Integrated Insect, Mite and Disease Management on Vegetable Crops

IPM, to many people, means integrated insect and mite pest management. These are not the only pest problems. Plant pathogens and weeds are pests that can cause severe injury to most field and greenhouse-grown vegetable crops. A better term for IPM is integrated crop health management, which tends to broaden the concept for most people to include plant disease management. Whatever this system is called, it simply means that we use as many methods as possible to minimize problems caused by insects, mites and plant diseases. These methods include cultural, mechanical, physical, environmental, chemical (=pesticides), and biological controls.

The components of integrated crop health management, discussed individually below, must be used in a systematic way. All of the management tactics must include a monitoring program to detect problems before they get out of control. For insects and mites, this will mean a trapping and scouting program for pest detection. For plant diseases, crop health management to minimize disease often relies on selecting resistant varieties, accurate weather or environmental monitoring, maintaining good air movement, and using proper irrigation practices. Whatever the program, planning and record keeping are essential.

Information presented here applies generally to field and greenhouse vegetables. More specific information is included in the chapters on greenhouse vegetables (page 291), cabbage (page 107), potatoes (page 210), sweet corn (page 253) and tomatoes (page 269).

Pest and Disease Detection

The most critical part of any management program is detecting and identifying problems before they have a chance to cause serious injury. For insects and mites, this can be done by inspecting plants on a regular basis and/or using traps, sweep nets, or shaking to detect flying insects.

Different types of traps are available for different target pests. Yellow or blue sticky traps are used in greenhouses to catch winged aphids, thrips, and other pests, and may be used in outdoor lettuce crops to detect leafhoppers. Pheromone traps that lure the males of specific pest species may be used in some field-grown vegetable crops; a small cardboard wing-style pheromone trap is used to monitor variegated cutworm in tomato fields, and a large cone shaped pheromone trap is used to monitor corn earworm and European corn borer. Blacklight traps are used to monitor European corn borer and other moth pests. Sources of traps are listed in the table on the next page.

Traps are usually placed just above the top of the crop canopy. The number of traps to use will depend upon your objectives and ability to inspect them. Traps should be inspected at least once per week, and counts or estimates made of pest numbers. Number the traps and keep records of trap locations and insect infestations. Once trapped, the pest insects must be identified. Recognition of these pests may take some training and a 10 or 15X hand lens for magnification, but it is very important to learn the general shape, size, and colors of the different pest groups. There are publications available that can help with the identification task.

Plant inspection or scouting is more important than traps for most crops. Inspect plants in all areas of the field or greenhouse, looking underneath leaves near the top, middle and lower parts of plants. The same hand lens used for trap inspection can be used for plant inspection. Keep records of the type of pests found, the number of plants infested, and the severity of infestation. A sample and general scouting form are shown on pages 66-67.

Crops should also be scouted for diseases on a regular basis. This is especially important for diseases that can cause significant damage in a short period of time, such as late blight of potatoes and tomatoes. Weather conditions, cultural practices, varieties and use of fungicides affect the timing of appearance of disease symptoms. Scouts should be examining plants visually for disease symptoms throughout the growing season but especially during times when weather conditions are favorable. For many vegetable diseases, this is during and after periods of high humidity, rainfall, dense fog, and hot or cool temperatures, depending on the disease. Proper scouting requires not only the ability to recognize symptoms, but also to understand the biology of the pathogens. Unusual symptoms can be diagnosed by contacting your county agent or by sending a sample to the Plant and Pest Diagnostic Clinic (see page 56, Using the Disease Control Recommendations).

Cultural and Mechanical Methods

Cultural, mechanical, physical, or environmental controls will often be effective in reducing pest and disease problems to the point at which other methods will be more effective. The following activities are examples of these methods. Select varieties that are resistant to diseases or insects.

- Destroy crop residues promptly after harvest.
- Rotate crops; aids in managing pests such as nematodes and Colorado potato beetle.
- Select a planting date that will not favor a pest, such as planting cabbage when the cabbage maggot fly is not active.
- Plant a trap crop around the desired crop, such as a few rows of potatoes around a tomato field for management of Colorado potato beetle.
- Select cover crops that will not favor a pest, such as using oats rather than wheat in areas where the onion thrips is a problem, because thrips overwinter well in wheat but not in oats.
- Row covers over field grown vegetables or insect screens in greenhouses can be useful in excluding the movement of some insects into the crop.
- Regulate heat and moisture in greenhouses to eliminate favorable conditions for pests or diseases.

Commercial Sources of Insect Traps	
Great Lakes IPM (general supplier) 10220 Church Street, NE Vestaburg, MI 48891 (989) 268-5693	**Trécé, Inc.** (manufacturer of pheromone lures and traps) P.O. Box 6278 Salinas, CA 93912 (408) 758-0204
Gempler's (general supplier) P.O. Box 270 Belleville, WI 53508 (800) 382-8473	**Olson Products Inc.** (manufacturer of sticky card traps) P.O. Box 1043 Medina, OH 44258 (216) 723-3210

Biological Control

Biological control is defined as the use of a living organism to control or manage another living organism. Natural enemies include parasites, predators, fungi, nematodes and viruses. Most biological control programs are directed at insects and mites. However, plant disease-suppressive composts are being used to effectively reduce problems with certain root rot pathogens. In addition, new products are being introduced for biological control of root and foliar diseases (see page 57, "Alternative" Disease Control Strategies).

Many of the most important biological control agents for insects and mites are available from commercial insectaries. Some of the companies that supply one or more biocontrol agents are listed in the table on the next page. Biological controls must be introduced properly or the system will fail. Natural enemies are often used similar to a regular insecticide application program; that is, introduced on a regular basis. Even more than with pesticides, pest management will fail if pest populations are too high when the natural enemies are introduced. Biological controls are not rescue treatments. Often, pest populations will not decline, and probably will even increase, for several weeks to two months after introducing natural enemies. Even though there are natural enemies available for many pests, manipulating this system may be too complicated and expensive on some crops. Biological control is usually most successful on crops that are attacked by only one or two major pests.

If you are interested in working with a biological control program, contact a reputable supplier of natural enemies several months before beginning a biological control program. The supplier should know what crop(s) you are producing, likely pest (and disease) problems, and approximate numbers of natural enemies that will be required. You probably will need to seek the advice of a knowledgeable expert (the natural enemy supply company, an experienced grower or consultant) on this. Try to get advice from someone with experience in your growing situation and/or general geographic area. Remember that several weeks to months may be required to lower an insect or mite pest population with any natural enemy.

A more passive form of biological control is conservation of naturally occurring natural enemies rather than release of commercially-reared natural enemies. Naturally occurring insect predators and parasitoids can be conserved by not using broad-spectrum insecticides. Where narrow-spectrum insecticides are used, natural enemies have a chance to survive and contribute to pest suppression. For example, if *Bacillus thuringiensis* (B.t.) is used for caterpillar control, it is not toxic to any parasitoids or predators that feed on caterpillars or on other pests that may be present such as aphids.

Some Suppliers of Beneficial Insects and Mites in the United States

Alternative
349 East 86th Street, Suite 259
Indianapolis, IN 46240
(317) 823-0432

ARBICO
P.O. Box 4247CRB
Tucson, AZ 85738
(800) 827-2847

Associates Insectary
P.O. Box 969
Santa Paula, CA 93061
(805) 933-1301

Beneficial Insectary
245 Oak Run Road
Oak Run, CA 96069
(800) 477-3715

Biotactics, Inc.
7765 Lakeside Drive
Riverside, CA 92509
(909) 320-1366

The Green Spot
93 Priest Road
Nottingham, NH 03290
(603) 942-8925

Hydro-Gardens, Inc.
P.O. Box 25845
Colorado Springs, CO 80936
(800) 634-6362

IPM Laboratories, Inc.
P.O. Box 300
Locke, NY 13092
(315) 497-2063

Koppert Biological Systems, Inc.
28465 Beverly Road
Romulus, MI 48174
(800) 928-8827
(734) 641-3763

Nature's Control
P.O. Box 35
Medford, OR 97501
(800) 698-6250

Planet Natural
(formerly Bozeman Bio-tech)
P.O. Box 3146
Bozeman, MT 59772
(800) 289-6656

Rincon-Vitova Insectaries, Inc.
P.O. Box 1555
Ventura, CA 93002
(800) 248-2847

The above list is for information only. Contact the individual company for information on prices and ability to supply the required biological controls.

Pesticides

Although there are many products registered for use on some vegetable crops and few products registered for use on others, insecticides, miticides and fungicides are integral parts of a pest and disease management system. Properly used, these chemicals can be very effective in reducing crop injury. The way to use pesticides most effectively is to rely on the early detection and problem diagnosis discussed earlier to determine what and how often to make applications. A good pest and disease detection program combined with judicious pesticide use can be a very effective integrated plant health management program.

See the table on pages 40-44 for a list of insecticides and their mode of action, characteristics, toxicity to mammals, pest spectrum, and impact on beneficial insects.

Integrating Pesticides With Biological Control

Integrating pesticides and biological control agents is not easy. Most insecticides and some fungicides are harmful to parasites and predators.

Some pesticides are "soft" on beneficial insects and mites. *Bacillus thuringiensis* (B.t.) formulations are harmless to natural enemies. Insecticidal soaps, horticultural oils, as well as plant-derived insecticides such as azadirachtin and pyrethrum tend to be less harmful than conventional materials. This does not mean that these materials are harmless, but that natural enemies can be re-introduced after an application without any deleterious effects.

sample

Pest Scouting Form

Date: 6/28/94
Crop: sweet corn
Plant Growth Stage: early tassel

Scout: Sue
Field No.: 1, 2 & 3
Weather: sunny, hot

Pest	early yellow corn borer		early white corn borer	early white aphids	early bicolor corn borer	early bicolor fall armyworm	
Plant #							
1	0		0		0	0	
2	0		0		+	0	
3	0		0		+	0	
4	+		0	few	0	0	
5	0		0		0	0	
⋮							
25	+		0		0	0	
Total	6/25		4/25	2/25	11/25	3/25	
Average							

Notes: Some flea beetles still active but not a concern now that corn is tasselling.

sample

Pest Scouting Form

Date: 7-12-94
Crop: Tomato
Plant Growth Stage: bloom

Scout: Dave
Field No.: 3
Weather: partly cloudy, 79°F

Pest	CPB	cutworm	Hornworm	TFW	CL	stink bug	aphids/ 10 leaflets
Plant #							
1	0	-	-	-	1	-	0
2	0	-	-	-	0	-	0
3	0	yes	-	-	0	-	5
4	0	-	-	-	0	1+ damage	7
5	0	-	-	-	3	-	0
⋮							
40	0	-	-	-	0	-	1
Total	0	1	1	0	7	1+ damage	63
Average	0.0				0.18		0.16

Notes: CPB = Colorado potato beetle, TFW = tomato fruitworm
CL = cabbage looper
some bacterial spot/speck in field

Pest Scouting Form

Date: Scout:
Crop: Field No.:
Plant Growth Stage: Weather:

Pest	____	____	____	____	____	____	____
Plant #							
____	____	____	____	____	____	____	____
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____	____	____	____	____	____	____	____
Total	____	____	____	____	____	____	____
Average	____	____	____	____	____	____	____

Notes: