AES

Current Research Projects

1990

CONTENTS

AGRICULTURAL ECONOMICS

PROJECT TITLE:

Small Land-holders of Guam: Production Analysis and Risk Avoiding Behaviors

PRINCIPAL INVESTIGATORS:

J.W. Brown

NATURE OF PROJECT:

The project is intended to examine both production and price risk as an impediment to the development of agricultural production on Guam.

RESULTS/IMPACT TO DATE OR EXPECTED:

Risks to the farmers of Guam can be divided into four general categories. Price risks occur when there is an over-abundance of a crop, and the price falls below production costs. Production risks fall into three groups: weather, diseases and insects. By developing a better understanding of the risks involved in fresh vegetable and fruit production on Guam, we hope to be able to offer methods of compensating for these risks. The long-run objective of the project is to aid in increasing local production of fruits and vegetables. Since the project is just beginning, there have been no impacts to date. Current effors are focusing on upgrading the information available to the farmers and marketers of Guam's produce. The current method of delivering this informaiton, the crop and price report, is being upgraded. Historical data on prices in is the process of being compiled and keypunched for analysis. Once the system for collection price and production information is upgraded, then attention will be focused on determining production costs and quantifying the risks to production along with analyzing how the farmers respond to them. The final result should be a set of information useful to farmers, researchers and planners in increasing fresh produce quantity and quality on Guam.

AGRICULTURAL ENGINEERING

PROJECT TITLE:

Micro-Irrigation for Optimum Crop Productivity and Minimum Contamination

PRINCIPAL INVESTIGATOR:

P.Singh and C.T. Lee

NATURE OF PROJECT:

Micro-irrigation using devices such as drip/trickle emitters, micro-jet/spray or spitters allows precise and uniform application of irrigation water to crops and orchards even under uneven field topographical conditions. It permits high frequency irrigation scheduling, water and nutrients application in a highly controlled manner to minimize deep percolation and subsequent groundwater contamination, to enable crop/vegetable production on very shallow soils such as those existing in most agricultural land areas of Guam. Thus the objectives of this project are:

1. To determine water/nutrient/salinity crop production functions for optimising yield and minimizing deep percolation in crops under micro-irrigation.

2. To develop management criteria for the application of nutrients and other materials through micro-irrigation systems for optimizing crop response while protecting ground water quality.

RESULTS/IMPACT TO DATE OR EXPECTED:

Currently experiments are planned for cucumber water/nutrient production functions. Moisture sensors, water quantity measurement and control equipment is being procured. Field experimental design and drip irrigation system design has been completed. Setting up of new automated weather stations with remote data retrieval and storage capabilities is under consideration. Thus the efforts are underway to establish basic facilities to conduct micro-irrigation research to determine the optimum quantity, frequency and rate of water/nutrient application for optimum yields for various commercial crops.

ANIMAL SCIENCE

PROJECT TITLE:

Use of Locally Available Feedstuffs and Potential FeedSources on Guam for Poultry Feeding

PRINCIPAL INVESTIGATOR:

F.G. Abawi

NATURE OF PROJECT:

The main objectives of this research are to explore ways of reducing feed costs, reduce dependency on imported feeds, and to stimulate animal production in Guam and Micronesia.

RESULTS/IMPACT TO DATE OR EXPECTED:

A poultry research complex with brooder, grower and layer cage system was designed and is due to be completed in Inarajan Agricultural Experiment Station by early April 1990. Upon completion of the building, experiments evaluating nutrient quality of local feedstuffs such as tangantangan, cassava (tuber and tops), coconut (with and without extruded fat) and by-products will be conducted. Processing methods and costs will also be evaluated.

AQUACULTURE

PROJECT TITLE:

Reproductive biology of three sea cucumber species of potential commercial value.

PRINCIPAL INVESTIGATOR:

R.H. Richmond

NATURE OF PROJECT:

Three species of sea cucumbers, chosen for their high market values and abundance in Micronesia, have been studied for reproductive timing and larval development. The goal is to develop the technology to enable the reef-reseeding and lagoon farming of these valuable organisms.

RESULTS/IMPACT TO DATE OR EXPECTED:

All three species are gonochoristic. *Holothuria (Microthele) nobilis* shows several peaks in gonadal index (weight of the gonad/drained weight of the whole animal) annually, with most frequent spawnings observed in the spring. Both *Actinopyga mauritiana* and *Thelenota ananas* show distinct seasonality, with peak gondal indices observed during the summer months. Maximum gonadal index values for *H. nobilis*, *A. mauritiana*, and *T. ananas* were 3.4%, 23.5% and 2.5% respectively.

Attempts at fertilization by mixing gonads excised from males and females were unsuccessful. Gametes obtained by induction of spawning via temperature stress were successfully fertilized with *H. nobilis* and *A. mauritiana*. Larval development was similar between these two species. The first larval stage, the auricularia, was reached within three days following fertilization. These planktotrophic larvae, raised on polycultures of phytoplankton, developed into doliolaria within two to three weeks, after which time settlement was observed. Attempts at raising these settled larvae through the juvenile stage have been unsuccessful thus far. Evidence suggests different feeding regimes need to be tested.

PUBLICATIONS:

Richmond, R.H., Hopper, D. and Hunter, C. 1989. Reproduction and larval development in the commercially valuable sea cucumbers *Holothuria (Microthele) nobilis* and *Actinopyga mauritiana*. Proceedings Fifth Int'l. Congr. of Invert. Reproduction, Nagoya, Japan (Abst.)

AQUACULTURE

PROJECT TITLE:

Bioenergetics and behavior of larval rabbitfishes (*Siganus* spp.)

PRINCIPAL INVESTIGATOR:

S.G. Nelson

NATURE OF PROJECT:

To determine the metabolic requirements and examine the feeding behavior of larval rabbitfishes to be used in guiding the development of hatchery procedures.

RESULTS/IMPACT TO DATE OR EXPECTED:

We have concentrated thus far on the growth and metabolism of the early larval stages of *Siganus argenteus* and *Siganus* sp. (a species which is soon to be described). Larvae grow rapidly in length over the first 24 hours and grow slowly until the yolk sac and oil-globule have been absorbed and the larvae start to feed. Even though the larvae are increasing in length during this period, they decrease in weight. The transition period from endogenus to exogenous nutrition has proven critical. The yolk sac is used before the oil globule, but by 36 to 48 hours after hatching the yolk sac and oil globule have disappeared, and the larvae must begin feeding. We have found that particles of boiled egg yolk and powdered feed, approximately 60 microns in diameter, are acceptable as a first feed, but live feeds (rotifers) are essential. We have determined the metabolic rates of eggs and early larval stages of both species. The results of this research are expected to lead eventually to the successful culture of these fishes through to metamorphosis.

AQUACULTURE

PROJECT TITLE:

Techniques for the mass production of larval rabbitfishes (Siganidae) for culture in Micronesia.

PRINCIPAL INVESTIGATOR:

S.G. Nelson

NATURE OF PROJECT:

To determine optimal densities of rotifers and fish larvae in the hatchery production of larval rabbitfishes for use in aquaculture of Guam.

RESULTS/IMPACT TO DATE OR EXPECTED:

We have obtained and matured broodstock of *Siganus argenteus* and *Siganus* sp. (soon to be described) from wild stocks around Guam. A monitoring program to examine the egg size and to detect ripe males has been initiated for both species. Spawning is induced by injection with Human Chorionic Gonadotropin. The neutrally bouyant eggs of *S. argenteus* are collected in 350-micron mesh baskets suspended in a small tank receiving the outflow from the spawning tanks. The eggs are then transferred to larval rearing tanks where they hatch. The demersal, adhesive eggs of *Siganus* sp. are collected on corrugated plastic roofing material placed on the bottom of the spawning tank. After the eggs hatch, the spawners and the plastic sheeting with the residuum of the eggs are removed from the tanks. A critical stage in rearing the larvae is reached when the yolk sac has been absorbed (between 36 to 48 hours) for both species. We have succeeded in rearing *Siganus* sp. through this period, but we have been unsuccessful thus far with *S. argenteus*. We are trying the fertilized eggs of local sea urchins as an initial feed since the larvae seem too small to accept even the s-type rotifers. Spawning the fish and handling of the early stage larvae have become routine. We are focusing on the critical transition from endogenous to exogenous nutrition.

ENTOMOLOGY

PROJECT TITLE:

Biology and control of *Aulacophora similis* and *Diaphania indica*

PRINCIPAL INVESTIGATORS:

D.M. Nafus and I.H. Schreiner

NATURE OF PROJECT:

The orange pumpkin beetle *Aulacophora similis* and the Asian melonworm *Diaphania indica* are pests that are widespread in the Asian-Pacific region but not present in Hawaii or the U.S.A. Pest management programs have been worked out for many of the pests of cucurbits, but little information is available on these two pests. Basic information about the biology, and economic importance and control of these two pests must be worked out in order to be able to develop managment systems for cucurbit pests on Guam.

RESULTS/IMPACT TO DATE OR EXPECTED:

The project began only 8 months previously. To date it has been found that the cucumber beetle adults are very sensitive to carbaryl. Evidence suggests that the adult beetles are sufficiently mobile that they could be controlled by only spraying strips within fields rather than the whole field. Future research will try to identify important wild hosts of cucumber beetles, determine at what population levels adult beetles damage melons and cucumbers, and study the biology of the beetle larvae and their importance to cucurbit crops.

Bittermelon has been found to be an important host of Asian melonworm, which contradicts findings from elswhere. Future research will focus on determining the seasons when the Asian melon worm is a pest, as preliminary indications are that it is uncommon in the dry season when melons are planted, though it can be a pest of cucumbers planted in the wet season.

ENTOMOLOGY

PROJECT TITLE:

Biological Control of *Lantana camara* in the Mariana Islands

PRINCIPAL INVESTIGATORS:

R. Muniappan, M. Marutani, and G.R.W. Denton

NATURE OF PROJECT:

To identify different taxa of *L. camara* in Micronesia. To survey and list different natural enemies of *L. camara* introduced and established in Micronesia. To determine the effective natural enemies of varioius taxa that exist in Micronesia and to introduce the effective natural enemies for suppression of these taxa.

RESULTS/IMPACT TO DATE OR EXPECTED:

A detailed survey of various taxa that exist in different islands, and the natural enemies introduced and established in Micronesia has been carried out. Surveys to assess the seasonal abundance and effectivieness of the natural enemies of *L. camara* on Guam are in progress. Currently, the effectiveness of the natural enemies against the different taxa are being examined. The island of Rota has been found to be free of *L. camara*. Hence, attempts are being made to introduce legislation to ban introduction of *L. camara* into Rota. The role of the Philippine turtle dove in lantana seed dispersal and the beneficial effects of the pod-fly, *Ophiomyia lantanae* in reducing palatability of the fruits to this species has been investigated. The natural enemy, *Uroplata girardi* was introduced to Tinian in 1989.

PUBLICATIONS:

Muniappan, R. 1988. Biological Control of the Weed, *Lantana camara* in Guam. J. Plant Protection in the Tropics 5:99-102.

Muniappan, R. 1989. Biological Control of *Lantana camara* in Yap. Proc. Hawaiian Entomol. Soc. 29:195-196.

ENTOMOLOGY

PROJECT TITLE:

Biological Control of the Red Coconut Scale, *Furcaspis oceanica*

PRINCIPAL INVESTIGATORS:

R. Muniappan and M. Marutani

NATURE OF PROJECT:

The red coconut scale, *Furcaspis oceanica* is an accidentally introduced pest into Guam in early 1970's. In 1987, it was found in the central part of the island. Severe infestation of the scale may cause drying of leaves and reduction in yield. An effective natural enemy of this scale, *Adelencyrtus oceanicus* was introduced from Caroline islands to Guam during 1988-1989. Additionally, the distribution of the scale and its natural enemies on Micronesian islands is being surveyed.

RESULTS/IMPACT TO DATE OR EXPECTED:

The establishment of *A. oceanicus* on Guam was confirmed in 1989. It is expected to suppress the population of the red coconut scale and prevent further spread of the scale on the island. The distribution of *F. oceanica* and *A. oceanicus* is being examined periodically to evaluate the effectiveness of the parasite. The survey of *F. oceanica* and its natural enemies in Micronesian islands revealed the presence of *F. oceanica* in all islands except Rota, Tinian and Aguijan in Northern Marianas. In addition to *A. oceanicus*, several hymenopteran species were found in association with *F. oceanica* including *Aphytis* sp., *Encarsia* spp., and *Rozanoviella* sp. Two hyperparasites of *A. oceanicus*, *Marietta* sp. and *Ablerus palauensis* were also recovered on some islands.

PUBLICATIONS:

Marutani, M. and Muniappan, R. 1989. Incidence of the red coconut scale, *Furcaspis oceanica*. [Diaspididae:Homoptera] and its parasites in Micronesia. J. Plant Protection in the Tropics. 6:61-66.

Marutani, M. and Muniappan, R. 1989. Use of *Adelencyrtus oceanicus* [Hym: Encyrtidae] for controlling the red coconut scale, *Furcaspis oceanica* [Hom:Diaspididae] in Guam. Presented at FFTC-NARC International Seminar for the use of Parasitoids and Predators to Control Agricultural Pests at Tsukuba, Japan, October, 1989.

ENTOMOLOGY

PROJECT TITLE:
Development of Cultural, Chemical, and Biological Control Methods for Pests of Cruciferous Crop on Guam

PRINCIPAL INVESTIGATORS:
R. Muniappan and M. Marutani

NATURE OF PROJECT:
To develop cultural, chemical and biological control methods for the management of the cruciferous crop pests on Guam. There are over half a dozen pests that attack cruciferous crops on Guam. Some of these are resistant to pesticides. Natural enemies introduced and established for control of diamond-back moth in the past disappeared due to heavy use of pesticides for control of other pests.

RESULTS/IMPACT TO DATE OR EXPECTED:
Hellula undalis is a serious pest of cabbage in the seedling stage in the nursery. The fire ant, *Solenopsis geminata* is a problem during dry season in the transplanted field.

Naled proved to be effective in controlling *H. undalis*. Diazinon was effective against *S. geminata*. Other pests that attack cabbage on Guam are *Plutella xylostella*, *Crocidolomia binotalis*, *Halticus tibialis*, *Spodoptera litura*, *Helicoverpa armigera*, and *Lipaphis erysimi*. Preliminary results show that the pests of cruciferous crops on Guam could be effectively controlled by using mustard alone or in combination with Chinese cabbage, caster and radish as trap crops.

PUBLICATIONS:
Marutani, M. and Muniappan, R. 1988. Imported cabbage webworm control. Insecticide and Acaricide Tests. 14:98.

Yalemar, J., Marutani, M. and Muniappan, R. 1988. Cabbage insect control. Insecticide and Acaricide Tests. 14:107.

Yalemar, J., Muniappan, R. and Marutani, M. 1988. Control of fire ant. Insecticide and Acaricide Tests. 14:108.

ENTOMOLOGY

PROJECT TITLE:

Biological Control of Fruit Piercing Moth in the American Pacific

PRINCIPAL INVESTIGATORS:

R. Muniappan, G.R.W. Denton and M. Marutani

NATURE OF PROJECT:

To organize a network of scientists engaged in research on fruit piercing moth. To survey primary and secondary fruit piercing moths in the American Pacific. To study the biology of *Othreis fullonia* and survey its natural enemies.

RESULTS/IMPACT TO DATE OR EXPECTED:

The biology of *O. fullonia* has been studied. The pest status and natural enemies of *O. fullonia* in Saipan, Tinian, Rota, Guam, Palau and Pohnpei have been examined. Other primary and/or secondary fruit piercing species have also been collected from these islands. Population dynamics of *O. fullonia* and its natural nemies are being carried on Guam. Three other species of primary fruit piercing moths have so far been identified (*Pericyma crugeri*, *Platyja umminia*, and *Ercheia dubia*) on Guam. Studies are continuing to identify their larval host plants, pests status and need for implementation of possible good control measures.

Data sheets for the assessment of parasitism, and procedures for standardizing methods and techniques of collection and examination of *O. fullonia* eggs have been compiled and distributed to the appropriate personnel on Rota, Saipan, Palau, Pohnpei, and American Samoa.

PUBLICATION:

Denton, G.R.W., Muniappan, R., Marutani, M., McConnell, J. and Lali, T.S. 1989. Biology and natural enemies of the fruit piercing moth. *Othreis fullonia* (Lepidoptera: Noctuidae) from Guam. Presented at the ADAP Conference in Honolulu, Hawaii.

ENTOMOLOGY

PROJECT TITLE:

A National Agricultural Program to Clear Pest Control Agents and Animal Drugs for Miner Uses

PRINCIPAL INVESTIGATORS:

R. Muniappan and M. Marutani

NATURE OF PROJECT:

To facilitate registration of pesticides for use on minor crops.

RESULTS/IMPACT TO DATE OR EXPECTED:

This project was initiated recently. We are in the process of evaluating the pesticides 'Padan' and 'Javelin' against cruciferous crop pests on Guam. 'Padan' is a pesticide used for control of diamondback moth in different parts of the world, however, it is not registered in the U.S. Diamondback moth is resistant to Dipel on Guam. 'Javelin' has been reported to be effective against diamondback moth elsewhere. Also, some pesticides against the pests of orchids are being screened.

PUBLICATION:

McConnell, J., Marutani, M. and Muniappan, R. 1989. Control of flat mite on orchids. Insecticide and Acaricide Tests: 15 (In press).

ENTOMOLOGY

PROJECT TITLE:

Biological control of the leucaena psyllid, Heteropsylla *cubana.*

PRINCIPAL INVESTIGATOR:

D. Nafus

NATURE OF PROJECT:

The leucaena psyllid accidentally established on Guam in the early 1980s and became a serious pest. Stands of leucaena were defoliated and many trees were killed in certain sites. Since this was an important source of firewood and of timber used for agricultural stakes, a project to introduce natural enemies of the psyllid was initiated. The goal was to reduce the abundance of the psyllid to more acceptable levels.

RESULTS/IMPACT TO DATE OR EXPECTED:

The coccinellid beetle, *Curinus coeruleus*, was released in 1985 for control of the psyllid. *C. coeruleus* is now established at two sites, Mangilao and Agat and has been released at Asan and Yona. In 1988-9, populations of the psyllid remained below 100 nymphs and 50 adults per gram of tip leaves (dry weight). Outbreaks were only noted at Asan, and Yona. Levels of general predators are high. *Olla v-nigrum, Orius niobe* (Anthocoridae), *Campylomma lividicornis* (Miridae) and an unidentified mite have also been found associated with psyllid populations and are thought to be feeding on the psyllid. *O. v-nigrum* is present at only a few sites and did not become abundant until 1989, although it has been present on Guam for a long time. *C. coeruleus* has reduced populations of the psyllid in Mangilao, the only site at which it has had enough time to become abundant so far.

ENTOMOLOGY

PROJECT TITLE:

Biological control of leafminers, *Liriomyza* sp.

PRINCIPAL INVESTIGATOR:

D. Nafus

NATURE OF PROJECT:

The leafminer *Liriomyza trifolii* entered Guam about 1978 and quickly became a serious pest of several agricultural crops on Guam. It is difficult to control as it is resistant to many pesticides and has the capacity to develop resistance to other ones within a single crop season. It is a particularly serious problem on beans. To aid farmers in its control, additional natural enemies were imported to Guam.

RESULTS/IMPACT TO DATE OR EXPECTED:

The parasitoid *Ganaspidium utilis* was introduced and established in 1984. Since then, it has increased to become the dominant parasitoid on leafminers on a variety of crops. On beans, the number of leafminers attacking untreated plants are substantially lower than they were in the years prior to the introduction of *Ganaspidium* . In 1989, peak densities of leafminers remained below seven per leaf compared to populations up to 45 leafminers per leaf in 1982-4. Mean seasonal densities dropped from about 11 leafminers per leaflet to less than three.

Estimated gains in yield associated with the introduction of *G. utilis* are about 150 kg per 100 m row, or about 7,000 kg per ha. Because *G. utilis* is very sensitive to insecticides, growers are still having some problems with the leafminers. To combat this problem, a management system stressing the use of less insecticides is under development.

PUBLICATIONS:

Nafus, D. and Schreiner, I. 1989 Biological control activities in the Mariana Islands from 1911 to 1988. Micronesica 22: 65-106

ENTOMOLOGY

PROJECT TITLE:

Developing pest management systems for vegetables compatible with *Liriomyza* management

PRINCIPAL INVESTIGATOR:

I. Schreiner

NATURE OF PROJECT:

The leafminer *Liriomyza trifolii* attacks a wide variety of vegetable crops including yard-long beans, cucurbits, tomatoes and other crops. There are a number of parasites which can control this pests which are present on Guam. These parasites are quite sensitive to insecticides, whereas the leafminers are very resistant. Therefore insecticides must be carefully managed on crops affected by these leafminers in order to not disrupt the biological control of the leafminers. This project seeks to understand when pests other than leafminers are abundant enough to cause noticeable losses to crops and to develop control methods for the other pests which do not kill leafminer parasites.

RESULTS/IMPACT TO DATE OR EXPECTED:

Several experiments on cucumber have shown that low to moderate levels of melonworms do not affect cucumber yields. No significant yield loss can be detected until on the average each cucumber leaf has at least one caterpillar on it. When there are between four and five melonworm caterpillars on each leaf, the cucumbers will yield one third less than plants with no caterpillars. The significance of this result is that caterpillars are frequently fairly rare on cucumber leaves, and this data shows that in many cases it is not necessary to apply any pesticides for their control.

Similar experiments have been performed on yard-long beans, examining the whole complex of pests of this crop. Leafminers have been found to be very significant pests of yard-long beans, measurably reducing yields even at low infestation levels. In contrast, to date it has not been shown that there is a yield loss due to bean flies once the seedling stage is over.

PUBLICATIONS:

Schreiner, I. 1989. Efficacy of insecticides on cucumber, Guam 1987. Insecticide and Acaricide Tests 14: 57E.

Schreiner, I. Damage threshold for *Diaphania indica* Saunders (Lepidoptera: Pyralidae) on cucumbers. Tropical Pest Management. In Press.

ENTOMOLOGY

PROJECT TITLE:

Biology and control of mango shoot moth and mango blotch miner of Guam.

PRINCIPAL INVESTIGATORS:

I. Schreiner and D.Nafus

NATURE OF PROJECT:

Studies of mango on Guam had shown that over 50% of the foliage of mangos on Guam were being consumed by caterpillars of *Penicillaria jocosatrix*. The mango shoot caterpillars also had a significant impact on flowers, causing both direct damage and reducing the ability of the trees to produce flowers. Leaves are further damaged by a cecydomyiid blotch miner, which was not taxonomically identified at the beginning of the project. This project was directed at studying the biology of *Penicillaria* and developing methods to control this pest. In addition we wished to determine whether the botch miner was a significant pest.

RESULTS/IMPACT TO DATE OR EXPECTED:

Three larval parasites from India and a *Trichogramma* egg parasite from California were imported and released. Two larval parasites became established in late 1986 and are now parasitizing up to 40% of the larvae. Long term monitoring has shown that the caterpillar population has been subtstantially reduced since July 1987 compared to previous levels. Mango trees have responded positively to the decreased pressure of the mango shoot caterpillar. Trees have more leaves and, in 1988 and 1989 fruit yields were 10-80 times higher than in previous years.

Specimens of larvae and adults of the mango blotch miner were determined to be an unidentified species of *Procontarinia*, which is now being described. Long-term monitoring showed that blotch miner populations are generally low, with only ocasional outbreaks. These outbreaks are loosely correlated with periods of rainy weather. *Procontarinia* has been determined to be an unimportant pest most of the time except on certain susceptible trees.

PUBLICATIONS:

Schreiner, I. H. 1987. Mango shoot caterpillar control on mango flowers. Insecticide and Acaricide Tests. 12: 94.

Schreiner I. H. and Wall, G.C. Blotch miner associated with mango leaf anthracnose in Micronesia. Plant Disease. In Press.

INTEGRATED PEST MANAGEMENT

PROJECT TITLE:
Development of Integrated Pest Management Systems for Guam Watermelon and Cruciferous Crop Production

PRINCIPAL INVESTIGATORS:

AES	G.C. Wall, I. Schreiner, D. Nafus, R. Muniappan, A.Moore (Visiting Postdoctoral fellow)
CES	L. Yudin, F. Cruz

NATURE OF PROJECT/PART 1:
The major objective is to implement an integrated pest managerment (IPM) system which can be used by watermelon growers on Guam. This IPM system will consist of a decision model which generates pest control recommendations based on data collected through drop monitoring.

RESULTS/IMPACT TO DATE OR EXPECTED:
Major problems affecting watermelon production on Guam were determined by farm surveys conducted during the first year of this project. Major pests include the melon aphid (*Aphis gossypii*) which transmits plant viruses (Zucchini Yellow Mosaic Virus, Watermelon Mosaic Virus 1), orange pumpkin beetle (*Aulacophora similis*), melon fruit fly (*Dacus cucurbitae*), melon thrips (*Thrips palmi*), cluster caterpillar (*Spodoptera litura*), and melonworm (*Diaphania indica*). *Liriomyza* leafminer populations are currently controlled by introduced parasitoids (*Ganaspidium utilis* and *Grotonoma* sp.) but remain a potential threat. Expected benefits from implementation of a watermelon IPM program are a reduction in unnecessary pesticide use, an increase in biological control of pest populations, and a decrease in the development of pesticide resistance.

NATURE OF PROJECT/PART 2:
To develop a pest management program for cruciferous crops on Guam.

RESULTS/IMPACT TO DATE OR EXPECTED:
Major pest problems of cruciferous crops on Guam are *Plutella xylostella, Spodoptera litura, Crocidolomia binotalis, Hellula undalis, Halticus tibialis, Solenopsis geminata, Lipaphis erysimi, Helicoverpa armigera,* and *Liriomyza* sp.

An integrated management program using trap cropping as a major component in the system will be developed.

ORNAMENTAL HORTICULTURE

PROJECT TITLE:
Evaluation of ornamentals for use on Guam

PRINCIPAL INVESTIGATOR:
J. McConnell

NATURE OF PROJECT:
To identify which ornamental crops have potential for commercial production in Guam and to determine optimum techniques for culture.

RESULTS/IMPACT TO DATE OR EXPECTED:
Several crops have been identified for further study. These include several genera of orchids, anthuriums, heliconias and gingers. Currently cultivars are being evaluated for their flower production. In addition various cultural methods are being evaluated to determine which are suitable for Guam's conditions. Ongoing studies are looking at optimum levels of light, water and fertilizer. Another study is evaluating growing media. It has been found that crushed limestone is suitable for growing vandas, dendrobiums and cattleyas. The coarseness varies with the age of the plants and the genus involved. Overhead irrigation with spinner sprinklers was found to be superior to impact or shrub sprinklers because they give the best distribution of water at low pressures. Spinner sprinklers have also reduce scale populations on the leaves and stems of vandas. This gives the added benefit of needing to spray insecticides less frequently.

CULTIVAR RELEASE:
Aranda Marianas Lila. 1988. Parentage: *Aranda* Wendy Scott (4N) X *Vanda*. Sanderiana 'Alba' (2N). A triploid highly suited in Guam for use a a cut flower. Flowering occurs during much of the year.

PUBLICATIONS:
McConnell, J. and Muniappan, R. 1989. Control of scale by sprinkler irrigation on *Vanda* Miss Joaquim. HortScience. 24:86. (Abstr).

McConnell, J. 1990. Crushed limestone aggregate and coconut husk as potting media for *Vanda* Miss Joaquim. Univ. of Guam, Agriculture Experiment Station Publication. 7p.

ORNAMENTAL HORTICULTURE

PROJECT TITLE:

Environmental Factors Affecting Flowering in some Dendrobiums and Vandas.

PRINCIPAL INVESTIGATOR:

J. McConnell

NATURE OF PROJECT:

To study how various environmental factors such as solar radiation, air temperature and rainfall affect flowering in some orchid hybrids.

RESULTS/IMPACT TO DATE OR EXPECTED:

Understanding how different environmental factors affect various stages of growth helps in predicting flower production. Reduced light does reduce flowering in dendrobiums and vandas. This will allow growers to plan in advance the quantity of flowers they can supply on a given date by monitoring the weather. Also this information will help in screening and selecting which cultivars of orchids to grow in order to have flowering throughout the year. This study will also contribute to an understanding of how light intensity affects CO2 uptake and the impact of this on flowering.

PUBLICATIONS

McConnell, J. 1988. Computer data management system for agricultural research. HortScience. 23(3):735. (Abstr.)

McConnell, J., Mafnas, J. and Leon Guerrero, R. 1990. Environmental factors affecting flowering in vandas and dendrobiums in the tropics. Proceedings of the Nagoya International Orchid Symposium. In Press.

PLANT PATHOLOGY

PROJECT TITLE:

A study of the diseases of beans on Guam, their importance and control.

PRINCIPAL INVESTIGATORS:

C. A. Kimmons, Research Associate and G. C. Wall

NATURE OF PROJECT:

Yard-long bean is a popular vegetable crop on Guam, and its production is limited by several diseases; powdery mildew (*Oidium sp.*) can defoliate the crop and shorten the harvest period. An unknown virus disease has been observed frequently in high incidence levels, and is suspected to have a detrimental effect on plant growth and yield. The objectives of this study are to dentify the diseases of major importance that affect bean production on Guam, assess yield losses caused by those diseases whose impact on production is unclear, but whose potential for damage is a serious threat to bean production on Guam, and develop economically and environmentally sound control measures for those bean diseases that can cause economically significant yield reduction.

RESULTS/IMPACT TO DATE OR EXPECTED:

A research associate was hired to work on this project, starting in July 1989. Two major diseases have been targeted for these studies; they are powdery mildew and an unknown virus disease.

A mosaic disease of yardlong bean, *Vigna unguiculata* var *sesquipedalis*, has been experimentally determined to be aphid-borne, and transmitted mechanically. There is evidence that it can also be seed-borne. The cowpea aphid, *Aphis craccivora*, was capable of transmitting this virus, in what appears to be a non-persistent manner. Of fifty-four weed hosts tested, thirty-nine were infected with this yardlong bean virus. These included 30 legumes and 9 of other families. *Chenopodium amaranticolor* is a local-lesion host.

A variety trial is under way, which includes 9 cultivars. Besides yield comparisons, they will also be screened for field resistance to this virus disease. There is also a fungicide test under way, for the control of powdery mildew.

Work planned for this year includes ELISA tests to attempt a serological identification of the virus, and yield loss tests.

PLANT PATHOLOGY

PROJECT TITLE:

Diseases of cucurbit crops on Guam and development of strategies for their control

PRINCIPAL INVESTIGATOR:

G. C. Wall

NATURE OF PROJECT:

Cucurbits, in particular watermelon, are among the most important cash crops on Guam. Various cucurbit disease outbreaks have occurred, resulting in widespread and serious losses. The objectives of this project are to determine the identity of important viral and other diseases occurring on cucurbits, identify sources of resistance, or test other control methods.

RESULTS/IMPACT TO DATE OR EXPECTED:

The viral diseases of cucurbit crops have been identified via ELISA; we now know that Watermelon Mosaic Virus I (synon. Papaya Ringspot Virus, watermelon strain), Zucchini Yellow Mosaic Virus, and Cucumber Mosaic Virus are present here. Weed hosts have also been identified. These virus diseases occur on all cucurbit crops including watermelon, melons (different types), cucumber and squash. A bacterial disease of watermelon has been identified as fruit blotch, its causal agent being *Pseudomonas pseudoalcaligenes* subsp *citrulli*. The pathogen can be seed-borne; heat treatment of seed for 50°Cx20 min was found to effectively clean seed of this bacterium. Fruit inoculations have shown a differential reaction, with cultivar Crimson Sweet developing smaller and slower-growing lesions than cultivar Glory. After pathogenicity tests were completed, the local isolate was compared to the type culture. Work on comparing their carbon source utilization is in progress. This year's work plans include resistance screening of watermelon and melon cultivars.

PUBLICATIONS:

Wall, G. C., and Santos, V. M. 1988. A new bacterial disease of watermelon in the Mariana Islands. Phytopathology (Abstr.) 78:1605.

Wall, G.C., 1989. Control of watermelon fruit blotch by seed heat-treatment. Phytopathology (Abstr.) 79:1191.

Wall, G.C., Santos, V. M., Cruz, F. J., Nelson, D. A., and Cabrera, I. 1990. Outbreak of watermelon fruit blotch in the Mariana Islands. Plant Disease 74:80.

PLANT PATHOLOGY

PROJECT TITLE:
Fungicide control of citrus foot rot on Guam

PRINCIPAL INVESTIGATOR:
G. C. Wall

NATURE OF PROJECT:
A solution to the foot rot problem affecting many citrus trees on Guam is needed. The objectives of this study are to test the efficacy of fungicides available for citrus foot rot, under Guam's environmental conditions, and to select the most efficient, practical, economical, and environmentally sound treatments for the control of this important disease.

RESULTS/IMPACT TO DATE OR EXPECTED:
It is very common to see foot rot symptoms on citrus trees throughout Guam. Isolations of *Phytophthora sp.* from diseased root tissue indicate that root rot is also widespread. Recently developed systemic fungicides effective against oomycetes are being used elsewhere for the control of this citrus pathogen. It is necessary to test these in Guam's unique soils, however. Two testing sites have been identified; one in Yigo, in the northern shallow soils overlying coral plateaus, and the other in Ipan, Talofofo, in the southern mountainous terrain.

The fungicides to be tested are fosetyl-al, and metalaxyl. They will be applied as a soil drench and as a foliar spray. The test is expected to be completed in June.

PLANT PATHOLOGY

PROJECT TITLE:
Biological suppression of soilborne plant pathogens

PRINCPAL INVESTIGATOR:
G. C. Wall

NATURE OF PROJECT:
Soilborne plant pathogens are often difficult to control by contemporary means. Recent findings have shown that various kinds of soil organisms interact antagonistically with certain plant pathogens. One objective of this project is to identify organisms with potential for suppression of specific soilborne plant pathogens; another is to establish acceptable procedures for application and/or enhancement of the efficacy of biocontrol agents identified.

RESULTS/IMPACT TO DATE OR EXPECTED:
Guam's participation in this regional project has just recently been renewed. One of the most troublesome soilborne plant pathogens on our island is the bacterial wilt organism. *Pseudomonas solanacearum* causes wilt on over 200 plant species, including all economically important members of the solanaceous family, and a number of common weeds. Certain soils on Guam are free of this malady, while in other soils it is a chronic problem. A number of fungi were isolated from soil and screened for antagonistic behaviour against *P. solanacearum.* No antagonistic fungi have been found so far. A fluorescent pseudomonad isolated from soils where this disease is not a problem was shown experimentally to retard the normal progress of this disease. Other experiments here have shown that soil texture has a marked influence on disease incidence; infested field soil amended with 50% sand sustained significantly less disease incidence than unamended soil. In another experiment, the addition of sulfur retarded disease progress, but only after 3 months' time.

This year's plans include testing a combination of factors that have shown an ability to suppress the bacterial wilt organism, and continued testing of fungi.

SOIL SCIENCE

PROJECT TITLE:

Nitrogen and Potassium Interaction on the Production of Selected Vegetables

PRINCIPAL INVESTIGATOR:

J.A. Cruz

NATURE OF PROJECT:

To assess the N and K levels of the Guam and Yigo Series soils; to evaluate the effects of N and K and their interaction on the growth and yield of selected vegetables on Guam and Yigo series soils during the wet and dry seasons.

RESULTS/IMPACT TO DATE OR EXPECTED:

On a pot experiment with different levels of N and K applied to Yigo soils, it was observed that at a high levels of applied N the head cabbage yield increase with the increased rates of K. A field experiment with different levels of N and K applied to Yigo soil is currently being monitored. During the wet season, soil samples will be taken from different locations on the Guam and Yigo series soils to determine N and K status. More field experiments will be established during the wet season.

HATCH PROJECTS

GU0020	Improving the status of tropical fruit crops through selection, introduction and breeding
GU0030	Evaluation of different cultural methods for production of ornamental plants on Guam
GU0059	Reproductive biology of three seacucumber species of potential commercial value
GU0060	Bioenergetics and behavior of larval rabbitfishes (*Siganus* spp.)
GU0063	Developing pest management systems for vegetables compatible with *Liriomyza* management
GU0064	Diseases on cucurbit crops on Guam and development of strategies for their control
GU0065	Development of cultural, chemical and biological control methods for pests of cruciferous crops on Guam
GU0067	Nitrogen and potassium interaction on the production of selected Vegetables
GU0068	Use of locally available feedstuffs and potential feed sources on Guam for poultry feeding
GU0072	Small land-holders of Guam: Production analysis and risk–avoiding behaviors

REGIONAL RESEARCH PROJECTS

GU0015	Establish, improve and evaluate biological control in pest management systems of plants
GU022	Water nutrient management of crops under micro irrigation
GU0066	A national agricultural program to clear pest control agents and animal drugs for minor uses

USDA, CSRS–SPECIAL GRANT, PBAG–PROJECTS

GU0057	Biology and biological control of the red coconut scale, *Furcaspis oceanica* Lindinger
GU0058	Environmental factors affecting flowering in some *Vanda* and *Dendrobium* hybrids in the tropics
GU0061	Biological control of *Lantana camara* L. in the Mariana Islands
GU0062	A study of the diseases of beans on Guam, their importance and control
GU0070	Development of techniques for the mass production of larval rabbitfishes (*Siganidae*) for culture in Micronesia
GU0071	Biology and control of *Aulacophora similis* and *Diaphania indica*

ADAP PROJECT

Development of integrated pest management systems for Guam watermelon and cruciferous crop production

RPAR PROJECT

Fungicide control of citrus foot rot on Guam