

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Invasive Species Education and Management

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
112	Watershed Protection and Management	0%		4%	
136	Conservation of Biological Diversity	0%		5%	
204	Plant Product Quality and Utility (Preharvest)	0%		5%	
205	Plant Management Systems	15%		2%	
211	Insects, Mites, and Other Arthropods Affecting Plants	20%		8%	
212	Pathogens and Nematodes Affecting Plants	15%		21%	
213	Weeds Affecting Plants	12%		19%	
215	Biological Control of Pests Affecting Plants	8%		16%	
216	Integrated Pest Management Systems	30%		10%	
312	External Parasites and Pests of Animals	0%		8%	
721	Insects and Other Pests Affecting Humans	0%		2%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	5.0	0.0	5.0	0.0
Actual Paid Professional	2.3	0.0	3.8	0.0
Actual Volunteer	0.4	0.0	0.0	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
54133	0	148049	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
244450	0	796399	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	639101	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Invasive species threaten the quality of agricultural products, the health of farming businesses and the surrounding natural and urban ecosystems. Sound management of agroecosystems in Hawaii depends on mitigating the effects of alien invasive species. Invasive species threaten our native plant heritage and economically important plants, pastures, rangelands, forests, and critical watersheds. In addition to their economic damages, invasives also threaten conservation efforts for native endangered plants and insects. Invasive biology and conservation biology are opposite sides of the same coin. CTAHR plays a significant role in developing and delivering information and technologies that minimize the impacts of invasive species.

Hawaii nurseries shipping ornamental potted plants out-of-state continued to use hot water on plants for disinfestation of coqui frogs (*Eleutherodactylus coqui*), nettle caterpillar (*Darna pallivitta*), and little fire ants (*Wasmannia auropunctata*) as part of a systems approach to quarantine pest management developed by CTAHR faculty. In FY 2013 more than 80,000 potted plants (estimated \$3.9 million) were hot water-showered, and nearly all 35 species and cultivars tolerated the heat well; 2,112 coqui frogs (adults, juveniles, egg clutches) and numerous ants, slugs, snails, lizards, and worms were killed and removed by the treatment. Use of hot water on potted ornamental plants continues to be validated as a practical, cost-effective IPM strategy available to large-scale commercial growers, to prevent pest interceptions by receiving ports in the US and Guam.

Currently, there are four fruit fly species of economic importance to Hawaii: Melon fly (*Bactrocera cucurbitae*), Mediterranean fruit fly (*Ceratitis capitata*), Oriental fruit fly (*Bactrocera dorsalis*), and Solanaceous (Malaysian) fruit fly (*Bactrocera latifrons*). These four fly species attack over 400 different host plants. To ensure the sustainability of the fruit fly area wide program, extension agents across the state are continuing to deliver fruit fly suppression workshops to producers and backyard gardeners. The cooperators in CTAHR's Area-wide Fruit Fly Suppression Program comprise 357 commercial farm acres; many have been participants for several years and have adapted management strategies to suit their farming operations. As a result, growers have reduced infestation rates and crop losses significantly, thus increasing their farm revenue. Many growers have also reduced their reliance on organophosphate insecticides and adopted the use of GF-120 protein bait spray. In addition, the parasitoid *Diachasmimorpha kraussi*, which was released to control the Solanaceous fruit fly was found to be well established and surviving at relatively low numbers.

The diamondback moth (DBM) is a major pest of crucifers, including head cabbage, Chinese cabbage, broccoli, bok choy and watercress. The crucifer industry was valued at \$7.5 million in Hawaii

(Hawaii Agricultural Statistics Service, 2009). This pest is notorious for its resistance to many classes of pesticides. When insecticides are not used in a sound insecticide rotation schedule, resistant DBM are selected and control failures result, causing massive crop losses. The DBM Insecticide Resistance Management Program was developed at the CTAHR in order to enable growers to manage the DBM effectively by rotating insecticide chemistries on an areawide basis. As a result of this continuing effort, diamondback moth populations continued to be very low in Maui and Hawaii Counties through 2013. This method of rotating very effective insecticides with less effective ones seems to prevent buildup of high DBM populations during the hot summer months.

In FY2013, the DBM resistance management team collected and reared populations of DBM from statewide crucifer growers. Bioassays were conducted to identify resistance to six commercially available crop protection chemicals: Avaunt, Synapse, Rimon, Radiant, Movento, and Proclaim. Bioassays for the Oahu population concluded that there was no resistance to Synapse while there was some resistance to Avaunt (54%), Rimon (8%), Radiant (62%), Movento (41%), and Proclaim (98%). As a result, recommendations were made to remove Radiant and Avaunt from the spray rotation for six months due to the high level of resistance.

Efforts continued to mitigate the impact of the coffee berry borer (CBB) in the Kona and Kau regions of the island of Hawaii, with distribution of Hawaii-centric best management practices to farmers, and evaluation of the efficacy of both entomopathogenic fungi and alternatives such as a garlic-based pesticide, which was found to have significant but minor repellent effect. The macadamia felted coccid, introduced to Kona in 2005, also began to cause significant macadamia losses, with research efforts focused on biological control, identification of effective insecticides, and modification of orchard structure to obtain spray coverage.

Weed management efforts involved both application of Herbicide Ballistic Technology (HBT), employing paintball gun technology for targeted applications of very small quantities of herbicide, to combat *Miconia* in natural systems (reducing aerial application costs by 50%); and turf grass weed control through development of a novel tank mix of the post-emergence herbicides mesotrione and metribuzin to replace herbicides discontinued by the US EPA in 2009.

2. Brief description of the target audience

Target audiences include 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 fruit flies work with extension educators to deliver best management practices to agricultural and residential clientele. Natural resource managers (including those responsible for forestry, rangeland and conservation lands) depend on CTAHR researchers and extension to develop and deliver technologies for improved control and management of invasive plants in Hawaii's landscapes.

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	3906	1940	1464	5

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	9	23	32

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops, field days, demonstrations held

Year	Actual
2013	129

Output #2

Output Measure

- Number of grant proposals submitted

Year	Actual
2013	19

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1412

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Residents are not aware of the problems associated with invasive species. Increased awareness of best management practices is the first step in implementing improvements in invasive species control and management.

What has been done

Workshops, demonstrations, field days, presentations and publications make residents aware of the problems associated with invasive species and control practices which are most successful.

Results

Farmers and residents will be more likely to assist in controlling invasive species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
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
216	Integrated Pest Management Systems

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

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	17

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

Farmers and residents better understand how to control invasive species and Hawaii is better protected from crop destruction and ecosystem damage caused by invasive plants and animals.

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	Actual
2013	1025404

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Funding is needed to conduct research and extension activities to augment that accomplished with formula funds.

What has been done

Extramural grants have been received and funding utilized.

Results

Hawaii has been able to better accomplish meaningful and comprehensive invasive species control.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
136	Conservation of Biological Diversity
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
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215	Biological Control of Pests Affecting Plants

216	Integrated Pest Management Systems
312	External Parasites and Pests of Animals
721	Insects and Other Pests Affecting Humans

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, different priorities in extramural grant programs
- Difficulty in coordination with external agencies and partners

V(I). Planned Program (Evaluation Studies)

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.