NRCCA Basic Training

Integrated Pest Management

Presented by Jaime Cummings – Field Crops and Livestock Coordinator, NYS IPM
With content adapted from Keith Waldron and Ken Wise, NYS IPM

Objectives: Elements of IPM

- **Basic concepts of IPM**
- **Steps of IPM**
- **Sampling methods**
- **Additional resources**

What is Integrated Pest Management?

IPM is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks.

-National IPM Network

Image from: ThoughtForFood.org

IPM is…

- A pest management philosophy that utilizes all suitable techniques to keep pest populations below economic injurious levels.
- Each approach must be environmentally sound and compatible with producer objectives.


Ken Wise

The IPM Philosophy….


Jaime Cummings

- **Recognizes there is no ‘cure-all’**
  - Dependence on any one method results in undesirable effects
- **Identifies and corrects the problem**
  - Understand pest biology and ecology
  - Manipulate the environment to benefit the crop over the pest
- **Recognizes that eradication is seldom necessary, desirable or possible**
  - Some damage is unavoidable and acceptable

Slide adapted from www.cias.wisc.edu IPM presentation

How IPM Works….

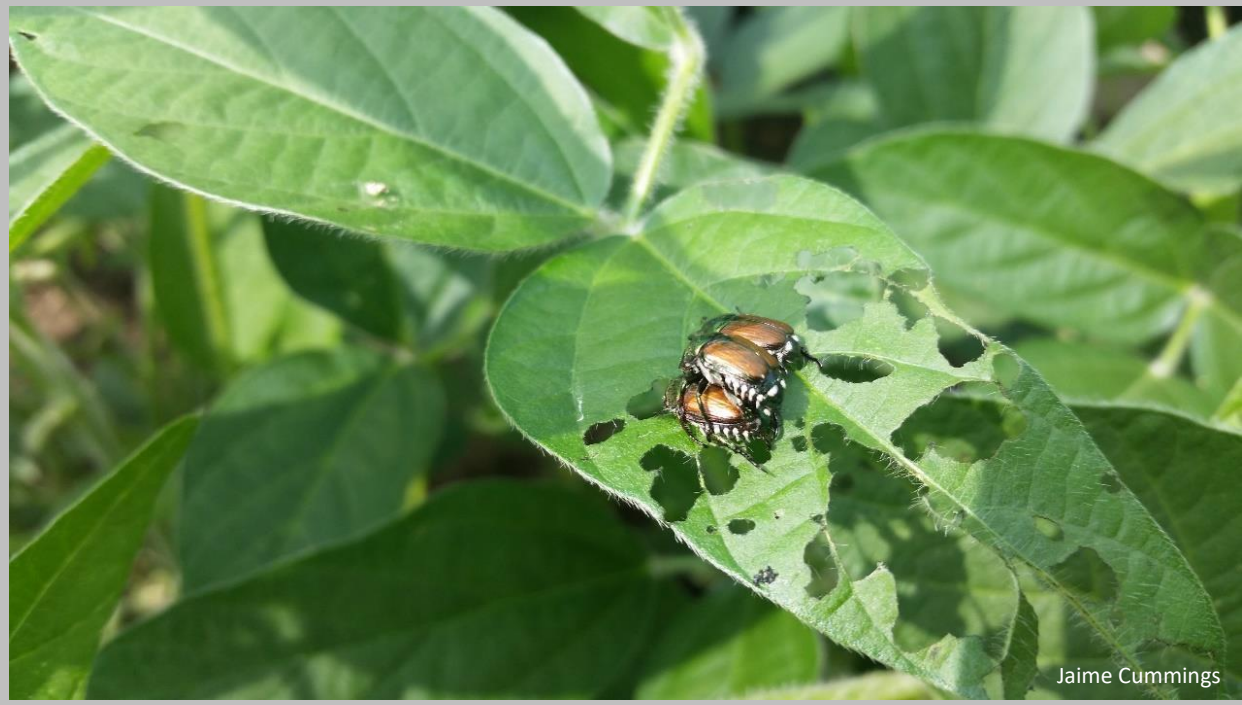

Image from Hoopoe NHBS

- Early detection of pests
- Proper identification of pests
- Accurate assessment of potential economic impact
- Timely employment of appropriate, economically efficient and environmentally sound management strategies

General IPM Strategies

- **Do nothing**
  - If at low levels, control may not be justified
- **Reduce numbers**
  - Treat-as-needed basis when thresholds reached, or as preventative based on history of problem
- **Reduce crop/host/ecosystem susceptibility**
  - Rely on host resistance, proper fertility, planting date, etc.
- **Combined strategies**
  - Diversify and integrate management options (cultural, chemical, mechanical, biological)

IPM Involves:

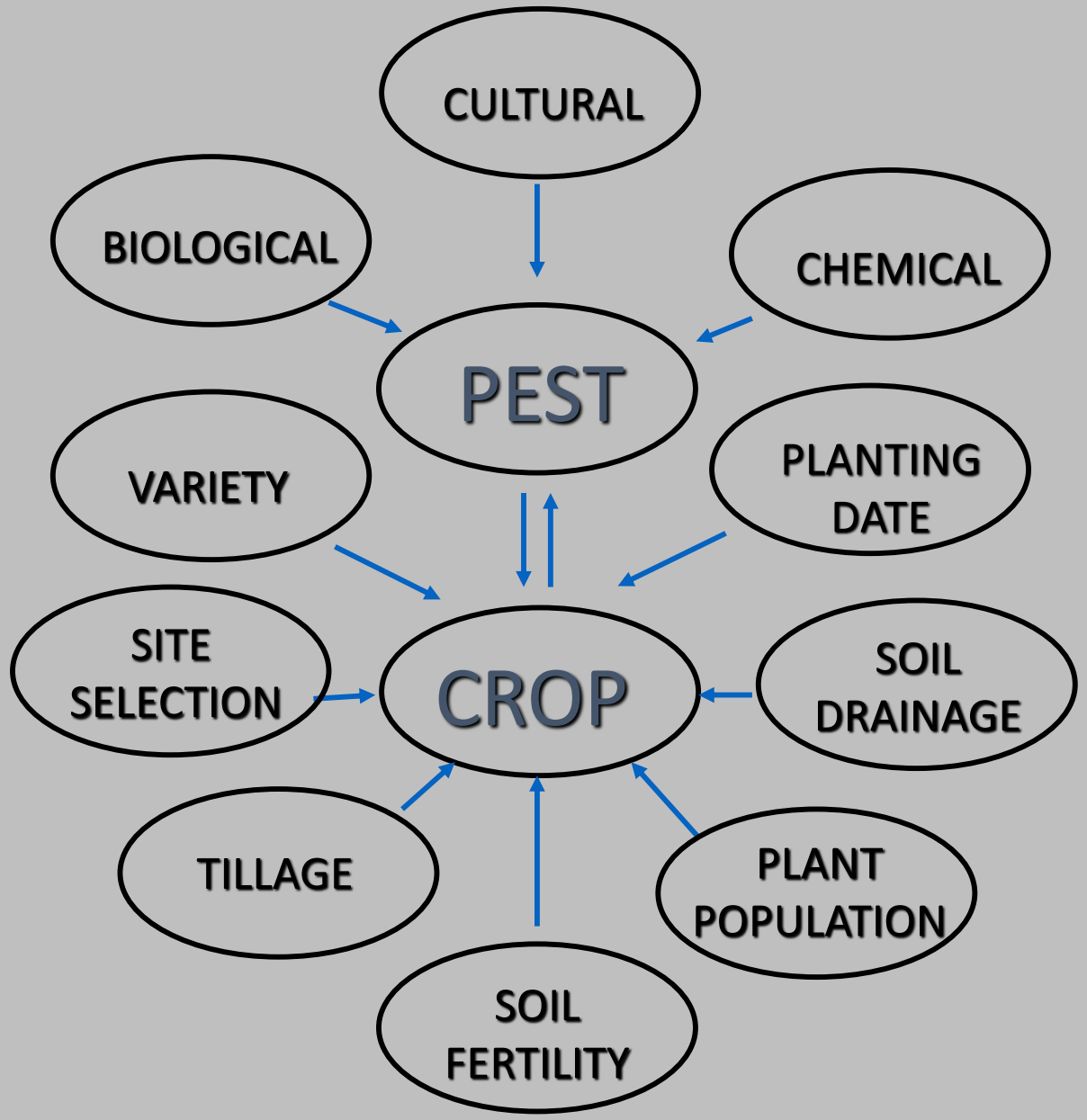


- Planning & Prevention
- Monitoring, thresholds
- Diversity of control options
- Pesticides as a last resort

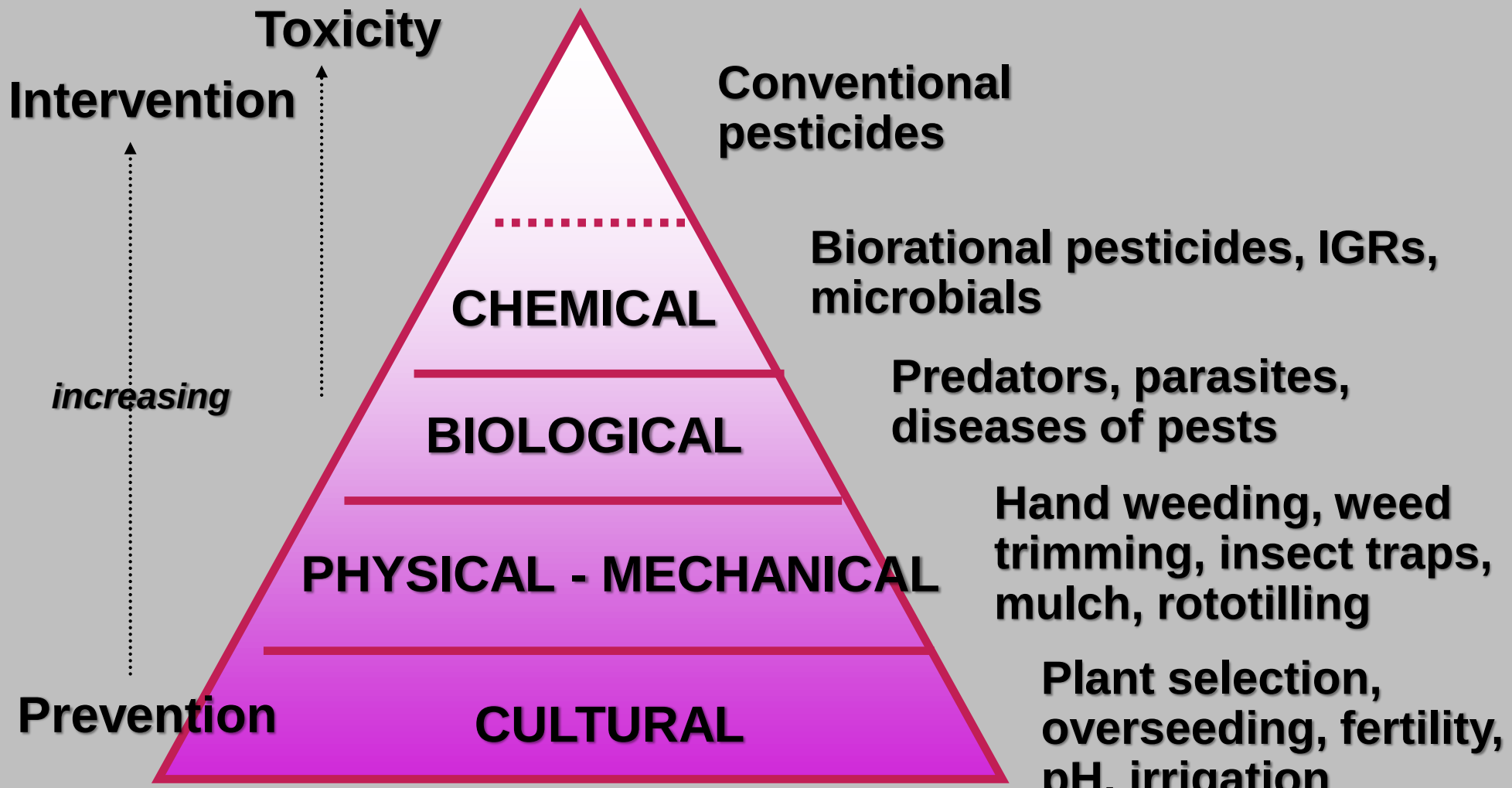
Factors Affecting Pest Population Development

- Pest and host biology
- Field history
- Presence of biocontrol (pathogens, predators, parasites)
- Initial pest levels (seed bank, inoculum)
- Temperature and weather patterns
- Soil characteristics

IPM is: Integration of Components that *Best* fit an Individual Situation



Pyramid of Pest Management Tactics



Pyramid diagram modified from PSU IPM

How do we know when we need to take action with a pesticide???

How do we know when we need to take action with a pesticide???

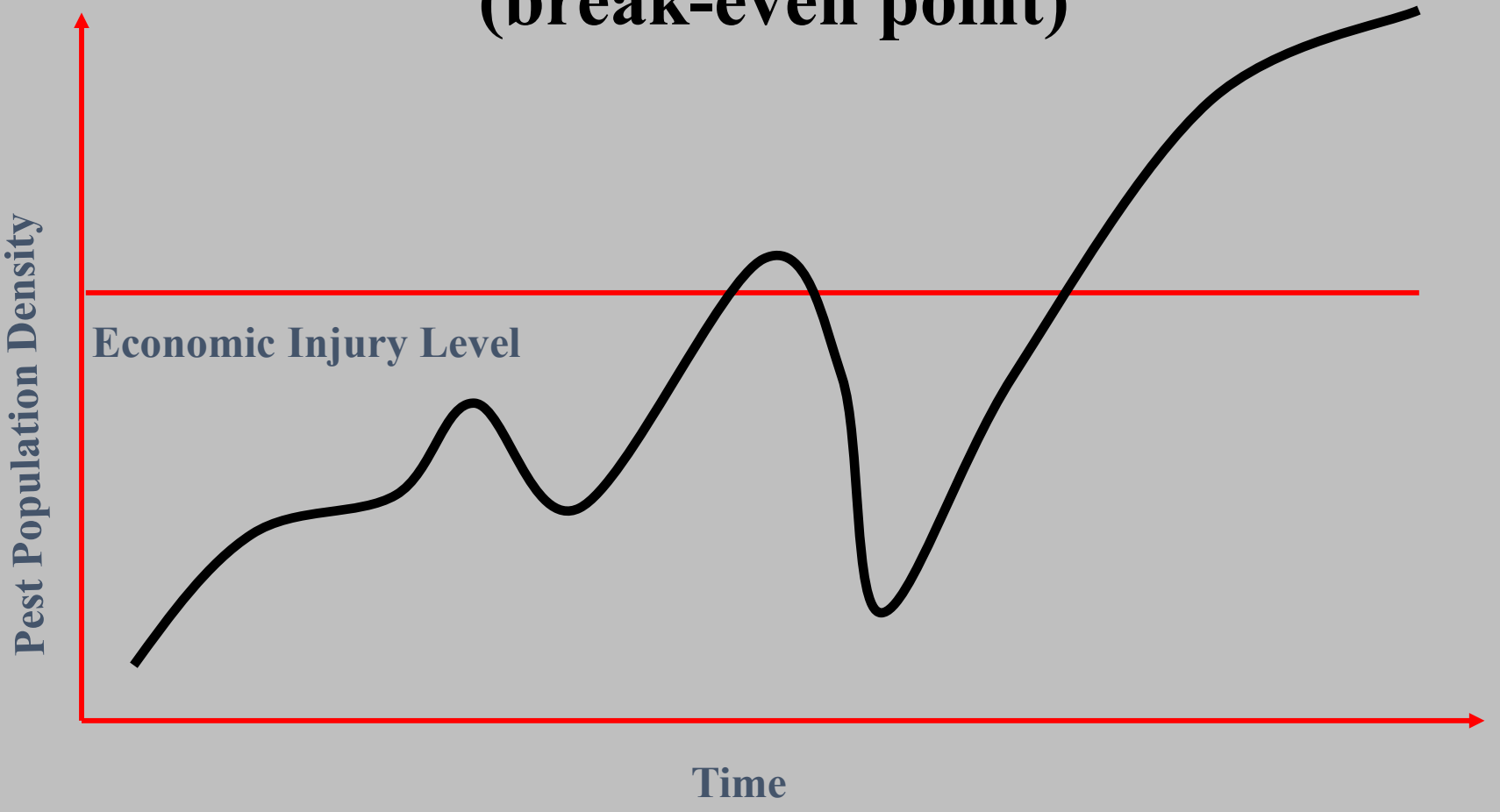
Thresholds!

Economic Injury Level

Cost of pest control = Savings from damage avoided or crop protected

(break-even point)

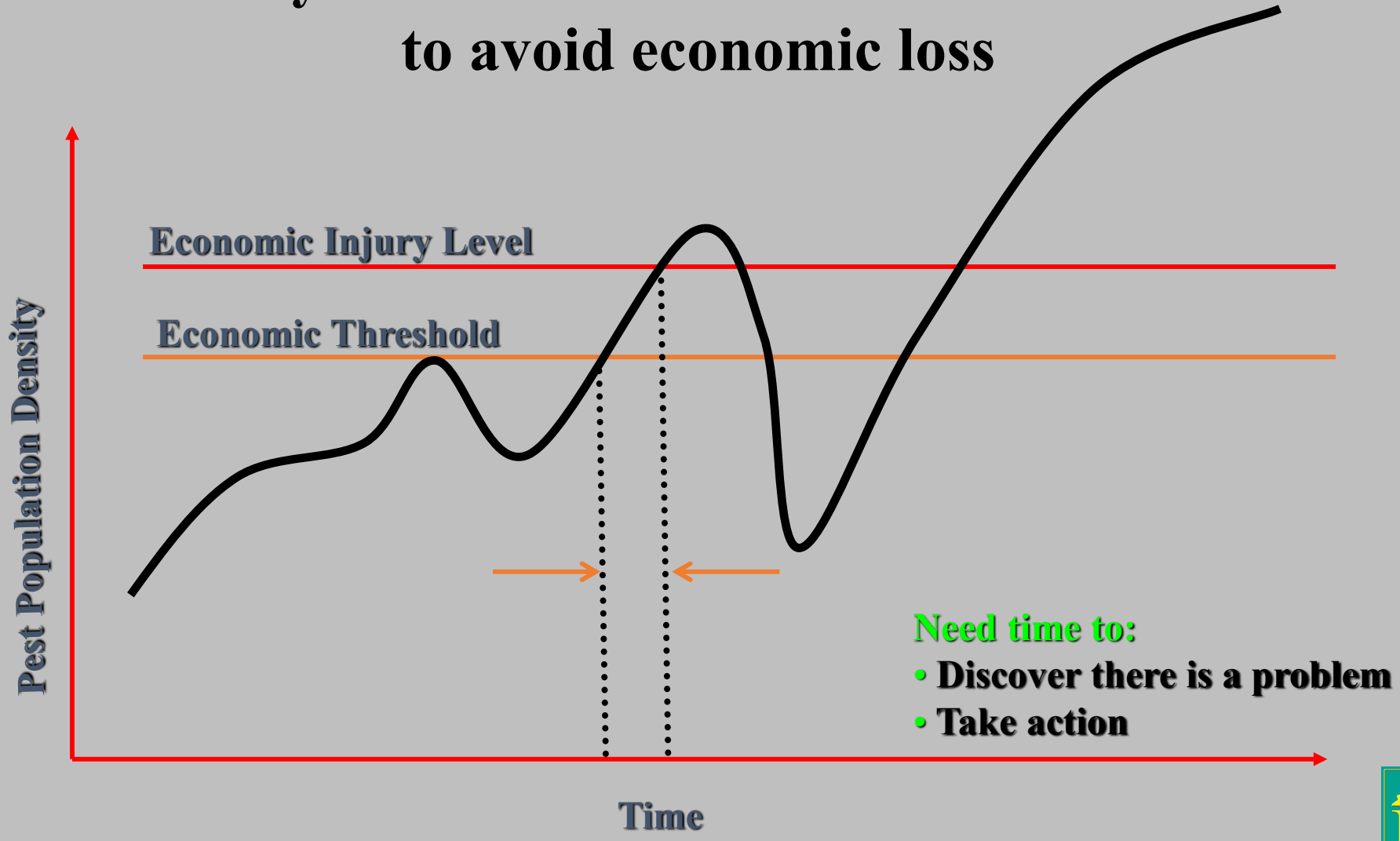
The amount of pest injury that justifies cost of a pesticide application given control costs and value of the crop



Economic Threshold

Pest density at which a control action must be taken to avoid economic loss

By setting the ET at a lower value than the EIL, we are predicting that once the population reaches the ET, chances are good that it will grow to exceed the EIL.



- **How is the EIL determined:**
  - **<u>Gain Threshold</u>: what will be the increase in yield caused by the treatment, and will it be economical**
  - **Considers cost of application and crop prices**

$$\textit{Gain threshold} = \frac{\text{Insecticide Appln. (\$18/acre)}}{\text{Harvested corn marketed (\$5/bu)}} = 3.6 \text{ bu/acre}$$

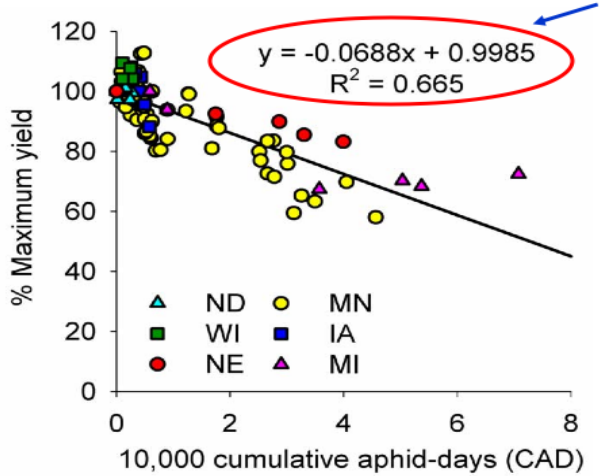
How are Economic Thresholds determined???

How are Economic Thresholds determined???

Research!

Economic Injury Level: Example: Soybean Aphids

Yield potential on y-axis



Graphic from: Ragsdale et al. 2007 JEE 100(4): 1258-1267

Yield loss equation from linear regression analysis of field research data gives us the slope and y-intercept of the line.

Measure of increasing pest insect density along the x-axis

$$EIL = \left(\frac{100C}{VYp} + a \right) \times \frac{1}{b} \times \frac{1}{K}$$

C: Cost of treatment per acre
V: Value of crop (bu/acre or tons/acre)
Yp: Yield potential
a : *y*-intercept of the yield-loss equation
b: Slope of the same yield-loss equation
K: Proportion of reduction in potential injury or damage.

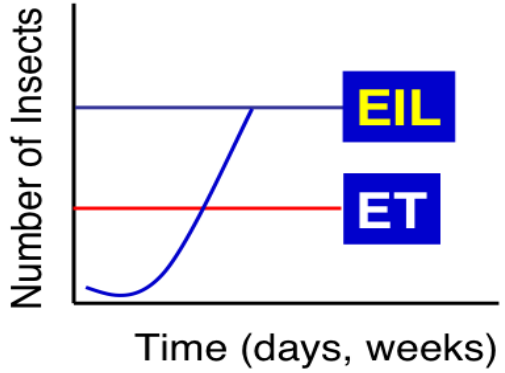
Economic Injury Level equation (Pedigo, 1999)

Economic threshold for soybean aphid. J. Econ. Entomol. 100(4): 1258-1267.

EIL: 674 ± 95

ET: 273 ± 38

250

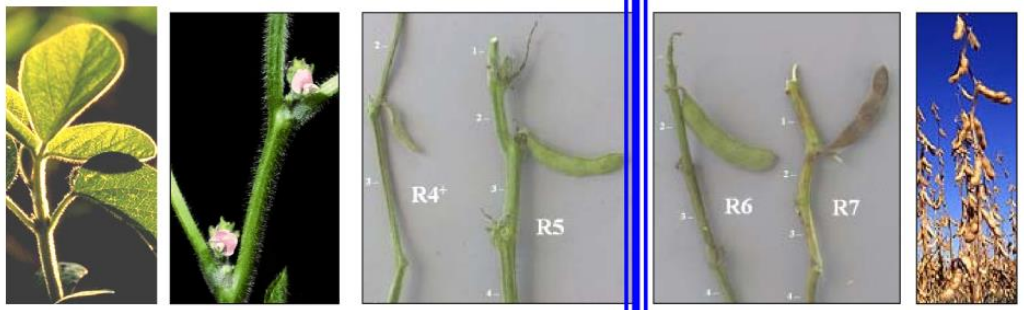


Valid from R1 through R5, NOT appropriate for R6 beans

Data from Ragsdale, et al. 2007. JEE 100(4): 1258-1267

250 aphids per plant throughout field & ACTIVELY Increasing

Do Not treat

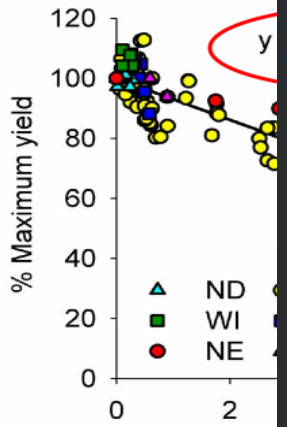


Veg stages | R1 - R2 bloom | R3-R4 pods forming, growing | R5 seeds forming, filling | R6 full seed | R7 matur-ing | R8 mature

Slide: Chris DiFonzo, Michigan State University
Photos: Iowa State University

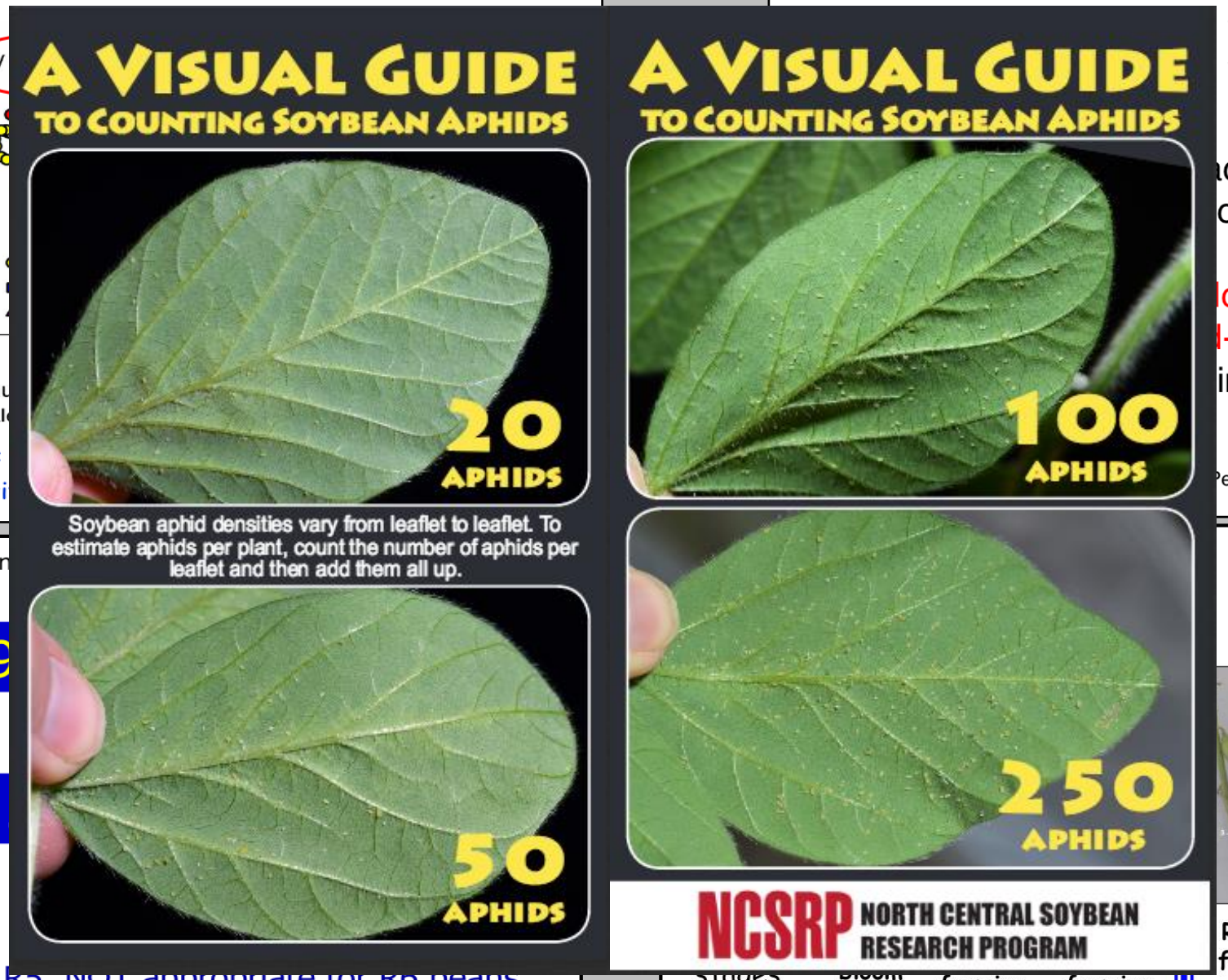
Economic Injury Level: Example: Soybean Aphids

Yield potential on y-axis



Graphic from: Ragsdal

Measure of insect densi



$$\left(\frac{1}{b}\right) \times \frac{1}{K}$$

acre
or tons/acre)

loss equation
l-loss equation
in potential injury or

Pedigo, 1999)

Economic threshold for soybean

EIL: 674 ± 9

ET: 273 ±

250

Valid from R1 through R5, NOT appropriate for R6 beans

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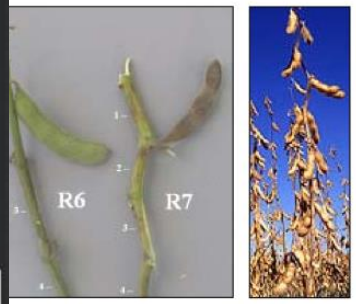
Do Not treat



R6 full seed

R7 matur-ing

R8 mature

forming, growing

forming, filling

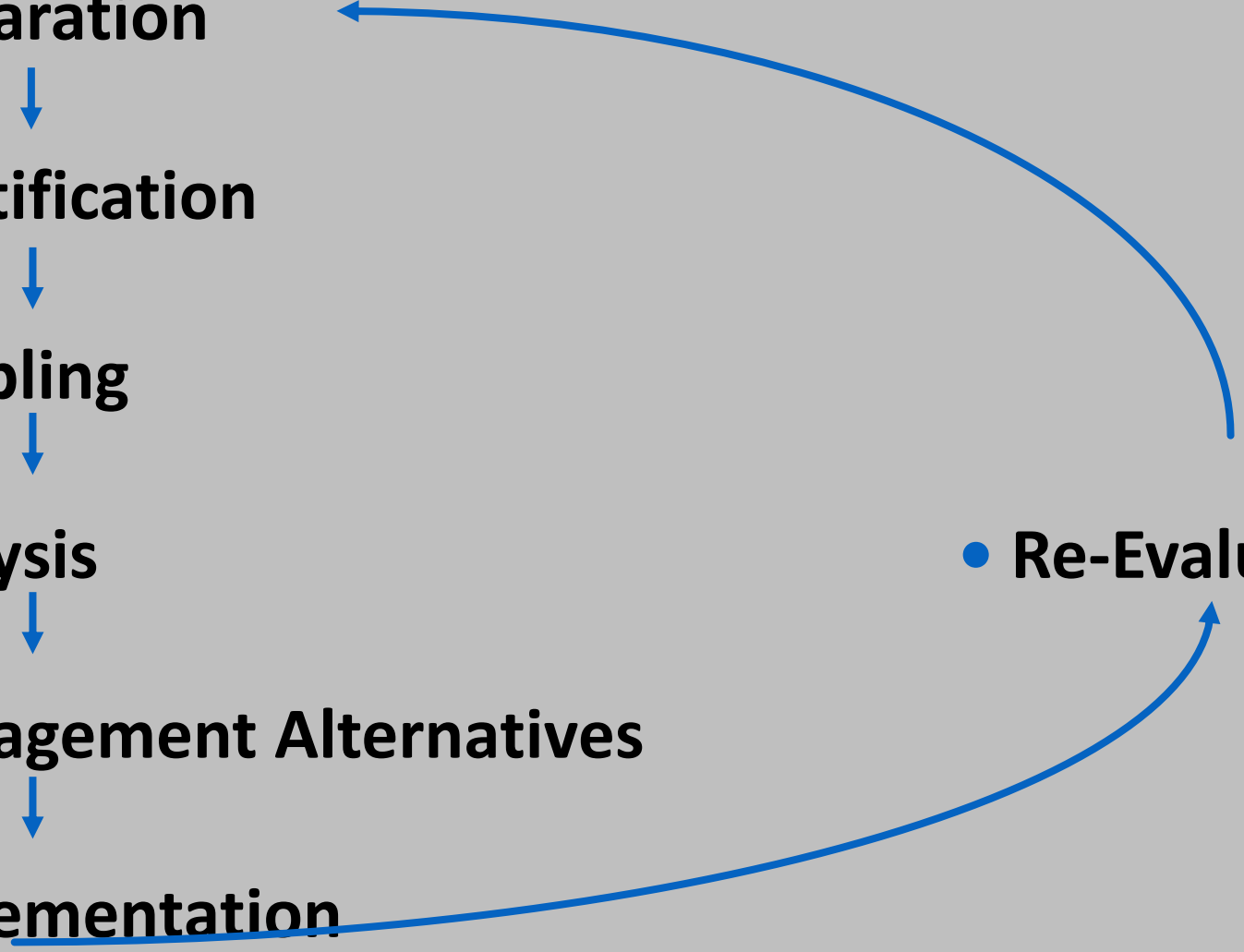
Slide: Chris DiFonzo, Michigan State University
Photos: Iowa State University

Why use an Economic Threshold?

- **EIL** – research based information on the relationship between pest population levels and crop yield loss per insect
- **Results in Improved Management Decisions**:
  - Avoid unnecessary pesticide applications ($$)
  - Avoid risk of environmental impacts
  - Reduced risk of pesticide resistance
  - Avoid risk to non-target organisms
  - Considers potential pest resurgences and secondary pests

Steps of Integrated Pest Management

- Preparation
- Identification
- Sampling
- Analysis
- Management Alternatives
- Implementation
- Re-Evaluation

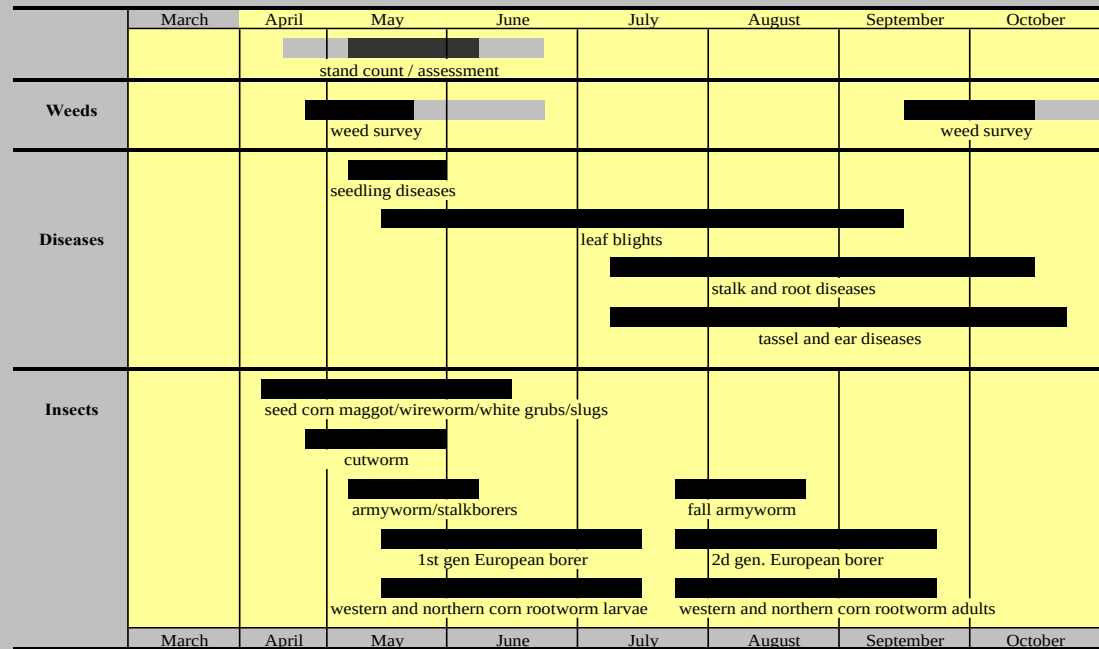


Steps of Integrated Pest Management

- **Preparation and Planning:**
  - What should you expect – common/annual problems?
  - Any new problems to be aware of?
  - Have pest/disease identification resources
  - Understand the crop – developmental stages – when stressed or susceptible
  - Understand the pest – proper ID, life cycle, when present and susceptible to control
  - Understand scouting calendars

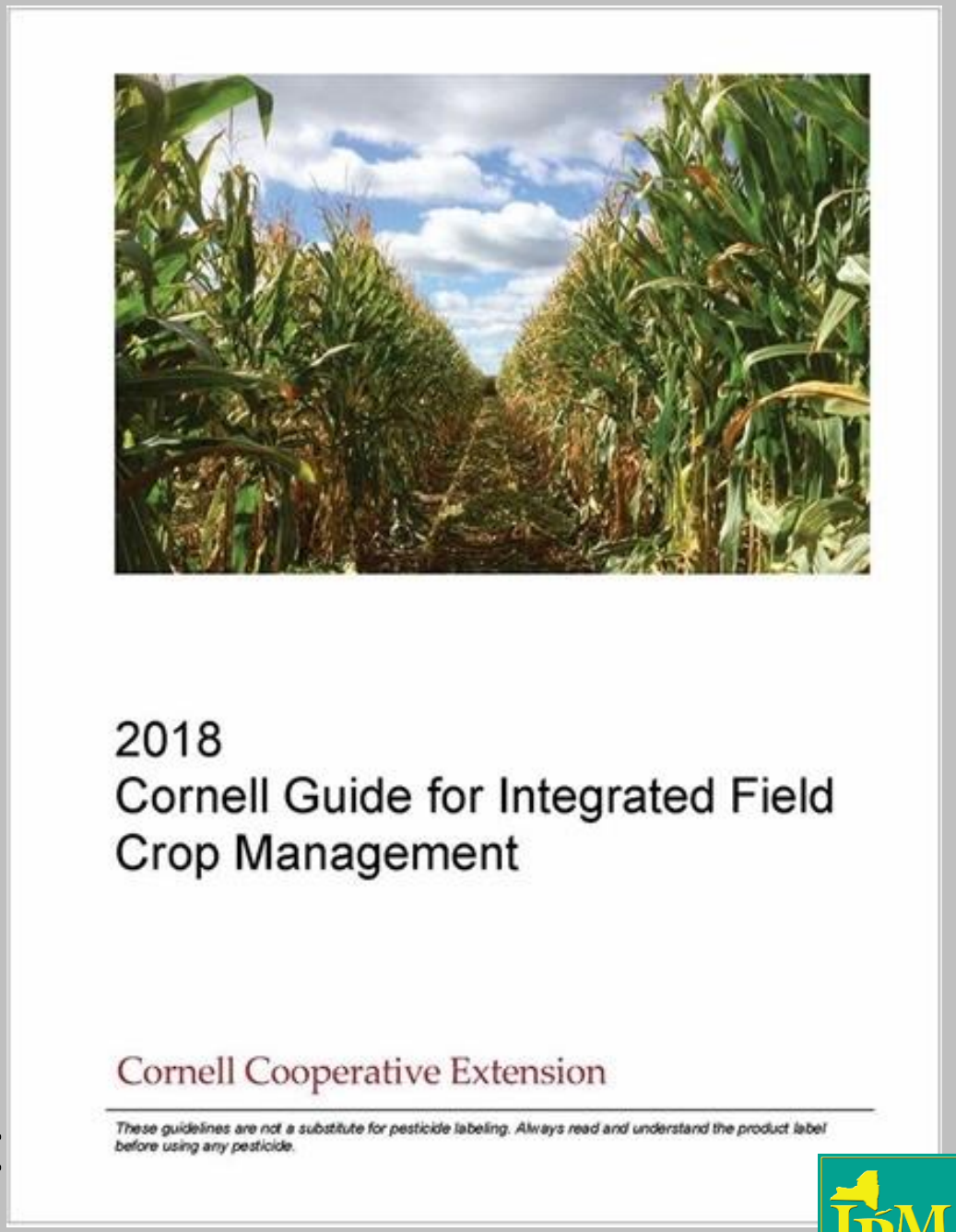
Table 4.8.1 Alfalfa pests and crop monitoring activities

Routine	Occasional
Early season through first cutting	
Population counts (crowns per square foot), weed assessments; alfalfa weevil, winter kill crown rot (established stands); seedling diseases, establishment problems (new seedings); watch for "occasional" pests	Alfalfa snout beetle, Phytophthora root rot, Sclerotinia crown and stem rot, leaf spots, cutworm, boron deficiency
Immediately after first cutting	
Population counts (crowns per square foot), alfalfa weevil; watch for "occasional" pests	Downy mildew, Phytophthora root rot, Sclerotinia crown and stem rot, leaf spots
First to second cutting	
Potato leafhopper; watch for "occasional" pests	Alfalfa weevil, Phytophthora root rot, Sclerotinia crown and stem rot, leaf spots
Second to last cutting	
Potato leafhopper, watch for "occasional" pests	Leaf spots, anthracnose, Verticillium wilt, summer black stem
After last cutting	
Weed assessments, population counts (crowns per square foot), soil sampling; watch for "occasional" pests	Alfalfa snout beetle–stressed plants, Sclerotinia crown and stem rot



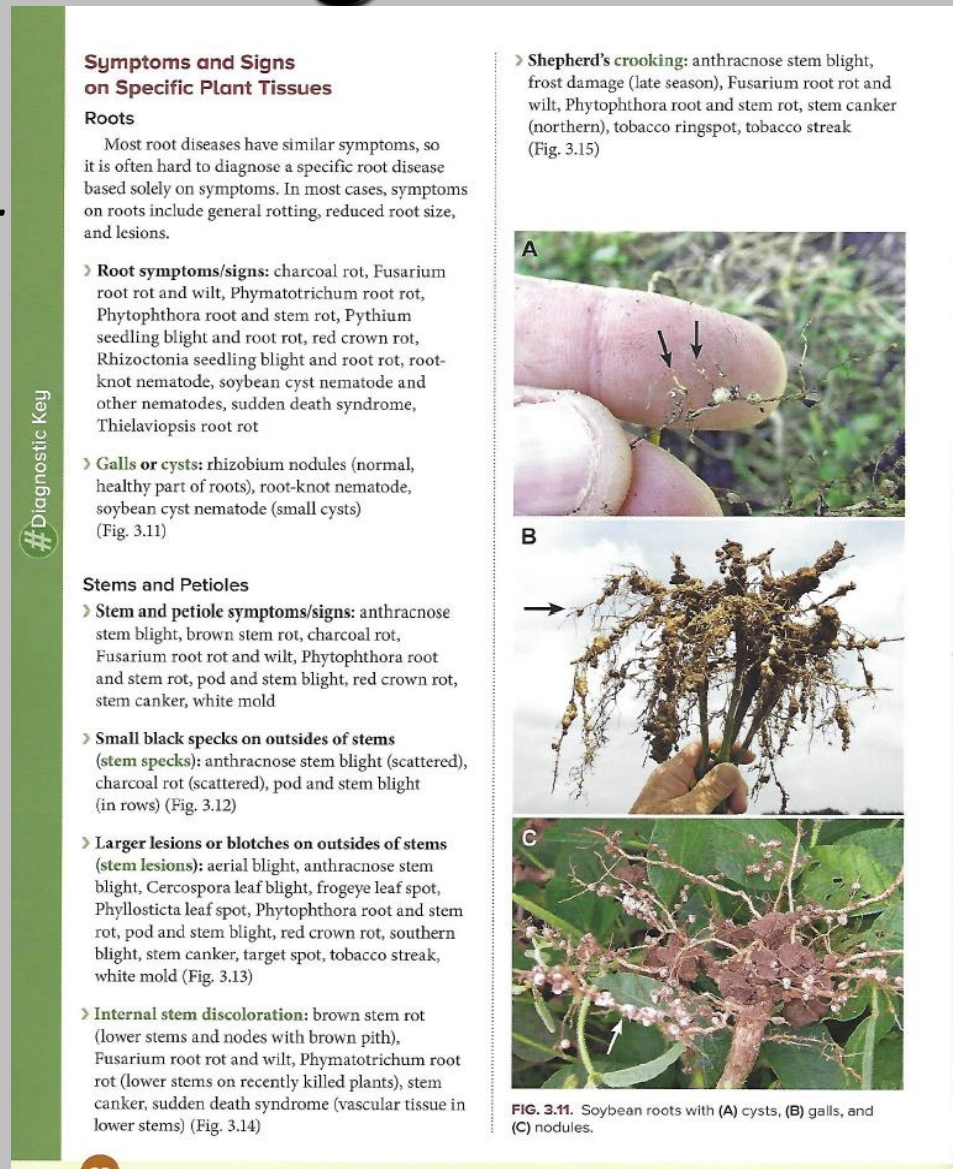
Planning Resources:

- CCE's, CCA's, growers, company reps
- Cornell Guides
- NYS IPM
- Fieldcrops.org
- Scouting calendars and guides
- Workshops, field days, meetings, other trainings
- Apps and models
- Trade journals, newsletters, weekly pest report and other publications



Steps of Integrated Pest Management

- **Identification:**
  - *MISIDENTIFICATION = MISMANAGEMENT*
  - Pest vs. Beneficial
  - Know vulnerable crop stages
  - Have keys, fact sheets or other identification aids
  - Understand proper sampling for accurate diagnosis
  - Rely on CCE or CCA or diagnostic clinic



Diagnostic Key

Symptoms and Signs on Specific Plant Tissues

Roots

Most root diseases have similar symptoms, so it is often hard to diagnose a specific root disease based solely on symptoms. In most cases, symptoms on roots include general rotting, reduced root size, and lesions.

› **Root symptoms/signs:** charcoal rot, Fusarium root rot and wilt, Phymatotrichum root rot, Phytophthora root and stem rot, Pythium seedling blight and root rot, red crown rot, Rhizoctonia seedling blight and root rot, root-knot nematode, soybean cyst nematode and other nematodes, sudden death syndrome, Thielaviopsis root rot

› **Galls or cysts:** rhizobium nodules (normal, healthy part of roots), root-knot nematode, soybean cyst nematode (small cysts) (Fig. 3.11)

Stems and Petioles

› **Stem and petiole symptoms/signs:** anthracnose stem blight, brown stem rot, charcoal rot, Fusarium root rot and wilt, Phytophthora root and stem rot, pod and stem blight, red crown rot, stem canker, white mold

› **Small black specks on outsides of stems (stem specks):** anthracnose stem blight (scattered), charcoal rot (scattered), pod and stem blight (in rows) (Fig. 3.12)

› **Larger lesions or blotches on outsides of stems (stem lesions):** aerial blight, anthracnose stem blight, Cercospora leaf blight, frogeye leaf spot, Phyllosticta leaf spot, Phytophthora root and stem rot, pod and stem blight, red crown rot, southern blight, stem canker, target spot, tobacco streak, white mold (Fig. 3.13)

› **Internal stem discoloration:** brown stem rot (lower stems and nodes with brown pith), Fusarium root rot and wilt, Phymatotrichum root rot (lower stems on recently killed plants), stem canker, sudden death syndrome (vascular tissue in lower stems) (Fig. 3.14)

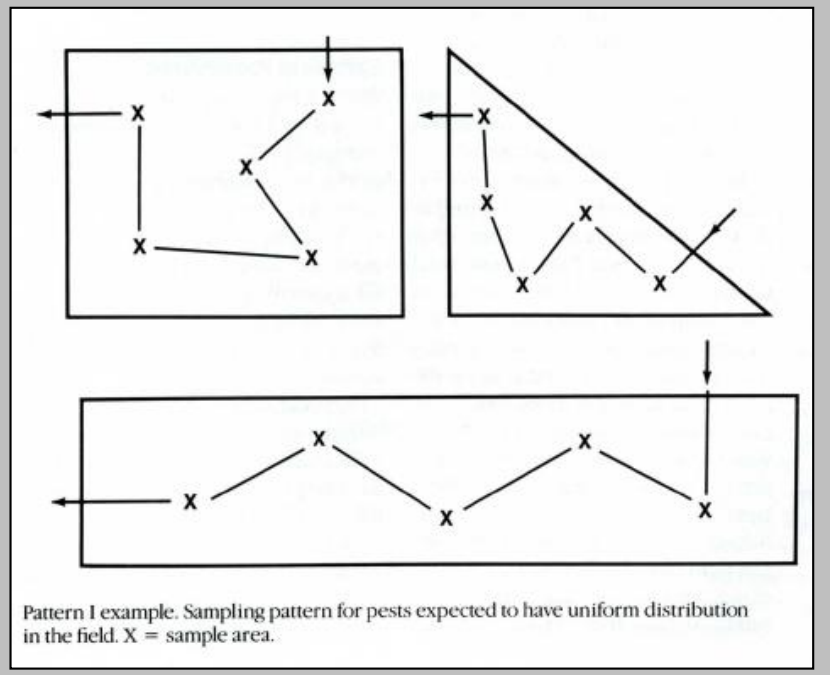
› **Shepherd's crooking:** anthracnose stem blight, frost damage (late season), Fusarium root rot and wilt, Phytophthora root and stem rot, stem canker (northern), tobacco ringspot, tobacco streak (Fig. 3.15)

FIG. 3.11. Soybean roots with (A) cysts, (B) galls, and (C) nodules.

From: Farmer's Guide To Soybean Diseases

Steps of Integrated Pest Management

- **Sampling:**
  - = Scouting!
  - Quantifying old problem or discovering new problem?
  - <u>Follow proper scouting procedures for EACH individual pest</u>
    - One time vs. consecutive scouting
    - Random vs. sequential sampling
    - Incidence vs. severity – diseases and insects
    - Males vs. females – different damage?



Pattern I example. Sampling pattern for pests expected to have uniform distribution in the field. X = sample area.

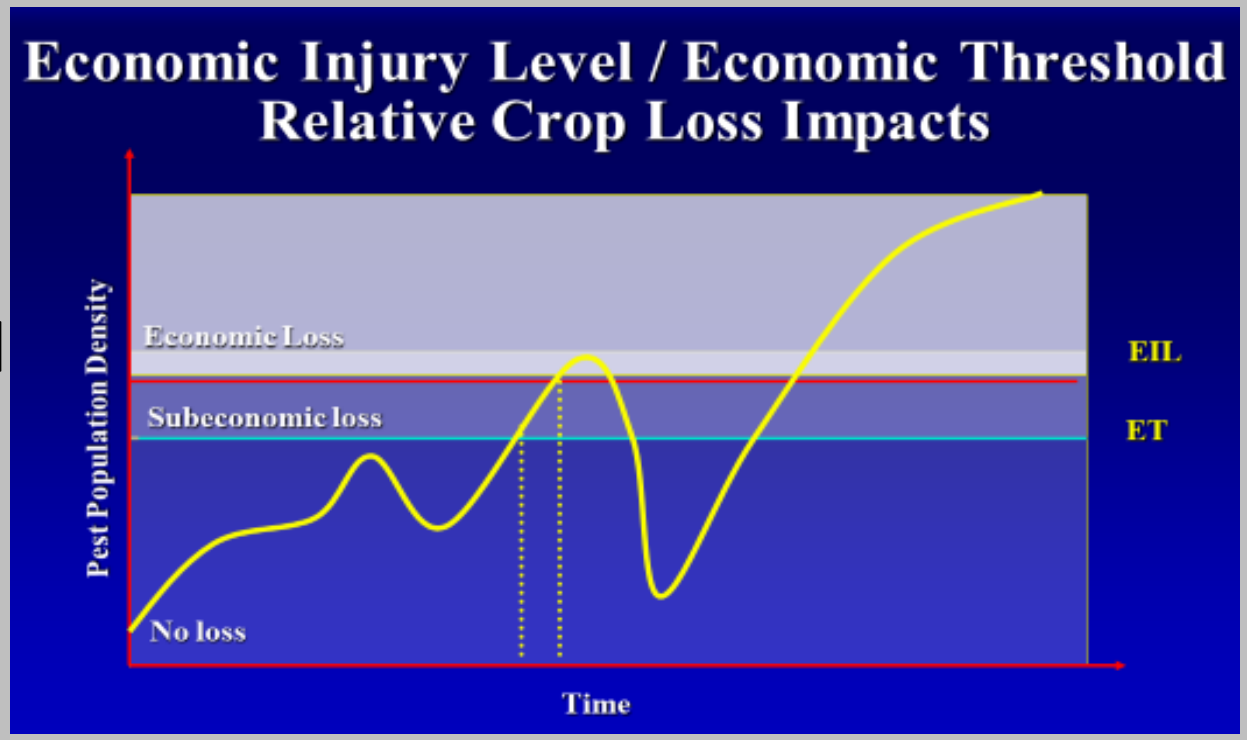
Scouting Field Kit

- Clip board with paper/scouting form
- Phone/camera/GPS/Apps
- Hand lens
- Bags or containers for samples
- Trowel/shovel/knife
- Flagging tape
- Pocket guides
- Sweep net

Image from Decisive Farming

Steps of Integrated Pest Management

- **Analysis:**
  - Evaluate the risk
  - Is there a problem? How bad?
  - Consult threshold guidelines
  - Weigh economic, environmental and time concerns
  - Is damage more costly than control?
  - What happens if you do nothing?
  - Economic Injury Level (EIL)
  - Economic Threshold (ET)



Steps of Integrated Pest Management

- **Management Alternatives:**
  - What can be done?
    - Cultural, mechanical, biological, chemical
    - What are the economics of each option?
    - What are the windows of opportunity for action?
  - Does the system allow for the options?
    - Ex: will early harvest interfere with other plantings?
  - What is the optimum IPM option(s) for an individual farm based on their situation and resources?

Image from IVA Information

Steps of Integrated Pest Management

- **Management Alternatives:**
  - **Cultural** – genetic resistance (GMO), planting date, early harvest, improving drainage, rotation, populations, sanitation, fertility and pH
  - **Mechanical** – roguing, hand-picking off pests, row covers, traps, tillage
  - **Biological** – biocontrol (ex: entomopathogenic nematodes, beneficial fungi/bacteria/insects)
  - **Chemical** – pesticides, attractants, repellents, baits

Steps of Integrated Pest Management

- **Implementation/Intervention:**
  - Timely action with precision and thoroughness!
    - Actions at appropriate growth stages (ex: weed emergence)
    - Use quality control (ex: calibrate sprayer)
  - Integrated approach: use pesticides only where necessary
  - Leave non-treated areas for comparison
  - Keep good records of actions taken

Image from Sprayers 101

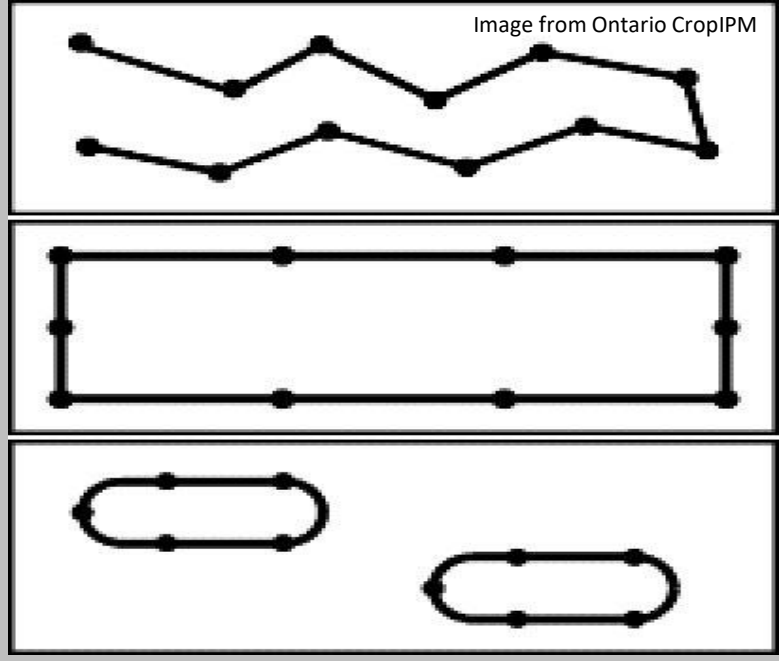
Steps of Integrated Pest Management

- **Re-evaluation:**
  - What worked or went wrong?
  - Were pests and thresholds correctly identified?
  - Was sampling unbiased to arrive at decision?
  - Was control choice sound, or based on salesperson pressure?
  - Compare treated to non-treated areas
  - What changes to the management system would make it better in the future???

Sampling Method Matters

- **<u>Scouting/sampling varies by crop and by pest!</u>**
- Correct sampling accurately quantifies pest problems
- **Insects**:
  - Scouting calendars available for specific pests
  - Sweep net – mobile insects (ex: potato leaf hopper)
  - Beat cloth – less mobile insects (ex: spider mites, aphids)
  - Traps – pheromone, lights, sticky
- **Diseases**:
  - Scout throughout growing season
  - May be in patterns or randomly distributed
- **Weeds**:
  - Scout in spring and fall
  - Document weed type rather than counts of species

Field Sampling Patterns



- **Random**: for mobile insects, some diseases
- **Consecutive**: immobile insects

- **Distribution in the field**:
  - Random – ex: European corn borer, potato leaf hopper, most foliar diseases
    - Walk a random pattern in the field
  - Concentrated – ex: black cutworm, white grubs, many soilborne diseases
    - Focus on low/wet or dry areas that pests/disease prefer
  - Edges First – ex: spider mites, army worm, alfalfa snout beetle
    - Walk fence rows, field borders and ditches

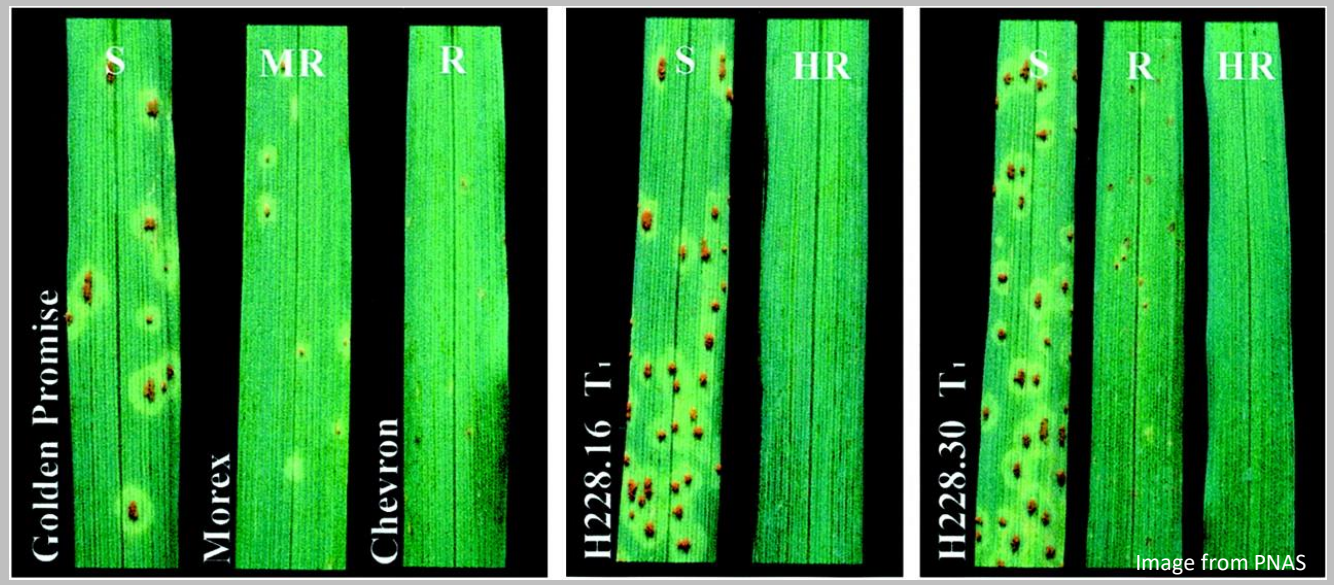
Monitoring Methods and Quantification

- **Absolute**: direct visual counts of pest/disease per plant/field
  - Advantage: broad range of applicability
  - Disadvantage: time consuming
- **Relative**: estimate per unit of time/effort (ex: sweep net, traps)
  - Advantage: easy and less time consuming
  - Disadvantage: efficiency affected by pest behavior, requires more info to relate estimates to potential damage
- **Population Indices**: percentage of plants infected, % defoliation, % root rot, etc.
  - Advantage: more directly related to yield loss
  - Disadvantage: may not allow time to take action (quantifying damage too late)

Responses to Injury from Pests and Diseases:

- **Resistance**: ability to overcome, completely or to some degree, the effect of the disease or pest
- **Tolerance**: ability to sustain the effects without dying or suffering serious injury or loss
- **Susceptibility**: inability to withstand the effects of a pathogen or pest

- Rating Scales:
- S, MS, MR, R



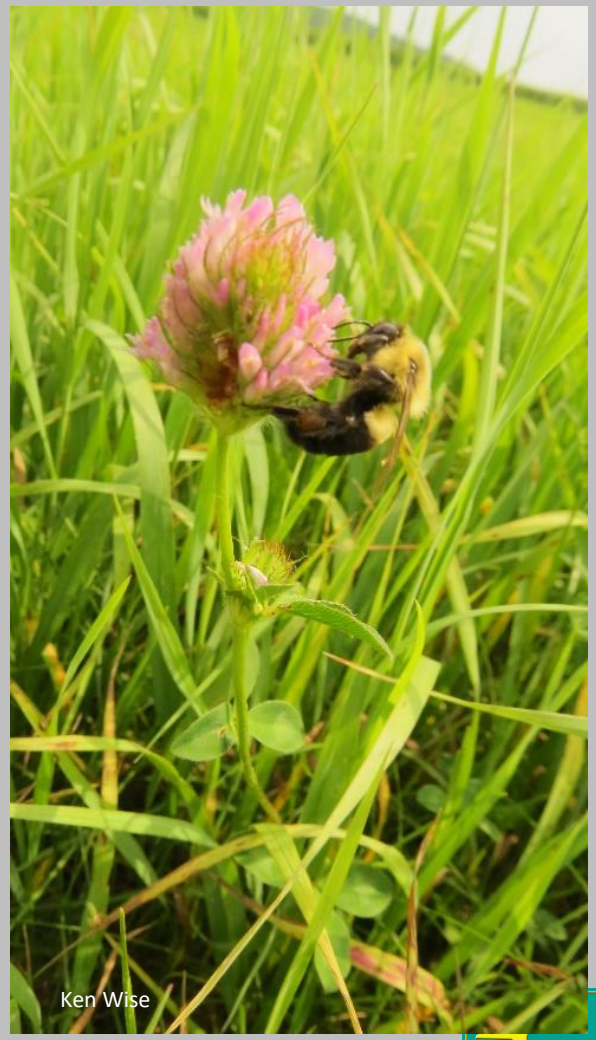
In Summary: 4 Basic Principles of IPM

1. **Thorough understanding of the crop, pest and environment and their interrelationships**
2. **Requires advanced planning**
3. **Balances costs/benefits of all control practices, including doing nothing!**
4. **Requires routine monitoring of crop and pest conditions**

Image from weleadworship.com

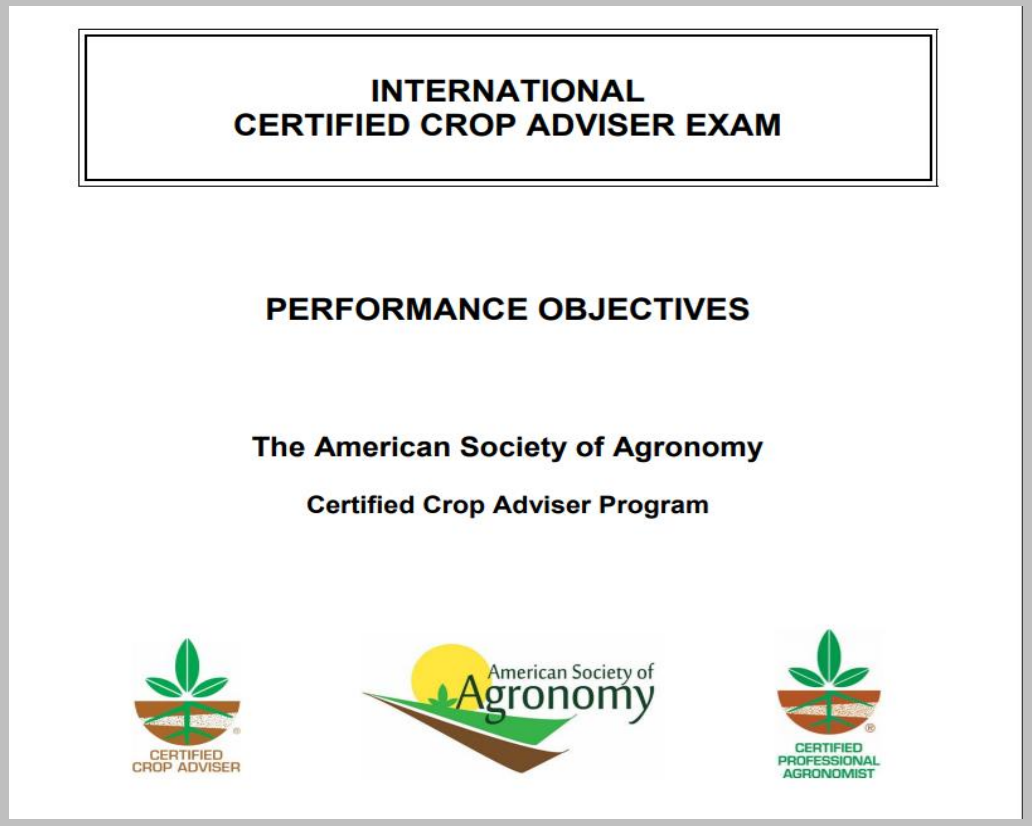
In Summary: The Benefits of an IPM Program

- **Protects the environment and personal health through elimination of unnecessary pesticide applications**
- **Improves profitability by eliminating wasteful pesticide applications**
- **Reduces crop loss because of scouting practices and thresholds**
- **Peace of mind!**



Study Resources for CCA Exam

- NRCCA Pest Management Study Guide
- ICCA Performance Objectives Study Guide
- Cornell Guide for Integrated Field Crop Management



INTERNATIONAL
CERTIFIED CROP ADVISER EXAM

PERFORMANCE OBJECTIVES

The American Society of Agronomy

Certified Crop Adviser Program

CERTIFIED CROP ADVISER

American Society of Agronomy

CERTIFIED PROFESSIONAL AGRONOMIST

Nutrient Management
Pest Management
Crop Management
Soil and Water Management

Northeast Region Certified Crop Adviser (NRCCA) Study Resources

Search: go

ANNOUNCEMENTS

The next Northeast Region Certified Crop Adviser exam will be held February 2, 2018.
Exam information.

WHAT IS CCA?

The Certified Crop Adviser (CCA) Program is a voluntary professional certification program offered by the American Society of Agronomy (ASA). It is the largest certification program in agriculture with over 12,000 certified throughout the USA and Canada.

CCA RESOURCES

- ICCA website
- NRCCA website
- ASA website
- How to become a CCA
- ICCA performance objectives
- NRCCA performance objectives
- NRCCA manual
  - Nutrient management (pdf)
  - Soil+water management (pdf)
  - Pest management (pdf)
  - Crop management (pdf)
- Additional resources

The learning modules and materials available through this course website prepare prospective Certified Crop Advisers (CCAs) for the Northeast Region CCA exam. The exam covers four major areas of expertise: nutrient management, pest management, crop management, and soil and water management. Each area of expertise is divided into competency areas (CAs) composed of performance objectives (POs). Click on the links below to access the various sections of the course.

NUTRIENT MANAGEMENT COMPETENCY AREAS

- CA1: Basic concepts of plant nutrition
- CA2: Basic concepts of soil fertility
- CA3: Soil testing and plant issue analysis
- CA4: Nutrient sources and application methods
- CA5: Soil pH and liming
- CA6: Nutrient management planning

PEST MANAGEMENT COMPETENCY AREAS

- CA1: Integrated pest management
- CA2: Weed management
- CA3: Management of infectious plant diseases
- CA4: Management of arthropods
- CA5: Pesticide formulations and labels
- CA6: Management of pesticide resistance
- CA7: Using pesticides in an environmentally sound manner
- CA8: Protecting humans from pesticide exposure

CROP MANAGEMENT COMPETENCY AREAS

- CA1: Crop adaptation
- CA2: Crop staging, growth and development
- CA3: Tillage systems
- CA4: Seeding factors
- CA5: Seeding rates and row spacing
- CA6: Considerations in replanting decisions
- CA7: Forage harvesting factors
- CA8: Cropping systems

SOIL AND WATER MANAGEMENT COMPETENCY AREAS

- CA1: Basic soil properties
- CA2: Soil hydrology AEM
- CA3: Drainage and irrigation AEM
- CA4: Soil health and compaction
- CA5: Soil conservation AEM
- CA6: Watershed hydrology AEM
- CA7: Non-point source pollution A
- CA8: Concentrated source pollutio
- CA9: Conservation planning AEM

IPM

KEEP
CALM
AND
GOOD LUCK
WITH THE EXAM!

Image from Askideas.com

Image from TechFlourish

STUDY HARD!