V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Invasive Species Education and Management

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	30%		20%	
212	Pathogens and Nematodes Affecting Plants	30%		50%	
213	Weeds Affecting Plants	30%		30%	
215	Biological Control of Pests Affecting Plants	10%		0%	
	Total	100%		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	1.0	0.0	8.3	0.0
Actual	3.2	0.0	4.1	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**
45425	0	81573	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
351031	0	734406	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	263293	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We surveyed aphid species on all major Hawaiian islands, analyzed and described geographic and host relationships. We also analyzed the morphological and ecological factors contributing to invasiveness in these species. Experiments were performed on deliberately introduced biological control agents of aphids; and on fortuitous biocontrol agents (that arrived by unknown means) to Hawaii. We presented the first description and gave life history information on a new species of aphid parasitoid, Endaphis fugitiva, found to parasitize the banana aphid, Pentalonia nigronervosa Coquerel, the vector of banana bunchy top virus We published several papers in peer-reviewed scientific journals, and gave multiple talks, seminars, and presentations about our results at scientific symposia; and provided testimony and published a Draft Environmental Assessment for the introduction of new aphid parasitoids in Hawaii.

Anthurium mosaic: In 2003, a disease with viral-like symptoms appeared at an anthurium farm on the island of Hawaii that supplies the cut flower market. The anthuriums were established about two years prior to the onset of the disease. Diseased anthurium plants collected from this farm exhibited mosaic, mottling, and vein-clearing symptoms on leaves, which along with the

spathe, were often distorted with irregular margins, rendering the plants unsuitable for sale. We have isolated three distinct dsRNAs ranging from 3.0-3.5 kbp in size, from symptomatic anthurium plants. These dsRNA segments were completely sequenced and found to belong to a virus that is most closely related to members of the mycovirus family Chrysoviridae. An RT-PCR assay was developed to detect this putative virus. Ti Ringspot: In early 2009, ti farmers on the windward side of the island of Oahu reported unusual symptoms on their ti plants. Symptoms were small (3-15mm) ringspots present primarily on the basal 2/3 of the leaf. These viral-like symptoms have not been previously reported from ti. Symptomatic plants were widespread at affected farms, and according to the farmers, the disease spread quickly throughout the fields. Agarose gel electrophoresis revealed that high molecular weight (15-20 kbp) dsRNA was present in both types of tissue. The dsRNAs were isolated from the gel and used as templates for molecular cloning. We sequenced over 300 clones from the dsRNA libraries that were generated. Analysis of the sequence data revealed that at least four previously unreported species of closteroviruses were present in the ti samples. Tomato yellow leaf curl virus: Tomato yellow leaf curl is perhaps the most destructive viral disease of tomato (Lycopersicon esculentum) with losses of up to 100% in the tropics and subtropics. The disease is caused by Tomato yellow leaf curl virus (TYLCV) (sensu lato), a complex of circular monopartite ssDNA viruses of the genus Begomovirus, Family Geminiviridae. On tomato, TYLCV inhibits leaflet growth, causing yellowing and upward curling of the leaf margin. Flowers are aborted, and the entire plant will develop a stunted appearance. Whiteflies (Bemisia tabaci) are the natural vector of TYLCV which transmit the virus in a persistent, circulative manner. In October 2009, a home gardener in Kahului, Maui reported tomatoes with symptoms similar to tomato yellow leaf curl to the University of Hawaii Agricultural Diagnostic Service Center (ADSC) in Manoa. Samples were sent through the ADSC to our laboratory where we isolated DNA from symptomatic tissues. PCR was performed using degenerate primers PAR1c715 and PAL1v1978. An amplicon of expected size (~1.5 kilobases) was generated, cloned, and sequenced. The sequence data revealed the tomato plants were infected with a strain of TYLCV that was most similar (>98% identical) to strains of TYLCV from Japan (Tochigi and Tomigusuku) and China (ZJHZ12, Sh10, and ZJ8). This represents the first known case of TYLCV in Hawaii.

2. Brief description of the target audience

Farmers, consumers, and rural citizens who can appreciate reduced pesticide inputs as we come to rely more on biological means of pest control. Scientists who study invasive species and in particular aphid biology.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	80	700	300	300
Actual	619	37	0	0

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

Year: 2009
Plan: 0
Actual: 2

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	5	10	
Actual	0	36	36

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops, field days, demonstrations held

Year	Target	Actual
2009	2	14

Output #2

Output Measure

- Number of grant proposals submitted

Year	Target	Actual
2009	10	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Awareness created
2	Number of agency professionals, including extension agents who implement or install demonstration or similar programs for clientele education
3	Total dollar value of grants and contracts obtained.

Outcome #1

1. Outcome Measures

Awareness created

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	30	45

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Residents are not aware of the problems associated with invasive species.

What has been done
Workshops, demonstrations, filed days, presentations and publications make residents aware of the problems associated with invasive species.

Results
Residents will be more likely to assist in controlling invasive species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #2

1. Outcome Measures

Number of agency professionals, including extension agents who implement or install demonstration or similar programs for clientele education

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	8	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Residents are unaware of how to control invasive species.

What has been done
Demonstration project have been installed.

Results
Residents will better understand how to control invasive species and Hawaii will become more sustainable

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #3

1. Outcome Measures

Total dollar value of grants and contracts obtained.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	300000	1174290

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Resources are needed to fund research and extension programs.

What has been done
Extramural funds have been received

Results

Hawaii's economy will benefit from the funds received and the environment will be more sustainable as invasive species are better controlled.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

- Intentional introductions of invasive species
- Lack of funding/grant proposals don't come through.
- Other agencies and partners are not willing to partner and coordinate efforts.
- Communities and stakeholders are not willing to cooperate or don't do their share of the effort.

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

1. Evaluation Studies Planned

- After Only (post program)
- During (during program)

Evaluation Results

All projects conducted under this program were peer-reviewed before initiation. Annual progress reports were collected and evaluated by the associate deans for research and extension. Funds are not released for those projects which did not show tangible progress.

Key Items of Evaluation

None.