

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change - Integrated Management of New and Emerging Pest and Diseases

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
211	Insects, Mites, and Other Arthropods Affecting Plants			24%	
212	Pathogens and Nematodes Affecting Plants			33%	
215	Biological Control of Pests Affecting Plants			24%	
216	Integrated Pest Management Systems			19%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	14.1	0.0
Actual Paid Professional	0.0	0.0	1.5	0.0
Actual Volunteer	0.0	0.0	2.5	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	1016545	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	643331	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

The goal of enhancing our capacity to conduct disease diagnostics continues to be met: two new diseases caused by viruses affecting soybean and other legumes were identified last year. A new Tospovirus in Puerto Rico was also characterized using Reverse Transcriptase Polymerase Chain Reaction (RT-PCR), leading to the first report of Tomato Chlorotic Spot Virus (TCSV) in tomato, pepper, lettuce and jimsonweed. In 220 accessions of wild and cultivated cucurbits using RT-PCR the presence of Potyvirus (ZYMV and PRSV) was confirmed. Papaya Ringspot Virus (PRSV) was found in *Parthenium hysterophorus* L. and *Xanthium occidentale* Bertol. Citrus Greening caused by *Candidatus Liberibacter asiaticus* (CLA) was detected by PCR assay in 23 of 345 samples. Using serological methods Citrus Tristeza Virus (CTV) was detected in 42 samples negative for CLA, and Citrus Variegated Chlorosis (CVC) in one sample. The presence of Phytoplasmas was detected by PCR in a consistent manner in the north transect of the highlands, while their absence from south coast samples was noticed. Phytoplasma DNA has been detected in native palms and in several of *Fulgoroidea*.

Progress in the development of biological control strategies to mitigate invasive species has been accomplished for *Harissia cactus* mealybug in the Guanica Dry National Forest Reserve and in Cabo Rojo Natural Reserve, with the integration of biocontrols and cultural practices. Findings related to the epizootic enhancement of *Beauveria bassiana* in the coffee berry borer (CBB) in coffee plantations throughout the rainy season (July-September) indicated that infection levels were higher in the shaded-grown coffee than in sunlit. Correlations between percent shade (UV) and *B. bassiana* were found. Sun intensity (UV) seems to be more important than relative humidity for enhancing epizootic of *B. bassiana* in Puerto Rico's coffee plantations. These results suggest that important changes in the use of this biocontrol should be made for the management of the coffee berry borer.

The development of disease management strategies for Black Sigatoka, compatible with a sustainable food production system in Puerto Rico, was concluded. The use of mechanical de-leafing combined with chemical control produced the highest yields. The intensive use of systemic fungicides will be, however, needed in the humid mountainous areas, while in the northwest area of Isabela fewer applications will be needed.

Scientists have disseminated research results in twenty-three conferences and twelve seminars. A total of forty-three refereed and non-refereed publications have been released, and two field days were organized. To reach our target audiences of extension specialists and agents, government partners, students, producers, consumers and environmental agencies, the faculty of the program have continued to participate in national and international events.

2. Brief description of the target audience

- Coffee, citrus and vegetable growers
- Banana and plantain growers
- Ornamental growers
- Landscaping, plant nursery industry and growers of cucurbits - southern USA and Puerto Rico

- IPM Specialists
- Researchers in the vegetable Industry
- Forest and land managers
- Undergraduate and graduate students from Crops and Environmental Sciences
- Federal and state agricultural agencies (PRDA, USDA/APHIS, USDA/ARS, USDA/NRCS), PR Dept. of Natural Resources, US Fish & Wildlife Service, International Institute for Tropical Forestry.
 - American Phytopathological Society (APS), Agronomy Society of America, Horticultural Society, Puerto Rican Agricultural Sciences Society, Entomological Society of America.
 - Consumers and homeowners

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2013
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	1	8	9

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of 'Pest Management Strategic Plans' (PMSPs) developed

Year	Actual
2013	2

Output #2

Output Measure

- Number of peer-reviewed articles in major scientific journals resulting from program activities.

Year	Actual
2013	8

Output #3

Output Measure

- Peer reviewed articles in local Scientific Journals resulting from program activities.

Year	Actual
2013	6

Output #4

Output Measure

- Abstracts or oral presentations in professional scientific society meetings resulting from program activities.
Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Poster presentations in professional scientific society meetings resulting from program activities

Year	Actual
2013	32

Output #6

Output Measure

- Number of joint Research-Extension activities that include pest diagnostics and identification, use of reduced impact pesticides, or research on pesticide impact assessment on non-target beneficial organisms.

Year	Actual
2013	4

Output #7

Output Measure

- Number of program-sponsored scientific events, like symposia, topic conferences, and open houses

Year	Actual
2013	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of stakeholders with increased knowledge on emerging pests and aware of non-target pesticide effects (Short Term)
2	Number of persons who adopted reduced risk pesticides and practices
3	Number of farmers reporting decreased losses due to key and emerging pests
4	Number of stakeholders knowledgeable of climate changes issues and their importance in agricultural production.

Outcome #1

1. Outcome Measures

Number of stakeholders with increased knowledge on emerging pests and aware of non-target pesticide effects (Short Term)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	474

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Fusarium oxysporum f. sp. cubense tropical race 4 (Foc TR4), which is attacking banana in Asia, represents a threat to the banana and plantain industry of Latin America and the Caribbean which is almost completely based on subgroups that are susceptible to Foc TR4. Raising awareness to this threat is important in order to prevent its entrance to the Americas. Accurate disease detection and education on management alternatives is vital for maintaining the productivity of crops affected by new and emerging pests and diseases.

What has been done

In 2013, a workshop directed to 8 laboratory technicians and scientists was held for Fusarium race 4 identification. This initiative included a conference with 100 participants, including agronomists, extension specialists, producers and government personnel. Three workshops on Tospovirus and thrips? vectors were held at the Juana Diaz Substation with a total of 128 attendants. Information about the disease etiology, epidemiology and vector management was provided. Information about the effect of Tospoviruses in vegetables was delivered via trainings, publications and presentations in scientific meetings and informal discussions.

Results

The Plant Disease Clinic (PDC) at Juana Díaz (Southern Plant Diagnostic Network) communicate closely with the agronomists of 6 different seed companies and growers that submit diseased samples. A total of 246 visits to the Plant Disease and Insect Clinic provided an opportunity to educate the clientele in the importance of accurate disease and pest detection.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

Outcome #2

1. Outcome Measures

Number of persons who adopted reduced risk pesticides and practices

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	83

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

New and emerging diseases compromise the production of important crops for the food security of the island and for export trade. Farmers lack of awareness of reduced risk pesticides and practices makes them prone to adopt more chemical intensive methods which may affect biological and other alternative control practices.

What has been done

PRAEXS completed the Strategic Management Plan for Black Sigatoka and for the coffee berry borer. The practices in banana include chemical and cultural practices for two different ecological zones. An extension document about Tospoviruses in vegetables was prepared in collaboration with Puerto Rico Department of Agriculture. The identification of a Tomato Chlorotic Spot Virus affecting tomatoes and peppers in the southern coastal production area provided an opportunity to raise awareness and prevent the dissemination of the vector and the disease.

Results

Approximately 83 growers received recommendations for disease and pest management and adopted IPM practices. Banana and plantain farmers changed their management practices by adopting the IPM recommended practices for the control of Black Sigatoka.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

Outcome #3

1. Outcome Measures

Number of farmers reporting decreased losses due to key and emerging pests

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Growers increasingly visit plant disease and insect detection facilities in Juana Diaz in search of diagnostics and recommendations for diseased crops.

What has been done

The Plant Disease and Insect Clinic in Juana Diaz engages growers who visit the clinic in the process of disease detection and identification. This is essential for growers and general public acquisition of knowledge and to promote ownership of the disease and pest detection process. Disease and Pest detection has been fast and accurate and improvement in the methods used for pathogen identification is reflected in the number of new diseases identified, and in the number of publications submitted and published.

Results

The largest producer of tomatoes and several hydroponic producers of lettuce, tomatoes and peppers in Puerto Rico have adopted the recommendations issued for Tomato Chlorotic Spot Virus (TCSV) prevention. By scouting the thrips vector and producing seedlings in insect-proof facilities plus the eradication of symptomatic plants, losses were decreased in the hydroponic facilities and less incidence of TCSV was reported in field tomatoes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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

Outcome #4

1. Outcome Measures

Number of stakeholders knowledgeable of climate changes issues and their importance in agricultural production.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Other (Reduction of AEXS personnel)

Brief Explanation

While the continued stagnation of the Puerto Rican economy affects everyone it is increasingly difficult to keep pace with the rapid entry of new diseases in the island with a reduced faculty roster due to retirement and a freeze on new hirings at the university. Personnel limitations are perhaps the biggest obstacle we have for making more progress toward meeting our goals.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

During the annual meetings of the different commodity groups, the program progress and results were compared with the objectives planned. Last year the program evaluation was centered in the implementation of the citrus greening management program. Some of the highlights of this process are:

- The new orange cultivars 'Swingle', 'HRS 812' and 'Carrizo' were released by the fruit program.
- The State Department of Agriculture extension agents were educated in the recommendations for citrus greening management that include a nutritional program and the vector control. These recommendations are being delivered to the citrus growers.
 - A request for additional funds to respond to the citrus greening outbreak was successfully delivered to the Legislature. Additional funding for the growers was approved for the implementation of management practices.
 - Citrus growers implemented the education program for citrus greening.
 - The certification of disease free citrus plants was implemented at the substations of Isabela and Adjuntas. The successful protocol of this initiative will be applied in the nurseries and orchards of the State Department of Agriculture to provide disease free citrus plants to the growers.

- Two hundred and seventy three growers, extension agents and agronomists received training in Citrus greening management in 8 different workshops. During these events an evaluation form was handed out to the participants. Results of these evaluations have not yet been made available to PRAEXS program coordinator by our collaborators in Extension and the Dept. of Agriculture, but are expected to be shared in future meetings of the integrated work group created for citrus greening management.
- The broad participation and attendance to the meeting organized by the Fruit Commodity Program is a measure of the success of the workshops and of the widespread interest in the information being delivered by the different research programs.

Key Items of Evaluation

Last year the program evaluation was centered in the implementation of the citrus greening management program.

- The State Department of Agriculture extension agents were educated in the recommendations for citrus greening management that include a nutritional program and the vector control. These recommendations are being delivered to the citrus growers.
- A request for additional funds to respond to the citrus greening outbreak was successfully delivered to the Legislature. Additional funding for the growers was approved for the implementation of management practices.
- The certification of disease free citrus plants was implemented at the substations of Isabela and Adjuntas. The successful protocol of this initiative will be applied in the nurseries and orchards of the State Department of Agriculture to provide disease free citrus plants to the growers.