and floral characteristics, propagation information that may be useful for controlling it, and fungal pathogens identified on Guam. For the amateur botanist the appendices contain a glossary of botanical terms and a collection of drawings of plant parts to help in understanding the botanical terms. There is also a section with photographs of herbarium specimens.

Color Atlas of Common Weeds of Guam is available through the College of Natural and Applied Sciences, UOG. To purchase a copy of this book contact Doris Camacho at 735-2100 or visit her at the Agriculture and Life Sciences Building, UOG.

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