

# 2009 University of Guam Research Annual Report of Accomplishments and Results

**Status: Accepted**

**Date Accepted: 06/02/2010**

## I. Report Overview

### 1. Executive Summary

Guam, an unincorporated Territory of the United States, is located in the Western Pacific at 13 degrees north latitude and 144.4 degrees east longitude. It is the largest of 16 islands in the Marianas. It is approximately 3,600 miles west-southwest of the Hawaiian Islands and about 1,500 miles due east of Manila, Philippines. Guam's population is approximately 180,000. About forty percent of the population is under 20 years old. The ethnic background of the island includes: Chamorro (native islanders), Filipinos, Caucasians (including members of the U.S. Armed Forces and their dependents), other islanders (Micronesians and Palauans) and Asians (Koreans, Japanese and Chinese).

On June 22, 1972, the U.S. Congress passed Public Law 92-318, which designated the University of Guam as a member of the 1862 Land Grant institutions. In March 1974, the University of Guam Board of Regents created the College of Agriculture and Life Sciences (CALs) to facilitate the tripartite functions of the college: research, extension and teaching. On August 1, 2003, the University executed a major reorganization, which included consolidating five colleges into three major colleges. CALs was merged with mathematics and science disciplines from the former College of Arts and Sciences to form the College of Natural and Applied Sciences (CNAS). The Dean of CNAS retained the Directorship of the Agriculture Experiment Station, while the Vice President of University and Community Engagement reassumed his appointment as Director of Cooperative Extension Service.

In December 2007, as a result of another reorganization tripartite functions of the college was restored with the dean being simultaneously a director of Cooperative Extension Service as well as a director of Agriculture Experiment Station. In 2006 AES was renamed to Western Pacific Tropical Research Center. This new name more accurately reflects the division's broad mission and research priorities. The primary mission of WPTRC is to conduct applied and basic research in agriculture and to protect the natural environment. The Hatch funds and their respective Government of Guam matching funds are used to maintain operations of the Western Pacific Tropical Research Center. These funds principally support the salaries of permanent personnel of WPTRC.

The Western Pacific Tropical Research Center conducts research for the development of the island's agriculture, for the protection of natural environment as well as in related fields. The University of Guam Cooperative Extension Service translates and delivers technical information and conducts informal education programs for farmers, homemakers, families, youth and the community.

Research productivity over last several years continuously increase and 2009 was no exception. Further significant growth in refereed journal publications as well as substantial increase in successful grant proposals in 2009 was evident. The new position in aquaculture resulted in development of a successful program. Investments related to the increase in military presence on Guam had positive impact on the island's economy and local businesses. Overall Guam experience less severe impact of recession than US average. Overall, 2009 was a successful year for WPTRC.

#### Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	9.0	0.0
Actual	0.0	0.0	9.0	0.0

## II. Merit Review Process

### 1. The Merit Review Process that was Employed for this year

- External University Panel

- Expert Peer Review

## 2. Brief Explanation

Because of the small size of WPTRC, review of individual projects was conducted by WPTRC administrators (Director and Associate Director). Planned programs and activities addressed the critical issues of strategic importance, including those identified by the stakeholders during the development of 2006-2011 Strategic Plans. All new research proposals were submitted to WPTRC Associate Director who checked proposals for completeness and format. Afterwards proposal were sent for review to external ad hoc peer reviewers. Based on the review, that includes assessment of (1) significance, (2) need, (3) approach, (4) new knowledge to be generated, (5) potential for impact, and (6) potential for success, WPTRC administrators are submitting proposals to CRIS and make decisions regarding allocation of resources.

## III. Stakeholder Input

### 1. Actions taken to seek stakeholder input that encouraged their participation

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to selected individuals from general public

#### Brief explanation.

In 2009, numerous research projects were driven by stakeholders demand and addressed environmental issues, integrated plant protection, biocontrol as well as served ethnic needs of local population. Relatively large portion of research aimed to develop control mechanisms for eradication/ suppression of non-indigenous/invasive species, to improve and implement effective early detection and prevention strategies, and to develop Integrated Pest Management strategies for major exotic insect plant pests and diseases. Another important research project defined the genetic structure of the Cycads populations among the island habitats of Guam, Rota, Yap, Palau, and the Philippines. We continued to focus on issues that assure the understanding and protection of natural environment and sustained management of precious natural resources waste management, water quality and other natural resources vital for people of Guam.

### 2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

#### 1. Method to identify individuals and groups

- Open Listening Sessions
- Other (Guam's stakeholders are well identified)

#### Brief explanation.

WPTRC researchers employed several input methods to solicit input from individual farmers, farmers groups, representatives of the industry and representatives from federal and local agencies. Because of relatively small number of faculty and stakeholders on Guam, it has been a long-lasting practice to invite stakeholders for various functions in the college and give them frequent opportunities to express their needs in informal settings such as personal contact with faculty members. In 2009 stakeholders (farmers, golf course superintendents, managers from nurseries etc.) were invited to the college numerous times to express their needs and concerns. Of particular importance was creation of good understanding and stakeholders' support on issues related to the natural environment.

### 2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

#### 1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting with invited selected individuals from the general public

**Brief explanation.**

Guam's stakeholders are well identified. About fifty farmers who supplement their income with some sort of agricultural production ranged in their activities from substantial (full time farmers) to hardly significant. Their associations are rather loose and based on personal contacts, friendships, etc. Their research requests are consequently not strong however researchers are required to listen and then to address their concerns. Many researchers modified their research programs to improve a service to stakeholders and provided additional opportunities for continued feedback. Research Information were disseminated to communities through newsletters, local newspaper coverage, radio and sometimes television programs.

**3. A statement of how the input will be considered**

- In the Budget Process
- To Identify Emerging Issues
- Redirect Research Programs
- In the Action Plans
- To Set Priorities

**Brief explanation.**

We feel our informal and formal contact system with stakeholders works quite well. Perhaps one of the best examples of how stakeholder input is translated into action by CNAS is the rapid manner in which UOG was able to react to the sudden appearance of certain invasive species, especially rhino beetle on Guam. Due to the close contact extension and research scientists maintain with local growers, and because of the breadth of experience on other islands in the region, UOG-CNAS entomologists and extension agents were able to identify, characterize and provide a rational method of management for these species. Scientists were then able to apply for funding for more in depth research on the nature and optimal management technique to contain these species.

**Brief Explanation of what you learned from your Stakeholders**

For the most part, our professionals know the primary stakeholders in their particular disciplines, and interact with them regularly in the course of their normal university duties. Input from these interactions allows the faculty to tailor their programs to the unique needs of Guam's diverse community. Because Guam is a small island where most business is transacted in an informal setting, we felt it necessary during 2009 to introduce a more structured and easily evaluated format for obtaining community input into faculty endeavors.

IV. Expenditure Summary

<b>1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)</b>			
<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	943978	0

<b>2. Totaled Actual dollars from Planned Programs Inputs</b>				
	<b>Extension</b>		<b>Research</b>	
	<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
<b>Actual Formula</b>	0	0	895894	0
<b>Actual Matching</b>	0	0	500000	0
<b>Actual All Other</b>	0	0	0	0
<b>Total Actual Expended</b>	0	0	1395894	0

<b>3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from</b>				
<b>Carryover</b>	{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

## V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Sustain, Protect, and Manage Guam's Natural Environment and Resources.
2	Development and Protection of Guam's Diversified Tropical Plant Systems, and Aquaculture.

**V(A). Planned Program (Summary)****Program # 1****1. Name of the Planned Program**

Sustain, Protect, and Manage Guam's Natural Environment and Resources.

**V(B). Program Knowledge Area(s)****1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			100%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual	0.0	0.0	1.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	90000	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	50000	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

**V(D). Planned Program (Activity)****1. Brief description of the Activity**

Two years ago WPTRC lost Agriculture Engineer and decided not to fill up this position. One soils scientist addressed issues related to soil management practices conducting Hatch and multistate projects. Accelerated erosion as a consequence of poor soil quality is manifested more seriously in tropical landscapes, especially in small island settings. The overall goal of this hatch proposal is to develop techniques and management practices that will help to improve the soil quality in the island of Guam. An integrated approach was designed to evaluate the effect of conservation tillage, rotation with leguminous crops as well as green manure for organic matter build up. The residue management for soil conservation will be evaluated for re-habilitation and restoration and for enhancement and maintenance of soil productivity and quality. As part of in-field experiment and in order to evaluate the re-generating of soil surface that is degraded by erosion the following regimes are being practiced: a) No-tillage b) Reduced tillage c) Conventional Tillage d) Conventional Tillage with Rotation to leguminous Sunnhemp These regimes represent a wide range of practices that will be evaluated as conservation and restoration techniques. Field experimentation and methods: Sets of 12 field plots (each 8.5 X 10m) were set up at the University of Guam's Experiment Stations in Ija located in southern

Guam. Corn was planted and on one set (3 replicates) of conventionally tilled plots, has been rotated with sunn hemp year round since that time. An attempt was made to plant irrigated corn during the dry season and sunnhemp during the wet season (corn/sunn hemp rotation). The experiment included corn plantings under four conditions, conducted on different plots: a) Conventional Tillage (CT) without sunn hemp rotation (the Control), b) Conventional Tillage in rotation with Sunn Hemp (CT/SH - described earlier), c) Reduced Tillage (RT), and d) No-Tillage (NT). "Conventional tillage" consisted of tillage before and after planting. In the CT treatment the soil surface remained exposed between annual corn plantings. This treatment (control) was the yardstick for erosion measurements and parameters. In the CT/SH treatment, sunn hemp was grown in rotation with the corn crops. In the No-tillage treatment, the soil was never tilled and corn seeds were planted directly (drilled in) through the existing plant residue. In the Reduced-tillage treatment, the soil surface was left undisturbed after each corn harvest and tilled only immediately before the next corn planting. After each round of harvest, yield of the corn crop was measured, and soil samples were analyzed for soil-property evaluation. Also, after each harvest, we used a rainfall simulator to measure runoff in order to evaluate the effect of experimental treatments on the infiltration rate and runoff. The results of this ongoing research will contribute to the overall scientific efforts in understanding the role of agriculture in sequestration of carbon in soils, and the ways in which this may reduce atmospheric carbon dioxide.

## 2. Brief description of the target audience

The primary audiences of this project are farmers and ranchers. The other audiences include; soil scientists, extension agents, USDA technical personnel, and staff, other agriculturists and producers.

### V(E). Planned Program (Outputs)

#### 1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Plan</b>	0	0	0	0
<b>Actual</b>	30	100	0	0

#### 2. Number of Patent Applications Submitted (Standard Research Output)

##### Patent Applications Submitted

Year: 2009  
 Plan: 0  
 Actual: 0

#### Patents listed

#### 3. Publications (Standard General Output Measure)

##### Number of Peer Reviewed Publications

2009	Extension	Research	Total
<b>Plan</b>	0	0	
<b>Actual</b>	0	3	0

### V(F). State Defined Outputs

#### Output Target

#### Output #1

##### Output Measure

- Conference Presentations

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	4	4

**Output #2**

**Output Measure**

- Journal Publications

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	4	3

**Output #3**

**Output Measure**

- Newspaper, magazine and other non peer reviewed publications.

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	4	4

V(G). State Defined Outcomes

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	<p>Action outcomes:                      Adopt sustainable natural resource management practices.                      Condition Outcomes: Enhance the economic and environmental sustainability of Guam's agriculture                      Improve the lives of Guam's citizens through positive human development</p> <p>Learning Outcomes:                      Aspire to contribute to ecological health and biodiversity                      Learn about nutrient sources, recycling and delivery methods that are compatible with crop, soil and production systems \</p> <p>Learn about water and land interaction, and related water-quality issues</p>

## Outcome #1

### 1. Outcome Measures

Action outcomes: Adopt sustainable natural resource management practices. Condition Outcomes: Enhance the economic and environmental sustainability of Guam's agriculture Improve the lives of Guam's citizens through positive human development Learning Outcomes: Aspire to contribute to ecological health and biodiversity Learn about nutrient sources, recycling and delivery methods that are compatible with crop, soil and production systems \ Learn about water and land interaction, and related water-quality issues

### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Farmers and ranchers benefited from research by increasing profitability of their production. People of Guam benefited from protection of the natural environment, quality of water, air and soil.

#### What has been done

Most of the specific objectives attained progress and sometimes the full accomplishment.

Large number of personal contacts, popular articles, peer review articles, conference abstracts etc. was completed and numerous sources with research results are available to the public on the WPTRC website and libraries.

#### Results

Large number of personal contacts, popular articles, peer review articles, conference abstracts etc. was completed and numerous sources with research results are available to the public on the WPTRC website and libraries.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes

**Brief Explanation**

none

**V(I). Planned Program (Evaluation Studies and Data Collection)**

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**V(A). Planned Program (Summary)****Program # 2****1. Name of the Planned Program**

Development and Protection of Guam's Diversified Tropical Plant Systems, and Aquaculture.

**V(B). Program Knowledge Area(s)****1. Program Knowledge Areas and Percentage**

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
202	Plant Genetic Resources			10%	
205	Plant Management Systems			20%	
211	Insects, Mites, and Other Arthropods Affecting Plants			20%	
212	Pathogens and Nematodes Affecting Plants			10%	
215	Biological Control of Pests Affecting Plants			10%	
216	Integrated Pest Management Systems			10%	
307	Animal Management Systems			10%	
601	Economics of Agricultural Production and Farm Management			10%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)****1. Actual amount of professional FTE/SYs expended this Program**

<b>Year: 2009</b>	<b>Extension</b>		<b>Research</b>	
	<b>1862</b>	<b>1890</b>	<b>1862</b>	<b>1890</b>
Plan	0.0	0.0	6.0	0.0
Actual	0.0	0.0	8.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

<b>Extension</b>		<b>Research</b>	
<b>Smith-Lever 3b &amp; 3c</b>	<b>1890 Extension</b>	<b>Hatch</b>	<b>Evans-Allen</b>
0	0	805894	0
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
0	0	450000	0
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
0	0	0	0

**V(D). Planned Program (Activity)****1. Brief description of the Activity**

The 2009 germplasm performance test were conducted for leafy lettuce (*Lactuca sativa*) in Yigo Experiment Farm. In aquaponics system, heat and insect pest tolerant lines were evaluated for their performance.

We continued to study the response of papaya plants to Guam's trade winds. Papaya trees exposed to uni-directional winds developed eccentric stems with the eccentricity occurring on both leeward and windward sides of the stem.

We continued to survey for *Solenopsis invicta* on Guam, but due to reduced funding from USDA-APHIS were not able survey for *Wasmannia auropunctata* on Guam or on the CNMI islands.

We also continue to refine our description of ant-host associations for several ants and aphids occurring on Guam. Results show that banana aphids normally found on banana are a distinct species from those normally occurring on ginger and heliconia.

During the year 2009, aquaculture activities included: 1. Continuing genetic and nutritional study 2. Analyzing experimental data Mating matrix design Statistical analysis 3. Continuing on the shrimp genetic breeding program, 4. Setting up a molecular biology lab for aquaculture study.

In order to develop the most sensitive technique possible for the detection of the Coconut Tinangaja Viroid (CTIVd a more sensitive technique for the detection of CTIVd, were tested. A Guam survey of 2 ORCHID viruses was completed and results were published.

The banana root borer is a major pest of bananas throughout the world. Studies were conducted to determine the pheromone trap efficacy, effect of shade on trap catches and to monitor the population of *C. sordidus* using pheromones in Guam. In Guam, pheromone traps were used to monitor the population level of *C. sordidus*.

Food safety is an important and global public health issue with an increase of problems and consumers' concerns. Most of foodborne illness occurs in private homes and fast restaurants. To reduce the risk of foodborne illness, it is essential to improve food processing or preparation methods and to identify antimicrobial agents from tropical or subtropical plants and herbals to kill and inhibit foodborne pathogens in foods.

We have continued to develop or improve methods, techniques, or processes to maintain or improve quality or functionality of food products; identified and developed new knowledge to influence quality and functionality of foods and determined pathogenic foodborne microorganisms in processed or inadequately processed and preserved foods in order to improve methods of food handling, processing, storage, and preparation for greater food security.

We have continued to study Asian cycad scale that appears is under good biological control in many areas of Guam. Ongoing surveys are periodically conducted to evaluate the effectiveness of *Rhizobius lophanthae*, a coccinellid, on controlling populations of the Asian cycad scale, *Aulocaspis yasumatsui* on *Cycas micronesica* on Guam.

We continued to survey invasive ants on the islands of Guam, Saipan, Tinian, and Rota in the Mariana Islands during 2009. We also monitor the spread of invasive insects to the various islands of Micronesia. We continued to study the spread of invasive insects in Micronesia. We have been documenting population survivorship using a demographic approach.

**2. Brief description of the target audience**

No extension, this is researchreport only.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	100	1000	0	0

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

Year: 2009

Plan: 0

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

<b>2009</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Plan</b>	0	0	
<b>Actual</b>	0	26	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Journal publications

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	12	26

**Output #2**

**Output Measure**

- Newspaper, magazine, and other non peer reviewed publications.

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	15	30

**Output #3**

**Output Measure**

- Abstracts and conference presentations.

<b>Year</b>	<b>Target</b>	<b>Actual</b>
2009	12	20

V(G). State Defined Outcomes

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	<p>Action outcomes                      Adopt healthy lifestyle practices, Adopt independent living practices, Adopt sustainable living practices, Adopt sustainable natural resource management practices, Implement food safety practices at all stages of the food handling system, Improve and expand Integrated Pest Management.</p> <p>Condition Outcomes:                      Enhance the economic and environmental sustainability of Guam's agriculture and aquaculture.                      Improve the lives of Guam's citizens through positive human development, healthy lifestyles and nutrition</p> <p>Learning Outcomes                      Aspire to contribute to ecological health and biodiversity                      Learn about integrated pest management (IPM)                      Learn about invasive species                      Learn about IPM technologies and benefits                      Learn about new crops and varieties                      Learn about nutrient sources, recycling and delivery methods that are compatible with crop, soil and production systems                      Learn about principles of aquaculture resource management                      Learn about the environmental risks of handling and applying pesticides                      Learn about the risks of not handling food safely                      Learn about water and land interaction, and related water-quality issues                      Learn alternative pest management techniques that minimize pesticide use                      Learn appropriate food safety practices                      Learn proper food handling practices                      Learn sustainable living skills                      Learn to apply pesticides safely and effectively                      Learn to identify invasive species</p>

**Outcome #1****1. Outcome Measures**

Action outcomes Adopt healthy lifestyle practices, Adopt independent living practices, Adopt sustainable living practices, Adopt sustainable natural resource management practices, Implement food safety practices at all stages of the food handling system, Improve and expand Integrated Pest Management. Condition Outcomes: Enhance the economic and environmental sustainability of Guam's agriculture and aquaculture. Improve the lives of Guam's citizens through positive human development, healthy lifestyles and nutrition Learning Outcomes Aspire to contribute to ecological health and biodiversity Learn about integrated pest management (IPM) Learn about invasive species Learn about IPM technologies and benefits Learn about new crops and varieties Learn about nutrient sources, recycling and delivery methods that are compatible with crop, soil and production systems Learn about principles of aquaculture resource management Learn about the environmental risks of handling and applying pesticides Learn about the risks of not handling food safely Learn about water and land interaction, and related water-quality issues Learn alternative pest management techniques that minimize pesticide use Learn appropriate food safety practices Learn proper food handling practices Learn sustainable living skills Learn to apply pesticides safely and effectively Learn to identify invasive species

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Quantitative Target	Actual
2009	{No Data Entered}	0

**3c. Qualitative Outcome or Impact Statement****Issue (Who cares and Why)**

Farmers and ranchers benefited from research by increasing profitability of their production. People of Guam benefited from protection of the natural environment, quality of water, air and soil.

**What has been done**

Most of the specific objectives attained progress and sometimes the full accomplishment.

**Results**

Large number of personal contacts, popular articles, peer review articles, conference abstracts etc. was completed and numerous sources with research results are available to the public on the WPTRC website and libraries.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems

211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
307	Animal Management Systems
601	Economics of Agricultural Production and Farm Management

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes

**Brief Explanation**

one

**V(I). Planned Program (Evaluation Studies and Data Collection)**

1. Evaluation Studies Planned

- During (during program)

**Evaluation Results**

**Key Items of Evaluation**