UMass Extension IPM
2013 Annual Report

Extension Integrated Pest Management Coordination and Support Program (EIPM-CS) 2010-2014
University of Massachusetts-Amherst
Year 3 Report
Reporting Period September 1, 2012 to August 31, 2013

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UMass Extension IPM
2013 Annual Report
Year 3, EIPM CS PROGRAM

Project Faculty & Staff

Anne Averill
Assoc. Professor of Entomology, Dept of Environmental Conservation
UMass Extension

A. Richard Bonanno
Extension Educator: Weed Specialist
UMass Extension

Katie Campbell-Nelson
Extension Educator, Vegetables
Umass Extension

Jon Clements
Extension Educator: Tree Fruit Specialist
UMass Extension

Daniel Cooley
Assoc. Professor of Plant Pathology, Stockbridge School of Agriculture
UMass Extension

M. Bess Dicklow
Extension Educator: Plant Disease Diagnostician
UMass Extension

Katherine Ghantous
Research and Extension Technician
UMass Extension

Ruth Hazzard
Extension Educator, Vegetable Specialist
Project PI
UMass Extension

Craig Hollingsworth
Extension Educator: Entomology & IPM
UMass Extension

Lisa McKeag
Extension Assistant
UMass Extension

William A. Miller
Evaluation Specialist
UMass Extension

Stephen Rich
Assoc. Professor, Dept of Microbiology
UMass Amherst

Hilary Sandler
Extension Faculty
IPM Program Coordinator
Cranberry Weed Specialist
UMass Extension

Sonia G. Schloemann
Extension Educator, Small Fruit Specialist
UMass Extension

Susan B. Scheufele
Extension Assistant
UMass Extension

Martha M. Sylvia
Research and Extension Technician
UMass Extension

Arthur Tuttle
Fruit IPM Specialist
UMass Extension

Robert Wick
Professor of Plant Pathology, Stockbridge School of Agriculture
UMass Amherst

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IPM Program Coordination

EIPM Advisory Panel

The 2013 advisory meeting at Ward's Berry Farm, Sharon,

The EIPM Advisory Panel convened for its third annual meeting on March, 28th 2013 to discuss outcomes and impacts of the project since 2010, and to plan projects for the 2013 growing season. In attendance were eight fruit and vegetable growers including four mentor growers, an independent IPM field consultant, staff from NRCS and non-profits including Red Tomato and Southeast MA Agricultural Partnership, and UMass Extension Fruit and Vegetable Educators. Growers reported that their increased knowledge and use of weather stations, pest monitoring and crop scouting have helped them improve crop health, avoid crop losses and save costs. They consulted the NEWA late blight, early blight, apple scab, and fire blight models to time their preventative fungicide applications and to avoid unnecessary applications. This would not have been possible without the introduction of weather stations to their farms as part of the current EIPM grant. Monitoring for Spotted Wing Drosophila and other pests resulted in better timing of sprays and less crop loss. UMass training in related practices such as nutrient management and reduced tillage has helped growers improve crop quality, drought tolerance, and soil health. All growers unanimously agreed that the on-farm, one-on-one regular support provided by UMass staff, made possible by the financial support of this grant, was invaluable.

NRCS staff reported that the specific goals and IPM methods developed by UMass in partnership with growers was very helpful in preparing EQIP contracts. Records of IPM practices helped growers receive EQIP payments, and achieve recognition for advanced IPM.

Growers' feedback on delivery of IPM information affirmed their reliance on regular weekly newsletters from UMass, and suggested a need for better integration of fruit, vegetable and floriculture information as well as use of blogs, social media and phone alerts.

During the meeting, growers identified which demonstration trials and partner projects they hoped to work on, and which general IPM issues they still required assistance with.

Summary of Evaluation Activities

Mentor Grower Evaluations

This year the UMass Vegetable and Fruit teams sought to develop methods for evaluating our work with mentor farms that would capture patterns and trends across diverse crops, production systems, and farms. Our goal was to assess the impact of the project on crop health, quality and yield, pesticide

choices and use, and on the grower's intentions for further use of IPM pactices in the future. We involved William Miller who has worked on IPM evaluation at the national level. Throughout the growing season we kept detailed records, called 'timelines', for each mentor farmer. These chronicled the observations made and the actions recommended at each farm, such as: scout, use diagnostics, use cultural controls, use biocontrols, use weather based forecasting, apply spray at threshold, or use reduced-risk or selective pesticides. These timelines were used to generate an evaluation template where the adoption and outcomes of recommended actions were assessed during extensive post-season interviews with mentor growers. Data were obtained from 10 farms where a total of 310 recommended actions were documented. Preliminary analysis of these data is reported below,and further analysis will be presented in the final report.

Of the 310 recommended actions:

- 51% were taken/followed as recommended
- 28% were taken/followed with some modification
- 21% were not taken/followed

For all recommended actions that were taken/followed as recommended, success was rated as:

- 8% - not successful
- 3% - minimally successful
- 29% - moderately successful
- 60% - very successful

For all recommended actions that were taken/followed with some modification, success was rated as:

- 3% - not successful
- 18% - minimally successful
- 39% - moderately successful
- 40% - very successful

Our evaluation process also captured the project's unique impacts at the individual farm level; these are described below under Primary Emphasis Area – Specialty Crops IPM, On-farm implementation and training (see page 10).

Surveys at Educational Programs On-farm educational programs focused on scouting training, IPM for specific crops, and major crop production challenges. These were also evaluated individually through post-program surveys. Participants reported increased knowledge in many topics including: pest identification; sprayer calibration; apple IPM; storage technologies; and season extension.

Primary Emphasis Area: IPM Implementation in Specialty Crops -- Vegetable and Fruit IPM on Diversified Farms

IPM in Specialty Crops: Monitoring, decision support and pest alert network

Pest Monitoring & Forecasting

One of our program goals was to increase access to weather data and use of weather-based IPM forecasting models by continuing to expand our participation in the Network for Environment and Weather Applications (NEWA) (http://newa.cornell.edu/). As of December 2013, we have purchased

and deployed 23 weather stations at collaborating farms (19 in MA and 4 in adjacent states) . Project scientists continue to maintain these stations, pay for the links with NEWA, and train growers in their use. Twenty-two other weather stations (airports) in MA have been linked to NEWA as well, providing a network of 45 sites across the region that growers can access to get up to the minute weather and pest information.

All mentor and partner growers received one-on-one training on how to use their local weather data to run the many disease and insect pest forecasting models available on the NEWA website. Growers used the forecasting models for pests of apple, onion, potato, sweet corn, crucifers, cucurbits and tomato. Blueberry pest models, while not yet integrated into the NEWA system, are available from other states and once a local biofix is set, pest progress and thresholds can be extrapolated from NEWA weather data. Mentor growers reported increased understanding and use of weather data and pest forecasting models to determine when to scout or set up traps; when to initiate, schedule or stop a spray program; or when to release biocontrols. NEWA users report significant pesticide use reduction, improved spray timing and enhanced IPM decision-making using this system. We also collaborated with Glen Koehler at the University of Maine, who runs Orchard Radar, a pest forecast system using data from SkyBit, in order to determine which of these systems (NEWA or Skybit) offers the best long-term solution to providing IPM decision support for apple orchards.

Growers consulted temperature data and forecasts on frost and wind, including hourly real-time data, to help with decisions on frost prevention measures. For one grower, a freeze that occurred in the middle of an orchard in the early morning hours was documented by the weather station, but not by thermometers checked in the evening or by other nearby weather stations.

Information on how growers can use this information was disseminated to vegetable and fruit farms through newsletters, IPM messages, and websites. Project staff gave talks and demonstrations about the stations, the NEWA website, and the available forecasting models at twilight meetings and other venues. Mentor and Partner Farm growers worked with project staff to evaluate and improve forecasting models for apple scab disease and summer diseases of apples.

Pest Alert Network

Subscribers receive weekly Pest Alerts and timely pest management articles through Vegetable Notes, Healthy Fruit, and Berry Notes during the growing season. These are disseminated through email subscriptions and websites. We continued to develop our UMass Vegetable and Fruit IPM Facebook page, which allows stakeholders to get pest alerts for vegetable and fruit all in one place.

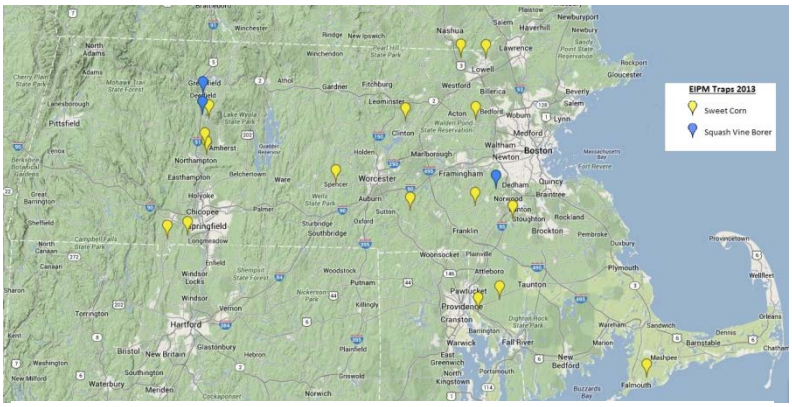


Figure 1. Sweet corn (CEW, ECB, FAW) and cucurbit (squash vine borer) trap locations, 2013.

Through our biweekly visits to our 13 mentor farms and regular visits to partner farms we were able to monitor crop conditions and pest outbreaks across the state. The UMass Vegetable sweet corn and squash trapping nework, with sites monitored by Extension staff, independent consultants and growers, tracks populations of corn earworm, European corn borer, fall armyworm, and squash vine borer

throughout the season (Figure 1). The Vegetable & Fruit IPM team monitored 20 sites across MA on a weekly basis for two emerging pests, Spotted Wing Drosophila (SWD) and Brown Marmorated Stink Bug (BMSB) (See Invasive Pests, p 22; Figure 5). Alerts including population levels and recommendations for timing of sprays as well as cultural practices.

Weather data from NEWA stations (Temperature, Growing degree days, rainfall) were reported in weekly newsletters. The growing degree day (GDD) reports allow growers to predict emergence or peak activity of key vegetable and fruit pests such as cabbage maggot, European corn borer, blueberry and apple maggot, cranberry fruitworm and codling moth. Using NEWA's decision support system for late and early blight, combined with field scouting and diagnostics, we alerted growers to outbreaks of late blight across the state, and provided spray recommendations for prevention and management during the period of high risk and confirmed late blight activity. The Cucurbit downy mildew(CDM) IPM-PIPE (http://cdm.ipmpipe.org/) was used to prepare a weekly pest alert that tracked the spread of the disease and giving forecasts; this was combined with field scouting to confirm CDM outbreaks in the state. Similarly, apple scab, fire blight and summer diseases were tracked and information disseminated to growers using NEWA data and scouting reports.

IPM in Specialty Crops: Summary of Outreach Activities

Web Access to IPM Information

A primary goal of this project was to increase access to IPM information on a range of commodities, in an effort to address the growing diversification of farms in the Northeast. To address this goal, updates were made to the IPM website (http://extension.umass.edu/ipm), targeting improved readability and navigation. Currently it serves as a gateway, directing visitors to IPM information on vegetable (http://extension.umass.edu/vegetable/), fruit (http://extension.umass.edu/fruitadvisor/) and other commodity websites. Analysis of the New England Vegetable Guide and UMass Vegetable Extension websites, based on Google Analytics, indicates that over 8,000 unique visits lasting over 1.4 minutes were made to these sites during the reporting period.

In addition, a "UMass Extension Fruit and Vegetable IPM" Facebook page has been developed (https://www.facebook.com/umassipmteam). This platform allows all three program areas (vegetable, fruit, and cranberry) to add content such as pest alerts, photos of pests observed on scouting visits, links to relevant newsletters and events. The Facebook page currently has over 500 followers at the close of 2013.

Management Guides in Print and Online

During this reporting year, UMass Extension fruit and vegetable specialists updated and published the following regional management guides:

N*ew England Vegetable Management Guide* (1500 copies; www.nevegetable.org)

The New England Tree Fruit Management Guide
(http://extension.umass.edu/fruitadvisor/publications/new-england-tree-fruit-management-guide)

New England Small Fruit Pest Management Guide (800 copies,
http://extension.umass.edu/fruitadvisor/).

For all three documents, UMass leads the editing process and coordinates contributions from Extension specialists in other New England states. Printed guides are disseminated to state extension offices and grower organizations across New England. The guides are available on websites that are housed and maintained by UMass Extension.

The *Cranberry Chart Book Management Guide for Massachusetts* was revised and distributed in early April 2013. This guide is written by the Extension faculty and staff who are involved with applied research projects that feed directly into the recommendations provided in the Chart Book. This publication is distributed free of charge to all MA cranberry growers and is available as PDFs on the UMass Cranberry web site. In 2013, almost 1200 copies of various chapters of the document were downloaded from the web site. Approximately 400 printed copies were mailed directly to growers and another 100 printed copies are distributed directly from the Station to other interested parties throughout the year.

On-Farm Educational Workshops

Hands-on field training was provided to 946 vegetable and fruit farmers at twenty-two workshops, from August 2012 through September 2013. An additional four winter meetings reached 173 farmers. Many programs included information and training about the invasive pests, Brown Marmorated Stink Bug and Spotted Wing Drosophila. Programs attracted both beginning and experienced farmers.

Table 1. Educational Workshops on Vegetable and Fruit IPM, August 2012 through September 2013

Date	Name of Program	Farm, Location	Special Topics or Audience*	# of Attendees
8/16/12	New England Fruit Consultants Summer Meeting	Apex Orchard, Shelburne MA	SWD and BMSB ID and MGT	50
10/11/12	UMass Fruit & Veg Team Twilight	Kosinski Farm, Westfield MA	SWD and BMSB ID and MGT	20
1/4/13	NEVBGA January Day-long Program	Northampton, MA		60
2/2/13	NEVBGA February Day-long Program	Concord, MA		50
2/23/13	SEMAP Local Food Conference	Bristol Aggie, Dighton MA	SWD MGT	25
3/5/13	Farm School; Berry Production	Farm School, Orange MA	SWD MGT BegF	12
3/18/13	Mass Aggie Seminar; Blueberry	Tougas Family Farm, Northboro MA	SWD MGT BegF	32
3/12/13	Disease Prevention with Hot Water Seed Treatment	Ward's Berry Farm, Sharon, MA		20
4/9/13	Working safely with pesticides	Elks Lodge, E. Wareham, MA		90
4/16/13	Fruit Twilight Meeting	Big Apple Farm, Wrentham, MA		45
4/17/13	Fruit Twilight Meeting	Outlook Farm, Westhampton, MA		30

4/24/13	Building Healthy Soils Workshop	UMass Crops Research & Ed Farm, S. Deerfield, MA		42
4/25/14	Building Healthy Soils Workshop	Bristol County Ag. High School, Dighton, MA		38
5/14/13	UMass Fruit Team Twilight Meeting	UMass Cold Spring Orchard, Belchertown MA	SWD MGT	35
5/16/13	Mass-RI Tree Fruit Twilight Meeting	Old Stone Orchard, Little Compton, RI		50
5/22/13	Beginning Farmer Network Meeting: IPM & Late Blight	Buckle Farm, Dighton, MA	BegF	40
6/3/13	Organic Crop Production Twilight Meeting	Waltham Fields Community Farm, Waltham, MA	BegF	40
6/11/13	UMass Fruit Team Twilight Meeting	Tougas Family Farm, Northboro MA	SWD and BMSB ID and MGT	57
6/21/13	Cranberry Pest Management Workshop	UMass Cranberry Station, East Wareham, MA		19
7/10/13	Mass. Fruit Growers' Assoc. Annual Meeting	Honey Pot Hill Orchards, Stow, MA		100
7/16/12	Mass Fruit Growers Summer Meeting	UMass Cold Spring Orchard, Belchertown MA	SWD and BMSB ID and MGT	55
7/18/13	Sprayer Calibration Workshop	Cold Spring Orchard, Belchertown, MA		15
7/31/13	Field Walk: Integrated Pest Management	The Bars Farm, Deerfield, MA	BegF	25
8/14/13	Field Walk: Integrated Pest Management	Powisset Farm, Dover, MA	BegF	50
9/18/13	Twilight: Winter Production, IPM, and Marketing	Tangerini Farm, Millis, MA		30
June to Aug, 2013	Field Walks, biweekly	Flats Mentor Farm, Lancaster, MA	BegF	49
June to Aug, 2013	Field Walks, biweekly	Farm School, Athol, MA	BegF	30
** BMSB (Brown Marmorated Stink Bug) and SWD (Spotted Wing Drosophila) were included in program topics; see Invasive Pest section. Beg F (Beginning Farmer) is indicated when the audience comprised >50% beginning farmers.				

Newsletters

Vegetable Notes: 21 issues were published through an email distribution list and on our website. Weekly issues from May-September and monthly from October-April provided pest alerts and articles in timely, scientifically accurate, and readable content relevant to a broad spectrum of vegetable farmers. Our email list has >1500 subscribers in Massachusetts, New England and elsewhere.

Healthy Fruit: 23 issues were published weekly or biweekly from April through September and periodically throughout the rest of the year. Meeting announcements, fact sheets and bulletins were published during the year, and updates to the New England Tree Fruit Management Guide were included. This publication reached 100 people, primarily tree fruit growers.

Berry Notes: comprehensive monthly publication that include seasonally relevant information on small fruit production, pest management, marketing, and related topics as well as recent research. Berry Notes include pest alerts, scouting results, and reminders and/or checklists for important crop management activities. This year Berry Notes subscribers could also sign up for **IPM Berry Blast**, a periodic e-message that highlights specific pest issues on a timely basis through the growing season. These publications reach 450 subscribers.

Cranberry Station Newsletter: In 2013, 5 issues of the Cranberry Station newsletter were published and distributed to 327 recipients; most are in Massachusetts, but 24 were national or international addresses. We also issued weekly IPM pest alerts from early May through early August as a phone message and on our web site. A small subset of growers do call in to hear the pest alert but many growers are moving towards accessing the information from the web.

IPM in Specialty Crops: On-farm IPM Implementation and Training

The UMass Fruit and Vegetable Teams worked with diversified vegetable and fruit farms across the state in several capacities, as *mentor*, *partner* and *cooperating* farms.

- **Mentor** farms set pre-season IPM goals for a variety of crops and pests and were visited biweekly for on-farm scouting with Extension staff. Mentor Farms received disease diagnostics, soil and tissue testing, and traps for monitoring particular pests important to them. Over 50 samples were analyzed by the UMass Disease Diagnostic Lab and over 30 soil and tissue samples were analyzed by the UMass Soil and Tissue Testing Lab, with consultation provided to growers. Six Mentor Farms were sites of on-farm field walks and twilight meetings this season. In 2013, UMass Extension worked with thirteen mentor farms across the state (see Figure 2); the goals of each farm and impact of our work with them are described in **Mentor Farm Reports**, below.
- **Partners** were farms where targeted research or a demonstration project on a specific pest or pest complex was conducted based on farmer need and Extension staff availability. Farm visits, treatment applications, and data collection was conducted by farmers and Extension staff as required by each project and results were shared with farmers and others through publications such as Vegetable Notes, Fruit Notes and Plant Disease Management Reports. In 2013, UMass Extension staff conducted projects on eight partner farms. Projects included: flea beetle trap cropping, biocontrol in beans and peppers, biological and synthetic pesticides in brassicas and cucurbits, cranberry fruitworm research, advanced IPM for apple scab and summer apple diseases, and brown marmorated stink bug and spotted wing Drosophila trapping. A summary of each project is listed in the **Applied Research and Demonstration** section, page 17.
- **Cooperator** farms were locations where monitoring of particular pests was conducted by the farmer or other agricultural consultant and results were shared with Extension Staff for publication in Extension newsletters, Pest Alerts and other IPM portals such as Facebook. Extension worked with 8 cooperating farms in 2013.

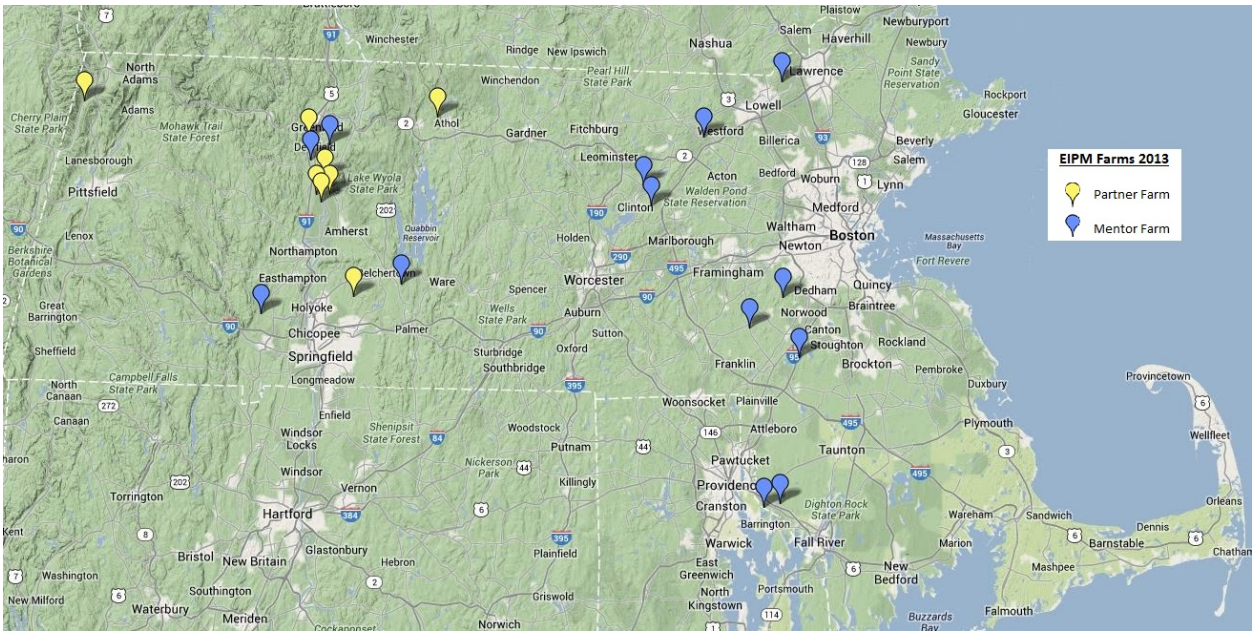


Figure 2. Location of Partner (yellow) and Mentor (blue) vegetable and fruit farms in 2013

Mentor Farm Reports

ME-FS is a 150 acre farm (50 acres in production) located in Worcester Co, marketing through a 175 member vegetable and fruit CSA, a 50 member meat CSA and several farmers' markets across the state. It is a non-profit farm education organization that provides learning opportunities to over 2,000 elementary school aged children each year in small groups for 3-day stays, 10-15 middle school aged children who attend its accredited full-time 'Chicken Coop' School, and 15-20 adult student farmers who attend the year-long 'Learn to Farm' program. It is this latter group, the student farmers and their instructors, that the UMass eIPM team worked with in 2013. One instructor is also the lead farm manager, responsible for growing wide range of vegetables and fruit using organic and biodynamic production practices. 2013 was this farm's first year as a Mentor Grower in this project. At the start of the season we developed the following IPM Goals:

•Monitor weekly for SWD and BMSB as part of the invasive pest monitoring/reporting network and consult best management practices.
•Monitor for pests and diseases in raspberries and consult on best management practices.
•Monitor for apple maggot fly and test a trap-out protocol in the organic apple orchard and advise growers on best management practices.
•Advise growers as needed on other pest and disease matters in grapes, blueberries and peaches.
•Advise growers on occasion as needed on other pest and disease matters in vegetables.

Impacts: We visited the farm weekly throughout the growing season from early June through October and met each week with student farmers and farm managers. At each of these visits SWD and BMSB traps were checked with the help of student farmers. Results were reported to the SWD and BMSB alert network. No BMSB were found in 2013. SWD numbers followed a similar pattern as found in many other locations in the state, beginning with low numbers in late June and escalating in mid July through August when numbers plateaued for the remainder of the monitoring season. No sprays were applied

but the high level of surveillance prompted the use of cultural practices to lessen the impact of SWD and extended the harvest period for raspberries. The farm plans to continue trapping in 2014, and integrate more cultural practices for SWD earlier in the season.

Raspberries and apples were monitored for other pest and disease incidence at each visit and discussed with the student farmers and lead grower. No sprays were saved as a result of our consultations because the only sprays applied (Surround WP, kaolin) were for plum curculio and occurred before scouting visits began. From July through September we also oversaw and assisted in a trap-out for apple maggot fly (AMF) using red sticky spheres in the 1/3 acre dwarf apple block. Spheres (provided by UMass) were checked weekly, fly numbers were tracked for the whole season, and traps were re-stickied every 2 weeks. 15 traps were installed around the periphery of the block and in the center. Numbers of flies peaked on 8/23 (avg of 2.7 per trap), but were low enough that the grower did not have to spray at all for this pest (a savings of 2-3 full block sprays). In another cluster of older apple trees red sticky spheres and fruit volatile vials were deployed to draw AMF from the harvested orchard, however trap captures were not significantly higher in this location. Overall fruit quality and harvestable yield was higher in 2013 than ever before. In 2014 the farm plans to continue AMF trap out trial, and to monitor and manage both plum curculio and apple scab using methods suitable for organic production.

Visits where vegetable scouting was performed helped inform student farmers about IPM concepts and scouting methods. More formal goals for targeting specific vegetable pest or disease problems are planned for 2014.

ME-BA is a 15 acre, third-generation family-owned vegetable and flower farm in Deerfield, MA, that markets through their farm stand and wholesale to local markets and restaurants. We met with the farmers in April and identified the following goals for the season:

- Reach a “high level” of IPM practices to qualify for a NRCS EQIP 595 contract.
- Learn cucurbit pest life cycles, scouting methods, and treatment options including trap cropping.
- Use biocontrols in the greenhouses to manage aphids and thrips.
- Host an on-farm IPM Field Walk to better educate customers and other growers in IPM.

Participants in the IPM Field Walk learn how to identify bacterial wilt in summer squash.

We visited the farm biweekly throughout the growing season to work with the farmers—checking squash vine borer traps, scouting vegetable crops to address management issues, collecting diagnostic samples and providing consultation on farm issues as they arose. The farmer scouted on his own on alternate weeks and checked the squash vine borer traps. The farm hosted a Field Walk with UMass Extension Educators in July that was attended by 25 beginning growers, customers, and NRCS staff who learned: thresholds for flea beetle when scouting eggplant; how to scout and identify leaf blights in tomato; and how to monitor and recognize pest problems in summer squash including squash bug, bacterial wilt and squash vine borers.

Impacts: In a post-season evaluation on the impact of our work, the farmers stated that they improved the quality of their brassica, cucurbit, and solanaceous crops by improving their scouting techniques and making more informed and efficacious pesticide applications. In brassicas: crop quality was improved by making boron applications based on soil test results; aphids were spotted early in Brussels sprouts; and complete control of insect pests was achieved with fewer pyrethrin, spinosad and acephate applications

this year. In cucurbits, the farmer learned to trap for squash vine borer, and to use disease forecasting and pest alerts to make pesticide applications based on action thresholds or predicted disease outbreaks. Based on our consultations, water use was reduced in the greenhouse and quality and yields of greenhouse tomatoes were improved. The farm is working with a representative of BioBest to select biocontrol options based on the pest scouting sheets and records they kept this year. All records of scouting observations and actions taken were submitted to the local NRCS office and the farm was awarded a "high level" (advanced IPM) EQIP Practice 595 contract.

ME-AT is a 90-acre USDA certified organic vegetable farm in Deerfield, MA. This was the farm's third and final year as a mentor farm. Goals for the 2013 growing season were to:

- Better anticipate pest problems by scouting early and acting quickly.
- Achieve effective control with fewer pesticide applications.
- Increase yield & quality in alliums, brassicas, cucurbits and solanaceous crops through improved disease identification and management.

ME-AT greenhouse tomatoes with potassium deficiency during a cloudy spell in June.

Impacts: Pesticide use for control of flea beetles in brassicas was reduced by increased scouting and monitoring. Timing and efficacy of sprays was improved for leaf hopper on potato. Pesticide use in cucurbits was reduced and the farmer gained knowledge about the transmission of soft rots and bacterial wilt through insect feeding. A tissue test of greenhouse tomatoes led to adjustment of fertility management to improve potassium uptake in his crop next year. In tomatoes, the farmer followed a tight schedule of copper applications based on the NEWA decision support system and Vegetable Notes pest alerts and was able to harvest field tomatoes into October, despite high disease pressure. Efforts to improve cultural and chemical controls of thrips and purple blotch in onions included use of raised beds, plastic, trickle irrigation, crop rotation, and timely applications of organic insecticides. These efforts were thwarted by sour skin (*Pseudomonas cepacia*), which was discovered in the onions post-harvest and destroyed the whole crop.

ME-FT is a 150-acre vegetable farm located in Seekonk and nearby towns. The farm has been managed by the family for 5 generations, and their commitment to IPM has continued from one generation to the next. The vegetable team met with the farmers and set the following goals for the season:

- Improve use of weather data.
- Improve understanding and use of biocontrols, especially in greenhouse crops.
- Use cultural practices to reduce pathogens.
- Reduce insecticide applications, especially those harmful to bee populations.
- Avoid resistance development by using alternative active ingredients.
- Use UMass Diagnostic Labs to improve pest ID and soil nutrition.
- Improve yield and crop health of fall turnips

This farm used the UMass soil lab to conduct tissue tests and PSNT to determine sidedressing needs for his crops. The beets on the left were not sidedressed and the beets in the the right were.

- Establish 595 EQIP contract

Impacts: The weather station was moved to a central farm office and connected to the internet so that the farmers can check forecasting models on smartphones. We submitted 4 samples to the UMass disease diagnostic lab, 3 soil or pre-sidedress nitrate tests and 1 plant tissue test. Nutrient management was improved and unnecessary fertilizer use was reduced in several crops based on results from the UMass soil testing lab. Trapping for SWD reduced the number of sprays in berry crops because they were able to spray based on thresholds. In solanaceous crops, the farmer learned to identify anthracnose in peppers and will rotate his eggplant to avoid *Verticillium* wilt. Use of hot water seed treatment, crop rotation, field sanitation, copper applications, along with drier conditions in the fall, reduced black rot in fall turnips. Scouting results were sent to the local NRCS office in support of an EQIP IPM 595 contract.

ME-FG in Rehobooth, MA is a third-generation farm run by a husband and wife team. They grow on 130 acres and produce the following key crops: sweet corn, squash, some tomatoes, eggplant, red shell beans and their own specialty, Portuguese pepper. We met with the farmers in May to set some IPM goals for the season including:

- Rotate pesticide active ingredients and include lower-risk products.
- Time sprays according to monitoring.
- Achieve control of cucumber beetle with lower levels of pesticide and protect bees.
- Use cultural practices to reduce pest problems, in the field and in tomato greenhouses.

ME-FG, transplanting eggplant into a rotated field with low Colorado potato beetle pressure.

Impacts: Perimeter trap cropping that was used in 2011-2012 was difficult to implement in winter squash and pumpkins due to extremely wet conditions in June. However, foliar sprays for cucumber beetle were based on scouting rather than on a schedule and applied prior to flowering. A reduced risk pesticide, Beseige (chlorantraniliprole, a diamide, plus lambda-cyhalothrin, a broad-spectrum pyrethroid), replaced use of a higher rate of lambda-cyhalothrin alone to control corn pests. Timing of sprays was adjusted to reduce impacts on bees. Traps were used to monitor corn pests and to time pesticide sprays and the farmers are often consulted by neighboring farmers about their trap captures and pest management. We submitted 3 samples to the UMass Diagnostic Lab. Cultural practices that the farm will continue or try in 2014 include: selecting Northern Corn Leaf Blight tolerant corn varieties; rotating eggplant a long distance from the previous year's crop to avoid Colorado potato beetle; staking tomatoes to avoid *Rhizoctonia* and other soil borne pathogens; and replacing the soil in their high tunnels and developing a better nutrient management plan to improve tomato production.

ME-WA is a diversified 175-acre vegetable and fruit farm in Sharon, MA, owned and operated by two brothers. They market their produce through CSAs and wholesale accounts, as well as their large on-farm store and pick-your-own operation. This was the farm's third and final season of work with UMass as an IPM mentor farm. The farm has also conducted reduced tillage

Farmers at ME-WA planting squash with a deep zone tillage (DZT) implement borrowed from UMass.

trials in collaboration with UMass. We met in the spring of 2013 to establish goals for the season, building on this previous work:

- Achieving effective insect control in sweet corn, using trapping data to make fewer sprays and rotating with lower risk chemistries.
- Controlling weeds in low- and no-till sweet corn and winter squash/pumpkins with well-timed, targeted herbicide applications.
- Managing disease, including late blight, in his 15 acres of tomatoes through early detection using diagnostic and weather-based forecasting tools, and appropriate fungicide and biofungicide applications.
- Controlling insects in potatoes with fewer, targeted pesticide applications based on scouting.
- Continue evaluating efficacy of releasing *Trichogramma ostrinae* in sweet peppers to control European corn borer.
- Trap for spotted wing Drosophila and BMSB, and use trap data to time insecticide applications.

A Caliente biofumigant cover crop was planted to reduce root pests in strawberries that followed.

Impacts: By using traps and scouting, the farmer was able to reduce insecticide sprays in both sweet corn and potatoes by at least one spray each. Scouting with UMass led to an early-season diagnosis of bacterial leaf spot in tomatoes from the UMass disease diagnostic lab, allowing the farmer take immediate preventive action against the disease, using copper and biological pesticides, which reduced its spread and severity in his four large plantings. Most of his tomato seed had been hot water-treated at a UMass-sponsored workshop in the spring, but untreated varieties were a possible source of the outbreak. We assisted the farmer in taking 2 early-season standard soil tests and 4 mid-season pre-sidedress soil nitrate tests (PSNTs) to help optimize his fertilizer applications , especially in his no-till and reduced-till fields. He has been working with UMass to optimize his strategies for growing some crops using reduced tillage, and for the second year was able to borrow DZT equipment from UMass. He noted that UMass' Vegetable Notes newsletter was his main source for, among other things, tracking downy mildew progress in the region and related spray recommendations. With this information he felt confident in waiting to apply downy mildew-specific materials until the risk was high. We coordinated with the farm to make four releases of *T. ostrinae*, for control of European Corn Borer in a 1½-acre pepper field (see Pepper IPM report, page 24). SWD trap numbers rose toward the end of blueberry harvest, allowing most of the harvest to occur without use of insecticides for SWD.

ME-TA farm, located in Millis, was established by the farmers in 1995 on 67 acres of land that has been farmed since the early 1800s. With the exception of sweet corn and apples, their produce is grown without the use of synthetic pesticides and fertilizers. They market their crops through a variety of CSA options, including main season, spring, and winter shares, as well as on-farm at their market store. This was the farm's third and final season of work with UMass as an IPM mentor farm, though they will continue on as a partner farm with an apple scab IPM research project. The farmers established the following goals for the season:

- Increase size and overall yield of onions.

- Improve sweet corn pest trap monitoring for better timing of pesticide applications, and test alternate CEW control materials.
- Improve brassica sanitation for better pest control.
- Continue evaluating efficacy of *T. ostrinae* releases in peppers to control European corn borer.


Carrot digging, fall 2013

Impacts: In a post-season interview, the farmer said that through learning how to scout for thrips on onions, she was able to better time her sprays and saw improved yields and size. By submitting samples to the UMass lab, she realized her onions had purple spot, and what treatment options were available. The farmer checked insect traps himself on a weekly bases, and used a lower rate of lambda-cyhalothrin combined with a diamide in a pre-mix product (Besiege) which he found effective against CEW even at longer spray intervals. Pesticide and preventative control applications for flea beetle and cross-striped cabbageworm in Brassicas were better timed, and the farmer estimates she reduced overall damage by 50%. Sidedressing based on PSNT results also helped improve overall crop health. In scouting with UMass, the farmers were able to identify problem areas in several crops, and used the diagnostic lab 5 times to positively identify each issue and determine a course of action. We coordinated with the farm to make 4 releases of *T. ostrinae* for control of European corn borer in a ½-acre pepper field (see Pepper IPM report, page 24). The farm was also a monitoring site for SWD. In September, UMass sponsored a twilight meeting at the farm, which was attended by about 30 people. We discussed IPM in fall storage crops and led a hands-on scouting workshop in Brassicas.

ME-PO farm is part of a 108.5-acre property in Dover, MA owned by the Trustees of Reservations. The land has been used for agriculture for three centuries, and since 2007, it has been managed by the farmer as an organic CSA. 2013 was the farmer's first year as an IPM mentor farm, and we established the following initial goals for the farm:

- Improve pest control in brassicas.
- Improve efficiency of spray program in tomatoes for disease control, esp. late blight.
- Improve yield and storage quality of onions.
- Improve control of leafhopper in potatoes.
- Improve control of striped cucumber beetle in summer squash and cucumbers.


Sonia Schloemann teaches about leafhopper on raspberries

Impacts: UMass visited the farm biweekly to monitor pest management issues as they arose, to train the farmer in scouting her crops for insects and diseases and to discuss management options. The farmer had historically used pesticides infrequently, and had not based her spray decisions on scouting data. She learned that appropriately timed sprays of the few OMRI-approved materials available could help to improve her produce quality and yields. She also was advised in safe-handling of pesticides and calibration of equipment. We held a field walk on her farm, attended by over 50, mostly apprentice and beginning, farmers. We led attendees through a hands-on scouting workshop for insects and diseases in fall Brassicas, a sprayer calibration demonstration, and a discussion of late blight and the use of copper in tomatoes. The farmer also reported that with taking PSNTs and making well-timed sidedress applications she was able to improve the quality of her potato and cucurbit crops. She used the UMass disease diagnostic lab two times, and was able to

make management decisions based on the results. We will continue to work with the farm in 2014.

ME-WF leases land at from public and private owners in Waltham, MA. The farm grows 17 acres of diverse vegetables, herbs, fruit and flowers for distribution through an on-farm CSA and at farmer's markets. The farm uses three fields, separated by up to 7 miles, which presents both challenges and opportunities for crop production, management, and harvest. This was their first season as a mentor farm. In our spring planning meeting, the farm managers identified the following goals:

- Improve disease management in cucurbits and brassicas.
- Reduce overwintering population of maggot flies.
- Reduce thrips damage in onions and brassicas.
- Use a biocontrol to reduce Mexican bean beetle (MBB) damage and improve yield in beans.
- Improve efficiency of spray program in tomato by using forecast models.
- Reduce impact of SWD in raspberries.

Impacts: During our biweekly visits, we provided pest identification, scouting training and recommendations for diseases and flea beetles in brassicas, maggot flies and onion thrips in both onions and brassicas, and leaf miner of chard and spinach; assisted with MBB scouting and biocontrol (see Bean IPM report, page 29). We scouted for tomato disease with the growers to properly ID late blight and discuss forecasts and spray recommendations for late blight and identified four diseases of cucurbits which were previously unknown to the grower and discussed their biology and management. We also established and helped maintain two SWD traps on the farm and communicated recommendations from the UMass fruit advisor. The farm hosted a Twilight meeting on organic pest management on June 15, 2013 which was attended by approximately 40 growers. Over the course of the season we submitted 3 soil and PSNT tests and 7 samples to the diagnostic lab. In our final evaluation meeting the farm manager reported that they had better quality and yield for 5 of the 6 target crops. They learned to identify new and old pests and learned to better appreciate the effects of diseases on crop health and yield. The grower commented that the program helped them "get a better handle on what's going on out there, now we can think about strategies."

ME-NI is a third generation family farm in Bolton, MA. Their primary focus is tree fruits, including apples, pears, and stone fruits, as well as blueberries, and they have a long history of using IPM in fruit. Over the last several years the farm has been expanding its vegetable production. The transition into vegetables can be a challenging one, as chemicals are not usually labeled for both types of crops and the types of equipment and general production practices vary greatly between perennial fruit crops and annual vegetables. Therefore, the goal of our biweekly scouting was:

- Improve vegetable crop management, including weed control and crop nutrition.
- Improve vegetable IPM in vegetable crops, including scouting, spray equipment, and pesticide selection.

These goals were addressed by scouting with the vegetable manager and discussing insect, disease, and crop health issues as they arose. Issues that we addressed together included: cucurbit bacterial wilt, cucurbit downy and powdery mildew identification, life cycle, and spray program; cucurbit nutrition and ozone sensitivity; improving tomato plant health through cultural practices; weed management strategies; basil downy mildew identification, life cycle and management; and planting concerns and bacterial diseases of peppers.

Impacts: As a result of increased understanding of the potential impacts of insects and diseases the vegetable manager plans to buy a new sprayer that is better suited for vegetable production which will improve coverage and efficacy of sprays. They will also consider treating seeds for bacterial diseases, planting resistant varieties, and they feel better prepared to use cultural controls and to adhere to preventive spray programs. They were also introduced to forecasting websites and pest alerts for vegetable crops and will use these for forecasting diseases such as late blight, cucurbit downy mildew and basil downy mildew.

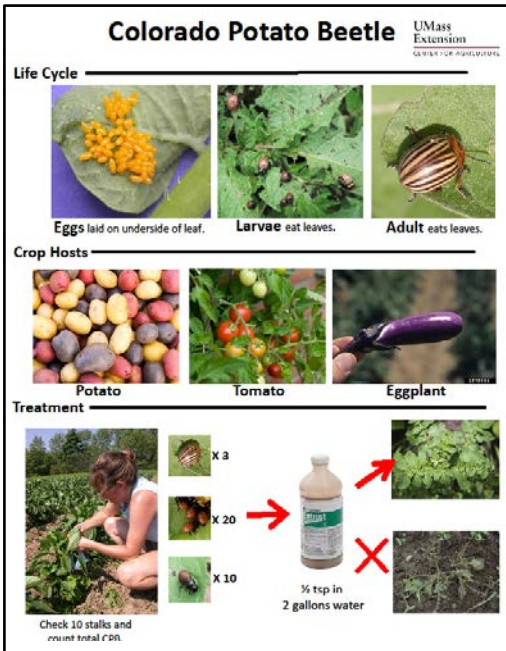
The coordinator at ME-FL made signs in three languages, to put in plots of farmers where pest damage was observed, to tell them where they could go for help.

ME-FL is a non-profit organization made up of about 150 immigrant farmers who grow commercially or produce food for their families on 1/4 to 2 acre plots within a 70-acre parcel of land in Lancaster, MA. The farm includes two immigrant groups: Hmong refugees who immigrated to the US in the early 1980's and African refugees who came to the US in the late 1990's and early 2000's. Both groups depended on agriculture for food and income in their home countries and want to apply their farming skills in the US. This requires adapting to New England's different climate, crops, pests, tools, and marketing systems. The IPM goals established with the farm coordinator included:

- Reduce damage caused by pests.
- Increase grower knowledge of pest problems and access to pest controls.

These goals were addressed in bi-weekly farm walks led by UMass Extension staff who, through the assistance of translators for Hmong, Swahili and Kurundi languages, pointed out pest damage, discussed life cycles, and gave simple control strategies.

Impacts: We successfully increased growers' understanding of some key IPM concepts including: insects and diseases are the cause of crop damage observed; insect life cycles consist of many stages which do not all resemble one another; some insects and diseases remain in the soil from season to season; why and how to scout for insect pests. Some concepts we still need to work on include: the use of action thresholds; how to choose the right product for chemical control; biology of fungal diseases. The farm coordinator commented that "The factsheets were really helpful for busy farmers with significant language barriers… Just the fact that [the farmers] for the first time understood the concept of how their vegetables were damaged, an idea of the cycle -- egg and larva and adults all the same type of bug. That made a huge difference." She also noted that some growers sprayed



Picture-based factsheets facilitated identification of life cycle, crop damage, and chemical control available for three major pests: Colorado potato beetle, potato leafhopper, and Mexican bean beetle.

for the first time this year while others switched from synthetic materials purchased from garden stores to reduced risk organic products that were were provided by the coordinator.

ME-KO in is a family owned and operated farm Westfield and Feeding Hills that grows about 45 acres of mixed vegetables, 40 acres of blueberries, and 15 acres of apples. They also operate a farm stand with a greenhouse and bakery. They are particularly well known for their blueberries. 2013 was their second year as Mentor Growers in the project. The following goals were identified at our early season meeting:

- To continue to help them improve IPM of apples, with particular emphasis on apple scab, bitter rot, and summer diseases.
- To conduct trapping of SWD in blueberries and BMSB in apples and to advise on blueberry IPM.
- To increase the use of the weather station data and the forecasting models on the NEWA website (the farm is the site of a UMass weather station).

Impacts: Incidence of apple scab disease and bitter rot in apples was reduced in 2013 compared to 2011 and 2012, when they were major problems. Frequent scouting yielded better identification of symptoms, timing of sprays, and choice of materials. In selection of pesticides, reduced-risk products were used when possible and resistance management was key. To help manage scab, we worked with the farmer to use the NEWA website to identify infection periods and to time protectant sprays. Inoculum density counts were made to predict overwintering scab on the leaves on the orchard floor. Leaf chopping and urea spraying were performed to break down scab on the leaves. Delays of sprays were not possible in spring 2013, but as a result of the work done in 2013, they will be possible in spring 2014 because inoculum will be lower. Disease models were also used for summer diseases. There was a modest reduction in sprays for all three diseases. There was a major increase in fruit quality due to improved management for all three diseases. Pheromone traps baited with commercially available and USDA research pheromone were used to monitor BMSB in peaches. The trap was monitored and maintained weekly and, though a few BMSB adults were caught in 2012, none were caught in 2013. We trapped for SWD in blueberries throughout the season, checking the traps weekly. The farmer had to start spraying for SWD on July 19. He was dismayed at the frequency of sprays needed to ensure a marketable crop. However, the rigorous spray program he employed did succeed in keeping his fruit clean and marketable. An innovation suggested by the UMass team, the use of overhead micro-sprinkler delivery of spray material, was installed at the Feeding Hills farm and used successfully for pesticide application as well as water. The 'mistigation' system applied adequate spray material throughout the planting. SWD were not a problem in his strawberries. In 2014, the farmer plans to improve his management of fire blight in apples and to maintain the gains he has won with scab, bitter rot, and summer diseases.

ME-FD is a group of farms in Dracut and Tewksbury, about 90 acres in all, owned and managed by one farmer. He grows fruit and vegetable crops and also has about 18,000 ft^2 of heated greenhouse space with flowers, greens, tomatoes and vegetable transplants. The farm markets through 2 farm stands, several farmers' markets, 3 seasons of CSAs, and some wholesalers. 2013 was his 3rd year and final as a Mentor Grower in this project. At the start of the season we developed the following IPM goals for 2013:

- To continue all aspects of apple IPM practiced in 2012 in ca. 5 acres of apples and to add intensive trap out for apple maggot fly and sanitation/urea strategies for apple scab disease.
- To continue trapping for SWD in small fruit crops and to advise grower on best management practices.

- To monitor for diseases in strawberries and raspberries and advise grower on best management practices.
- To continue advising grower on use of his weather data and the pest forecasting models available on the NEWA website, using the weather station that the project installed on the farm in 2011.

Impacts: We visited the farm biweekly throughout the growing season to work with the farmer and two interns. In May and June, the focus was on apple scab disease. One spray was saved by using the NEWA scab model to identify infection periods and to indicate protectant sprays, and by careful monitoring. No secondary scab sprays were needed. Scouting and models were used for fire blight and plum curculio management. In July, August, and Sept. the summer disease model was used to predict appearance of disease symptoms and to time sprays. During these months, we also oversaw and assisted in trap-out for apple maggot fly using red sticky spheres and fruit volatile vials in the 3-acre dwarf apple block. Spheres (provided by UMass) were checked weekly, fly numbers were tracked for the whole season, and traps were re-stickied every 2 weeks. Eighty-five traps were installed around the periphery of the block and in the center. Numbers of flies peaked on 8/7 (ave. of 4 per trap), but were low enough that the grower did not have to spray at all for this pest (a savings of 2-3 full block sprays). In the fall, apple scab incidence was monitored on leaves and plans for late-fall sanitation by leaf-chopping and urea spraying were developed with the farmer. Excellent scab control in 2013 will translate to savings of 1-2 full block sprays for scab in spring 2014. Season-long trapping (early July-end of harvest) for SWD in strawberries, blueberries, and raspberries helped the grower to pinpoint arrival of the pest in each crop and to initiate sprays. Diseases in small fruit, especially grey mold in strawberries and raspberries, were also scouted. For small fruit we were not able to save the grower any sprays, but were able to help improve fruit quality with choice of spray material and better timing. For all crops, we recommended reduced risk pesticides when possible and the farmer was quick to adopt their use when he could. At the wrap-up meeting, the farmer also said that he found the text alerts for SWD, the small fruit newsletter, Healthy Fruit, the late blight alerts and the vegetable IPM newsletter very useful. For next year, he would like to improve his late season rotation of sprays for late blight and to do a better job with resistance management across the board.

IPM in Specialty Crops: Applied Research & Demonstration

Cranberry IPM: Cranberry fruitworm research

Goal: Establish a three-year coordinated demonstration and education program (2011, 2012, 2013) and education program to phase in optimal use patterns of reduced-risk and organophosphate-replacement compounds and phase out broad-spectrum insecticides. Five paired bog systems with comparable traits, selected from the 32 farms where we have surveyed pollinators for the past 2 years, will be set up as demonstration sites with conventional vs. a reduced risk program of insecticide applications.

We were successfully able to clear hurdles including European MRL (Maximum Residue Limits) barriers, handler restriction, and long chemigation rinse times to have near-complete industry adoption of newer bee-friendly insecticides for Cranberry fruitworm use in MA cranberry. To place the 2013 data in the proper perspective, we are reporting data from 2011-12 in this report.

2011: Field trials run in 2011 showed excellent management of the number one cranberry pest, cranberry fruitworm with new chemistries available. We ran a replicated (4 reps/treatment) field trial of new reduced-risk compounds (Altacor, Cyazypyr, and Delegate). Altacor (chlorantraniliprole) and cyazypyr (cyantraniliprole) are new diamide compounds with a completely different mode of action compared to all previously registered compounds. These compounds release ryanodine that causes paralysis in insects by sustained contraction of muscles. Plots were 6' x 3' with 6" buffers along the NW edge of Section 1 (Howes) on State Bog at UMass Cranberry Station. We applied compounds at 9 days after 50% out-of-bloom and again 10 days later using a backpack sprayer and mimicked the labeled rate of 150 gpa application. We collected 15 berries from each plot after each spray and assessed them under the microscope for cranberry fruitworm eggs. These data were inconclusive. These compounds do not kill the eggs outright as previous organophosphates did. We did a harvest assessment by collecting all berries in eight-15 cm rounds from each plot (5 collected on 9/9/11 and 3 on 9/14). These were counted, sorted, and assessed for cranberry fruitworm injury on 9/23/11. A visual assessment of each plot was also made on 9/14. All treatments significantly reduced infestation when compared to the control. The data presented are the average of 32 samples per treatment (8 samples x 4 replicates).

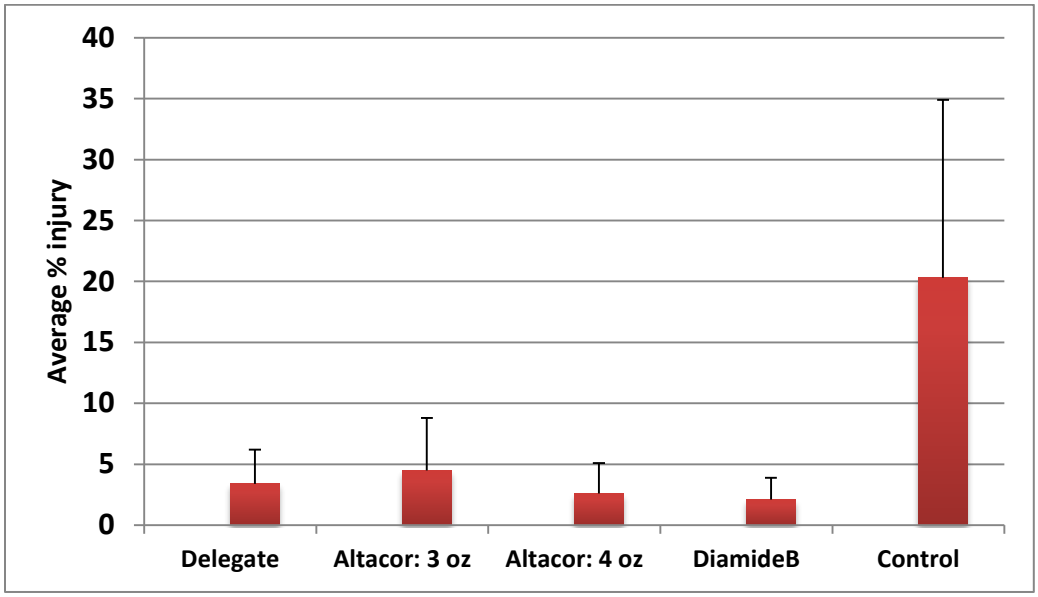


Figure 3. Mean (±SD) percent cranberry fruitworm injury; results show excellent substitutes for old compounds, 2011

The full chemigation label for Altacor was cleared through EPA in 2011 and was able to be used on cranberry bogs in 2012. We worked with growers to understand the limitations of chemigating the new compound as a rate of 4.5 oz would be diluted in bigger systems. In a 2011 survey conducted by the Cranberry Station, 73% of respondents said they had 50% or more of their chemigation systems under a 6-minute rinse time. Short rinse times were considered necessary for Altacor's efficacy.

2012: Altacor was successfully registered for use in cranberry through chemigation in 2012. Ocean Spray, the biggest handler of MA cranberry, restricted Altacor applications for the 2012 season by allowing applications only before July 15th. Applications made in late June and early July proved to be extremely useful as the compound is bee-friendly and that is perfect timing for first fruitworm applications. Additional insects, including fireworm and spanworm were added to the label.

We assessed cranberry fruitworm management under our new UMass recommendations. With the new bee-friendly compound, with no reported toxicity to bees, we moved fruitworm spray timing into bloom, when fruitworm egglaying pressure starts building up. We worked at twelve sites where growers agreed to manage early season infestation of CFW with Altacor and to follow a modified timing recommendation: spray early fruiting cultivars at 50% out---of---bloom.

Four sites were discarded from discussion: 2EB sites had no eggs, a site with cv 'Ben Lear' was sprayed twice by a nervous grower; a mixed cultivar site already had 31% of cv 'Stevens' berries infested with eggs at 50% out---of---bloom. Egg infestation levels at all sites were assessed by carrying out random samples of berries (200/acre) and inspecting for eggs under a dissecting microscope. Percent infestation ranged from 0-31% of berries containing eggs across the sites, there was an average infestation of 9.5%.

We did bloom counts at all sites every few days and asked growers to spray Altacor when 50% out of bloom was reached, followed with a Delegate spray 10 days later. Only one grower did not comply; at Site 6 the first spray was 9 days late. Also, at Sites 3 and 8, Altacor was sprayed 10 days later instead of Delegate. Of interest, we note that percent out---of---bloom calculations were particularly difficult in the 2012 season, with tremendous variation across beds.

Nonetheless, results were excellent. This was determined by counting infested berries/square foot in early August to evaluate yield lost to CFW infestation. At eight Stevens sites percent infestation at harvest was below 3% at all sites except 6, where the spray was over a week late. No larval infestation was detected at two sites (sites 7 and 8) where egg infestation was ca 10% of berries.

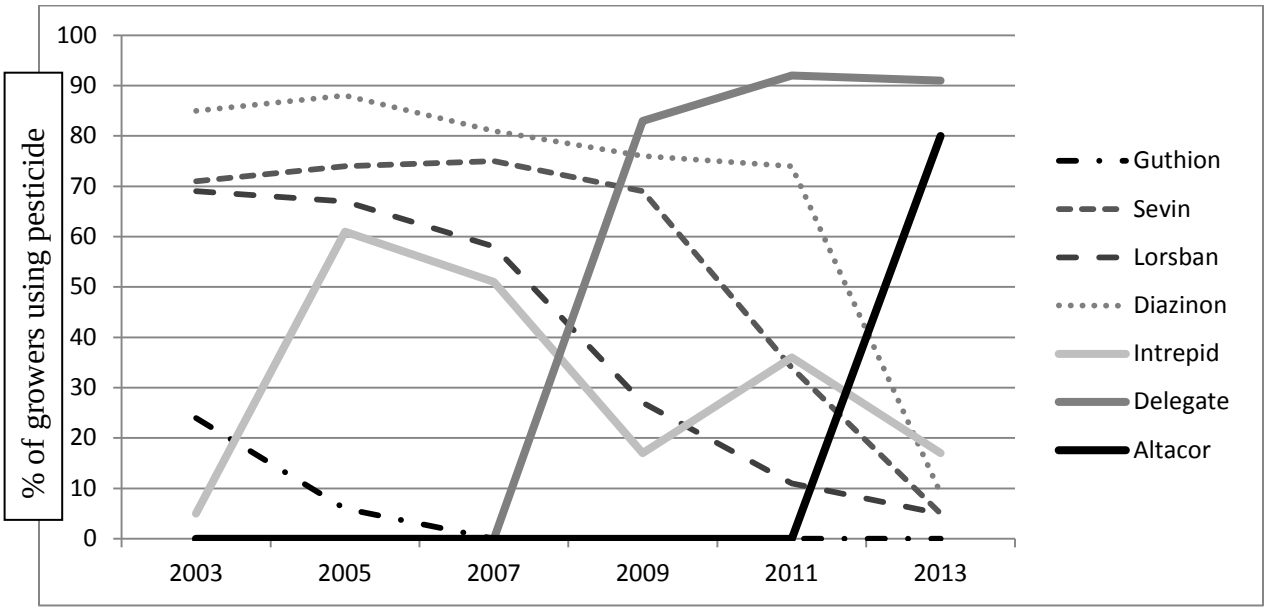


Figure 4. Cranberry Insecticide Applications over 10 years. Graph shows the decline of the organophosphates (dashed lines) and the adoption of the reduced-risk alternatives (solid lines) in cranberry!

2013: Amazing near-complete industry adoption of newer reduced risk insecticides targeting cranberry fruitworm was realized. Residue issues were resolved by Dupont and cranberry handlers allowing no restriction on usage of Altacor. An early spray during fruitworm egglaying using Altacor saves growers

later sprays, when they chase the direct fruit feeder already inside the berry. While we still have 3-4 insecticides going on the cranberry bogs each year, the majority of growers have adopted the new reduced-risk compounds (organophosphate replacements) and largely phased out the broad-spectrum insecticides. Five neo-nicotinoids have been registered in cranberry, but are only used as necessary on a small number of acres. Luckily we do not rely on neo-nicotinoids for most pests.

Every year, we report our results at the annual Cranberry Pesticide Safety Workshop (mid-April) to 100 growers and at the Cranberry Station Annual Research meeting (mid-January) to 250 growers. New compounds are incorporated into pesticide recommendations.

Invasive pest IPM: Spotted wing Drosophila (SWD) and brown marmorated stink bug monitoring (BMSB) network and alert system

Background - A monitoring, alert, and mitigation plan was created to assist Massachusetts' fruit and vegetable growers cope with two new invasive pests, Spotted Wing Drosophila (SWD, *Drosophila suzukii*) and Brown Marmorated Stink Bug (BMSB, *Halyomorpha halys).* SWD arrived in Massachusetts in late August 2011. Overwintered populations have had a serious impact on late summer fruit crops such as blueberries, raspberries, peaches and grapes. Some producers have had 100% crop loss, and many have had to apply insecticides at weekly intervals to have any viable produce to harvest. BMSB has been detected in small isolated events to date in MA, but has had an enormous impact on many fruit and vegetable crops in the Mid-Atlantic states since 2009. In the last 2 years it has had an increasing negative impact on growers in eastern NY and during September 2012 the trap captures in MA increased. There is no reason to doubt the impacts of both pests will increase in New England in the immediate future.

Goals - The overall goal of this project was to provide a resource for Massachusetts' fruit and vegetable growers of all sizes,types and locations to know when and where these new invasive pests are being found and what their management options might be. This is being done through the use of a multi-channel rapid-response reporting network as well as through more traditional face-to-face grower trainings. Two new web pages have been created to provide up-to-date information on the ID/Biology, Monitoring, and Management of both pests. The goals of the project have been met but there is more work needed.

2013 Impacts - The project established a network of 19 SWD and 26 BMSB monitoring sites across the state. Each county is represented with at least one site (see Figure 5). These sites were scouted weekly by a network of professionals from UMass Extension and partnering institutions (e.g., Arnold Arboretum), with assistance from private crop consultants and growers who provide additional data.

Data from the statewide reporting network is gathered into a centralized web page which also provides the capacity to disseminate updates and alerts to multiple channels automatically (email, test, web page posting, facebook, etc.).

Webpages located at:

https://extension.umass.edu/fruitadvisor/brown-marmorated-stink-bug
https://extension.umass.edu/fruitadvisor/spotted-wing-drosophila

Sample Alerts:

http://extension.umass.edu/fruitadvisor/bmsb-update-week-july-7
https://extension.umass.edu/fruitadvisor/news/swd-update-week-june-9-15-2013
https://www.facebook.com/umassipmteam

Outreach - In addition UMass Extension staff conducted 8 trainings about SWD and/or BMSB for growers in 2103 reaching approximately 285 growers. See Table 1, page 6, a list of events that included these trainings. Trainings included trap design and setup, pest identification, and management strategies using cultural and chemical controls for both organic and conventional growers. Numerous one-on-one trainings also occurred with growers; email and phone inquiries were answered; and articles have appeared in Fruit and Vegetable Team Newsletters.

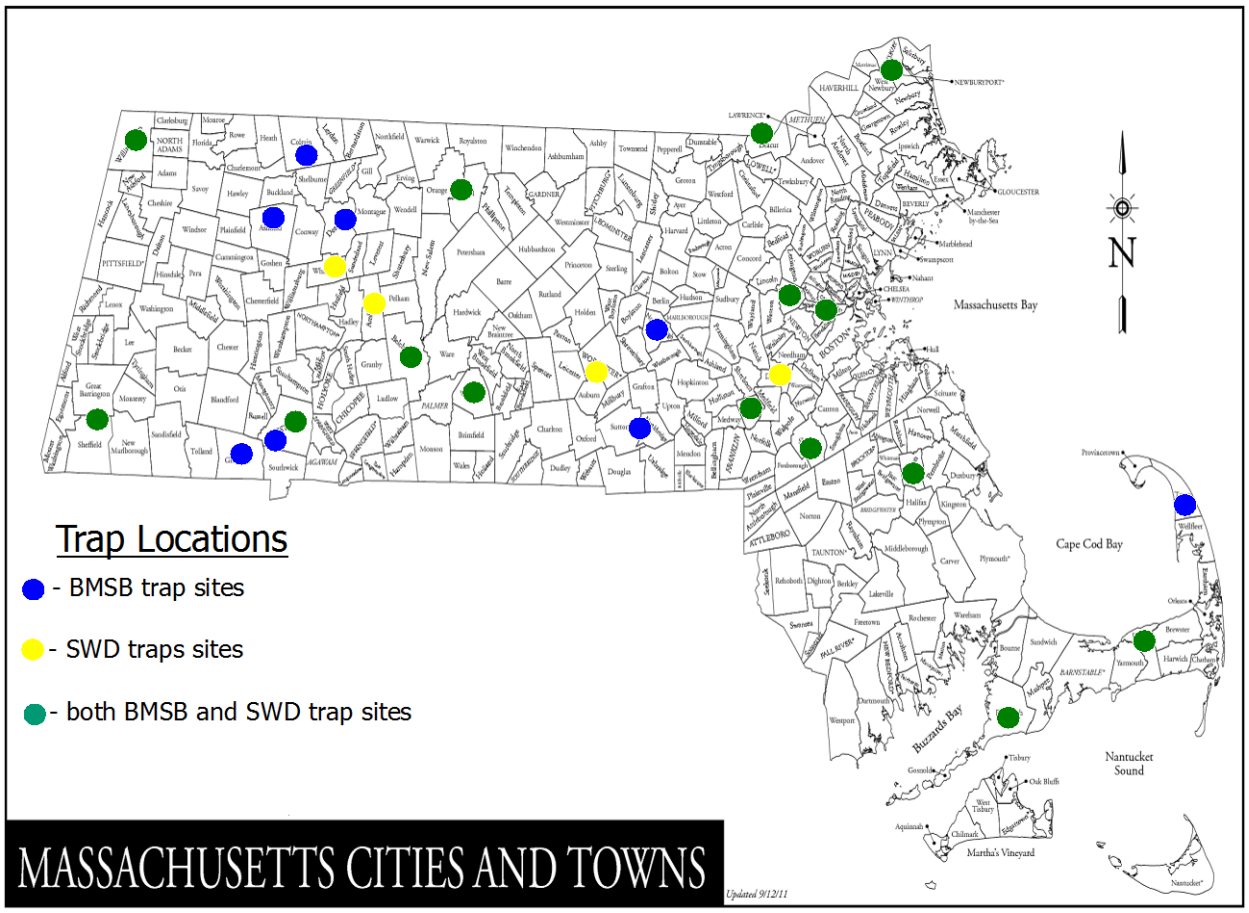


Figure 5. Locations of BMSB and SWD traps for the invasive pest scouting network, 2013

Advanced IPM for apples: Towards sustainable apple scab management using potential ascospore dose assessments, cultural controls, risk forecasts, and delayed fungicide applications

Our objective has been to work a wide range of apple growers to improve apple scab disease management in 3 specific areas: to improve methods of measuring scab inoculum in the field, to reduce scab inoculum by increasing and improving sanitation methods (urea sprays and leaf-chopping), and to make better use of decision support tools to track infection risks. These objectives have been carried out by a combination of university and commercial orchard research and demonstration trials, grower collaborations, educational events and publications. Improved scab management leads to the following conditions: a cleaner, more disease-free crop, and a cleaner less pesticide-laden environment.

In addition to the work described above on IPM for several pests in apples with Mentor Farm growers (ME-KO, ME-FD, ME-FS and ME-TF), there was considerable work by project scientists in the UMass D.R. Cooley Lab on apple scab disease (*Venturia inaequalis*) with Partner Farm growers in MA (PA- CBO, PA-HC, PA-BO, PA- AHO, PA-FF, PA-UMass Cold Spring Orchard) as well as 5 growers in neighboring states.

Trial 1. Cultural controls for apple scab disease combining inoculum incidence counts (PAD), leaf-chopping, and urea applications were developed and field tested for their effect on scab inoculum reduction. In 2013, 13 orchards cooperated with UMass on this study. PAD assessments were done with the growers in Fall 2012. Cultural controls (including urea spraying) were performed between leaf fall 2012 and silver tip 2013. Blocks of apple trees that had low PAD scores were not sprayed for scab until the pink bud stage in 2013. Each treatment block had a corresponding control block that was sprayed from green tip onwards. Control blocks did not receive urea applications. If they got leaf-chopping at all it was minimal compared to the leaf-chopping in the treatment blocks. Scab incidence was assessed in foliage in June and in fruit in Sept. and was found to be comparable to grower control blocks that received a standard fungicide program. In all cases, injury was kept below the economic injury level. There was no rainfall between the green tip and pink bud stages and therefore, no infection periods occurred. Because of this, the differences between test blocks and control blocks were fewer than expected. However, 4 of the growers who delayed their 1st sprays until the pink bud stage and started spraying their control blocks earlier, averaged 9 days of delay between the test blocks and the control blocks. They were able to save one spray compared with the control blocks.

Trial 2. A second trial was performed with blocks that "failed" the PAD counts in Fall 2012. These had too much overwintering inoculum to risk a delayed fungicide program in Spring 2013. For these blocks, the treatment consisted of urea spraying and maximum leaf-chopping. The corresponding control blocks had no urea and got minimal leaf-chopping. At 2 of the sites, there was less scab in the test blocks compared to the control blocks. At 4 sites the amounts were not different. Disease was assessed in June on leaves and at harvest on fruit.

Outreach and regional collaboration. Decision-support for tracking infection risk and making pesticide recommendations was provided by project scientists and weather-based support tools (NEWA and Orchard Radar). Project concepts, methods, and results were presented and discussed at grower workshops and meetings. Additional orchards entered the project in Fall 2013. PADs were performed in orchards for both trials in Fall 2013 and experiments were planned for 2014. Another annual cycle of urea spraying and leaf-chopping was begun. In both trials, growers benefited from major increases in knowledge about the disease and it's management. They also changed their behaviors by doing the PAD assessments, using the forecasting models, and changing the fungicides they were using and the

frequencies and timings of sprays. We think we are beginning to see a change in conditions also. These advanced IPM methods for scab management are also being conducted in ME and NH (under our supervision). We also have a few cooperators in VT and CT and in the recent past have had cooperators in NY.

Pepper IPM: Release of Trichogramma ostriniae for biocontrol of European corn borer.

We continued ongoing work with growers to release *Trichogramma ostriniae* (T.ost) for control of *Ostrinia nubilalis*, European corn borer (ECB) in pepper. Previous research in MA and other northeastern states (Kuhar et al 2004; Seaman et al, Final Report SARE R&E project LNE07-263) has shown that these wasps are capable of high levels of ECB egg parasitism, thereby reducing the need for applications of broad-spectrum insecticides and conserving beneficial generalist predators. In pepper, ECB larvae bore into fruit at the calyx, damaging the fruit and opening it up to secondary infections by soft rot bacteria. Fruit that is harvested ripe has a longer window when ECB can infest the fruit. In the summer of 2013, UMass worked with two EIPM mentor farmers who grow both sweet corn and peppers to trial release of T.ost in their pepper fields— ME-WA (Farm A, 1.5 acres of peppers in two fields) and ME-TA (Farm B, 0.5 acres of pepper). UMass worked with these growers over the previous two years to establish the practice of releasing T.ost in early sweet corn, and this was the second year of trialing the biocontrol in peppers. While neither grower typically uses an insecticide on their pepper crop for ECB or other insect pests, they were interested in potentially reducing both the number of ripe peppers culled due to ECB damage, as well as the total population of ECB on their farms. Because of small pepper acreage contiguous with sweet corn (about 20 times the acreage of pepper on each farm) and T. ost's ability to disperse, non-release comparison plots were not possible on these farms.

On each farm, wasps were released in the peppers weekly for four weeks, from July 11 to August 1 (Table 2), a period during which Farm A saw its highest ECB total weekly trap capture of 30 moths, and Farm B saw the peak of the second flight of ECB at 14 moths/week. The target rates were 90,000 wasps/A on the first date, and 120,000 wasps/A for each subsequent release, based on previous experience and the recommendations of the supplier, IPM Laboratories. Cards were distributed through the blocks of peppers. Pheromone traps were used to monitor flight of European corn borer throughout the season (Table 3) and to time the initial releases of T. ost such that they would parasitize the eggs laid during second-generation moth flight.

Table 2. *Trichogramma ostriniae* Release Dates and Rates

release date	7/11/2013		7/18/2013		7/25/2013		8/1/2013	
	Farm A	**Farm B**	**Farm A**	**Farm B**	**Farm A**	**Farm B**	**Farm A**	**Farm B**
# wasps	150,000	60,000	180,000	60,000	180,000	60,000	180,000	60,000
wasps/acre	100,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
# cards	20	8	24	8	24	8	24	8

Table 3. On-farm Pheromone Trap Counts for ECB

	6/19/13		6/26/13		7/3/13		7/10/13		7/17/13		7/24/13		8/1/13		8/8/13		8/14/13		8/21/13		8/28/13	
Farm	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
ECB	1	5	1	16	2	0	4	3	0	**14**	0	10	**30**	1	6	1	6	0	nd	0	nd	0

nd = no data; bold type = peak flight (2nd generation)

On September 4, 130 to 160 colored, ripe peppers were harvested from each of 2 varieties of bell peppers per farm. Ripe fruit was being harvested regularly at that time, and farmers were instructed not to harvest from these sample plots for a few days prior, to ensure adequate ripe fruit. Harvested fruits were classified as damaged or undamaged (marketable), and the type of damage (eg. ECB, physiological, or disease) was recorded. From Farm A, we found that 57.5% of one variety (orange) and 93.8% of the second (red) fruit had some kind of damage but 0% was determined to be caused by ECB infestation. Damage was primarily physiological (sunscald or spotting) with some Anthracnose present, possibly as a secondary infection after sunscald. From Farm B, we found that 3.8% of yellow peppers and 4.7% of orange were damaged by ECB larvae, while 45.2% and 60.7% of yellow and orange peppers, respectively, were damaged by other causes. Again, physiological damage such as cracking,sunscald or wilting (overripe fruit) were dominant causes of damage, possibly made worse by leaving fruit on the plant longer as per our request; Anthracnose caused <5% damaged fruit.

Because these on-farm trials did not include non-release controls, and ECB flights were not at high levels, it is not possible to conclude that release of T.ost contributed to the low levels of ECB infestation detected. However, in post-season interviews, both growers felt that these results along with both the relatively low cost and ease of use of this biocontrol organism made it worthwhile to continue the practice of releasing T.ost on their farms in future seasons, especially given the high value of both peppers and sweet corn in their markets.

Cucurbit IPM: *Phytophthora capsici* management in butternut squash using a *Trichoderma* biocontrol

This trial was conducted on a four acre field in Hadley, MA with a silt loam soil and a history of Phytophthora blight of cucurbits. Approximately two acres were prepared using vertical 'deep zone tillage' (DZT) and two acres were prepared using conventional tillage practices (plow-disk-harrow). The efficacy of a biological control product, Biotam (a.i. *Trichoderma asperellum* and *Trichoderma gamsii*), was evaluated at two different spray intervals—7 and 14 days. A randomized complete block design with 4 replications of each treatment was established in the DZT portion of the field and in the disk-harrowed section of the field. Product applications were made at the labeled rate of 5lbs/A by banded ground sprays at 40 psi using a CO_2-pressurized boom sprayer equipped with two XR TeeJet 804 nozzles in the equivalent of 2.0 gallons of water per treatment plot (180ft²). The first Biotam treatment was applied on 21 Jun 2013, when seedlings had reached the 5-leaf stage. The field was maintained by the farmer/collaborator who applied fertility and other pest controls as needed. Fungicides containing the following active ingredients (a.i.): *imazalil, dichloran, mancozeb, propiconizole, tebuconizole, thiram,* or *triflumizole*, were avoided, as they are prohibited on the Biotam label. Fungicide applications to manage other cucurbit pathogens (powdery mildew and cucurbit downy mildew) were made on a seven to ten day interval starting 31 Jul. This spray program involved two applications of Bravo (a.i. *clhorothalonil*) at 1.4 lbs a.i./A tankmixed with Revus (a.i. *mandipropamid*) at 0.13 lbs a.i./A, followed by an application of

Bravo at 1.4 lbs a.i./A tankmixed with Presidio (a.i. *fluopicolide*) at 0.09 lbs a.i./A. The final Biotam application was made on 2 Aug after fruit set and the canopy had completely closed.

All plots were checked for presence of disease weekly and rating took place at onset of disease. Disease was first observed on 20 Aug. Disease severity was evaluated by calculating the percentage of fruit with symptoms of Phytophthora blight wthin each plot. The number and weight of marketable fruit and rotten fruit was assessed for each plot and this information was used to calculate average fruit weight. Marketable fruit were those that had completely matured and were free of Phytophthora blight symptoms. Before all data was collected, the infected field was harrowed in an effort to reduce spread of the pathogen to other marketable fruit. Results indicate no difference in percent infected fruit, marketable fruit or total fruit weight between treated and untreated plots. Statistical analysis could not be conducted due to missing data. An entire replication was lost from the DZT portion of the field, and the first row (one treatment from each replication) was lost from the disk-harrowed portion of the field. Therefore, the efficacy of Biotam could not be assessed in this trial. Product applications may not have adequately targeted the soil surface once the plants began to fill the rows, thereby limiting product efficacy. More mature, larger fruit seemed to hold up better in the presence of disease than unripe, smaller fruit. Selecting earlier maturing varieties for fields in which Phytophthora blight is a concern may help growers get a harvest out before conditions become favorable for disease spread.

		Phytophthora Blight	Yield/Plot		Average weight/fruit	
Tillage Regime	**Treatment and rate/A (application interval)[z]**	**Infected Fruit (%)**	**Marketable Fruit (no)**	**Total Fruit weight (lb)**	**Marketable weight (lb)**	**Rotten weight (lb)**
Deep Zone Tillage	Untreated check	79.17	4.00	21.27	5.10	4.32
	Biotam 5lbs/A (7-day interval)	46.30	5.33	26.22	4.92	3.69
	Biotam 5lbs/A (14-day interval)	67.33	7.00	30.98	4.25	3.96
Disk, Harrow	Untreated check	50.94	8.00	45.94	5.89	3.63
	Biotam 5lbs/A (7-day interval)	72.76	5.00	28.55	5.48	4.17
	Biotam 5lbs/A (14-day interval)	36.63	16.00	72.75	5.14	5.21

Table 4. Phytophthora capsici and yield in winter squash plots, Hadley 2013

Brassica IPM: Evaluation of biological fungicides to control common diseases of Brassicas, 2013.

The proposed study on organic management of cabbage root maggot (*Delia radicum*) in brassicas was not carried out this year, due to issues of timing and personnel changes. However, a trial on chemical management of diseases in fall brassica plantings was completed in its stead. Three diseases—Alternaria leaf spot (ALS), black rot (BR), and downy mildew (DM)—occur commonly in the Northeast and we have observed increasingly severe impact on quality and yield of brassicas in recent years, especially in fall crops. Synthetic pesticides are available to conventional growers to control these diseases, but options for control are limited in organic cropping systems and efficacy of most available products is not well-documented. Therefore, a spray trial was conducted in order to evaluate the efficacy of biological fungicides and one synthetic plant defense activator in controlling the three diseases under natural disease pressure. These treatments were compared to an untreated control and to Quadris, a conventional standard for control of the most commonly occurring disease in fall brassicas, Alternaria leaf spot.

The experiment was conducted at the University of Massachusetts Research and Education Farm in South Deerfield, MA in a field with Hadley silt loam soil. 'Champion' collards (Johnny's Selected Seeds, ME) were planted into randomized complete blocks, with each treatment replicated four times. Spray treatments were applied on approximately a 10-day spray interval beginning on 14 Aug and a total of five applications were made using a CO_2 pressurized backpack sprayer. Due to the proximity of commercial farms, the trial was not inoculated. Disease severity was assessed by visually estimating the percentage of leaf area affected by each disease on ten plants at the center of each replicate plot and complete ratings were carried out three times, on 06 Sep, 19 Sep and 25 Oct.

Both ALS and BR were observed on 06 Sep but were slow to progress and the maximum disease severity observed for any plant was only 25%. Symptoms of BDM were never observed in any plot. All data were analyzed using a linear mixed model with treatment as the fixed effect and replicate as a random effect followed by pairwise comparison of means using Tukey's HSD ($\alpha = 0.05$). No significant differences were observed at the first two time-points but significant differences were observed at the final disease rating on 25 Oct. No treatment significantly reduced ALS severity relative to the untreated control. As for BR control, Double Nickel 55 and Badge X2 DF significantly reduced BR severity compared to the untreated control. No symptoms of phytotoxicity were observed for any treatment.

Table 5. Treatments and Disease Severity Ratings, Fall Brassica Trial 2013

Treatment and Rate (/A)[x]	ALS Severity (%)[y]	BR Severity (%)[z]
Untreated Control……..	1.4 ab	3.1 b
Quadris, 15 fl oz……..	0.1 a	1.8 ab
Actigard 50WG, 1 oz……..	2.0 ab	1.5 ab
Serenade Optimum, 20 oz……..	1.0 ab	2.3 ab
Sonata ASO, 4 qt……	1.0 ab	1.6 ab
Double Nickel 55, 6 qt……	0.5 a	0.6 a
Actinovate AG, 12 oz……..	2.3 ab	1.5 ab
Badge X2 DF, 0.75 lb……..	2.5 ab	0.6 a
Basic Copper 53, 3 lb……..	4.8 b	1.6 ab
Taegro, 5.2 oz……	1.0 ab	1.4 ab
P-value	0.0233	0.0472

[x]Treatments were mixed with NuFilm at 1 pt/100 gallons and applied to foliage on 20 Aug, 30 Aug, 11 Sep, 23 Sep, 03 Oct.

[y]Precentage of foliage affected by Alternaria leaf spot at the final disease rating on 25 Oct. Numbers in each column followed by the same letter are not significantly different from each other (Tukey's HSD, P=0.05).
[z]Precentage of foliage affected by black rot at the final disease rating on 25 Oct. Numbers in each column followed by the same letter are not significantly different from each other (Tukey's HSD, P=0.05).

Brassica IPM: Using trap cropping to manage flea beetle in brassica crops

Trap cropping relies on an insect's preference for feeding on certain crops within their host range. In perimeter trap cropping, preferred crop types are planted around the perimeter of a less attractive main crop ('cash crop'), and function by arresting and concentrating a colonizing insect pest in the border. Timely border sprays can reduce pest numbers and the need for sprays on the main crop in the center . Brassica flea beetles (FB; *Phyllotreta striolata* and *P. cruciferae*) are pests for which perimeter trap cropping has shown promise in previous studies. In Brassicas, flea beetle preference is for *Brassica rapa* (napa cabbage and bok choy), *B. juncea* (mustard) and *Eruca sativa* (arugula) crop types over *B. oleracea* (waxy types like cabbage, kale, and broccoli). The present study was initiated by an organic farmer who grows on a larger scale, and gave us the opportunity to evaluate the feasibility of trap cropping as an IPM tool for flea beetle management.

PA-FB farm, is a USDA certified organic farm growing on 150 acres in Whately, Sunderland, Hadley and North Amherst, MA. The farm produces vegetable crops and herbs for wholesale to supermarket chains across the Northeast and grows over 20 acres of brassica cooking greens including kale (Lacinato and Ripbor types), collards, Chinese cabbage, and bok choy. These are transplanted in 1-2 acre, contiguous blocks of each crop type, with side-by-side succession plantings for continuous harvest. Despite regular crop rotation, flea beetle (primarily *P. cruciferae*) populations are high from early spring through August, and are a major barrier to producing leafy greens that meet stringent wholesale quality standards. In recent years the farmer has used spinosad (Entrust) and Pyganic 5.0 EC (pyrethrin), alone or in combination, at nearly weekly intervals to achieve the control needed for wholesale markets.

In 2013, the farmer partnered with the UMass Extension Vegetable Team to plan and implement a trap cropping study in a 14 acre field of greens. He seeded a mix of mustard and arugula in a five-row bed around the perimeter of the field several days prior to transplanting the first succession (4 acres, planted May 25) of kale and collards. This planting was directly across a farm road from a field where brassicas were gown in the previous growing season. The second succession of kale and collards (4 acres) was planted on June 2, followed by bok choy and Chinese cabbage moving progressively farther from the 2012 field. No perimeter trap crops were seeded around these later blocks. UMass Extension personnel scouted the field approximately weekly from May 29 to July 13 after which point the grower scouted on his own. We scouted the border and the most attractive main crops, Lacinato kale and bok choy, by making observations on pairs of plants at 10 or 20 randomly selected locations within the crop, depending on size of planting. The number of beetles per plant pair was recorded as well as damage to total leaf area which was rated on the following scale: <10%, 10-25%, 25-50%, and >50%. Because of high plant density in the border, samples were on a per area basis (2 sq in) instead of per plant. Sprays were recommended at 1 FB /plant or when average damage was above 10% in > 50% of the samples.

Flea beetle injury on arugula

In the first two weeks, flea beetle (FB) pressure was higher in the border nearest the 2012 crop compared to the main crop. After bok choy was planted, numbers increased in that crop and declined in the border. FB numbers remained low in the kale, collards and Lacinato kale. When FB numbers were higher in the border or bok choy compared to kale and collards, sprays were recommended for bok choy and/or border only. The grower agreed with and followed most of the recommendations. The main crop received one application of garlic as a repellent on 30 May and one application of spinosad and pyrethrin on 13 June. The border was sprayed 3 times, all in the first 4 weeks. Bok choy and Chinese cabbage plantings were sprayed 10 times for FB control – essentially on

a weekly basis through July while the main crop (kale and collards) was sprayed only once. Starting in August, *Bacillus thuringiensis* (Dipel DF) was used to control caterpillars in all plantings, except where spinosad sprays were needed for FB and also controlled caterpillars.

It appears that the mustard/arugula border functioned to concentrate colonizing beetles, especially those coming from the 2012 brassica field, after which bok choy served as an effective in-field trap crop. Eight of the 14 acres needed no controls for flea beetle after 13 Jun, saving 8 sprays and reducing the total sprayed area by 64 acres or 46% compared to season-long, full-field sprays. This is a considerable savings of both time and money for the grower, and represents a significant reduction in pesticide use. The grower regarded the method as a success and plans to use it again. He also reported that the weekly scouting reports from UMass increased his confidence in his own scouting, because he consistently reached the same conclusions about where and when sprays were needed. This demonstration trial showed: the feasibility of implementing trap cropping for flea beetle on a larger scale; that the combination of border and interior trap crops can work together; and that a crop which is highly attractive to flea beetle can be managed to succeed as both a trap and a cash crop.

Bean IPM: Integrated biological and chemical control for Mexican bean beetle and potato leafhopper

ME-WF farm (see Mentor Farms) grows snap beans as "u-pick" crops for CSA shareholders, so they are never rotated away from the 6-acre home farm location. Because shareholders may be in the field picking at any time, sprays are avoided after beans are ready for harvest. As a result, populations of Mexican bean beetle have increased steadily over the years. ME-WF had used the larval parasitoid wasp *Pediobius foveolatus* to control Mexican bean beetle (*Epilachna varivestis*) since 2004 but they had difficulty assessing the success of parasitoid establishment and Mexican bean beetle (MBB) control. Potato leafhopper (PLH), typically arrives in June and will cause rapid decline of the crop if left uncontrolled. Because it overlaps with MBB and can only be controlled with insecticides, this pest complicates the biocontrol program. ME-WF wanted to try an integrated approach and partnered with UMass to provide support for MBB scouting, timing release of *P. foveolatus* and sprays for PLH, and assessing *P. faveolatus* establishment and the efficacy of their integrated approach.


The second succession of beans suffered the most damage due to MBB feeding.

Four succession plantings of green beans were direct-seeded on May 10, June 1, June 21 and in early July, within 200 feet of each other in the home field. Beans were scouted weekly for MBB egg masses, larvae, adults and mummified larvae and for PLH and damage was rated on the following scale: 0 = 0%, 1 = <20%, 3 = 25-50%, and 3 = >50% leaf area affected. PLH arrived in mid June, coinciding with arrival of MBB adults and eggs. Three releases of *P. foveolatus* mummies or adults were made, based on presence of egg masses and early-instar larvae, on June 18th, June 29th and July 24th. A pyrethrin (Pyganic 5.0 EC) spray was applied on June 17, before releasing the biocontrol. By mid-July, PLH pressure had dwindled but presence of MBB larvae skyrocketed, reaching 5.6 individuals per plant, and damage in the second succession was high (25-50%), while very few mummies were observed. *P. foveolatus* experts recommend two early season releases, but in this case a third was done because it seemed establishment was low. In addition to the third release, Pyganic was sprayed July 5 and July 29 to aid in suppressing MBB. This peak in mid-late July is consistent with what this grower had seen in previous years, but after that peak, the MBB pressure declined, and higher numbers of mummies were observed.

While we are unable to determine the independent effects and interactions of sprays and biocontrols, the grower felt that the work was a success, and they were pleased with the yield and quality of their crop. They noticed a marked improvement in the performance of their 4th succession, which in past years has been completely consumed by MBB and no crop harvested. We found that there are still challenges to getting good establishment of *P. foveolatus* in beans. In the future, ME-WF plans to continue to use Pyganic sprays to knock down PLH in the early season, but will work to optimize timing of *P. foveolatus* release so as to avoid using Pyganic later in the season.

Secondary Emphasis Area: IPM Coordination within Conservation Partnerships—Vegetable and Fruit IPM

The goal of this project is to support enrollment, planning and implementation of IPM Practice 595 on vegetable and fruit farms as part of their EQIP contracts with MA Natural Resource Conservation Service (NRCS).

Work with state and district staff: We contacted and interacted with the district staff who worked directly with individual growers, as well as state level NRCS program staff. The district staff who had a particular interest in IPM 595 were our most frequent contacts.

Publicizing NRCS EQIP programs. We published articles about NRCS programs in vegetable and fruit newsletters.

NRCS staff participation in the EIPM Advisory meetings: Three state and district NRCS staff members attended and spoke at the March Advisory meeting.

Collaborative educational programing: Specific outputs included field walks in Waltham, Bristol and Deerfield, MA attended by NRCS staff where they learned IPM practices pertinent to farmers receiving EQUIP 595 IPM contracts. Two soils work shops were co-hosted with NRCS in April in South Deerfield and Dighton MA where farmers, NRCS staff, and UMass staff (total attendance of 80) all learned soil conservation methods and simple assessments for testing soil health.

Assist growers with EQIP 595 IPM contracts: We helped two growers develop their IPM plan for EQIP 595 contracts, to be submitted for review by NRCS staff. Two growers were asked to respond to resource concerns identified in WN-PST, associated with 'intermediate risk' from pesticides that they had been using. With the growers, we developed a plan to replace higher risk with lower risk products that would be effective against the target pests. At another farm, a new EQIP 'high level IPM' 595 contract was awarded to a mentor farm, as a result of combined farmer and UMass staff monitoring and IPM management. NRCS continued to use UMass-generated checklists which describe detailed IPM methods for specific fruit and vegetable crops to assist growers in their IPM plans.

Secondary Emphasis Area: IPM Training and Implementation in Housing—Bedbug IPM

The primary goal of this project is to improve the health and quality of life of people in living in urban areas of Massachusetts. The project also seeks to reduce the significant economic burden on urban

dwellers and the community organizations which serve them, as well as on travel/hotel industry and, increasingly, the public at large, from bed bug infestations.

The initial activity of the project focused in the formation of a bed bug taskforce for the cities of Springfield and Holyoke. The group meets to discuss problems with bed bugs and to foster and schedule training sessions in the area and to review and comment on training material and session content. Updates in new trends and resources in bed bug management are provided at regularly scheduled talk force meetings. Included in the group are professionals associated with the housing authorities, social justice advocates, departments of health, landlords and the pest control industry. In Year 2, we added Westfield Housing Authority to the group. In Year 3, we hoped to expand the task force concept to Berkshire and Worcester Counties. Every housing authority in Berkshire County was contacted: every housing authority in the county denied the existence of bed bugs in their housing units. In Worcester county, only one housing authority expressed interest – a meeting was held where enthusiasm was expressed, but repeated attempts at communication were not acknowledged.

Nine training programs were held in Year 3

Training programs were tailored for the needs and of specific interest groups. Foreign language translators were used where appropriate. These training sessions have been shown to be effective in increasing knowledge. Last year training sessions for personal care providers were evaluated by conducting pre- and post-tests. In pre-tests, participants scored a mean of 45%, with a range from 0 to 100%. In post tests, participants scored 85%, with a range from 60% to 100%. The following training sessions were held *(# of attendees in parentheses):*

- Bed bugs: biology and management. Amherst landlords, Amherst. 10/25/12 (19)
- Bed bugs: biology and management. Hampden County landlords. Springfield. 5/3/12 (16 attendees: 600 units.)
- Introduction to bed bugs. Franklin County Home Care. Greenfield. 6/29/12(15)
- Bed bug for tenants. Westfield Housing Authority. 1/8/13 *(English, Spanish, Russian) (46)*
- Bed bug for housing staff. Westfield Housing Authority. 1/8/13 (9)
- Bed bugs for seniors. Holyoke Council on Aging. Holyoke. 5/23/13. (20)

Secondary Emphasis Area: IPM in Public Health—Tick Disease Assessment and Public Education

Pathogen-infected ticks are an increasing public health concern in the Northeast. The primary goal of this project is to improve the health and quality of life of people living in Massachusetts and the tick-infested regions of the Northeast. We seek to teach people about appropriate tick mitigation and risk reduction in the landscape and on their persons, reducing risks from both Lyme disease (and other tick-borne diseases) and inappropriate pesticide practices. They will use information from the tick diagnostic clinic to make appropriate decisions about their health and will avoid unnecessary antibiotic use.

The UMass Extension Tick-Borne Disease Diagnostics Clinic identified tick samples received from the general public and assessed them for the presence of *Borrelia burgdorfer*i, the pathogen responsible for Lyme disease and, optionally, for the pathogens nine other diseases. In 2013, from January 30 to June 30, 913 ticks were submitted for analysis, a 43% increase in tick submissions over the same period the previous year. Ticks were submitted from 37 states (see figure) including MA (448 ticks), NY (93), NH

(50); 30.1% of ticks were found infected with *Borrelia.* This is higher than findings in previous years (see Figure 6). Of 163 ticks tested in 2013 for *Anaplasma*, 3.1% tested positive and of 181 ticks tested for *Babesia*, 1.1% were positive. Tularema occurred in two Rocky Mountain wood ticks from Idaho.

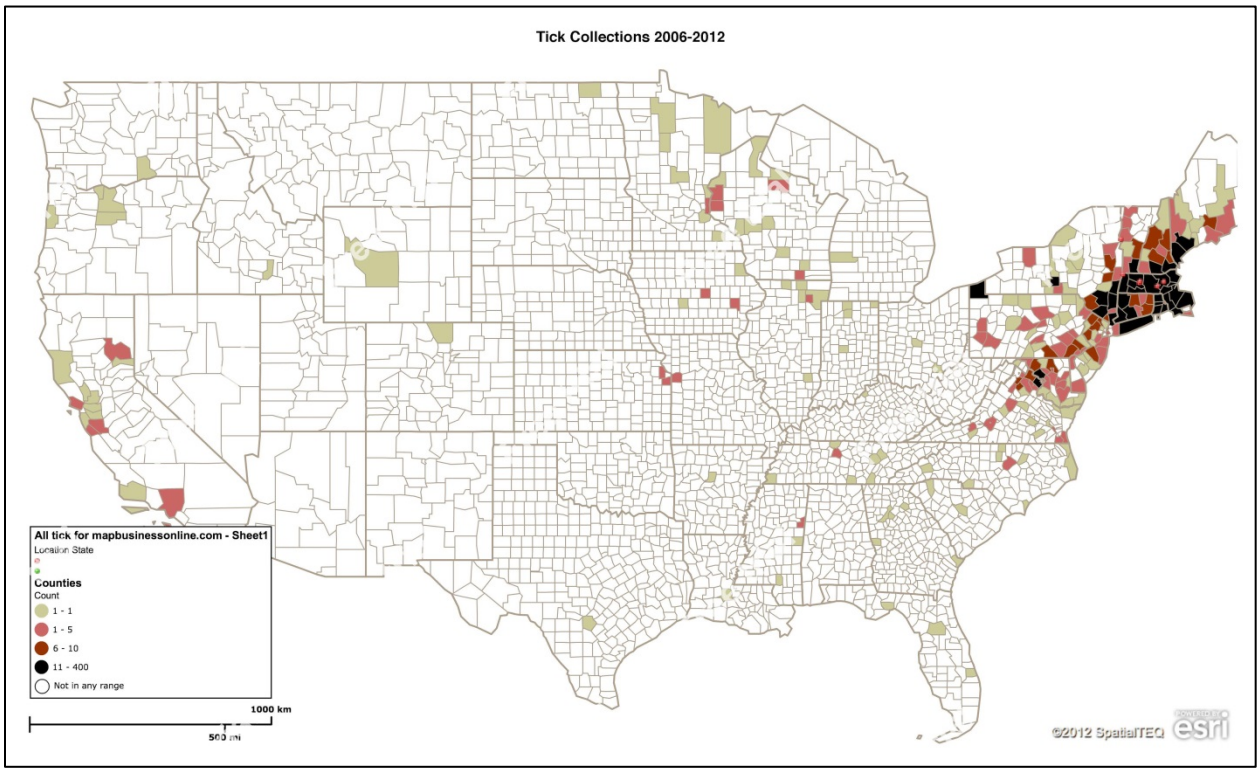


Figure 6. Sources (by state) of submissions to the Tick-Borne Disease Diagnostic Clinic, 2006 to 2012. *from* http://www.tickdiseases.org/

The website, www.umass.edu/tick, includes information on current tick activity, tick and disease recognition, personal protection and information on submission of ticks for disease assessment. Links are provided to information on tick management.

Figure 7. Summary of analysis of ticks for *Borrelia burgdorferi* in previous years

	negative	positive	other	total	% positive
2013	1002	457	347	1806	31.3%
2011	457	173	63	693	27.5%
2010	285	84	39	408	20.6%
2009	326	129	39	494	26.1%
2008	258	94	40	352	26.7%
2007	137	69	14	206	33.5%
2006	80	22	5	102	21.6%

Most significantly, a transition of the responsibility for tick analysis occurred in 2013. The UMass Laboratory of Medical Zoology has now taken the lead role in identification, analysis and result notification. A new website, www.tickdiseases.org, has been developed by the laboratory to service clientele. UMass Extension remains active in personal contact with clients and with education.

Evalution: Survey of tick diagnostic clinic clientele

To determine the impact of our tick analysis service on clientele practices and their level of satisfaction with the service, we conducted a brief email (>99% of clients received email reports) survey in winter 2013. We contacted 238 clients: 109 (45.8%) responded.

1. How did you find out about our tick analysis service?

    46% of clients learned of the service from an internet search
    37% learned of the service from a friend, doctor or veterinarian
    6% linked from the URI Tick Encounter website
    2% linked from another site
    9% responded "other

2. How did you use the information that we gave you? (more than one answer)

    39% This information helped us to decide whether or not to see a doctor.
    50% We used this information, with the doctor, to make a medical decision.
    51% This information gave us peace of mind.
    0% We did not use this information.
    4% Other

3. How useful was this information to you?

    81% Very important
    17% Important
    1% Fairly important
    0% Not important

4. Would you recommend our service to a friend? (Please check one)

    100% Yes
    0% No

Summary: Over 83% of our clients find us via the internet or recommendations from friends. 98% find the information important to very important (81%). All people answering the survey would recommend the service to friends. At least half the people use this information in making a medical decision.

Training programs held in Year 3

Training sessions included tick identification, biology, personal protection and management in the landscape. Programs were provided to pest management professionals and to the general public. The following training sessions were held (# of attendees in parentheses)

- Ticks and tick-borne diseases. Residex Pest Managment. Norwood. 3/1/12. (25)
- Ticks and tick-borne diseases for vegetation control workers. Orange. 3/27/12. (52)
- Ticks and tick-borne diseases. Quinsigamond Community College. Marlborough. 6/29/12. (36)
- Ticks and tick-borne diseases. New England Pest Management Assoc. Springfield. 11/1/12. (20)
- Ticks and tick-borne diseases. New England Pest Management Assoc. Marlborough. 3/8/13. (140)
- Ticks & tick-borne diseases in New England. Massachusetts Agriculture Club. Marborough. 4/11/13. (50)
- Ticks & tick-borne diseases in New England. Goshen Land Trust. Goshen. 5/23/13. (25)