V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Plant Protection

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
212	Pathogens and Nematodes Affecting Plants	10%		20%	
215	Biological Control of Pests Affecting Plants	10%		20%	
216	Integrated Pest Management Systems	80%		60%	
	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	7.0	0.0	2.0	0.0
Actual	5.2	0.0	1.2	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**
87282	0	20164	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
87282	0	20164	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
342425	0	101170	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Basic and applied research, field trials, Extension workshops, demonstrations

2. Brief description of the target audience

Agricultural producers, consumers, agency personnel at federal, state and local level.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	3000	12000	0	0
Actual	2800	10000	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
Plan	1	1	
Actual	1	1	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Websites developed

Year	Target	Actual
2009	1	1

Output #2

Output Measure

- Presentations and short courses

Year	Target	Actual
2009	35	40

Output #3

Output Measure

- Fact sheets, bulletins and newsletters

Year	Target	Actual
2009	30	31

Output #4

Output Measure

- Media contacts

Year	Target	Actual
2009	30	32

Output #5

Output Measure

- Books and monographs

Year	Target	Actual
2009	0	0

Output #6

Output Measure

- Conference abstracts

Year	Target	Actual
2009	0	0

Output #7

Output Measure

- Workshops and conferences hosted

Year	Target	Actual
2009	2	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased adoption (%) of recommended BMPs by targeted consumer populations
2	Increased adoption (%) of recommended BMPs by targeted grower populations
3	Pesticide use reduction (%) by participating growers
4	Increased certification (%) by pesticide applicators

Outcome #1

1. Outcome Measures

Increased adoption (%) of recommended BMPs by targeted consumer populations

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Increased adoption (%) of recommended BMPs by targeted grower populations

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	15	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In Connecticut, the greenhouse industry is a significant part of the agricultural industry with 280 wholesale commercial greenhouse growers producing greenhouse crops with a wholesale value of over $90 million dollars (NASS, May 2006). Greenhouse crops produced include bedding plants, specialty annuals, herbs, vegetable bedding plants, herbaceous perennials, garden mums, and pot crops such as poinsettias.
Customers have a very low tolerance for any evidence of insect pests or diseases while at the same time are increasingly interested in less pesticides, and more sustainable practices. Because of this, growers must produce very high quality, pest-free crops. In the enclosed greenhouse environment, pest populations can develop rapidly, so there is a need for timely up-to-date information to make pest management decisions. Pesticides in the greenhouse industry relate to worker safety, development of resistant insect and disease populations due to overuse of pesticides, adverse impacts on crop growth including phytotoxicity (plant damage), and pollution of ground and surface waters.

What has been done

The Extension sustainable greenhouse program targeted the 600 wholesale and retail greenhouse growers across Connecticut, consisting of intensive hands-on field training, and site visits, with diagnostics, nutrient and cultural management recommendations. Partners with University of Connecticut, Department of Plant Science, Soil Nutrient Analysis Laboratory, Connecticut Greenhouse Growers Association, Connecticut Agricultural Experiment Station, Connecticut Department of Environmental Protection, NORTHEAST SARE, University of Massachusetts and University of Rhode Island. Participants in the Sustainable Greenhouse IPM Program include businesses ranging in size from small 1300 square feet greenhouse operations to wholesale greenhouse businesses with 283,140 square feet of production. Participants included both spring seasonal businesses that grow bedding plants and garden mums as well as year-round producers of spring bedding plants, herbaceous perennials, garden mums and poinsettias. Growers learned to identify pests, nutritional and cultural problems, find sustainable solutions, learn how to use tools for early diagnosis, cultural practices to reduce pests and how to use low-risk pesticides and biological controls. Full season hands on training sessions were held at 12 businesses, impacting 13.0 acres (568,628 square feet) of intensive greenhouse production with an estimated crop value (assume sales of $12 per square foot) of approximately 6.8 million dollars. In addition, growers had approximately 8.2 acres of outdoor production of garden mums, herbaceous perennials and woody plants. Over 35 site visits to greenhouse businesses were also made throughout the state where growers received direct diagnostic advice and walk-in consultations. Over 95 IPM visits were made to growers participating in the Sustainable Greenhouse IPM program.

Results

Increased adoption (100%)of recommended BMP's by targeted grower population. 50% of participating growers reduced their pesticide use. 25% applied no pesticides so there could be no reduction. All participants increased their adoption of IPM practices. For the 12 participating businesses, insecticide use decreased as 0.76 pounds of insecticide active ingredient was saved from application. In addition, crop losses were reduced, cultural practices were improved, and crop quality increased. Whenever possible, growers selected more environmentally friendly products with shorter reentry levels, lessening worker exposure to pesticides. Examples of such environmentally friendly products included: Beauveria bassiana (insect killing fungus), azadirachtin (insect growth regulator derived from the neem tree), Bacillus thuringiensis, and a microbial insecticide. Contact materials, such as horticultural oils and insecticidal soaps were for both insects and diseases such as powdery mildew. Growers also used more reduced risk products (as defined by the EPA) such as acetamiprid, bifenazate, pymetrozine and spinosad. Biologically based fungicides such as Trichoderma harzianum, Bacillus subtilus and Streptomyces lydicus were used to improve root health and lessen use of traditional fungicides.
Growers increased use of of Biological Control Agents such as
predatory mites (Ambylseius cucumeris) against western flower thrips and entomopathogenic nematodes (Steinernema feltiae) for western flower thrips as a foliar application. As more selective insecticides and miticides were used, more natural enemies were observed including ladybird beetle larvae, hover fly larvae, predatory mites. Hunter flies (Coenosia attenuata) were also noted at a number of greenhouses in CT. These beneficial flies are originally from Europe and were most likely introduced on plant material. Hunter flies may prey on fungus gnats, shore flies, leaf miners and whiteflies. At one grower location, we observed Synacera pauperi (a parasitoid of fungus gnats) in their propagation houses. Growers were also encouraged to improve cultural practices to improve crop quality. One grower used ribbons of yellow sticky tape, "hopper tape" to mass trap out fungus gnats and shore flies in their propagation houses. The hopper tape was attached to the boom watering equipment. Increased nutritional monitoring helped improve crop nutrition, increasing plant's resistance to disease, avoid plant stress, and improved crop quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #3

1. Outcome Measures

Pesticide use reduction (%) by participating growers

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	15	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #4

1. Outcome Measures

Increased certification (%) by pesticide applicators

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

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

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)

Evaluation Results

Greenhouse program:

All growers said they would recommend the program to other growers. Insecticide use was calculated by comparing their current use with their use before participating in the program. All participants increased their adoption of IPM practices. For the 12 participating businesses, insecticide use decreased as 0.76

pounds of insecticide active ingredient was saved from application. In addition, crop losses were reduced, cultural practices were improved, and crop quality increased.

Whenever possible, growers selected more environmentally friendly products with shorter reentry levels, lessening worker exposure to pesticides. Examples of such environmentally friendly products included: Beauveria bassiana (insect killing fungus), azadirachtin (insect growth regulator derived from the neem tree), Bacillus thuringiensis, and a microbial insecticide. Contact materials, such as horticultural oils and insecticidal soaps were for both insects and diseases such as powdery mildew. Growers also used more reduced risk products (as defined by the EPA) such as acetamiprid, bifenazate, pymetrozine and spinosad. Biologically based fungicides such as Trichoderma harzianum, Bacillus subtilus and Streptomyces lydicus were used to improve root health and lessen use of traditional fungicides.

Use of Biological Control Agents

Two growers released predatory mites (Ambylseius cucumeris) against western flower thrips. One grower used entomopathogenic nematodes (Steinernema feltiae) for western flower thrips as a foliar application. One grower released predatory mites (Phytoseiulus .persimilis) against two-spotted spider mites. One grower released predatory mites (Hypoaspis miles) and Atheta (rove) beetles against fungus gnat larvae in propagation houses.

As more selective insecticides and miticides were used, more natural enemies were observed including ladybird beetle larvae, hover fly larvae, predatory mites. Hunter flies (Coenosia attenuata) were also noted at a number of greenhouses in CT. These beneficial flies are originally from Europe and were most likely introduced on plant material. Hunter flies may prey on fungus gnats, shore flies, leaf miners and whiteflies. At one grower location, we observed Synacera pauperi (a parasitoid of fungus gnats) in their propagation houses.

Improved Cultural Practices

Growers were also encouraged to improve cultural practices to improve crop quality. One grower used ribbons of yellow sticky tape, "hopper tape" to mass trap out fungus gnats and shore flies in their propagation houses. The hopper tape was attached to the boom watering equipment. Increased nutritional monitoring (more routine soil tests with soil test recommendations provided by Dr. McAvoy) helped improve crop nutrition, increasing plant's resistance to disease, avoid plant stress, and improved crop quality.

Outcomes

Increased adoption (100%)of recommendd BMP's by targeted grower population.

50% of participating growers reduced their pesticide use. 25% applied no pesticides so there could be no reduction.

Key Items of Evaluation