

FLORIDA EXTENSION INITIATIVE 1: AGRICULTURE / HORTICULTURE
INCREASING THE SUSTAINABILITY, PROFITABILITY, AND COMPETITIVENESS OF AGRICULTURAL AND HORTICULTURAL
ENTERPRISES

STATEWIDE EDUCATIONAL PROGRAMS IN **INTEGRATED PEST MANAGEMENT (IPM)**

SITUATION

Increasing the sustainability, profitability, and competitiveness of Florida agriculture and horticulture is becoming increasingly difficult as more invasive arthropod, plant pathogen, weed, nematode, and vertebrate pests invade the state (Oerke 2006, Dodds et al. 2014). New and established species rapidly become resistant due to over use of the same mode of action and sometimes cannot be managed chemically (Tiwari et al. 2011; Norsworthy et al. 2012). Unfortunately, protection of plants using an integrated pest management (IPM) approach also is particularly challenging in Florida because of the mild and variable climate, high number of farms, and diversity of cropping systems. Pest management is more challenging when farms are close to urban areas, and people can be exposed to agricultural pesticides. The number of semi-urban small farms is increasing in Florida, now over 90% of all farms are classified as small, <\$250,000 annual sales (Gaul et al. 2015). Many small farms in Florida are operated by limited resource farmers, often by women and minorities (USDA 2012, Tackie et al. 2009). Thus, significant pest problems are occurring more frequently and causing greater damage on all kinds of farms, and in communities and natural areas. This situation has created the following critical issues:

1. Increasing threats and control costs for current and emerging invasive pests (Pimental et al. 2005; Dodds et al. 2014)
2. Too much reliance on pesticides and not enough alternatives (Chandler et al. 2011; Leo and Pintureau 2013; Fishel 2016)
3. Increased pest resistance to pesticides (Tiwari et al. 2011; Norsworthy et al. 2012)
4. Non-sustainable impacts of agriculture, including pest management (Godfray et al. 2010; Foley et al. 2011)
5. Benefit/cost data on pest management options is lacking (Naranjo et al. 2015; Alvarez et al. 2016; Mhina et al. 2016)
6. IPM plans with appropriate pest management practices are infrequently adopted (Schut et al. 2014; Klerkx et al. 2012)
7. Over taxed pest diagnostics and management support (Miller et al. 2009; Palmateer et al. 2012)
8. Funding for faculty with expertise in sustainable pest management has declined (Krell et al. 2016; McDowell 2004)
9. IPM education and training programs and materials are inadequate (Tackie et al. 2009; Resel and Arnold 2010)

IPM is an ecosystem-based, socially acceptable, environmentally responsible, and economically viable approach to crop protection that focuses on long-term prevention of damage that can be caused by pests and diseases. A combination of techniques is employed such as biological control, habitat

manipulations, modified cultural practices, and use of resistant varieties (USDA 2013). Support for long-term IPM research and Extension is becoming increasingly difficult to obtain as funding shifts to more immediate problems, such as the current greening crisis in the citrus industry. More resources should be invested in maintaining the infrastructure to plan for new pests and diseases and respond intelligently. Resources are needed to develop pest management plans and rapidly detect pests before associated problems escalate. The investment in pest and disease prevention is minimal compared with emergency programs that are conducted in reaction to invasive pest outbreaks or disease epidemics, and is miniscule compared with the losses. For example, the current level of public and private investment in tick-borne disease research and development in the U.S. is less than \$55 million and does not match the scale of the threat, which is estimated to exceed \$3 billion a year in medical costs and lost productivity (Anonymous 2016).

To assure that IPM action is rapid and appropriate, UF/IFAS established plant pest diagnostic clinics and networks, such as the Florida Plant Diagnostic Network (FPDN) and the Distance Diagnostic and Identification System (DDIS) that collaborate with the Southern Plant Diagnostic Network (SPDN) and the Florida Department of Agriculture and Consumer Services (Palmateer et al. 2012). All capabilities of Florida's plant pest and disease diagnostic system will be fully operational when linked to First Detector Training designed to minimize grower plant protection costs and prevent the establishment of new invasive pests and diseases. This will be accomplished by increasing the speed, accuracy and effectiveness of local plant pest and disease scouting and identification, increasing high-risk sample submission, enhancing first detector and diagnostic capabilities, providing resources for appropriate sample submission, assuring rapid digital and actual specimen delivery, enhancing the Florida Pest Diagnostic System, and revitalizing the Florida Pest Alert listserv. Coupled with this diagnostic network is an extensive on-line library of Electronic Digital Information Source (EDIS) publications. Unfortunately, however, a multitude of EDIS publications for growers have been archived rather than updated.

Effective, safe, and sustainable IPM tactics must be developed for Florida growers, along with the training required for the tactics to be widely adopted before pest and disease problems become too difficult and expensive to manage. This will require stable, long-term support for the Extension IPM infrastructure and associated research (Leppla et al. 2009). Research priorities can be set based on risk assessments for global pests. The IPM tactics will provide effective, socially acceptable and environmentally responsible pest management that will increase the profitability of agriculture and horticulture enterprises in the state. UF/IFAS has invested in a comprehensive IPM Program, IPM Florida, that provides statewide, interdisciplinary and inter-unit coordination and assistance in IPM to protect agriculture, communities and the environment. Additionally, several IPM faculty positions have been established at key locations throughout the state. Coordination and collaboration should be encouraged in advancing IPM among UF/IFAS faculty members and our clientele to provide expert consultation, education and training, and written Extension information to protect Florida's agricultural and horticultural enterprises.

PROGRAM OBJECTIVES (#1) INTEGRATED PEST MANAGEMENT TO INCORPORATE NON-CHEMICAL AND CHEMICAL METHODS INTO A SYSTEMATIC CONTROL OF PESTS --IPM

Objective 1a. At least 60% of stakeholders will know about alternative IPM tactics for crops and landscapes.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increased knowledge of available IPM tactics and a decrease in crop and landscape losses.

Impact: Quantitative increase in knowledge recorded in program evaluations.

- : Participant success in adopting IPM tactics and decreasing losses.
- : Quantitative increase in developing sustainable IPM systems as recorded in program evaluations.
- : Documented decrease in unnecessary pesticide applications.

Objective 1b. At least 35% of stakeholders will know the benefit/cost for pest management options for crops and landscapes.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increased knowledge of how to calculate benefit/cost for pest management options

Impact: Quantitative increase in knowledge recorded in program evaluations.

- : Participant success in calculating benefit/cost for pest management options.
- : Quantitative increase in profits due to the adoptions of sustainable management tactics.
- : Participant success stories detailing the increase in profits due to the sustainable management of pests.

Objective 1c. Increase pest identification and diagnosis knowledge for at least 10% of stakeholders who participate in IFAS Extension activities.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increased knowledge of how to correctly identify pests and diagnose pest problems.

Impact: Quantitative increase in knowledge recorded in program evaluations

- : Participant success in correct pest identification and pest diagnosis
- : Quantitative decrease in pest management inputs due to misidentification and misdiagnosis
- : Participant success stories detailing the reduction in pest management inputs due to correct identification and diagnosis

Objective 1d. At least 15% of stakeholders will develop and implement sustainable IPM plans for their farms.

Type of outcome: Short-term Medium-term Long-term

Outcome: Sustainable IPM plans are developed and implemented for individual farms.

Impact: Quantitative increase in number of farms with sustainable IPM plans

- : Participant success in developing IPM plans.

Objective 1e. At least 10% of stakeholders will reduce unnecessary pesticide applications.

Type of outcome: Short-term Medium-term Long-term

Outcome: Pesticide applications will be made only when necessary.

Impact: Quantitative decrease in pesticide use when warranted.

- : Number of acres where pesticide use has been reduced.

Objective 1f. Reduce crop losses for at least 25% of stakeholders through the use of identification and diagnostic services compared to the previous year's losses.

Type of outcome: Short-term Medium-term Long-term

Outcome: Reduction in stakeholder crop losses, increase in crop yield

Impact: Number of stakeholders accessing available diagnostic services

: Percent crop loss for stakeholders in association with use and/or frequency of use of IDD services

: Participants reporting successfully reducing crop losses through utilization of IDD services

Objective 1g. At least 20% of stakeholders will have reduced pest management inputs, including pesticides, and increased profits due to adoption of IPM plans.

Type of outcome: Short-term Medium-term Long-term

Outcome: Adoption of IPM plans results in decreased inputs and increased profits.

Impact: Adoption of IPM plans.

: Management inputs including tillage, pesticide use, etc. decrease.

: Profits increase as a result of the adoption of an IPM plan.

Objective #1 Workload indicators

#4 Number of producers indicating adoption of recommended practices, including ag BMPs and Mobile Irrigation Lab (MIL)

#5 Number of acres on which the recommended practices were implemented

#6 Number of producers reporting reduction in fertilizer or pesticide use

#7 Number of producers who changed to appropriate fertilizer and pesticide rates

#8 Number of producers reporting increased dollar returns or reduced costs

#30 Number of viable technologies developed or modified for the increased sustainability, profitability, and/or competitiveness of agricultural or horticultural enterprises

#35 Number of producers that adopted one or more “good” water quality practices such as reduced pesticides, animal waste or other pollutants

#36 Number of producers that adopted recommended best practices for production agriculture related to invasive species, pest management, pollutant loads, and wetlands

PROGRAM OBJECTIVES (#2) PESTICIDE APPLICATION EDUCATION TO REDUCE RISK TO CONSUMERS, APPLICATORS, AND THE ENVIRONMENT. -- PESTICIDES

Objective 2a. At least 50% of licensed pest management professionals will increase their knowledge of correct pesticide application methods, applicator licensing laws in Florida, and pesticide safety.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increased knowledge of pesticide application methods, applicator licensing laws in Florida, and pesticide safety.

Impact: Quantitative increase in knowledge recorded in program evaluations and license examinations.

: Participant success in passing license examinations.

: Quantitative increase in adherence to pesticide labels and safety provisions as recorded in program evaluations.

Objective 2b. At least 10% of stakeholders will report an increase in adherence to pesticide labels and safety provisions over a 2 year period.

Type of outcome: Short-term Medium-term Long-term

Outcome: Pesticides will be applied appropriately while utilizing the correct safety precautions.

Impact:

Objective 2c. Increase the number of licensed pesticide applicators in the state of Florida by 5% over a 2 year period.

Type of outcome: Short-term Medium-term Long-term

Outcome: Clientele will see an increase in pay and/or increased job security by obtaining a pesticide license.

Impact:

Objective 2d. Increase the number of continuing education credits given through UF/IFAS Extension programs to stakeholders by 10%.

Type of outcome: Short-term Medium-term Long-term

Outcome: Licensed pesticide applicators will be able to retain their license by obtaining continuing education credit.

Impact:

Objective 2e. At least 50% of stakeholders will enjoy a decrease in the non-target effects of pesticides and improved human health.

Type of outcome: Short-term Medium-term Long-term

Outcome: Non-target effects of pesticides and improved human health will be realized as a result of adopted IPM plans

Impact: Reduced use of pesticides; the correct pesticide is used at the right place, right rate, and right time.

Objective #2 Workload indicators

#2 Number of jobs created or retained

#3 Number of participants reporting new leadership roles or opportunities undertaken

#4 Number of producers indicating adoption of recommended practices, including ag BMPs and Mobile Irrigation Lab (MIL)

#5 Number of acres on which the recommended practices were implemented

#6 Number of producers reporting reduction in fertilizer or pesticide use

#7 Number of producers who changed to appropriate fertilizer and pesticide rates

#8 Number of producers reporting increased dollar returns or reduced costs

#36 Number of producers that adopted recommended best practices for production agriculture related to invasive species, pest management, pollutant loads, and wetlands

#40 Number of adult residential participants that adopted one or more best management practices such as Florida Friendly Landscaping principles

PROGRAM OBJECTIVES (#3) INTEGRATED PEST MANAGEMENT OF PROBLEMATIC OR NEW PEST SPECIES THAT ARE RESISTANT OR INVASIVE. –RESISTANCE/INVASIVES

Objective 3a. Increase the number of stakeholders who report new pests and pathogens through IDD services by 10%.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increase pest detection and interception, and reduce the establishment or spread of invasive organisms.

Impact: Number of stakeholders who report pest identification and diagnosis to IDD services (no matter the pest identity).

: Number of reported pests and pathogens to IDD services from stakeholders.

: Quantitative increase in the detection of new pests and pathogens through IDD services.

Objective 3b. At least 45% of stakeholders will know how to prevent pest resistance to pesticides.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increased knowledge of how to avoid pest resistance to pesticides.

Impact: Quantitative increase in knowledge recorded in program evaluations.

: Participant success stories avoiding pest resistance to pesticides.

Objective 3c. Increase pest detection and reduce invasive organism dispersal by having at least 50% of stakeholders rapidly detect and report invasive pests to IDD services.

Type of outcome: Short-term Medium-term Long-term

Outcome: Rapid pest detection and regulation, reducing impacts to Florida's economy and ecosystems.

Impact: Number of stakeholders reporting pest diagnosis and identification to IDD services.

: Number of pests and pathogens reported to IDD services.

: Time from first detection to report to IDD services.

: Number of cases reported or detected in close proximity to point of first pest or pathogen detection (indicator of spread prior to detection).

: Follow-up clientele surveys and substantiated with state-wide economic data.

Objective 3d. At least 20% of stakeholders will experience reduced impacts of invasive pests.

Type of outcome: Short-term Medium-term Long-term

Outcome: The impacts of invasive species will be reduced on individual farms or cropping systems.

Impact: Quantitative decrease in the number of invasive species or decrease in costs.

: Number of acres where the impact of invasive species has been reduced.

: Adoption of sustainable IPM strategies.

Objective 3e. Reduce the impact of invasive pests via at least a 50% reduction in stakeholders who report pesticide inputs targeting invasive pests and pathogens.

Type of outcome: Short-term Medium-term Long-term

Outcome: Reduce economic, environmental, and human health impacts caused by invasive pests and pathogens

Impact: Monetary costs associated with crop losses, pest control inputs, and other management costs for invasive pests and pathogens.

: Number of reported pests and pathogens to IDD services from stakeholders

: Acres treated with pesticides targeting invasive pests and pathogens

: Number of pesticide applications and quantity of pesticides applied targeting invasive pests and pathogens

Objective #3 Workload indicators

#4 Number of producers indicating adoption of recommended practices, including ag BMPs and Mobile Irrigation Lab (MIL)

#5 Number of acres on which the recommended practices were implemented

#6 Number of producers reporting reduction in fertilizer or pesticide use

#7 Number of producers who changed to appropriate fertilizer and pesticide rates

#8 Number of producers reporting increased dollar returns or reduced costs

#30 Number of viable technologies developed or modified for the increased sustainability, profitability, and/or competitiveness of agricultural or horticultural enterprises

#36 Number of producers that adopted recommended best practices for production agriculture related to invasive species, pest management, pollutant loads, and wetlands

Objective 4a. Increase the number stakeholder participants who utilize diagnostic services by 50% compared to 2019 data.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increased use of identification and diagnostic (IDD) services

Impact: Quantitative increase in accessing available diagnostic services

: Quantitative increase in the detection of new pests and pathogens through IDD services

: Participants successfully reducing crop losses through utilization of IDD services.

: Individual faculty's annual reports. UF-wide usage statistics for diagnostic and ID service laboratories should be compiled and tracked to monitor for increased use and awareness by clientele directly involved with pest management decisions.

Objective 4b. Increase the number of up-to-date or new Extension resources and training events available to stakeholders by 5% and stakeholder awareness of available IPM education and training resources, including EDIS, and Pesticide Information Office resources by 10%.

Type of outcome: Short-term Medium-term Long-term

Outcome: Increased knowledge of how to access available IPM education and training resources.

Increased independent, self-driven access of Extension materials and resources by stakeholders

Impact: Quantitative increase in number of times education and training resources are accessed

: Participant success in accessing IPM education and training resources.

: Increased number of EDIS views, training material downloads, website visits, or social media interactions.

Objective 4c. Increase the number of revenue-generating Extension programs by 10% and program revenue generated by 20%.

Type of outcome: Short-term Medium-term Long-term

Outcome: Extension faculty offer more frequent, higher quality training to stakeholders, increasing the number of stakeholders reached and knowledge and behavioral change. Extension faculty offer more frequent, higher quality training to stakeholders, increasing the number of stakeholders reached and knowledge and behavioral change.

Impact: Quantitative increase in the number of revenue-generating events offered.

: Quantitative increase in the number of for-sale extension publications.

: Quantitative increase in the annual dollar amount generated through Extension workshops, classes, and training events.

: Quantitative increase in the annual dollar amount generated through Extension publications or products sold

Objective #4 Workload indicators

#4 Number of producers indicating adoption of recommended practices, including ag BMPs and Mobile Irrigation Lab (MIL)

#5 Number of acres on which the recommended practices were implemented

#6 Number of producers reporting reduction in fertilizer or pesticide use

#7 Number of producers who changed to appropriate fertilizer and pesticide rates

#8 Number of producers reporting increased dollar returns or reduced costs

#14 Number of participants who report ability to make informed decisions on agriculture and the environment in their community because of information gained in extension programming

- #19 Number of participants attending educational programming for small farm operators, processors (big and small), or beginning farmers/ranchers showing knowledge gain on recommended practices
- #20 Number of participants attending educational programming for small farm operators, processors (big and small), or beginning farmers/ranchers that adopt one or more recommended practices
- #36 Number of producers that adopted recommended best practices for production agriculture related to invasive species, pest management, pollutant loads, and wetlands
- #40 Number of adult residential participants that adopted one or more best management practices such as Florida Friendly Landscaping principles

EDUCATIONAL METHODS

The Extension community is helping to protect Florida's agricultural, urban and natural Environments through an extensive system of educational programming for stakeholders in all 67 counties. Supporting the Extension agents is a cadre of Extension specialists educated and trained in IPM. Coupled with this is an extensive on-line library of Electronic Digital Information Source (EDIS) publications. The UF/IFAS Pesticide Safety Education Program (PSEP) provides training and information to applicators on safe, environmentally sound pesticide application practices, personal safety, and regulations. PSEP also assists applicators in meeting state and federal certification and licensing requirements to use pesticides.

In the UF College of Agriculture and Life Sciences, IPM topics are taught in many course and several units, e.g., Entomology and Nematology, Agronomy, Plant Pathology, Horticulture, College of Natural Resources and Environment, etc. as described in their course catalogs. Curriculum from several courses has been delivered within county Extension programs and via distance education. IPM content is included in UF/IFAS programs, such as Florida Yards and Neighborhoods, and Master Gardener Training. IPM modules also are available from the IPM distance education program (Univ. of Minnesota), Entomological Society of America (BCE, ACE), American Society of Agronomy (Certified Crop Advisor – CCA), Certified Professional Agronomist (CP-Ag), Certified Professional Plant Pathologist, National Alliance of Independent Crop Consultants (Crop Certification), Weed Science Society of America, and State CCAs.

IPM education and training includes: Pest Prevention and Detection (prevent pest outbreaks through habitat manipulation and other cultural practices; gain experience with pest habitats, e.g., crops or buildings; know the life cycles of the host plants, pests, and beneficial organisms; understand the ecology and adaptability of the organisms), Pest Identification and Management (utilize scouting thresholds; design systems of mitigation that minimize environmental impacts), General Knowledge and Professionalism (practice safe and appropriate use of pesticides and other IPM tactics, know current laws and regulations pertinent to pest management, be able to rapidly access pest management information, be involved in pest management and related organizations). Many of these topics can be gleaned from EDIS publications, the scientific literature, Extension fact sheets, handbooks, slide sets, videos, mobile apps, websites, email lists, blogs, other social media, and so forth.

Training is delivered to target audiences through in-house Extension programming, invited presentations at cooperator's educational conferences, scientific meetings (Florida Entomological Society, Florida State Horticultural Society, Florida Weed Science Society, etc.), trade shows, workshops, and other functions. Most of these venues emphasize plant disease diagnostics, insect and weed identification, and nematode assays, and describe access to the UF/IFAS diagnostic laboratories

where identifications and diagnoses are provided through email, telephone, and onsite consultation with state and county faculty, and Extension volunteers such as master gardeners. Pest management Extension programming utilizes diverse methods to deliver research-based content, training and services. Educational materials include video libraries, digital apps for pest identification and decision making, intensive IPM schools (e.g., Pest Management University), demonstrations, field days and plots, electronic publications (EDIS, including IPM guides), insect and plant pest identifications, disease diagnoses, specialized tutorials, in-service trainings, pesticide applicator licensing and continuing education credits, IPM certifications, and “how to” workshops for pest identification and decision making (E.G., Suwannee Valley Agricultural Extension Center and Hastings Agricultural Extension Center).

PARTICIPATION

The IPM working group will work with organizations within the University of Florida including the Pesticide Information Office, Florida IPM, and the Florida Plant Diagnostic Network. Organizations outside the University of Florida include USDA-ARS, Sustainable Agriculture Research and Education, pesticide manufacturers, and the Florida Department of Agriculture and Consumer Sciences,.

NEEDS

The Integrated Pest Management Working Group includes county and state faculty. The state faculty members are part of multiple departments and research centers. The following needs are for increasing the coordination between all the individual Extension and research programs:

- Provide funding and staffing for the UF/IFAS Statewide IPM Program to implement training, education and Extension programs.
- Create a formal coordinating mechanism for new and established IPM faculty that can increase communication and collaboration among interdependent UF/IFAS pest management programs.
- Have more flexibility to rapidly mobilize state and county Extension faculty to address emerging pests.

Cooperative Extension provides information that is accurate and supported by scientific data. The following needs are research topics that are requested:

- Place greater emphasis on focused IPM projects with measurable objectives and deliverables.
- Increase incentives and support for new, innovative IPM projects in addition to ongoing work.
- Develop and implement methods for evaluating effectiveness and cost of pest management practices.

The following needs are education needs for agent training and information for clientele:

- Improved funding for hands-on county faculty training.
- Improve pest management guides (EDIS) to make them more comprehensive and useful to Extension faculty and clientele, including pesticide recommendations and searchable tables for updating pesticide availability lists.
- Fast-track review system for EDIS documents.
- Develop and disseminate resources for pest identification and management decision-making.

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