IPM *is the coordinated use of pest and environment information and available pest control methods to prevent unacceptable levels of damage by the most economical means with the least possible hazard to people, property and the environment.*

-EPA

IPM PRINCIPLES:

The principles and practices of integrated pest management (IPM) have been adopted by tomato and pepper growers in Florida because it is no longer possible to rely solely on programmed applications of chemical pesticides to prevent unacceptable crop losses. Moreover, some preferred practices may not be available to tomato and pepper growers, such as methyl bromide fumigation, so alternatives must be sought.

- The first principle of IPM is to use the best available practices, especially scouting, to prevent pests from reaching established damage thresholds. Best practices are defined by criteria that include **effectiveness, cost, convenience** and **risk** to human health and the environment.
- Another principle of IPM is to use cultural methods and information about the biology of pests to design pest resistant cropping systems. This has led to the use of crop rotation, cover crops, resistant varieties, plasticulture, planting and plow down dates, mapping of fields and other ways to manage crops.
- Scouting for the occurrence of pests and severity of crop damage is virtually universal in tomato and pepper farming and has led to the establishment of economic thresholds.
- Biological controls, both natural and augmentative, are the next level of defense against pests. Information is needed to have confidence in the level of pest suppression that can be expected.

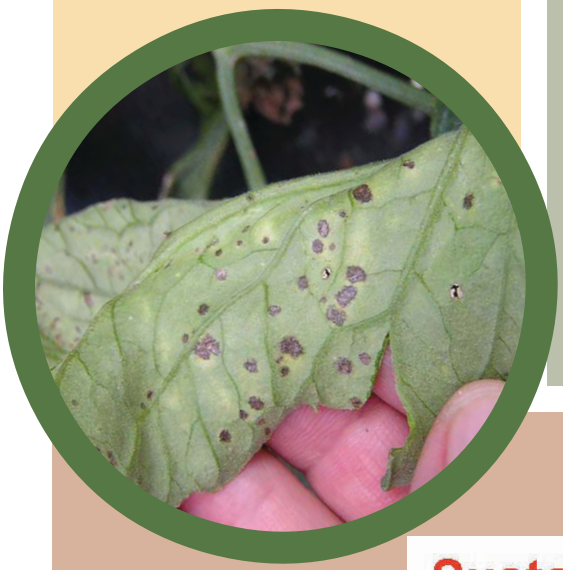

Figure 1. Bacterial leaf spot is one of the key diseases of both pepper and tomato. Although there are only a few primary pests of tomato or pepper, about 27 insects, nearly 30 pathogens, several weeds and two nematodes can significantly reduce tomato production. Photograph by: Ken Pernezny.

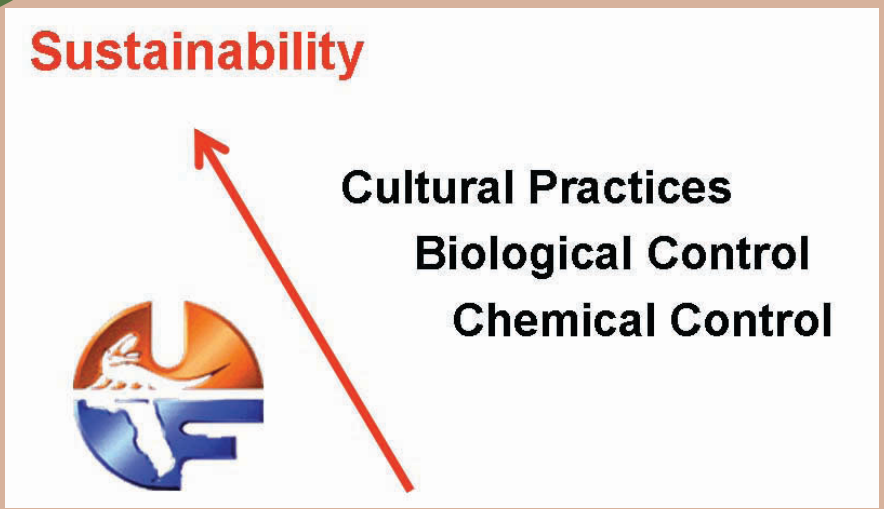

Figure 2. The IPM continuum leads from cultural practices and biological control to pesticides with minimal non-target effects and finally to those that are used as a last resort. Information is required to design a site-specific system that supports decisions resulting in cost-effective, safe and sustainable pest management. Figure by: Norm Leppla.

LESSONS FROM THE PAST:

Prior to the initiation of a rudimentary IPM program in the late 1970s, there was virtually no organized pest scouting on vegetable acreage in Florida. Growers sprayed at least two tank-mixed insecticides twice weekly, the equivalent of about 48 doses of insecticide per crop.

- Tomato growers in North Florida initially reacted to epidemics of tomato spotted wilt by spraying toxic, broad-spectrum insecticides in an unsuccessful effort to control transmission by the thrips vector.
- The silverleaf whitefly became the key pest of tomatoes in the southern half of Florida. Feeding by nymphs causes irregular ripening of tomato and adults transmit plant viruses, primarily *Tomato yellow leaf curl virus*.
- The heavy reliance on nicotinoids, particularly imidacloprid, for whitefly control resulted in the whitefly becoming resistant in some areas.
- Soil-borne pests, such as root-knot nematodes, nutsedge and others were controlled by methyl bromide fumigation prior to planting.

Figure 3. Cultural practices have been instituted to reduce whitefly exposure to nicotinoids, such as crop or host free periods and sod-based rotations with bahia, pangola and digit grasses. These methods, plus selected herbicides, also help reduce the impact of weeds. Photograph by: Joe Noling.

None of these practices were sustainable economically or environmentally, and led to widespread resistance and crop failures. Growers could no longer rely on broad-spectrum pesticides and had to incorporate several alternative practices for pest management. They had to adopt multi-tactic, ecologically based IPM by selecting the best available technologies for reducing pest risk in their farming systems while maintaining economic viability.

IPM SUCCESSES IN FLORIDA:

Tomato and pepper IPM continue to be among the greatest success stories in Florida agriculture. An estimated 75% of the tomato acreage is scouted twice weekly and sprayed only on demand. Management of the silverleaf whitefly with transplant applications of nicotinoids followed by applications of non-nicotinoid insecticides has been effective. The number of insecticide applications has been reduced by 50%.

In the long term, however, chemical pest management alone does not create sustainable production systems. Consequently, extensive research and extension programs have been conducted on IPM in tomato and pepper to help growers transition away from high-risk pesticides and adopt biologically-based IPM programs.

Figure 4. Research on alternatives for managing thrips and tospovirus on solanaceous crops resulted in efficacious, cost-effective, reduced-risk tactics, such as UV reflective plastic mulch that reduces the incidence of virus by as much as 75% and dramatically boosts tomato yields. Reflective mulch is being used together with the reduced-risk insecticide, spinosad that poses little threat to field workers or the environment, and a new immune-boosting treatment that induces systemic acquired resistance (SAR). Photograph by: Eric Zamora.

Prepared by: Dr. Norm Leppla

Ultimately, the only sustainable way to protect a crop and maximize profitability is to incorporate pest management into the planning process.

Figure 5. Regular scouting is critical when developing an IPM program. Photograph by: Thomas Wright.

Since preventative IPM practices reduce the use of high risk pesticides, they can provide marketing advantages and protection from claims of environmental pollution.

PLANNING AHEAD...

An IPM plan must be developed that is first preventative and then effective in virtually eliminating the key pests of tomato and pepper.

An IPM checklist is helpful for incorporating effective pest prevention, monitoring and management practices. There are many options and interactions for preventing pests that must be evaluated, including the selection of fields to plant based on pest history, farming practices of neighbors, crops in the area that could "grow" pests to infest adjacent fields, sanitation in the fields and borders, presence of hedgerows and other barriers, and myriad variables that could help maximize crop production.

- Preparing the fields usually requires decisions about soil testing, pH and nutrient adjustments, addition of organic amendments, solarization, fumigation and bedding. Appropriate resistant varieties are selected and obtained as clean transplants.
- After the variety to be planted is selected and the field prepared, decisions about appropriate cultural controls are implemented, e.g., planting dates, mulches, sanitation, fallow periods, crop rotation, cover and trap crops, hedge rows, etc.
- Scouting is well established for detecting pests but economic thresholds are low due to the high value of the crops. Consequently, the methods, frequency and intensity of scouting are critical decisions.
- Natural enemies are conserved and possibly augmented, particularly generalist predators.
- If pesticides will eventually be needed, consideration must be given to the cost of purchase and application, human health risks, environmental contamination, resistance management, and a host of legal issues.

ADVANTAGES OF IPM:

The concept of IPM has gained acceptance as single pest management technologies have failed, become too expensive or been made unavailable due to regulatory action. A process of adding technologies in succession as each fails can sometimes save a crop but is wasteful. Ultimately, the only sustainable way to protect a crop and maximize profitability is to incorporate pest management into the planning process.

Increasingly, food processors and retailers are prescribing pest management practices for their products to assure food safety. Their products automatically provide market access and usually command premium prices. This partnership along the food supply chain increases the involvement of each member in maintaining the sustainability of crop production for everyone's benefit, including the consumer. This total crop planning and marketing continuum that enables growers to anticipate and prevent most severe pest problems is the advantage IPM has over the unsustainable reactionary approach.

Greater adoption of prevention-oriented IPM practices will increase opportunities for growers to widen their options for managing pests and diseases while maintaining economic viability and reducing risks to human health and the environment.

Figure 6. There are many ways to implement integrated pest management, such as using lacewing larvae to control aphids. Photograph by: Lyle Buss.

Growers, researchers, extension agents, and crop consultants individually have vast experience in many of the specific components of effective IPM programs but usually lack a framework for overall crop planning that includes up-front pest management decisions.

PROJECT OBJECTIVES:

The overall goal of the guide is to provide producers of tomato and pepper the information and decision tools they need to adopt alternative pest management systems that focus on ecologically-based, multi-tactic IPM strategies.

Florida's high value vegetable crops are management intensive, with heavy pest pressure requiring constant vigilance and multiple control tactics. Growers need an organized and practical synthesis of all of the resources that can help them plan their pest management programs and move toward bio-intensive IPM.

Vegetable growers in Florida currently use a variety of IPM practices and many have expressed their willingness to incorporate new tactics when provided with sufficient information.

References:

Bloem, S. and R.F. Mizell. 2004. Tomato IPM in Florida. Department of Entomology and Nematology Document ENY-706, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611, http://edis.ifas.ufl.edu/IN178.

Momol, T. and K. Pernezny. 2005. 2006 Florida Plant Disease Management Guide: Tomato. Department of Plant Pathology Document PDMG-V3-53, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

Mossler, M., Aerts, M.J. and O.N. Nesheim. 2006. Florida Crop/Pest Management Profiles: Tomatoes. Department of Agronomy PI-039, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611, http://edis.ifas.ufl.edu/PI039.

Stall, W.M. and J.P. Gilreath. 2005. Weed Control in Tomato. Horticultural Sciences Department HS-200, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

Kogan, M. and W.I. Bajwa. A Collection of IPM Definitions and their Citations in Worldwide IPM Literature, Definition No. 41, http://www.ipmnet.org, http://www.ippc.orst.edu/IPMdefinitions/home.html.

CONTACT INFORMATION:

Dr. Norm Leppla
UF/IFAS IPM Florida
P.O. Box 110620
Gainesville, FL 32611-0620
ncleppla@ifas.ufl.edu
352-392-1901 ext. 120