Introduction to Integrated Pest Management

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What is Integrated Pest Management?

• Integrated Pest Management (IPM)
  – New concept; < 50 years old
  – Applied to Agriculture
What is a Pest?

- Any organism that competes with humans for food, shelter, or other commodities.

- Examples: insects, fungi, viruses, birds, mammals (rodents), or plants (weeds) that threatens the quantity, quality, or value of a crop

- A certain organism may be a pest in one place but a beneficial in another.
Types of Pests

• Direct Pests
• Indirect Pests
  – Key Pests
  – Occasional Pests
  – Secondary Pests
Direct Pests

• Direct Pest
  – Do damage to the crop that is to be harvested or sold
Indirect Pests

• Indirect Pests
  – Negatively impact the health of the plant
  – Can result in reduced crop quality and yield
Key Pests

• Key Pests
  – Cause major damage on a regular basis unless controlled
Occasional Pests

• Occasional Pests
  – Become intolerable only irregularly, often due to climate, environmental influences, or as a result of human activities
Secondary Pests

• Secondary Pests
  – Occur as a result of actions taken to control a key pest
Invasive Pests

- Invasive Pests
  - Result of the introduction of non-native species.
  - Commonly introduced through human activities like commerce.
  - Can be highly disruptive when first introduced because they often do not have natural enemies.
Management vs. Control

• Pest control - eradication of a pest

• Humans have been trying to control pests for many years

• IPM replaces the term “control” with the concept of management
Pest Management

• Main Focus- protect value of crop
• Killing the pest remains an option
• Alternative forms of activity include:
  – Repellency
  – Behavior Suppression or Deterrence
  – Disruption (i.e. mating disruption)
  – Biological control
Successful Pest Management

• A key strategy of Integrated Pest Management is to exploit the pest’s weaknesses in terms of life stage, behavior and biology.
Control Methods
(following 7 slides from Dieudonne Baributsa)

- Genetic (Host Plant resistance)
- Cultural Control (crop rotation, intercropping)
- Biological Control (predatory insects, insect pathogens)
- Chemical Control (Pesticides: herbicides, insecticides)
- Behavioral Control (mating disruptions)
- Regulatory Control (plant quarantine)
- Physical/Mechanical Control (Mulches, ...)


Genetic Host Plant resistance

Traditional plant breeding

- Tissue culture
- Genetic modification

Biotechnology

Grafting
Manipulation of the environment to reduce pest reproduction, growth, and damage

Take advantage of weaknesses in these factors by avoiding to use external inputs

Cultural control

- Mating sites
- Nutrients/food
- Habitat/shelter
- Oviposition sites
- Understanding of pest biology
- Movement
Physical or Mechanical Control

Tillage

Tillage changes soil moisture, temperature, texture. Insects, weed, pathogens,

Mulching

Plastic mulch, crop residue and living mulch reduce weed pressure in the crop.
Biological Control

1. Beneficial insect
   - Insect Augmentation (Biolaboratory)
   - Insect conservation (Landscape ecology)

2. Pest- Insect manipulation
   - Male sterility
Behavioral Control
(mating disruption)

• Dispense a large amount of sex pheromone within the crop

• Disturb the normal behavior of male insects so that they can not find female hence interfering with mating

Resulting in the reduction of the incidence of larvae
Chemical Control

• Synthetic Pesticides
  – Conventional
  – Reduced-risk

• Biopesticides
  – Naturally derived
Management

- Requires consideration of which pest stage is a threat to a crop
- Knowledge of optimal timing for each management approach
Integrated

• Integrate = to combine or incorporate

• IPM is intended to incorporate many different management methods into a single, logical, comprehensive effort.
The Philosophy of Integrated Pest Management

"Pest management is the reduction of pest problems by actions selected after the life systems of the pests are understood and the ecological as well as economic consequences of these actions have been predicted, as accurately as possible, to be in the best interest of mankind".

Integrated Pest Management in Practice

To conduct pest management we make use of an assemble of pest control tools and strategies (e.g. biological, chemical, cultural, etc.) to maintain pest populations and crop damage at economically acceptable levels, taking into consideration their short and long term impacts on the farm, environment and society as a whole.
Primary Forces Driving IPM

- Severity of pest pressure
- Impact of damage on crop
- Availability of control options
- Economics
Economics

• Pest populations can:
  – Lower crop yield
  – Lower crop quality
  – Impact long-term health of crops

• This reduces grower profits.
Pest Control Cost Factors

- Labor, Farm Equipment, Materials

- The benefits of the management action should outweigh the cost of the action.
Long-term Impacts

• These impacts should all be taken into account in the decision making process:
  – Potential of pest developing resistance
  – Agro-ecosystem health
  – Human health
Economic Injury and Thresholds for Horticultural Crops

• The economic injury level (EIL) represents the point at which losses in yield are greater than the cost of the action needed to prevent the injury.

• The economic threshold (ET) represents the point at which an action must be taken to control a pest population in order to avoid economic injury.
  – indirect pests (ET is applicable)
  – direct pests (zero-tolerance)
Forces Acting on Pests in Agro-ecosystems

Natural pest dynamics

- predators
- climate
- parasitoids
Introduction of Broad Spectrum Pesticides

Calendar spray schedule

EIL

ET

pest dynamics
Pest Response When Sprays are Stopped

- **EIL**
- **ET**

Calendar sprays

pest dynamics

Pest Outbreaks
Development of Pest Resistance to Pesticides

Calendar sprays have no effect

Resistant Pest Dynamics
Pest dynamics under IPM

Agro-ecosystem Dynamics Under IPM

EIL

ET

Target Sprays

monitor pest populations

biological control

Pest dynamics under IPM

Cultural control
IPM

- Decision making process
- Many options: cultural, biological, physical, mechanical, and chemical
- Requires information
How do we gain the needed information?

• Scientific Research
  – Pest life histories
  – Development models
  – Performance characteristics of control tools

• But eventually this knowledge must be applied to real world situations.
The Need to Intermediate with the Real World

• This demands that a person, which we call a pest scout, act as intermediary between the real world and all the scientific knowledge and theory behind IPM.
Site-specific Environmental and Biological Information

1. Weather and climatic conditions
2. Crop phenology and plant health
3. Pest biology and life stage
4. Beneficial organisms in the area
Role of Scouting

• The use of a scout is the primary means of obtaining the ecologically based information needed for effective IPM decision-making.
Scout’s Responsibilities

• Scouts must:
  – Understand the fundamentals of pest biology and crop health.
  – Learn the most effective and efficient methods of conducting field observations.
  – Have a working knowledge of the monitoring tools and predictive equipment available.
  – Master the pros and cons of each pest management alternative available.
Successful Pest Management

• Requires information about a pest’s
  – Biology
  – Distribution
  – Population density

• Use information to choose the best combination of tools to control the pest in a cost-effective manner.
Implementing IPM

• IPM Implementation is no easy task
  – Multitude of pest organisms present at any one time
  – Many management approaches to choose from
  – Array of tools with specific conditional requirements
QUESTIONS?