Interim Progress Report
USDA Northeast IPM Competitive Grants Program
August 31, 2007

A. Grant Data

- Title: **Promoting IPM Implementation in Greenhouses: Banker Plants, Grower Education and an Assessment of Consumer Attitudes**

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  The University of Vermont, Entomology Research Laboratory
  Cheryl Smith & Alan Eaton, The University of New Hampshire
  Bruce Watt, University of Maine Extension System

- State(s) involved: **Maine, New Hampshire, Vermont**

- Years funded: **5/15/2005-5/14/2008**

- Funding amount: **$86,743**

B. Nontechnical Summary. Overview outlining context and key components f*or lay audience.*

The goal of maintaining productivity and profitability while reducing pesticide use in greenhouse crops is challenging. Greater adoption of IPM practices is essential to meet this challenge, yet lack of time, knowledge, and perceived costs are barriers to broader implementation. This project will promote ways of decreasing reliance on chemical pesticides by increasing opportunities to use biological controls, providing IPM education for growers, and assessing the public's awareness and appreciation of IPM, and its value to them and the environment.

C. Introduction. An introduction to the project of approximately *500 words.*

Historically, dairy farms have dominated the rural landscape in the Northeast, but this traditional farming sector is declining as production agriculture becomes more diversified. In contrast, the greenhouse industry is expanding, and has become a vital component of the Region's agricultural economy. In fact, revenues from greenhouse crops far exceed that of any other crop commodity in the Northeast, with annual sales in excess of $551 million in New England alone. Public demand has driven this expansion, as people seek to beautify their homes and gardens with flowering plants.

Arthropod pests and diseases limit productivity and economic returns in greenhouse crops. Growers rely heavily on conventional pesticide-based strategies for their control. The

compounds used pose a risk to applicators, consumers and the environment, and there are many negative aspects associated with extensive pesticide use. Repeated pesticide applications can also adversely impact plant physiology and appearance.

Thrips, aphids and spider mites remain the most significant persistent insect pests in greenhouse ornamentals and bedding plants. The specific economic losses associated with these pests are unknown. However, growers repeatedly ask what non-pesticide strategies are available for their management. Concerns are regularly expressed regarding the potential for pesticide resistance to develop in these pest populations.

The goal of maintaining high levels of agricultural productivity and profitability while reducing pesticide use presents a significant challenge. Research and outreach efforts must focus on increasing IPM implementation on all crops–strategies that emphasize cultural and biological controls as the main defense against pests but include the judicious use of pesticides. IPM reduces risks associated with pesticides, yet growers assert that they must use these materials to meet consumer demands for 100% pest-free plants. To be successful, control agents and IPM programs that are appropriate to local conditions must be developed. Generic IPM techniques developed for large, year-round facilities in southern states – where pests may be year-round rather than seasonal threats –are often not applicable to small, family-run greenhouse operations that are predominant in the Northeast. Furthermore, if not accompanied by appropriate extension and outreach activities, they will have little chance of adoption. Educational efforts must not only target growers, but also consumers. Consumers are a driving force in our market society; if, through education about the value of IPM-grown crops in terms of human health and environmental quality, consumer demand could be created, this would serve as a valuable incentive for growers to implement IPM.

Adoption of IPM is essential to ensure that high-quality plants are produced, the greatest revenue generated, and the least amount of chemical insecticide used. Time, knowledge (or lack of), and ease of implementation are the greatest barriers to the wider adoption of IPM techniques. This project will promote ways of reducing risks associated with pesticide use. The research components address issues related to the cost and quality of natural enemies and novel strategies for their greenhouse use. Outreach/extension activities promote grower education and document consumer knowledge and attitudes about IPM.

D. Objectives. Restate objectives. and provide a brief narrative about whether you've achieved it; if it was modified, mention how.

1. Evaluate the use of banker plants for production of predatory mites in spring bedding plants. **This is the third year of conducting research relating to this objective and all is on target**. **All that remains is to analyze the data.**
2. Assess the quality of natural enemy shipments received at different times of the year from Regional and National distributors. **Research for this objective is complete**. **All that remains is to analyze the data.**
3. Develop, organize, and conduct hands-on IPM training programs for greenhouse growers in ME, NH and VT. Workshops were held in January 2007 in Maine, New Hampshire and Vermont. Plans are underway to organize workshops in January 2008. **No modification is required, the objective is ongoing throughout the project and thus is not yet achieved**.
4. Conduct follow-up surveys at garden centers in ME, NH and VT to determine changes in consumer attitudes and knowledge about IPM. **This objective is not to be initiated until the last year of the project, so it has not been started, achieved or modified**.

E. Approach. *Briefly, in 1-2 paragraphs,* describe your approach, the methods used, and the overall design of your project.

Lack of time, knowledge, and ease of implementation appear to be the greatest challenges to increased adoption of IPM practices in greenhouse ornamentals. The research objectives evaluate banker plants for in-house production of natural enemies to provide a steady supply for control of spider mite in spring bedding plants. Cost, quality and availability are factors currently limiting growers' use of natural enemies. Banker plants reduce the need for multiple releases, and ensure a resident population is present should a pest outbreak occur. Few inputs are needed to achieve long-term suppression. The cost of shipping natural enemies is often higher than the cost of the beneficials themselves. Costs can be reduced by using ground shipping, which is one-third the price of overnight shipping. However, this can take 1-2 days longer, and we do not know how this will affect the quality of the natural enemies received by the grower. We will thus assess the quality of predaceous mites used over a growing season by ordering natural enemies from three distributors and shipping via these two methods. We will produce and distribute an informational pamphlet reporting results of our research, outlining methods to evaluate the viability of shipments. In the extension component of our proposal, we address grower-identified needs by offering effective hands-on educational IPM workshops, drawing on the expertise of specialists in Europe and North America. Through our customer surveys, and other IPM education activities, we want to raise public awareness about the value and benefits of IPM. Understanding the criteria people use when purchasing a plant, and influencing these criteria, will play a key role in creating demand for IPM-grown plants. The survey proposed for the current project will provide a means of measuring the outcome of these activities.

F. Progress. *Describe, in 1-2 paragraphs, progress made on your project during the past year.*

Early intervention is critical for successful biological control. We assessed banker plants as a reservoir for biological control agents. Banker plants serve as a food source, by producing pollen. These systems can be a cost effective means of providing a continuous supply of beneficials, which spread throughout the greenhouse. In 2005-2007 banker plants were tested in a 30x30 m research greenhouse containing bedding plants, managed according to better management practices (BMP), where pesticide applications were used sparingly as a last resort, relying on biological control when possible. Two varieties of marigolds and green pepper were tested as banker plants for sustaining predatory mites to control spider mite pests. The ability of the predatory mites to survive over the season on the plants was assessed. In addition, the ability of these plants to maintain the spider mite pest populations at low levels was also evaluated.

Biological control agents must be healthy and released in sufficient numbers to be effective. Natural enemies are commonly shipped long distances under adverse conditions which may reduce survival. The quality of shipments of three predatory mite species, *Amblyseius cucumeris, Hypoaspis miles*, and *Phytoseiulus persimilis,* were assessed, using different methods to determine the number of live mites per shipment.

Greenhouse IPM workshops were held in ME, NH and VT in January, attended by 160 growers, extension personnel and pest specialists. Insect and disease specialists presented IPM information focused on practical approaches to reduce grower reliance on chemical pesticides. Growers presented their IPM successes and challenges. This session is effective for stimulating discussion among growers.

G. Results. Provide a brief explanation of your results *in 1-2 paragraphs*. Include a discussion of any unexpected events that seem noteworthy.

Three types of banker plants were assessed: Lemon gem marigolds, Hero yellow marigolds, and green pepper, as a reservoir for the predatory mites, *Amblyseius californicus* and *A. fallacis*, used against spider mites. In 2006, populations of the pest and predaceous mites were sustained on banker plants when both were released. However, insufficient control of the pest was achieved by the predators resulting in heavy mite damage. In 2007, we evaluated the ability of these three plant types to sustain predatory mites with their pollen in the absence of spider mite prey. Predator populations were determined with visual inspection and plant tapping. Predatory mites were sustained at higher levels in the Hero yellow marigolds than the other two plant types tested. Blossoms were taken from each plant type to determine residual populations after visual and tapping inspection. Significantly more mites were found in blossoms than from the visual inspections or plant tapping, indicating that standard scouting procedures used to monitor predatory mites underestimates the population level. In addition, more predatory mites were sustained in Hero yellow blossoms than the other two plant varieties, demonstrating that over time, predatory mites can be sustained without prey on pollen from Hero yellow marigolds. Although predatory mites were sustained on the banker plants this year, as in the past two years of research, western flower thrips became a serious problem on the plants. Thrips control would be needed for banker plants to be used in a commercial greenhouse.

Natural enemies are often shipped long distances in adverse conditions which may reduce their effectiveness. They must be released in sufficient numbers and be healthy to be effective. We assessed the quality of shipments of three predatory mites: *A. cucumeris*, *Hypoaspis miles* and *P. persimilis*. Data from Yr. 1 and 2 show that survival was greatest for *H. miles*. Using *P. persimilis* as a test agent, a visual count method growers could use to assess shipment quality was compared with Berlese funnel results. We found that a visual count provided results similar to those from the Berlese funnel, suggesting that growers could effectively evaluate mite shipments for survival. When mite survival following overnight shipping was compared with that after standard ground shipping, results indicated that mite survival was slightly higher following overnight shipping for all three mite species. The difference was most noticeable for *P. persimilis*, which had the lowest overall survival rate. *P. persimilis*, which is a voracious predator, is typically shipped with low numbers of spider mite, which may be consumed before release. *A. cucumeris* is shipped with many bran mites as prey, which is typically not consumed before release. Though overnight shipping is expensive, it may be recommended for shipping *P. persimilis*, whereas overnight shipping may not offer a great advantage in terms of survival for *A. cucumeris* and *H. miles*.

Greenhouse IPM workshops were held in ME, NH and VT in January, attended by 150 growers, extension personnel and pest specialists. Insect and disease specialists from northern New England and Canada presented IPM information focused on practical approaches to reduce grower reliance on chemical pesticides. Growers presented their IPM successes and challenges. This session is effective for stimulating discussion among growers.

H. Impacts. Describe and assess the impacts of your work--highlight the value of IPM research and education and the real-world impacts of project. Below are some questions that will guide you in assessing the impacts of your project. The relevance of each question may vary depending on whether yours is a research or extension project. Please answer as many as you can to the best of your ability, and feel free to discuss any impacts not mentioned below.

Growers need cost-efficient and effective methods to replace routine chemical pesticide sprays with biological control for management of their serious arthropod pests. They also need opportunities to learn about these novel IPM strategies. Through this project we are investigating practical approaches to maximize the benefits and reduce the cost of the release of natural enemies by using banker plants. Our results show that indeed this approach can sustain natural enemies in a greenhouse in the absence of prey. These findings are disseminated through hands-on grower workshops held in ME, NH and VT every January. Growers indicate that this type of applied research is exactly what they need to increase implementation of IPM. They frequently tell us that the workshops we offer are the most useful for learning new methods to expand IPM use in their greenhouses and are the reason they are using biological control today. Ten percent of the growers who completed the evaluation form this year indicated they use banker plants compared with last year. This suggests that last year's workshop had a significant impact on grower behavior in this area.

1. *Safeguarding human health and the environment:*
   - **a.** Are there new IPM practices that have been or could be adopted as a direct result of your project? What is the total number of acres (or homes, schools, greenhouses, nurseries) on which these practices could be implemented? **No new IPM practices are ready yet for adoption at this stage in the research. However, there may be a time when banker plants could be used effectively when the approach has been fully tested.**
   - **b.** Has the project reduced risk (or could it potentially do so) by changing the use of pesticides on farms, or in homes, schools, etc.? For example, could it result in fewer sprays per season or a switch to lower-risk pesticides? **Not yet, the value of using banker plants has not yet been determined.**
   - **c.** Are there any other impacts on human health or the environment as a result of your project? **The IPM brochure encourages homeowners to use IPM rather than relying heavily on chemical pesticides. This will reduce their exposure to pesticides.**

2. *Economic benefits:*
   - a. What is (or could be) the economic benefit (e.g., dollars saved) for clientele who adopt IPM strategies and systems you studied? Do you envision potential commercialization or mass production of these systems? **It is premature at this time to determine the economic benefit of the banker plants to growers. First we have to determine if they are effective.**
   - b. How many IPM personnel might be employed as a result of your work? (e.g., private consulting services, nursery operators, food service growers) **Ideally a scout would be employed to assist in the maintenance of the banker plants and to ensure that pest populations are monitored regularly.**
   - **c.** How many clients are satisfied with IPM results (such as improved yield, quality of yield, reduced pest populations, more effective pest control, greater preservation of nonpest species)? **At least 94% of the growers who attended the workshops indicated they would try new IPM techniques this year as a result of learning about them from our program.**
   - d. Are there other financial benefits that might be realized as a result of your project? **With help from growers we are spreading the word to consumers about the positive aspects of IPM, and why it is worth purchasing IPM-grown plants. In time, this will hopefully result in increased revenues for growers who market their crops as IPM-grown.**

3. Implementation of IPM:

a. How many IPM strategies and systems have been validated through this project? **One strategy, banker plants, is being tested in research greenhouses.**
b. How many educational materials were delivered? **6** To whom? **Greenhouse growers and Extension specialists and educators who attended the workshops**
c. What is the number of growers/personnel trained? **160**
d. For a website, what volume of traffic and type of use has the site experienced? **Not applicable.**
e. How many more people adopted IPM practices as a direct result of your project, or how many people adopted new IPM practices? **Over 90% of the growers who attended the workshop indicated on their exit evaluation that they learned techniques they planned to use in the coming year. For example, several growers indicated they would use banker or habitat plants, others said they intended to implement better sanitation and preventative control programs.**
f. Are there other ways in which your work will result in improved use or increased implementation of IPM strategies in your region or across the Northeast? **Yes, growers were encouraged to distribute brochures about IPM. These included recommendations on how homeowners could implement IPM. Though there is no way to directly determine how many heed these recommendations, the information is being disseminated. (summary of responses from participating growers is being sent by mail.)**

4. Has your project or study enhanced collaboration among stakeholders interested in the development and implementation of improved IPM strategies and systems? (e.g., number of growers or other stakeholders that have participated in advisory committees, surveys).

The Tri-state Greenhouse IPM Advisory Group has worked together for over 10 years, putting on cost-effective workshops together. These workshops would not occur without external funding from organizations such as NEIPM. As last year, Dr. Bruce Watt, Univ. of Maine Extension System, assisted with the workshop and has become an integral part of the Advisory Group. We also enlisted Dr. Timothy Schmalz, plant pathologist for the VT Depart. of Agric. He has also agreed to continue to participate in workhops in the future in Vermont.

I. Appendices. Please attach to your report any of the following that will enhance our understanding of your project and its impacts:

• Photographs **Provided them last year, nothing new this year.**
• Any presentations, such as in Powerpoint, resulting from this project. **Program and list of presenters for the 2007 Greenhouse IPM workshops are attached.**
• Printed fact sheets or other publications resulting from your work.

- Frank, C., M. Skinner and B.L. Parker. 2006. Commonly Used Predatory Mites for Greenhouse Biological Control Fact Card. Univ. of VT, Entomology Research Laboratory, Burlington, VT.
- Frank, C., M. Skinner and B.L. Parker. 2006. Predatory Mite Fact Card. Univ. of VT, Entomology Research Laboratory, Burlington, VT.
- Frank, C., M. Skinner and B.L. Parker. 2006. *Delphastus* Fact Card. Univ. of VT, Entomology Research Laboratory, Burlington, VT.
- Frank, C., M. Skinner and B.L. Parker. 2006. *Eretmocerus* Fact Card. Univ. of VT, Entomology Research Laboratory, Burlington, VT. **These are being sent by mail.**

How to submit: electronically, as an attached MS-WORD file, to ckk3@cornell.edu and to jea@psu.edu. If you have questions, contact Carrie Koplinka-Loehr, 607-255-8879.

2007 Tri-state Greenhouse IPM Workshops, January
Executive Summary of Participant Evaluations

This year marks a decade of holding our greenhouse IPM workshops in Maine, New Hampshire and Vermont, affectionately termed the "Traveling Road Show". As in past years, feedback from the attendees was generally positive and always constructive. It is clear from their written comments and personal conversations, these workshops are directly responsible for reducing grower reliance on chemical pesticides and increasing their use of biological control and biorational compounds. The evaluations clearly show we are having an impact on grower practices that is good for the environment and human health. This success would not be possible without our Tri-state collaboration involving growers, state Departments of Agriculture and the Extension systems. From its inception, this educational experiment demanded significant effort and dedication by the collaborators. For many years growers attended, but made it clear that IPM and biological control was interesting, though not for them. In contrast, now most growers at these workshops are using IPM to a great extent, and many are using biological control for the first time because they learned about it and gained confidence in it from us. Extension administrators often want or expect to see quick impacts. The results of these workshops show that it takes time to change grower practices. Growers need to hear an idea a couple of times, and even more important, to see and touch it, before they try it themselves.

General Summary and Quotable Quotes

- 88% of the workshop attendees were growers, 4% were educators or extension personnel.
- In all states we had more attendees than last year, exceeding our limit in VT and ME. This year we reached over 160 people, including the presenters.
- 94% of the growers indicated that they learned new IPM techniques they would use this year.
- Many growers indicated that they will try indicator plants or banker plants this year, a major focus of the workshops. This shows the message got through.
- 87% of the growers indicated they made new contacts. Many said they appreciated this opportunity to meet with other growers.
- Averaged over all of the individual sessions, growers gave the workshop program a ranking of 4 out of 5, about the same as last year.
- In general growers recognized the expertise and knowledge of all of the presenters, and appreciated the efforts we made to transfer IPM information to them.
- Many growers expressed their desire for more hands-on formats. This is definitely how these growers learn best. In the future I would like to ban all powerpoint presentations. Growers don't like them. We must find effective ways to reach them without that medium. Our growers are doers--they learn by doing.
- Most growers liked the Grower-to-Grower sessions, though it is always an unknown how well they will go. It all depends on how the growers respond.
- Growers seemed to appreciate hearing what's going on for research in our region. I think they like knowing that their universities are doing research that addresses issues they face in their greenhouses.
- We are at the point where there is a significant gap between new learners and advanced growers. It is difficult to meet the needs of both levels of learners with the same program. Thus, it may be time to offer a workshop for "novices", with basic pest and disease ID and IPM principles. We will lose advanced growers, but maybe get their workers instead.
- The sessions need to be shorter. It is a long day and they get tired, uncomfortable and overloaded with information. I always thought we needed to give them a long program to maximize on the presenters and effort, plus give them their money's worth, but it is time to cut back.
- Growers listed many topics they would like to learn about. A few common subjects mentioned were: pest and predator ID; IPM for scale/mealybug; cost analyses of IPM/biocontrol; specific guidelines for using biocontrol (the cookbook approach).

- A high percentage of growers use biological control: ME: 44%; NH: 68%; VT: 60%. The growers that attend these workshops may not be representative of all the growers in our states. There are thousands that don't make our events, but it does show there are a lot of growers who are shifting away from chemical control, and many of them are doing it because they learned about it and gained confidence in it at our workshops. You all deserve to feel proud of that!
- 10% more growers this year indicated they use banker plants compared with last year. This suggests that last year's workshop had a significant impact on grower behavior in this area.

Thank you to all who contributed to making this series of workshops a success!

Tri-state Greenhouse IPM Workshop

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AGENDA

TRI-STATE GREENHOUSE IPM WORKSHOP - 2007

Monday, January 8; Longfellow's Greenhouses, Manchester, ME
Tuesday, Jan. 9; University of New Hampshire Greenhouses, Durham, NH
Wednesday, Jan. 10; University of Vermont, Burlington, VT

8:00-8:30	**Registration & Coffee** *Cheryl E. Frank -Univ. of Vermont* *Chris Rallis- NH Dept. of Ag.*
8:30-8:45	**Welcome** *Margaret Skinner – Univ. of Vermont*
8:45-10:00 (concurrent)	**Eggplants as Biocontrol Production System: A New Approach to Banker Plants*** *Graeme Murphy – Ontario Ministry of Ag., Food & Rural Affairs* *Mike Short – EcoHabitat Agri Services, Grimsby, Ontario*
10:00-10:30	**Coffee Break**
10:30-11:45 (concurrent)	**Advanced Disease Diagnosis & Management*** *Cheryl Smith – Univ. of New Hampshire* *Bruce Watt – Univ. of Maine*
1:45-12:45 12:45-1:45	**Lunch** **Grower to Grower Discussions: Sharing Challenges and Solutions** *ME: Kevin Kerns – Morrison Development Center, Portland, ME* *Tony Elliott – Snug Harbor Farm, Kennebunk, ME* *NH: Robb Day – DBA Mill Gardens Farmstand, Orford, NH* *Matt Kobs – VanBerkum Nursery, LLC – Deerfield, NH* *VT: Kate Duesterberg - Cedar Circle Farm – East Thetford, VT* *Will Allen - Cedar Circle Farm – East Thetford, VT* *Tobias Von Trapp – Von Trapp Greenhouse, Waitsfield, VT*
1:45-2:45 (concurrent)	**What's New for Research in Greenhouse IPM in Our Region?*** *Cheryl Smith & Alan Eaton – Univ. of New Hampshire* *Cheryl E. Frank – Univ. of Vermont*
2:45-3:45 (concurrent)	**Biocontrol in Ornamentals… Its Working!*** *Mike Short – EcoHabitat Agri Services, Grimsby, Ontario* *Graeme Murphy – Ontario Ministry of Ag., Food & Rural Affairs*
3:45-4:15	**What's Out, What's In, What's New, What are Growers Using?** All Participants

Award Door Prizes and Pesticide Credits (6 credits!)

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Longfellow's Greenhouses
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Univ. of Maine, Coop. Extension, IPM Prog.
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Northeast IPM Competitive Grants Program
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The Green Spot Ltd.
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Vermont Department of Agriculture
New Hampshire Department of Agriculture
Maine Department of Agriculture
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American Floral Endowment
EcoHabitat Agri Services, Grimsby, Ontario
Ontario Ministry of Ag., Food & Rural Affairs