

#### 4. Project Description

There are three subprojects within this proposal, all associated with the Vegetable IPM Working Group. Each is described below under its subtitle.

##### I. IPM Working Groups (IWGs): Vegetable IPM Working Group Meetings and Educator Exchange

###### 4a. Problem, Background and Justification

The vegetable industry in the Northeast consists of at least 12,000 farms that cultivate and harvest over 370,000 acres of vegetables (2002 Census of Agriculture). These figures do not include potatoes, strawberries, or greenhouse vegetable crops, which are important components on many vegetable farms. Farms range in size from 1 acre to >2000 acres, and vegetables are marketed in many ways -- for processing, through wholesale distributors or direct to supermarkets and institutions, as well as retail through farm stands, farmers markets, restaurants, and Community Supported Agriculture. Relative to field crops, vegetables have high value per acre, with gross value ranging from about \$1500 per acre for wholesale processing vegetables to >\$30,000 per acre for intensively grown fresh market retail crops. Thus, as land values increase and farmers seek higher value crops with direct market potential in order to sustain their farms, farmers often turn from other commodities to vegetable production. Quality demands are high, and effective pest management is essential to meet market demand. Integrated pest management, when implemented through an on-farm monitoring program, has proven that it saves money, reduces health and environmental risks, and provides effective control of pests.

The Northeast Vegetable IPM Working Group (Vegetable IWG) was established in 2002 under the umbrella of the Northeast Pest Management Center. The group represents diverse types of vegetable farmers, as well as consultants, marketing specialists, processors, University, state agency, and other agricultural professionals from the Northeast Region 2008 (Attachment A, membership list). Our mission and goals are as follows:

**Mission Statement.** The mission of the Northeast Vegetable IPM Working Group is to foster the development and use of IPM as a means to achieve ecological and economic sustainability of vegetable farms in the Northeast. Our goals are:

1. Identify and prioritize regional vegetable and strawberry IPM needs, in particular gaps in research, extension and regulation.
2. Represent the views of vegetable and strawberry farmers and other stakeholders to the Northeast IPM Center.
3. Develop, facilitate or implement appropriate research and educational projects that address work group priorities.
4. Strengthen partnerships and exchange of information among vegetable farmers, agricultural professionals, and other stakeholders throughout the Northeast region.

**Update on activities.** The following activities and projects have been undertaken by the Vegetable Working Group. Some have been completed, while others are in progress.

**1. Annual meeting.** The group held its sixth annual two-day meeting on November 27-28, 2007, in Manchester, NH. Twelve of our fifteen members were present, along with a representative from the Northeastern IPM Center. We celebrated the completion of the *Northeast Vegetable and Strawberry Pest Identification Guide*, reviewed ongoing projects, and made plans for next steps.

**2. Membership.** Our success depends upon being an engaged, energetic group with membership that rotates on a regular basis (see Attachment A). Our annual meeting with two days of face-to-face interaction is the heart of our group's existence. For several members who had served from 4-6 years (Luke McConnell, crop consultant, MD; Jim Ward, Ward's Berry Farm, MA; Kathy Murray, Maine Dept. of Ag.; Ken Gauen, Pictsweet Foods, DE), this was their final meeting. New members have agreed to serve, including a representative of the processing industry (Ken Martin, Furmano Foods, PA), an independent crop consultant (Tom Coleman, DE), an Extension IPM Specialist (Abby Seaman, Cornell Cooperative Extension, NY). Our next meeting will be held in February, 2009. We will be seeking two new farmers, a representative of NRCS, and a representative of a state department of Agriculture for 2009. We also have plans for a new plant pathologist and weed specialists to rotate into the group. The new members provide fresh ideas from around the region, while the ongoing members provide continuity and the functionality of an established team. The group works well together, hearing each other's diverse views and reaching consensus to move forward. Ruth Hazzard (MA) will continue as chair and Joanne Whalen (DE) as co-chair through the 2009 meeting. Tim Elkner (PA) is providing leadership for the Educator Exchange program. Kathy Murray (ME) will continue to provide leadership for the NRCS/IPM collaboration effort, although she is stepping down as a member. Administrative support is being provided by Andy Cavanagh and Amanda Brown from UMass.

**3. *Northeast Vegetable and Strawberry Pest Identification Guide*** (Attachment B). Thanks to funding from the Northeast IPM Center Partnership grants program and EPA Region I Strategic Agriculture Initiative, we completed the *Northeast Vegetable and Strawberry Pest Identification Guide* in late November 2007. These will be distributed free of charge, as a supplement, with all of the 2008 vegetable/strawberry management guides that are purchased by or given to vegetable growers in the Northeast. There are basically three recommendation guides in the region: New England, Cornell, and Mid-Atlantic (published with a state-specific cover), with total circulation of 5,430. A collaborative effort with eight co-editors from six states, the photo guide has color photos of all the weeds, insects and diseases of vegetables and strawberries that are mentioned in any of the vegetable recommendation guides. We anticipate that these photos will help growers make more accurate identifications more rapidly, leading to more timely response, selection of more appropriate pesticides, and more effective control with fewer pesticides.

**4. Regional Sweet Corn Pest Management Strategic Plan:** This was funded in 2004, drew upon a regional stakeholder meeting in December 2004, a New England sweet corn survey conducted in 2004, and other sources, and was written from 2005 through 2006. The Sweet Corn PMSP is now posted on the national IPM Center website

([http://www.ipmcenters.org/pmsp/pmsp\\_form.cfm?usdaregion=National%20Site](http://www.ipmcenters.org/pmsp/pmsp_form.cfm?usdaregion=National%20Site)) and is available as a reference for researchers, agencies and stakeholders.

**5. Priority Needs for Vegetable IPM in the Region.** Our recommendations on priority needs for IPM on vegetable farms in the Northeast are updated annually and posted on the Northeast IPM website (Attachment C). Part I identifies general needs or barriers in infrastructure, tools, or information that should be addressed. Part II lists the priority insects, diseases, weeds and general production problems that need more research or extension work to be effectively and safely managed through an IPM approach.

**6. Vegetable Educator Exchange Program within the Northeast Region.** One of our major goals is to “strengthen partnerships and exchange of information among vegetable farmers, agricultural professionals, and other stakeholders throughout the Northeast region.” Historically, vegetable extension programs in the Northeast have functioned primarily on a state or sub-regional basis. There is strong collaboration within the mid-Atlantic region and in New England, as reflected by collaborative organization of major vegetable conferences and vegetable management guides. However, communication outside of these regions is far less active. It is common for agricultural professionals at the county or state level to be unaware of research or extension work that is taking place outside their nearby area. This situation leads to less collaboration, less information for growers, and less adoption of newly developed practices, to the detriment of the advancement of IPM and of sustainable vegetable production in general. Continuing budget cuts to Extension programs exacerbate this geographic and informational isolation.

In response to this situation, with support from the NEIPM Center, we have established the Northeast Vegetable/Strawberry IPM Educator Exchange Program. Our goal is to raise the level of interaction among vegetable agricultural professionals in different parts of the Northeast region by funding travel that would not otherwise be possible. We expect that educators will gain knowledge at the conferences they attend, meet a new set of colleagues and growers, and return with fresh ideas, contacts, and information that will be passed on through educational programs and projects for farmers in their home area. The program is open to growers, vegetable and/or strawberry specialists, Cooperative Extension educators or county agents, crop consultants, government agency staff, agricultural professionals in nonprofit organizations, or anyone who will be in contact with many vegetable or strawberry growers. Successful applicants have

- a demonstrated ability to present the information they gain to an audience of farmers in their home area;
- interest in, and involvement with, IPM-related subjects in vegetable or strawberry crops;
- a plan for follow up outreach activities: what will be learned at the proposed meeting should help the applicant address specific integrated pest management issues of importance to strawberries or a vegetable crop in their state or region.

The NE IPM Center allocated \$15,000 in support of a Vegetable and Strawberry IPM Educator Exchange program, to be used in 2007 and 2008. The Request for Proposals has been circulated through the NEIPM Center website and newsletters and within each state’s Extension system. The maximum award is \$800 per person. To date, the Vegetable IWG has reviewed and approved travel to eight different conferences by 15 applicants from five states, with average grants of \$700 for a total of just over \$10,000. Recipients include county and state Extension agents and

specialists, an independent crop consultant, an agricultural journalist, and an organic agriculture technical specialist. The balance must be used by September 1, 2008. We have established a subcommittee to review applications on a rolling basis, and applications continue to arrive. Participants are required to submit an article or report on what they learned or on their outreach activities. The Northeast IPM Center website will post these articles and reports and we will make them available to use in Extension newsletters.

**6. Sustainability.** The Vegetable IWG would not exist and would not have accomplished anything without the consistent financial support that we have received from the Northeastern IPM Center. We recognize that there are many demands upon the Center's resources and that we need to find alternative sources of funding to sustain our work over the long term. We believe that there are other agencies and grant programs that will value and support the work that we do, and we plan to seek funding for meetings and projects that will take place after the term of this grant proposal, which will end in May 2009. Of course, other funding sources will likely require a shift in direction and focus. The funding requested in this proposal will provide an essential bridge to a new phase of our work and our sources of funding.

#### **4b. Objectives and Anticipated Impacts.**

##### **Objective 1. Maintain and strengthen the capacity of the Vegetable IPM Working Group to accomplish its mission and goals.**

This proposal will provide capacity to do our work, including travel funds to meet in February 2009. It will support administrative staff to coordinate our communications, membership and projects through May 2009. It will enable us to seek alternative sources of funding for our work.

**Anticipated impacts:** Growers, regulators, researchers and educators will learn about the Northeast Vegetable IPM Working Group and will use one or more of the tools and resources created through our projects. Impacts of specific projects will be listed for each project. As a result, wider use of IPM on vegetable farms will occur.

##### **Objective 2. Continue the Vegetable/Strawberry Educator Exchange Program through 2009**

We would like to see this exchange program continue, because its impact will grow over time. Some states have been slow to respond, and applicants represent only 5 of 13 states. As the awareness of the program grows we expect that more educators from more states will take advantage of it. Through this proposal, we seek an additional \$7,200 in direct costs to support at least nine more travelers in 2009. This request is included in the IWG project, but is a supplemental allocation for the Educator Exchange, as requested in the Partnership RFP.

**Anticipated impacts:** Participants in the Educator Exchange will attend an educational program that is outside their state or their sub-region, or possibly outside the Northeast region. They will gain new knowledge about IPM programs and technologies and will meet new colleagues. When they return, they will be expected to share what they learn about vegetable or strawberry IPM. Possible methods include:

- Present or organize a program at a conference, workshop, or twilight meeting;

- Write newsletter articles that could also be posted on the Northeastern IPM Center website;
- Work directly with growers to implement or evaluate a new practice;
- Participate in the planning committee for the next vegetable or strawberry conference (or other educational program) in their home state;
- Make use of new professional contacts to invite speakers to the region.

They may also be in a position to develop collaborative projects with colleagues from another part of the Northeast or outside the region. Because of the above outreach efforts, growers will become more aware of the latest IPM research and practices. By offering travel funds to growers, crop consultants and agricultural professionals in other types of organizations besides land grant universities, we will broaden everyone's horizons, enhance respect among colleagues, and encourage interchange on a wide range of topics.

#### **4c. Approach and Procedures.**

##### **Objective 1. Maintain and strengthen the capacity of the Vegetable IPM Working Group to accomplish its mission and goals.**

**a. We will maintain regionally representative and diverse membership in the working group.** See Attachment A and 'Membership' section of the update on activities, above.

**b. We will meet annually to evaluate ongoing projects, review priorities and initiate new projects.** An annual face-to-face meeting strengthens the relationships in the group and makes it possible for us to monitor our current projects, review priority pest management needs, and develop our next work plan. Our challenge is to meet after the end of the harvest and direct marketing season, which often goes until Thanksgiving, but before planting starts in Delaware and Maryland, around March 1. We also avoid the major vegetable conference dates in mid-winter. Our next meeting is planned for February 23-24, 2009 in the mid-Atlantic area, close to a major airport to keep travel costs to a minimum.

**c. We will engage stakeholders in review of priority pests and needs.** Our group represents a wide range of stakeholders, and each of us interacts with many growers over the course of the season. Each year we will update priority needs and pest concerns and post them on the Center website (Attachment C). At winter programs and meetings of vegetable grower associations, we poll growers to get their views on priority needs.

**d. Develop and disseminate information about the working group and its projects.** The best publicity is to deliver a valuable tool to those who need it. The *Pest Identification Guide* will reach 5,400 commercial vegetable growers in the region in 2008. We will also post articles in *On Target* and disseminate information through the IPM Center website.

##### **Objective 2. Continue the Vegetable Educator Exchange Program within the Northeast Region through 2009.**

We will post and circulate the RFP through the IPM Center and state Extension channels. Word of mouth will also spread awareness of the program as more Educators use it for travel in 2008.

Applications will be reviewed on a rolling basis with a maximum 4-week review period for notification of awards. The review committee consists of Tim Elkner (chair), Hank Bissel, Carrie Koplinka-Loehr, and Andy Cavanagh. Administrative staff at UMass will be responsible for disseminating applications to the review committee, as well as communicating with applicants.

#### **4d. Evaluation Plans.**

**Objective 1:** Good turnout at meetings, active participation of members in our projects, and progress toward completing our projects are measures of success as a working group. The impact of our completed projects will be monitored in a time frame and a method appropriate to each project. For example, we will survey grower groups after the 2008 season to evaluate the impact of the *Pest Identification Guide*.

**Objective 2.** Participants will be asked to report on what they learned, how they shared the information, what new contacts were made, and other outcomes such as enrichment of educational programs in the home area.

## **II. Regional IPM Publications: Web-based Vegetable IPM Resource Database: Publicity and Upkeep**

### **4a. Problem, Background and Justification**

A wealth of information on vegetable and strawberry IPM has been published in the Northeast, but most of this was developed at the state level or within one part of the region (New England or Mid-Atlantic, for instance). Often these resources are not known and used in other parts of the region, despite the fact that they likely to be highly relevant and useful to growers in other states. One of the first objectives of the Vegetable IPM Working Group was to centralize and provide access to vegetable IPM information by making it available through the Northeastern IPM Center website. The Vegetable IPM Resource Database was created in 2004 as a joint project of the Vegetable IWG and the Northeastern IPM Center. The goal has been to house data on all of the available information resources about Vegetable IPM in the Northeast in one database that can be searched by type of information, by crop, by state, or by pest. Searches yield links to University websites where electronic publications are available, or to websites that tell where and how to order hard copy publications. Types of information on the website include Guides, Alert/Advisories, IPM Element/Protocol/Guidelines, Field Guides, Fact Sheets, Resource Indexes, IPM Curricula, and Videos. This database is designed to incorporate information on any commodity or type of IPM system, from specific crops to school and community IPM.

The vegetable component of the database has >900 entries from the Northeastern states, ([http://www.nepmc.org/vege\\_all.cfm](http://www.nepmc.org/vege_all.cfm)). As more and more farmers use the Internet to seek out information, this selected, high quality database will help them to find information that is research-based, derived from a public source, and appropriate for our bioregion and farming systems. It will also lead them to time-sensitive information such as pest alerts, disease forecasts, and newsletters. The web is, however, a constantly mutating entity with frequent web address changes and additions. A database that is not maintained can become detrimental to enhancing the use of IPM by frustrating information seekers or housing out-of date information.

agricultural best management practices as part of a sustainable approach to farm production.

#### **4c. Approach and Procedures**

This meeting will be held in Feb 25-26, 2009 immediately following the next meeting of the Vegetable IWG. In addition to members of the working group, we will invite field, state, and national level NRCS staff to participate. We will also invite others who have a vital stake or have made important contributions in this collaborative effort at the regional or national level. Like the Harrisburg meeting it will be 1 ½ days long.

#### **4d. Evaluation Plans.**

We will contact participants prior to and after the meeting and ask them several questions regarding their activities in this area and their assessment of the effectiveness of NRCS program support in helping growers to use IPM. We will identify future needs and discuss how to meet them. The impact of the overall NRCS/IPM collaboration can be measured in several ways, including the number of vegetable farms in each state with EQIP contracts that include the Pest Management Practice Standard, and which resource concerns are mitigated through IPM.

#### **5. Cooperation and Institutional Units Involved.**

This project will be directed by Ruth Hazzard at the University of Massachusetts Amherst. Only one institutional unit is formally involved: the University of Massachusetts Extension, Agriculture and Landscape Program.

#### **6. Key Personnel.**

Ruth Hazzard, University of Massachusetts Amherst, will serve as Project Director and coordinate all aspects of the project. She has been the Chair or Co-Chair of the Vegetable IPM Working Group since its inception in 2002 and the group has requested that she continue in a leadership role. She will facilitate meetings of the Vegetable IWG and the NRCS/IPM meeting in 2009, network on behalf of the Vegetable IWG, organize one or more NRCS/IPM farm tours, and supervise staff dedicated to each of the projects. Ruth has been working to develop and implement IPM programs in vegetable crops since 1986. See Attachment F, Curriculum Vitae.

Andy Cavanagh and Amanda Brown, University of Massachusetts Amherst, will serve as project administrators. Both have five years of experience with sweet corn, Brassica and cucurbit IPM field research and extension and have served as project administrators for the Vegetable IWG since September 2007. Currently the Educator Exchange and Resource Database are being managed by Andy Cavanagh, while meeting arrangements and the NRCS/IPM project are being management by Amanda Brown.

Joanne Whalen, Vegetable Entomologist, University of Delaware, is serving as co-chair of the working group. She is the IPM coordinator for Delaware and has been active in planning and developing IPM programs in the mid-Atlantic region for many years, and is recognized regionally as a leader in IPM. She is taking responsibility for membership and other tasks.

Kathy Murray, Maine Department of Agriculture, Food, and Rural Resources, will continue to work on coordinating the NRCS partnership, funded through the 2006 Vegetable Working Group Partnership grant. Kathy has 16 years experience in IPM research, demonstration and teaching. She coordinates IPM programs for the State of Maine Department of Agriculture.

### **7. Collaborative Arrangements.**

Collaboration and shared leadership among members of the Vegetable IWG will be extensive, but does not involve financial arrangements except that the project will cover individual travel costs to working group meetings and stipends to individuals who work on updating the vegetable IPM resource database.

**Northeast Integrated Pest Management Center**  
**Vegetable Work Group - Membership 2008**  
 updated November 07

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<p><b>Tim Elkner</b>            Penn State Cooperative            Extension            1383 Arcadia Rd., Room 1            Lancaster, PA 17601-3184            (717) 394-6851            (717) 394-3962 (fax)            tee2@psu.edu            Joined: 12/05</p> <p><b>Stay thru 2009</b></p>	<p><b>David Handley</b>            University of Maine            Highmoor Farm            PO Box 179            Monmouth, ME 04259            (207) 933-2100            dhandley@umext.maine.edu            Joined 10/05</p> <p><b>Stay thru 2009</b></p>	<p><b>Joanne Whalen, co-chair</b>            Entomologist            Dept. Entomology &amp; Applied            Ecology            248B Townsend Hall            Newark, DE 19716            (302) 831-1303            (302) 530-8948            jwhalen@udel.edu            Joined 12/04</p> <p><b>stay thru 2009</b></p>	<p><b>Ruth Hazzard, chair</b>            IPM Spec., Entomologist            Dept of Plant Soil and            Insect Science            Agricultural Eng.Bldg.            University of Massachusetts            Amherst, MA 01003            (413) 545-3696            rhazzard@umext.umass.edu            Initiating member 2002</p> <p><b>Stay thru 2009</b></p>
<p><b>Ken Martin</b>            Food Processor            Furmano Foods            P.O. Box 500            Northumberland, PA 17857-            0500            (570) 412-0691            (570) 473-3516 (cell)            Joining 1/ 2008</p> <p><b>Stay thru 2010</b></p>	<p><b>Susan Futrell</b>            Red Tomato            1033 Tumpike St.            Canton, MA 02021            (319) 337-7770 (home)            (319) 321-1554 (cell)            sfutrell@mchsi.com            Joined 3/06</p> <p><b>Replaced by Betty 2008,            stay thru 2009 ?</b></p>	<p><b>Abby Seaman</b>            WNY Vegetable IPM Educator            NYS IPM Program            P.O. Box 462            Geneva, NY 14456            PH: (315) 787-2422            ajs32@cornell.edu  <b>Start 2008</b></p> <p><b>Stay thru 2010</b></p>	<p><b>Brad Majek</b>            Weed Specialist            Rutgers University            88 Lipman Drive C/O Per            New Brunswick, NJ 08901            (856) 455-3100 ext. 4122            (609) 202-2028            majek@aesop.rutgers.edu            (856) 455-3133 (Fax)            Joined 12/04</p> <p><b>stay thru 2009</b></p>
<p><b>Tom Coleman</b>            Crop Consultant            Trap Woods, Inc            25018 East Trap Pond Road            Georgetown, DE 19947            Phone: 302-856-3858            tcolemancca@yahoo.com</p> <p><b>Stay thru 2010</b></p>			

included in this list in the past. All pests listed here are considered a priority for vegetable crops within the Northeast region. Some may have broader geographic range, involve more serious crop losses, or be cause for higher pesticide use at the present time, but all are serious and in need of further research and extension activities in some or all of the Northeastern states. In particular, there is need for effective IPM methods that utilize cultural, biological, and reduced risk methods.

### Category and Pest

#### DISEASES

- Phytophthora of all the cucurbits, beans, and solanaceous crops and strawberries
- Striped cucumber beetle/ bacterial wilt especially in organic systems.
- Powdery mildew, downy mildew and other disease management on cucurbits
- Plectosporium in pumpkin and summer squash
- Fungal pathogens on solanaceous crops
- Bacterial pathogens on tomatoes and peppers
- Potato pathogens
- Sweet corn leaf diseases
- Insect vectored viruses in vegetable crops
- White mold (Sclerotinia) in vegetable crops
- Diseases in high tunnel vegetable systems
- Soil borne diseases of vegetables and strawberries
- Plant parasitic nematodes in vegetable crops

#### INSECTS

- Lepidopteran complex in sweet corn
- European corn borer in, beans and peppers
- Integration of the transgenic vegetable crops with overall pest management
- Sap beetle on corn
- Potato leafhopper in beans, strawberries and potatoes, especially in organic systems
- Wireworm on potatoes
- Tarnished plant bug in vegetables and strawberries
- Stink bug on vegetables
- Flea beetle in brassicas
- Aphid control on leafy vegetables
- Lepidopteran complex in peppers and leafy greens
- Squash bug
- Striped cucumber beetle/ bacterial wilt especially in organic systems
- Grub complex in strawberry
- Root maggots in vegetables

#### WEEDS

- Increase post-emergence options, both chemical and cultural
- Weed control and resistance management in no-till systems
- Solanaceous weeds in solanaceous crops
- Canadian thistle and other perennial weeds
- Galinsoga
- Non Chemical weed control (cultural, biological, and mechanical)

#### VERTEBRATES

- Deer
- Bird problems

**GENERAL**

- Pollination in vine crops
- Better understanding of crop rotations
- Role of transgenic crops in IPM

## IPM PRACTICES FOR VEGETABLE PRODUCTION

PRINCIPLE	PRACTICES	Examples/References*
<b>PREVENTION</b>  "Preventing Pest Populations"	Use certified pest-free seeds if available and pest-free transplants	Purchase certified seed and ensure plants are free of insects, diseases and weeds before transplanting
	Prevent weeds from going to seed	Cultivation, pulling, mowing, flaming <sup>7</sup> , or other means.
	To prevent disease, use drip irrigation or avoid overhead irrigation between 6 p.m. and midnight.	
	Employ methods to avoid spreading pests (pathogens, weeds and insects).	Working crop when dry, working infested fields last, hosing down equipment between fields, etc.
	Destroy and/or remove crop residues for potatoes, corn, and others (list) according to Extension recommendations for field sanitation procedures. Including fall tillage where appropriate to control weeds and break pest cycles.	See NEVMG <sup>1</sup> for guidance. Example: plow-under corn refuse in fall to control European corn borer.
	Eliminate unmanaged plants that serve as pest reservoirs, such as abandoned crops and volunteers from previous crop.	
	Nutrient Management - Soil test annually to determine proper fertility and pH levels for crop and time application according to crop needs. Apply nutrients, fertilizers, and liming agents according to recommendations.	See NEVMG <sup>1</sup>
<b>AVOIDANCE</b>  "Avoiding Pest Populations"	Rotate crops that break the pest cycle. Do not plant crops from the same family at less than recommended intervals for the identified pest(s).	See NEVMG <sup>1</sup>
	Match crops to appropriate sites to optimize plant health and avoid known pests.	Example: Avoid planting crops susceptible to fungal diseases in low wet fields.
	Choose pest-resistant cultivars.	Example: Virus and powdery mildew resistant vine crops.
	Adjust planting dates and select cultivars with maturity dates that allow avoidance of early or late-season pests.	Example: Plant cucurbits after early season striped cucumber beetle activity, delay planting of brassica crops to avoid cabbage maggots.
	Use and manage trap crops to protect main crop from insect pests and insect-vectored diseases.	See CT factsheet on Perimeter Trap Cropping <sup>4</sup> for guidance
<b>MONITORING</b> "Identifying the extent of pest populations and/or the probability of future populations"	Monitor for pests as recommended for each crop; if no monitoring guidelines available monitor weekly to determine presence, density and locations of pests and to determine crop growth stage. Map weeds, scout crops and use other appropriate monitoring aids such as pheromone traps, disease diagnostic tests, etc. Utilize University of Maine Cooperative Extension pest monitoring data from newsletters and websites as an additional guide for on-farm pest monitoring activities.	See NEVMG <sup>1</sup> , and Weed Assessment sheet. **Record findings. Recordkeeping is required.** See NEVMG Pest Identification Supplement <sup>1</sup> , Invasive Plant Atlas <sup>12</sup> , and other pest identification guides (see Resource List). See MA NRCS 595 Recordkeeping Forms. See UMCE IPM Programs for pest monitoring services and information <sup>2</sup>
<b>MONITORING</b> "Identifying the extent of pest populations and/or the probability of future populations"	Use on-farm weather monitoring devices to measure precipitation, humidity, temperature, and leaf wetness and/or use weather prediction and/or crop pest and disease prediction service to determine need and timing for pest management actions, especially for prevention and control of plant diseases.	Example: install weather station with rain gauge, hygrometer, maximum and minimum temperature recording equipment, leaf wetness sensors; utilize commercial satellite weather prediction and recording service such as Skybit <sup>16</sup> .
<b>MONITORING</b> "Identifying the extent of pest populations and/or the probability of future populations"	Use pest-forecasting tools (e.g., computer modeling software) in conjunction with weather data to predict risk of pest infestation.	Example: Pestwatch for corn <sup>24</sup> , Blite Cast or UMCE Potato Pest Alerts <sup>3</sup> for potatoes, UMaine Coop. Ext. weather forecast at <a href="http://pmo.umext.maine.edu/apple/forecast.htm">pmo.umext.maine.edu/apple/forecast.htm</a> , or similar.

PRINCIPLE	PRACTICES	Examples/References*
<p><b>SUPPRESSION</b></p> <p>"Using cultural, biological, and chemical controls to reduce a pest population or its impacts"</p> <p>All suppression actions applied only when pest exceeds the action threshold.</p>	<b>CULTURAL AND PHYSICAL CONTROLS</b>	
	Use cover crops, especially pest-suppressing crops (allelopathic) in the rotation cycle to reduce weeds and disease incidence, and to improve soil quality.	See references 7, 14, 15 and 26 in Resource List for cover crop guidance
	Plant using appropriate within- and between-row spacing optimal for crop and site.	See NEVMG <sup>1</sup> for crop-specific recommendations.
	Use strip-till, no-till and other residue management practices to suppress weeds and maintain soil organic matter as appropriate for crop.	See NRCS practice standards 329, 345, 346 for Residue Management.
	Use mulches including plastic or reflective mulches for insect or weed control.	
	Interseed cover crop within or between rows to suppress weeds.	See resources 7, 14, 15 and 26 in Resource List for cover crop guidance
	Use mechanical pest controls.	Cultivate, mow, hoe, and hand remove insects and weeds, prune diseased or insect-infested plants, remove diseased plants.
	Use physical pest controls and deterrents. e.g., flame weeding or other heat methods for insects, disease and weed control; noise-makers, reflectors, ribbons, and predator models.	
	Use exclusion devices for insects or wildlife.	Synthetic row covers <sup>19</sup> , fencing.
	Maintain or improve soil aeration and drainage to avoid standing water and minimize plant disease.	Example: Use tile drainage, sub soiling, grassed waterways, raised beds, organic matter additions, avoid planting in low and wet spots in field
	<b>BIOLOGICAL CONTROLS</b>	
	Use insect mating disruption devices, if available	Example: pheromone laminate clip-ons or rings for tomato pinworm.
	Conserve naturally occurring biological controls.	Select pesticides and time applications to minimize impact on beneficials, use floral perimeter crop to attract and support beneficial insects. See NEVMG <sup>1</sup> , Guide to Natural Enemies <sup>29</sup> , and Environmental Impact Quotient <sup>17</sup>
	Release beneficial organisms where appropriate.	Example: release predatory mites for control of two-spotted mites and thrips <sup>20</sup> .
Use compost as a soil amendment to increase biological diversity in soil and plant health and suppress plant disease.	See NEVMG <sup>1</sup>	
<b>CHEMICAL CONTROLS</b>		
Minimize chemical use; use in conjunction with accurate pest identification and monitoring, action thresholds and alternative suppression tactics (biological, cultural, etc), and judgements based on previous year's weed map, and/or pest scouting records.	See NEVMG <sup>1</sup>	
Select pesticides, formulations and adjuvants based on least negative effects on environment, beneficials (e.g., pollinators, predators, parasites), and human health, in addition to efficacy and economics.	See environmental cautions on pesticide label and Environmental Impact Quotient <sup>17</sup>	
Use the lowest effective rate.	Based on label, scouting results and Extension-recommended action thresholds for target pest.	
Limit applications to partial fields to reduce quantity or impact of pesticide.	Example: spot treatment where pests are found; or seed, edge or field perimeter (border) treatments.	
Calibrate sprayers or other application devices prior to use.	See Pesticide Calibration Guide <sup>21</sup> . Calibrate application equipment at least once pre-season and any time there's a significant modification or repair to the equipment.	
Use pesticide-resistance management strategies as appropriate and where required on pesticide label, using practices such as alternating applications of chemicals with different modes of action to avoid development of pest resistance or leaving part of crop unsprayed to serve as a refuge for pesticide susceptible pests and natural enemies.	See Managing Pest Resistance to Pesticides <sup>18</sup> in Resource List	
Use specialized pesticide application equipment to increase efficiency and reduce chemical drift.	Example: wiper applicators, digitally controlled adjustable tool bars, direct injection sprayer, double-drop sprayer, laser guided precision sprayers, direct injection, low-drift nozzles, shielded applicators or air induction booms, built-in tank washers, etc.	
Use spray-monitoring equipment.	Example: water-sensitive cards to measure spray pattern and drift.	
<p><b>NOTE:</b> Additional pesticide use requirements from the 595 Practice Standard: &gt; Always follow all pesticide label instructions and environmental cautions. &gt; Store, handle, transport, mix, use, and dispose of pesticides and pesticide containers per Maine Board of Pesticides Control recommendations and requirements. &gt; Follow state and federal Worker Protection Standards. &gt; When drawing water for pesticide mixing from any surface waters of the State, use anti-siphoning devices and do not use hoses that have been in contact with pesticides &gt; Do not mix or load pesticides within 50 ft from the high water mark of any surface waters of the State.</p>	<p><b>*NOTE:</b> See documents listed in the attached IPM Resource List for additional guidance. Unless otherwise noted, the New England Vegetable Management Guide (first document in the Resource List) is the best and most comprehensive resource for IPM practices for New England.</p>	