Northeastern IPM Center – IPM Partnership Grants – 2009 – Proposal
Statement of Work (SNPs and Minigrants) or Project Description (other Project Types)

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Project Title: Developing Key Indicators for Greenhouse Grower Discovery and Implementation of Guardian Plants in IPM

1. Project Category: IPM Issues:

This proposal addresses the Greenhouse and Ornamental IPM Commodity Working Group priority "Evaluate pest / natural enemy / host plant population dynamics and factors that influence these dynamics"

2. Project Summary

Growers demonstrate a natural ability to observe pest/plant interactions and make reasoned decisions accordingly. Many growers in the region are exploring the use of Guardian Plants to trap and kill pests and/or, grow natural enemies. The pest/natural enemy/crop/Guardian Plant combinations are too numerous for any one person to cope with, but the effectively facilitated communication of the many growers that are working with these combinations could be an invaluable resource, if compiled in a usable fashion. We propose to develop a database in which grower's observations can be recorded and shared. In order to do this, we propose to cooperate with growers to set up and evaluate a Guardian Plant monitoring template and develop a decision tree for grower's interested in producing their own Guardian Plant. We will test this template and decision tree on 2 Guardian Plant systems at 3 grower sites, and together with the growers identify and quantify key indicators of Guardian Plants impact. The two Guardian Plant systems have been discovered by growers and are: 1. black pearl ornamental peppers supporting thrips predator, Orius insidiosus and 2. lantana supporting whitefly parasites. With our experience, we will revise the monitoring template and decision-tree as needed, then publish these together with a Guardian Plant database that we compile from the 2009 work, 5 years of data developed in Guardian Plant and Habitat Plant work supported by NE IPM and NE SARE and all other Northeast grower records that we know of. In addition, we will set up grower presentations on their experiences at grower meetings in Maine, New Hampshire, Vermont, New York and possibly Ohio.

3. Background and Justification

It has been generally assumed that biological control is not feasible in a greenhouse that has mixed species of plants. But botanical garden conservatories and ornamental growers that grow 10 to 100 species in the same greenhouse are using biological controls in these very diverse settings. Taking advantage of this diversity, enterprising growers are attempting to use pests' innate preference for certain plant species to concentrate pests and deal with them on a few plants. These plants serve various roles from early warning of pest presence to trapping and killing pests to natural enemy production. These roles dynamically change with the crops, pest availability and year. For example, in one year, if natural enemy establishment fails, what was expected to be a banker plant will serve successfully as a trap plant where pests are killed either physically or with pesticides. To overarch these distinctions, we have chosen the term Guardian Plant and investigated the Guardian Plant roles of eggplant with NE IPM Center funding in 2007 and 2008.

In ideal biological control situations, the pest is nearly undetectable and the natural enemies even harder to find. A Guardian Plant may be the only place in the crop where any pests or natural enemies are detectable at very low levels. For example, IPM Labs did a quick count on 6 lantana leaves collected with whitefly evidence on November 20, 2008 at Mischler's Florist and Greenhouse. It took several minutes of searching to find those infested leaves on this species that is highly prone to whitefly outbreaks in the greenhouse. The rest of the leaves were clean. On the 6 leaves, 7 immature whitefly were alive and 5 of the 7 were young and still vulnerable to the parasites and 9 were dead with 5 of those 9 showing parasitism. For any greenhouse grower familiar with whitefly, if there are whitefly to be found in a greenhouse, they will be found on the lantana or hibiscus or eggplant and develop into numbers high enough to create clouds of whitefly. A Guardian Plant that carries a low pest level and obvious biological control is likely to be one of the best ways for growers to be able to assess and support the natural enemy activity in their greenhouses

Growers demonstrate a natural ability to observe pest/plant interactions and make reasoned decisions accordingly. Several growers in the region have been informally exploring the approach of guardian plants for some time. These include Don Banyar of PA who uses tomato plants to draw whitefly out of poinsettias and John Sirak of PA who used marigolds to trap thrips. P. Ramakers, Glasshouse IPM Research, NL noted that many years ago Dutch growers used eggplant to attract whitefly from peppers, reducing inputs of *Encarsia formosa*. In Canada, growers have used eggplants in poinsettias and tomatoes in fuchsias for whitefly control , and the mum var. Saskia in mums to trap thrips. These are described in a 2007 GrowerTalks article by IPM Laboratories staff (O'Connell, 2007). **I**n 2008, growers have used eggplants independent of research projects for control of sweet potato whitefly in poinsettias (McLeod's in Concord NH) and greenhouse whitefly in geraniums (Lou Schenck in Ontario as witnessed by Lloyd Traven). In both these cases, growers directly killed adults by squashing or vacuuming. Black pearl ornamental peppers have supported reproduction of thrips predator, Orius insidiosus at Peace Tree Farm in Kintnersville, PA and Mischler's Florist and Greenhouses in Williamsville, NY. Lantana trees have supported year round populations of Eretmocerus and very low levels of whitefly at Mischler's. Hibiscus serves as an ongoing Guardian Plant for aphid natural enemies and whitefly parasites in Mahoney's retail stores near Boston, MA. Bakers Acres of North Lansing, NY used marigolds as Guardian Plants for thrips in their herb greenhouse by using them to attract the thrips to the marigold flowers, then removing the marigolds along with the thrips from the greenhouse. In fall 2008, Longfellows Greenhouse in Manchester, ME trialled beans as Guardian Plants for spider mite in their foliage greenhouse.

Very large Canadian greenhouses now use chrysanthemums to trap thrips out of their crops, and then discard the plants with the thrips on them. This practice is based on the following research. Buitenhuis and Shipp (2006) observed that flowering stage chrysanthemums were more attractive to thrips than the vegetative, bud and crack-bud stages of chrysanthemums up to a distance of 36 feet. Their most recent research reports that thrips 1. are unlikely to disperse from untreated trap chrysanthemums, and 2. can be killed with spinosyn spot treated on the trap plants (Buitenhuis et al, 2007). There has also been some formal evaluation of using predatory mites with bean plants for spider mite control in a tomato crop (Berlinger et al, 1996).

IPM Laboratories has 2 years experience evaluating eggplant Guardian Plants in bedding plants and poinsettias, funded by the NE IPM Center and carried out in collaboration with the University of Vermont researchers Margaret Skinner and Cheryl Frank. At the bedding plant site in both years, whitefly detection took a small fraction of the time required on the crop and the greenhouse whitefly parasites (genus Trialeurodes) reproduced well on the eggplants with crop plants Fuchsia variety Gartenmister and Lantana appearing to offer similar services. Pesticides were eliminated for whitefly control in the bedding plants. At three poinsettia sites in both years, sweet potato whitefly (genus Bemisia) was detected on the eggplants in a small fraction of the time that it took to detect whitefly in the poinsettias. In 4 of the trials, the eggplants remained with the poinsettias throughout the season. At one of these 4 trial sites, excellent whitefly suppression occurred in both years with 100% reduction in pesticide use. At one site, pesticides were reduced 50% in the first year, but whitefly numbers were so low in the second year that they could barely be found in the conventional or the Guardian Plant treatment, with no pesticides were necessary in either case in 2008. At the third site, pesticide residue on the poinsettias cuttings appear to have caused biological control failures in both years, and pesticide treatments were necessary in both years. Production of the whitefly parasite, Eretmocerus spp. on the eggplants was present in the poinsettias, but lower than in the bedding plants. Other difficulties with the eggplants included production of other pests like spider mites, thrips, and aphids, although our skill at suppressing these improved in the 2nd year.

In all the Guardian Plant use, grower skill and ingenuity have been essential. Furthermore, there are so many pest/plant species Guardian Plant combinations to discover and evaluate that the best avenue of discovering Guardian Plant applications may be through a form of Citizen Science which this proposal proposes to support. For example, the discovery of the lantana Guardian Plant role in overwintering Eretmocerus occurred at Mischler's. Lantana was chosen by Bakers Acres owner Reenie Sandsted for 2005 SARE grant Habitat Pot trials to offer nectar and pollen to natural enemies during the hot summer months when the primary habitat plant, sweet alyssum was suffering from high temperatures. This decision appears to have serendipitously resulted in 3 years of successful biological control of greenhouse whitefly by another whitefly parasite, Encarsia formosa, in Baker's Acres herb greenhouse. In this case, extremely low levels of whitefly were apparent on the lantana in the Habitat Pots for the 3 years of the trial with none of the parasites overwintering, but IPM Laboratories data on this Habitat Pot systems for whitefly and parasite is simply presence/absence.

4. Objectives and Anticipated Impacts

I. Cooperate with growers to set up and evaluate a Guardian Plant monitoring template and develop a decision tree for grower's interested in producing their own Guardian Plants.
II. Identify and quantify key indicators of Guardian Plants impact. Demonstrate in-depth observation of 2 Guardian Plant systems at 3 grower sites, 1. black pearl ornamental peppers supporting thrips predator, Orius insidiosus and 2. lantana supporting whitefly parasites.
III. Find venues for growers to explain their Guardian Plant activities at grower meetings. Support with 4 page handout and web article of the same information formatted appropriately.
IV. Compile and publish a static Guardian Plant database with key indicators input from existing Guardian Plant projects. This static database will provide a template for developing a sortable database that can answer questions by pest, natural enemy, crop, or Guardian Plant.

V. Research web based citizen science databases and develop a proposal to create a searchable online database to record and communicate Guardian Plant development and use by growers.

Anticipated Impacts for Growers, the Environment and IPM Implementation

Safeguarding human health and the environment: This project will facilitate the development of Guardian Plants and support increased grower confidence in biological controls, encouraging biological control adoption, and decreased pesticide use. In our 2007 NE IPM research, pesticide use was reduced 50 and 100% at two VT poinsettia greenhouses through the use of Guardian Plants and whitefly parasites. This impact could be realized region-wide with development of simple but effective IPM tools like Guardian Plants.

Economic Benefits: This project supports the development of IPM tools that growers can produce themselves. The development of Guardian Plants will aid growers in transitioning to biological control. In the case where the Guardian Plants successfully produce natural enemies that control the pest, repeated and ongoing purchases of natural enemies will be not be necessary and pesticide use will be reduced 100%. For example, Mark Yadon at Mischler's has not purchased whitefly parasites or pesticides for whitefly control in his spring crops for 2 years. He attributes this to the populations of Eretmocerus whitefly parasites that are overwintering on his lantana and hibiscus plants. Guardian Plants used as traps to physically remove pests from the greenhouse can likewise result in 100% reduction of pesticide use. If pesticide spot treatments are necessary on the Guardian Plants, approximately 95% pesticide reduction would be expected, since Guardian Plants are expected to occupy far less than 5% of the available greenhouse space.

Implementation of IPM: We are witnessing rapid grower adoption of Guardian Plants because there is minimal cost or risk associated with trying them. Efficient communication is key. This project will be presented to the Tri-State Greenhouse IPM workshops in ME, NH and VT, and offered to New York grower meetings, and the Ohio Florist Short Course. Manuscripts will be offered to the Association of Educational Research Greenhouses, Assoc. of Zool. Horticulture, NYS Flower Industries, and GrowerTalks. Our results will be disseminated rapidly to IPM professionals, including the GO IPM working group, hundreds of growers at our presentations and thousands via the web. A thousand Guardian Plant fact sheets will be distributed to growers at grower meetings and a web version will be uploaded for growers and extension personnel. This project evaluates Guardian Plants in Northeast greenhouses, but the model will be adaptable to other regions, crop types and pests.

5. Approach and Procedures

I. Set up, validate and adjust a decision tree and Guardian Plant monitoring template for growers interested in developing their own Guardian Plants

Based on the relative numbers of natural enemies and pests on the Guardian Plants and crop in any given week, we will map out a series of decisions, such as "Reexamine next week", "Pests too high, spray or discard plant", or "Excellent natural enemy/pest balance, no more natural enemy purchases necessary." For each Guardian Plant/grower combination we will record each decision point and data blank actually used. We will describe the actual flow of work on the Guardian Plant handout.

II. Identify and quantify key indicators of Guardian Plant impacts. Demonstrate in-depth observation of 2 Guardian Plant systems at 3 grower sites, 1. black pearl ornamental peppers

supporting thrips predator, Orius insidiosus and 2. lantana supporting whitefly parasites. Evaluation must be do-able and meaningful in a grower's eyes. At Bakers Acres, scout Michelle Ten Eyck will record whitefly and natural enemy numbers on 6 Lantana Guardian Plants in a 3000 square foot herb greenhouse. At Mischler's, grower Mark Yadon will record pest and natural enemy numbers on black pearl ornamental peppers and lantana and adjacent crops. At Peace Tree Farm, the pest manager will record pest and natural enemy numbers on black pearl.
Data from weekly inspections of Guardian Plants will include:
Number of immature and adult natural enemies and pests per 6 inch terminal, flower, plant or other appropriate measure.
Measurement of pest and natural enemy numbers on nearby crop plants,
First observation of pest on the Guardian Plant
First release of natural enemy
First observation of natural enemy on Guardian Plant more than 7 days after release.
First observation of natural enemy immatures from a generation different than the release
First observation of pest in named crop
First observation of natural enemy in named crop
First observation of natural enemy immatures in named crop
Relative number of pests per Guardian plant compared to relative number of pests per crop plant
Relative number of natural enemies per Guardian plant compared to relative number of natural enemies per crop plant
Undesirable additional pests supported by Guardian Plant
Baseline number of whole-crop pesticide treatments to crop for pest before adding Guardian Plants
Number of whole-crop pesticide treatments in present crop.

III. Find venues for growers to explain their activities at grower meetings and set up grower presentations to present their experiences with Guardian Plants.
We will propose grower presentations to report on their experiences with Guardian Plants. Growers will describe the way they use, monitor and evaluate their Guardian Plant systems, ideally bringing functioning Guardian Plants to the meeting for the audience to examine if the season allows it. Funding is included for travel support of 2 long distance grower or pest manager participants for the 3-day Tri State IPM Meetings that travel through Maine, New Hampshire, and Vermont, to one New York grower meeting yet to be determined, and to the Ohio Florist Short Course meeting where a session on this topic has been proposed. Each grower panel is expected to have 3 to 5 participants, with the funding going to the people least likely to attend the meeting on their own funds.
IV. Compile and publish a static Guardian Plant database with the results of the 2009 studies and key indicators gleaned from existing Guardian Plant projects. The database will include IPM Laboratories research supported by NE IPM : information from the 2 years of eggplant trials in poinsettias, and SARE-supported work: 3 years of habitat plant data. We will create, print and supporting documentation a 4 page 4 color glossy handout with Guardian Plant monitoring template, decision tree and database of grower experiences collated to date. We will post this same information to the web in an appropriate format.
V. Research web based searchable online databases and develop a proposal to create a searchable online database to record and communicate Guardian Plant development and use by growers. Ideally, the database will compile statistics on the success averages of each Guardian Plant

species/ crop combinations for the various Guardian Plant roles. We will dedicate 40 hours to examining current online searchable databases, including the Citizen Science work of the Cornell Lab of Ornithology. Within this time, we will write a brief report (about 5 pages) on the compatibility of our data with such an idea, a list of questions that a grower would ask of the database and how it should be formatted to respond, set up expense, hosting expense, and maintenance expense. We will compare that expense to the expenses associated with a static database.

Timetable

Objective	Task	Complete by
I.	Create draft decision tree and monitoring template, review with grower-cooperators and revise to suit their needs	March 2009
II.	Identify and quantify pest and natural enemy parameters on 2 Guardian Plant species at 3 grower sites	July 2009
III.	Propose Guardian Plant panels for summer, fall and winter grower meetings to meeting organizers	April 2009
	Facilitate Guardian Plant panels with data and graphics	July 2009 and ongoing
IV.	Compile database	July 2009 and ongoing
	Decision tree, monitoring template and database to designer for 4 page brochure, followed by printer	October 2009s
	Create web page with brochure information	November 2009
V.	Research web-based databases and write background report on possible Guardian Plant database	December 2009
All	Submit annual report	December 2009
All	Submit final report	March 2009

6. Evaluation Plans

For each Guardian Plant/grower combination we will note each decision point and data blank actually used by the grower cooperators and report on the actual flow of Guardian Plant evaluation by grower in the Guardian Plant handout.

We will measure the success, impact, and likely future impact of the Guardian Plant concept by the number of participating growers in the panel and audience each grower panel session, the number of Guardian Plant systems entered in the database, and the number of brochures distributed.

7. Cooperation, Institutional Units and Key Personnel

Bakers Acres, North Lansing, NY opened in 1980. As a 30-acre 10-greenhouse operation, it is one of the largest herb and perennial growers in central NY. Its nursery offers trees and shrubs, and they grow >1000 varieties of perennials, 250 varieties of herbs and >75 kinds of specialty annuals. During its busy season Bakers Acres employs about 30 people. Maureen Sandsted, the owner, is involved with Tompkins Sustainable, a grassroots project that educates the public about the importance of sustainable agriculture.

Mischler's Florist and Greenhouses grows and retails ornamentals year round in Williamsville, NY. Mischler's first released biological controls in 1989. Co-owner/manager, Mark Yadon manages the growing and pest management. Yadon is a long-time user of natural enemies. Before coming to Mischler's, Yadon managed a large cut rose greenhouse in Colorado and a large bedding plant greenhouse in New Hampshire also has experience managing large numbers of gerberas, poinsettias and potted ornamentals. Yadon became acquainted with biological controls in the 1970's when he scouted apples in Washington State. Scouting reports detailed the numbers of spider mites and the number of spider mite predators. Yadon observed in spring 2006 that the fall 2005 Eretmocerus releases colonized some hibiscus plants and lantana plants which served to supply the greenhouse with whitefly parasites all spring and summer. Mark did not have to use chemicals for whitefly control on the spring and summer crops once in 2007 or 2008.

Peacetree Farm in Kintnersville, PA specializes in growing superb finished plants for fine independent garden centers, botanical gardens, and exhibition in North America. They pride themselves in their selection of unusual and extraordinary plants, propagating a wide range of outstanding starter plants and offering a wide choice of spectacular herbs from global sources including an exceptional begonia collection. Peacetree Farm offers superior plants and genetics, a state-of-the-art greenhouse and environmentally-friendly sustainable techniques. Peacetree Farm is in the process of transitioning to certified organic crops, uses beneficial insects, mites, and nematodes for pest control, and is searching for sustainable methods of thrips control. Lloyd Traven, co-owner of Peacetree Farm is has a Masters degree from Cornell University and is a well-known speaker at horticultural conferences.

Flora & Fauna in Moravia, NY is an ecological consulting firm that specializes in the evaluation of natural systems. The firm's president, Dr. Sally Newman possesses a Ph.D. in Plant Physiology with a minor in Genetics from the University of Minnesota. As a postdoc at Cornell University, Dr. Newman examined natural insect resistance in wild relatives of tomato as conferred by glandular hairs on the leaf surfaces. As a fellow with the American Association for the Advancement of Science working at the EPA. Office of Pesticides Program in Washington DC, Dr. Newman developed a risk assessment approach for evaluating the potential for transgenic crop plants to transfer genetic material (pollen) to weedy relatives. Dr. Newman has experience working with greenhouses (tomato) and field (corn) crops, and the statistical evaluation of data.

References:

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