

IPM Plan Guide Sheet Practices for Vegetable Production

This tool has been designed as a guide for developing the integrated pest management (IPM) component of an NRCS Pest Management Plan.

Integrated Pest Management, or IPM, is a long-standing, science-based, decision-making process that identifies and reduces risks from pests and pest-management-related strategies. It coordinates the use of pest biology, environmental information and available technology to prevent unacceptable levels of pest damage by the most economical means, while posing the least possible risk to people, property, resources and the environment. IPM provides an effective strategy for managing pests in all arenas from developed agricultural, residential, and public areas to wild lands. IPM serves as an umbrella to provide an effective, all encompassing, low-risk approach to protect resources and people from pests. (IPM Roadmap, USDA, 2004)

IPM can help protect resource concerns by reducing pesticide use and impacts.

Soil - Reducing pesticide use reduces the amount of pesticide in the soil and/or on the soil surface, and potential for impacts on soil biology, and carryover to subsequent crops.

Water - Reducing pesticide use reduces potential for leaching or runoff of pesticides into water and impacts on aquatic life, wildlife, and humans.

Air - Reducing pesticide use reduces potential for drift, air contamination, inhalation toxicity to humans and other animals and deposition on non-target surfaces.

Plants - Reducing pesticide use reduces potential for off-target movement and phytotoxicity to non-target plants.

Animals - Reducing pesticide use lessens potential for exposure and impacts on beneficial and other non-target organisms.

Humans - Reducing pesticide use reduces exposure potential and impacts on applicators, consumers, and others.

The first step in the planning process is to develop a basic pest management plan. NRCS will use the WIN-PST program to evaluate the environmental and human risks of the pesticides to be used. Soil type, methods of pesticide application, and other factors will influence this assessment. NRCS will evaluate which, if any, mitigating practices may be needed to reduce the potential risks and will develop a plan to reduce risks related to runoff, erosion, and/or leaching to groundwater which is specific to the site and resources. Alternatively or in addition, a producer may choose to substitute pesticides that pose less risk in accordance with WIN-PST. Pesticide application setbacks and buffers from sensitive areas will be identified (such as surface waters, schools, residences, neighboring crops, etc.) based upon label instructions for each pesticide and marked on field maps. (Labels may also be viewed at: <http://www.greenbook.net/>.)

The addition of IPM practices to a pest management plan reflects a higher level of management, with the objective of further reducing the impacts of pesticides used. Implementing IPM practices can enhance the environmental benefits of a plan, and improve the health of crops and the farm system.

To develop an IPM component of a Pest Management Plan, the following requirements apply.

- Pesticide applicators must be properly licensed as per their state regulations. However, it is recommended that all IPM adopters become certified.
- Producer will obtain a copy of the regional IPM guidelines or vegetable production guide for reference and for use in developing the IPM plan. (Contact state Cooperative Extensions. *New England Vegetable Management Guide* available on-line at <<http://www.nevegetable.org>>. Hard copies available from UMCE Highmoor Farm: 207-933-2100 or University of Massachusetts Outreach Bookstore: 413-545-2717.)
- Develop a pest management plan with NRCS, as above, that includes needed mitigation practices.
- Develop an IPM plan. In addition to items in the pest management plan, you will need to choose appropriate practices from each major category (Prevention, Avoidance, Monitoring, Suppression) in the "IPM Practices" table below. Utilize this table to choose general practices and refer to the regional IPM guidelines, *New England Vegetable Management Guide*, and/or other references for crop-specific recommendations.
- Keep records. Records form the basis for decision-making including selection of crop rotations, economic thresholds, and suppression options. Keep records of scouting results including pest incidence and distribution, crop plantings/rotations, yields for each crop and field, pesticide applications, cultivations, and other activities.

NRCS encourages the building of soil health as an important part of an IPM plan. Increasing soil organic matter, reducing soil compaction, and managing nutrients will lead to healthier, more pest-resistant plants and reduce the need for chemical or other interventions. Practices that enhance soil quality include:

Cover crops

Crop rotation with high residue crops (grains/grass/legumes)

Residue management/reduced tillage

Nutrient management

Mulching with compost or other organic materials

Manure utilization

Limiting traffic/tillage on wet soils

IPM PRACTICES FOR VEGETABLE PRODUCTION

PRINCIPLE	PRACTICES	REFERENCES
<p style="text-align: center;">PREVENTION</p> <p>“Preventing Pest Populations”</p> <p>Preventing pest problems reduces the need for pesticide applications and thus potential impacts of pesticides on resource concerns.</p>	Use certified pest-free seeds and pest-free transplants where available. (Example: Purchase certified seed and ensure plants are free of insects, diseases, and weeds before transplanting.)	
	Prevent weeds from going to seed. (Example: Cultivate, pull, mow, flame, etc.)	Flaming ⁹ , Organic Weed Management ²³
	Reduce moisture on plant surfaces to prevent disease incidence. (Example: Use drip irrigation or avoid overhead irrigation between 6 p.m. and midnight to minimize disease.)	
	Employ methods to avoid spreading pests (pathogens, weeds and insects). (Example: Work crop when dry, work infested fields last, hose down equipment between fields, etc.)	Organic Weed Management ²³
	Destroy and/or remove crop residues for field sanitation procedures. Include fall tillage where appropriate to control weeds and break pest cycles. (Example: Plow under corn refuse in the fall to control European corn borer.)	New England Vegetable Management Guide ¹ , Mid-Atlantic Commercial Vegetable Production Recommendations ² , & NYS IPM Elements ³
	Eliminate unmanaged plants that serve as pest reservoirs, such as abandoned crops, volunteers from previous crop, or weed hosts of viruses.	
	Test soil or plant tissue annually to determine proper fertility and pH levels for crop and time application according to crop needs. Apply nutrients, fertilizers, and pH-adjusting agents according to recommendations.	New England Vegetable Management Guide ¹ , Mid-Atlantic Commercial Vegetable Production Recommendations ² , & NYS IPM Elements ³
<p style="text-align: center;">AVOIDANCE</p> <p>“Avoiding Pest Populations”</p> <p>Avoiding pest populations reduces the need for pesticide applications and thus potential impacts of pesticides on resource concerns.</p>	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).	New England Vegetable Management Guide ¹ , Mid-Atlantic Commercial Vegetable Production Recommendations ² , & NYS IPM Elements ³
	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: Plant 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.	CT fact sheet on Perimeter Trap Cropping ⁶

PRINCIPLE	PRACTICES	REFERENCES*
<p>MONITORING</p> <p>“Identifying the extent of pest populations and/or the probability of future populations”</p> <p>Monitoring limits pesticide use to those occasions when intervention is needed to prevent economically significant damage to crops.</p>	<p>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. **Record findings. Record keeping is required**. (Example: Scout crops and use other appropriate monitoring aids such as pheromone traps, disease diagnostic tests, etc. Map weeds in the fall to help plan where specific measures may be needed to target problem weeds the following spring. Utilize University of Maine Cooperative Extension pest monitoring data from newsletters and websites.)</p>	<p>New England Vegetable Management Guide¹, Mid-Atlantic Commercial Vegetable Production Recommendations², NYS IPM Elements³, Invasive Plant Atlas¹⁷, Weed Assessment List³⁰, other pest identification guides, UMCE IPM⁴¹ programs for pest monitoring services and information</p>
	<p>Use on-farm weather monitoring devices to measure precipitation, humidity, temperature, and leaf wetness and/or use commercial weather prediction service for prevention and control of plant diseases. (Example: Install weather station with rain gauge, hygrometer, maximum and minimum temperature recording equipment, leaf wetness sensors.)</p>	<p>Skybit³³, UMCE Apple IPM Program Forecast³⁴</p>
	<p>Use pest-forecasting tools (e.g., computer modeling software) as additional guides for on-farm pest monitoring activities in conjunction with weather data to predict risk of pest infestation.</p>	<p>Cucurbit Downy Mildew Weather Forecaster³¹, Pestwatch³² for corn, UMCE Apple IPM forecast³⁴, Blite Cast or UMCE Potato Pest Alerts⁴²</p>
<p>SUPPRESSION</p> <p>“Using cultural, biological, and chemical controls to reduce a pest population or its impacts”</p> <p>Applying suppression actions only when pest populations exceed the action threshold reduces potential impacts of pesticides on resource concerns.</p>	<p>CULTURAL AND PHYSICAL CONTROLS</p>	
	<p>Use cover crops, especially pest-suppressing crops (allelopathic), in the rotation cycle to reduce weeds and disease incidence and to improve soil quality.</p>	<p>See references 4, 7, 16, 18, 23, and 26 for cover crop guidance and SARE Nematode fact sheet¹¹.</p>
	<p>Plant using appropriate within- and between-row spacing optimal for crop, site, and row orientation. (Example: Use row spacing and plant densities that assure rapid canopy closure.)</p>	<p>See New England Vegetable Management Guide¹ and NYS IPM Elements³ for crop-specific recommendations.</p>
	<p>Use reduced tillage and other residue management practices to suppress weeds and maintain soil organic matter as appropriate for crop.</p>	<p>See NRCS practice standards 329, 345, 346 for Residue Management.</p>
	<p>Use mulches including plastic or reflective mulches for insect or weed control.</p>	
	<p>Inter-seed cover crop within or between rows to suppress weeds.</p>	<p>See references 4, 7, 16, 18, 23, and 26 for cover crop guidance.</p>
	<p>Use mechanical pest controls. (Examples: Cultivate, mow, hoe, and hand remove insects and weeds, prune diseased or insect-infested plants, remove diseased plants.)</p>	
	<p>Use physical pest controls and deterrents. (Example: Use flame weeding or other heat methods for insect, disease, and weed control; noise-makers; reflectors; ribbons; and predator models.)</p>	<p>Flaming⁹, Organic Weed Management²³, Guide to Biological Control²⁸</p>
	<p>Use exclusion devices for insects or wildlife. (Examples: Use synthetic row covers and/or fencing.)</p>	<p>Synthetic row covers^{5,38}, Organic Weed Management²³</p>
	<p>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, and organic matter additions. Avoid planting in low and wet spots in field.)</p>	

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<p>SUPPRESSION</p> <p>"Using cultural, biological, and chemical controls to reduce a pest population or its impacts"</p> <p>Applying suppression actions only when pest populations exceed the action threshold reduces potential impacts of pesticides on resource concerns.</p>	BIOLOGICAL CONTROLS	
	Use insect mating disruption devices, if available. (Example: Use pheromone laminate clip-ons or rings for tomato pinworm.)	
	Conserve naturally occurring biological controls. (Example: Select pesticides and time applications to minimize impact on beneficials, use floral perimeter crop to attract and support beneficial insects.)	New England Vegetable Management Guide ¹ , Environmental Impact of Pesticides (EIQ) ¹⁹ , Guide to Biological Control ²⁸
	Release beneficial organisms where appropriate. (Example: Release predatory mites for control of two-spotted mites and thrips.)	Guide to Biological Control ²⁸
	Use compost as a soil amendment to increase biological diversity in soil and plant health and suppress plant disease.	New England Vegetable Management Guide ¹ , Mid-Atlantic Commercial Vegetable Production Recommendations ² , & NYS IPM Elements ³
	CHEMICAL CONTROLS	
	Minimize chemical use. Use in conjunction with accurate pest identification and monitoring, action thresholds, alternative suppression tactics (biological, cultural, etc), and judgments based on previous year's weed map and/or pest scouting records. (Example: Use pheromone traps to monitor for corn earworm in sweet corn.)	New England Vegetable Management Guide ¹ , Mid-Atlantic Commercial Vegetable Production Recommendations ² , & NYS IPM Elements ³
	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 of Pesticides (EIQ) ¹⁹
	Use lowest labeled rate that is effective based on label, scouting results, and Extension-recommended action thresholds for target pest.	Contact state NRCS or Extension office for spray record keeping forms.
	Limit applications to partial fields or banding to reduce quantity or impact of pesticide. (Example: Spot treat where pests are found or use banding, seed, edge or field perimeter/border treatments.)	
Calibrate sprayers or applicators prior to use to verify amount of material applied.	Pesticide Calibration Guide ⁸ .	
Use pesticide-resistance management strategies as appropriate and where required on pesticide label. (Example: Alternate applications of chemicals with different modes of action to avoid development of pest resistance or leave part of crop unsprayed to serve as a refuge for susceptible pests and natural enemies.)	Managing Pest Resistance to Pesticides ²⁰ .	

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<p>SUPPRESSION</p> <p>"Using cultural, biological, and chemical controls to reduce a pest population or its impacts"</p> <p>Applying suppression actions only when pest populations exceed the action threshold reduces potential impacts of pesticides on resource concerns.</p>	CHEMICAL CONTROLS (cont.)	
	<p>Use specialized pesticide application equipment to increase efficiency and reduce chemical drift. (Examples: Use wiper applicators, digitally controlled adjustable tool bars, direct injection sprayers, double-drop sprayers, laser guided precision sprayers, direct injection, low-drift nozzles, shielded applicators or air induction booms, built-in tank washers, etc.)</p>	
	<p>Use spray-monitoring equipment. (Example: Use water-sensitive cards to measure spray pattern and drift.)</p>	
	<p>Use vegetative buffers, setbacks, or filter strips to minimize chemical movement to sensitive areas such as surface waters, schools, residences, and neighboring crops.</p>	
	<p>Use mitigation practices as necessary in accordance with pest monitoring results, pest predictions, action thresholds, and WinPST output.</p>	
	<p>Pesticide applicator must be properly licensed and certified when using restricted use pesticides or when doing custom pesticide applications for hire. Contact state pesticides regulatory agency for license and certification requirements.</p>	
	<p>*NOTE: Additional pesticide use requirements from the 595 Practice Standard:</p> <ul style="list-style-type: none"> > Always follow all pesticide label instructions and environmental cautions. > Store, handle, transport, mix, use, and dispose of pesticides and pesticide containers per state pesticides regulatory agency recommendations and requirements. > Follow state and federal worker protection standards. > 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. > Do not mix or load pesticides within 50 ft from the high water mark of any surface waters of the state. 	<p>*NOTE: See documents listed in the attached resource list for additional guidance. Unless otherwise noted, your regional vegetable IPM guide or vegetable production guides are the best and most comprehensive resource for IPM practices.</p>

IPM Practices for Vegetable Production Resource List

IPM Guidelines and Elements

1. Howell, J.C., A.R. Bonanno, T.J. Boucher, R.L. Wick, R. Hazzard, & B. Dicklow. New England Vegetable Management Guide 2008-2009. <<http://www.nevegetable.org/>>. [Hard copies available from state Extensions, UMCE Highmoor Farm: 207-933-2100, or University of Massachusetts Outreach Bookstore: 413-545-2717.]
2. Mid-Atlantic Commercial Vegetable Production Recommendations. 2007. University of Delaware. <<http://ag.udel.edu/extension/vegprogram/pdf/DEvegrecs2007.pdf>>. [This guide is identical for PA, MD, DE, VA, and NJ].
3. NYS IPM elements. n.d. New York State IPM Program. Cornell University. <<http://www.nysipm.cornell.edu/elements/default.asp>>.
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Crop Specific Guides, Pest Fact Sheets, and Other Resources

5. Bachman, J. 2005. Season extension techniques for market gardeners. National Sustainable Agriculture Information Service. ATTRA Publication #IP035. <<http://attra.ncat.org/attra-pub/seasonext.html>>. [PDF version available at <<http://attra.ncat.org/attra-pub/PDF/seasonext.pdf>>. Information on floating row covers, mulches and other techniques for pest management, and season-extension].
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7. Clark, A. (Ed.). Managing Cover Crops Profitably 3rd ed. 2007. Sustainable Agriculture Network. Beltsville, MD. Handbook Series Book 9. [Available online at <<http://www.sare.org/publications/covercrops/covercrops.pdf>>.]
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<<http://www.attra.ncat.org/attra-pub/flameweedveg.html>>.
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<<http://www.attra.org/attra-pub/ipm.html>>.
[PDF version available online at
<<http://www.attra.ncat.org/attrapub/PDF/flameweedveg.pdf>>.]
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<<http://www.sare.org/publications/factsheet/0605.htm>>.
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<<http://soilhealth.cals.cornell.edu/Soil Health Manual Edition 1.2.pdf>>.
14. Hazzard, R., A. Brown, and P. Westgate. 2008. Using IPM in the field: Sweet corn insect management field scouting guide (draft). University of Massachusetts Extension Vegetable Program.
15. Hazzard, R., A. Brown, and P. Westgate. 2008. Using IPM in the field: Sweet corn insect management record keeping book (draft). University of Massachusetts Extension Vegetable Program.
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<http://www.hort.wisc.edu/FreshVeg/Publications/Cover_crops_on_the_intensive_market_farm.pdf>.
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<<http://nbii-nin.ciesin.columbia.edu/ipane/icat/catalogOfSpecies.do>>.
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<http://www.newenglandvfc.org/2005_conference/sessions/soil_health/cover_crops_soil_health.pdf>.

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<<http://www.ces.ncsu.edu/depts/pp/cucurbit/>>.
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33. Skybit.com. n.d. <<http://www.skybit.com/>>. [Commercial weather service].
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<<http://www.umext.maine.edu/topics/pest.htm>>.
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<<http://www.umaine.edu/umext/potatoprogram/>>.