Introduction to Integrated Pest Management (IPM)

Key points of IPM

- **Integration**
  - Harmonious use of multiple methods to control single pests or pest complexes
- **Pest**
  - An organism detrimental to humans, including: invertebrates, vertebrates, weeds, and pathogens
- **Management**
  - Decisions based on ecological principles and economic and social considerations

Kogan, M. 1998. INTEGRATED PEST MANAGEMENT: Historical Perspectives and Contemporary Developments, Annual Review of Entomology. Vol. 43: 243-270.

Key points of IPM

- ***IPM is a multidisciplinary endeavor***
  - Agronomy (crop and soil science)
  - Entomology (insects: pests and beneficial)
  - Plant pathology (plant diseases)
  - Economics (decision-making)
  - Agricultural Engineering (machinery, grain handling, etc.)
  - Climatology (weather trends and effects)

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History

- ~2500 BC: The element sulfur was found to help control mite and insect populations

- ~1500 AD to present: some plants found to generate insecticidal—and more recently—herbicidal compounds
  - Pyrethrum (pyrethrin - insecticidal)
  - The Neem tree (NEEM - insecticidal)
  - Bottlebrush plant, *Callistemon sp.* (herbicide Callisto)

History

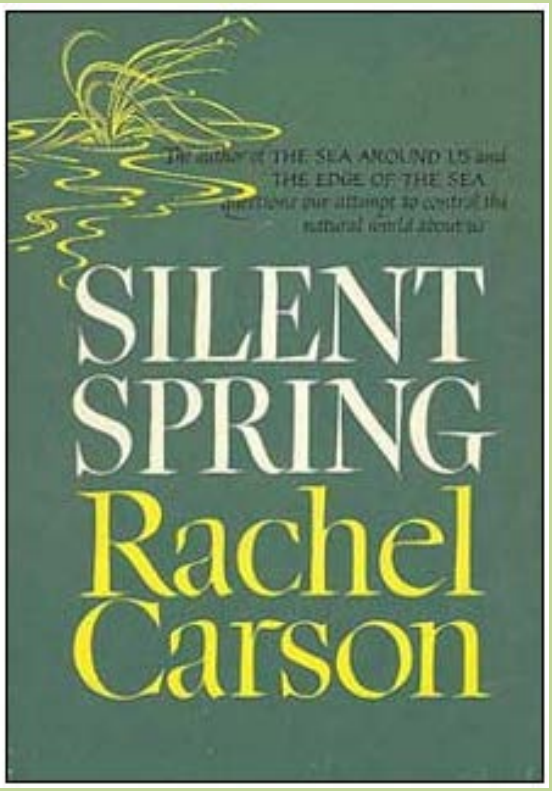
- Late 1800s: inorganic compounds used for insect and fungal organism control, including:
  - Paris green (copper acetoarsenate)
  - Bordeaux mix (copper sulfate and hydrated lime)
  - Lead arsenate
  - Creosote (coal tar derivative)
  - Sodium hypochlorite solutions (bleach)

History

- 1939 (dawn of the modern insecticide era): DDT recognized as an effective insect control
- Late 1940s (post WWII): the advent of “chemical” pesticides including 2,4-D
- 1948 Warfarin™ registered as a rodenticide (and later -in the early 1950s- as an anticoagulant in human medicine)

History

- 1962: Silent Spring published
- 1967: the term “IPM” first used



History

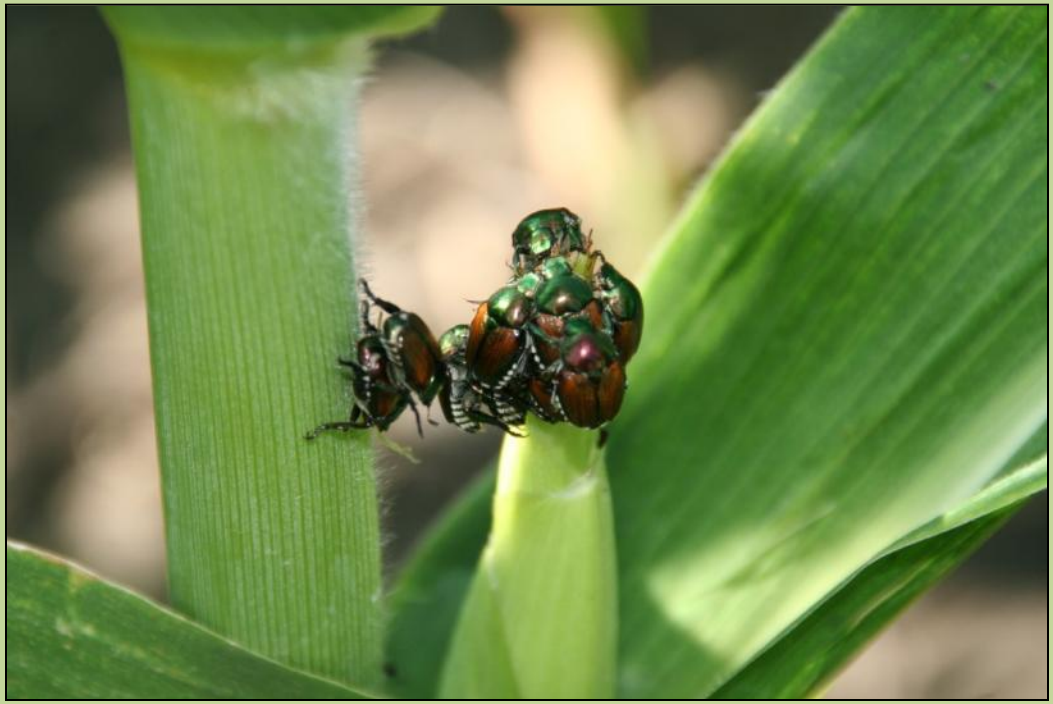
- 1970: the United States Environmental Protection Agency (EPA) was founded
- 1979: the Iowa State University IPM program began
- 1993: call for 75% of U.S. crop acreage grown under IPM principles (by 2000)

History

- 1996: Roundup-ready® soybeans introduced in the U.S. By 2005, 87% of commercial U.S. soybean acres were Roundup-ready® varieties
- In 1998 Roundup-ready® corn introduced in the U.S.
- 2000s: U.S. farmers now apply over 1.2 billion pounds of pesticides annually
- Today: with increasing knowledge of pests, crops, and improving technologies, field-specific management is possible

IPM

1. **What is "normal?"**
   - Is it really a problem?



IPM

2. What is the problem?

- Proper identification is critical; that is why it is the first step.

3. How and what does the pest attack?

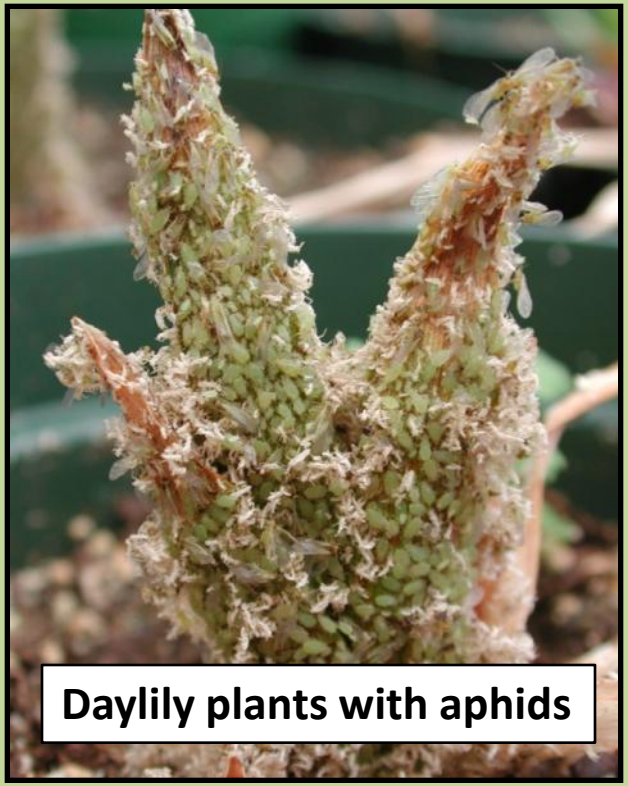
- Only the plant of interest affected?
- Parts of plant affected?
- Patterns in field?

Kogan 1998

IPM

4. How many pests are there?

- Is it too early or too late to control?
- Management must be at the correct time to maximize effectiveness.



5. Determine an action threshold

- How many pests are too many?
- Economic, health, and aesthetic threshold

Kogan 1998

IPM

6. <u>Choose appropriate management tactics</u>

- For many pests, there are several management options to consider.

7. Review your work:

<u>Was the management effective?</u>

- Did actions do what you wanted?
- Was the method itself satisfactory?
- Were there any unintended side effects?
- What will be done in the future for this pest situation?

Kogan 1998

Three important components

- **Economic injury level**
  - Lowest population density that will cause economic damage
- **Economic threshold**
  - Population size large enough to trigger an action to prevent an increasing pest population from reaching the economic injury level
- **General equilibrium position**
  - Average density of a population over time

Stern et al. 1959

Costs vs. Benefits of a Practice

Costs

- Product cost
- Fuel
- Labor
- Marketing options
- May increase crop damage from secondary pests

Spider mite damage to soybean

Costs vs. Benefits of a Practice

Costs

- Product cost
- Fuel
- Labor
- Marketing options
- Predisposition to secondary pests

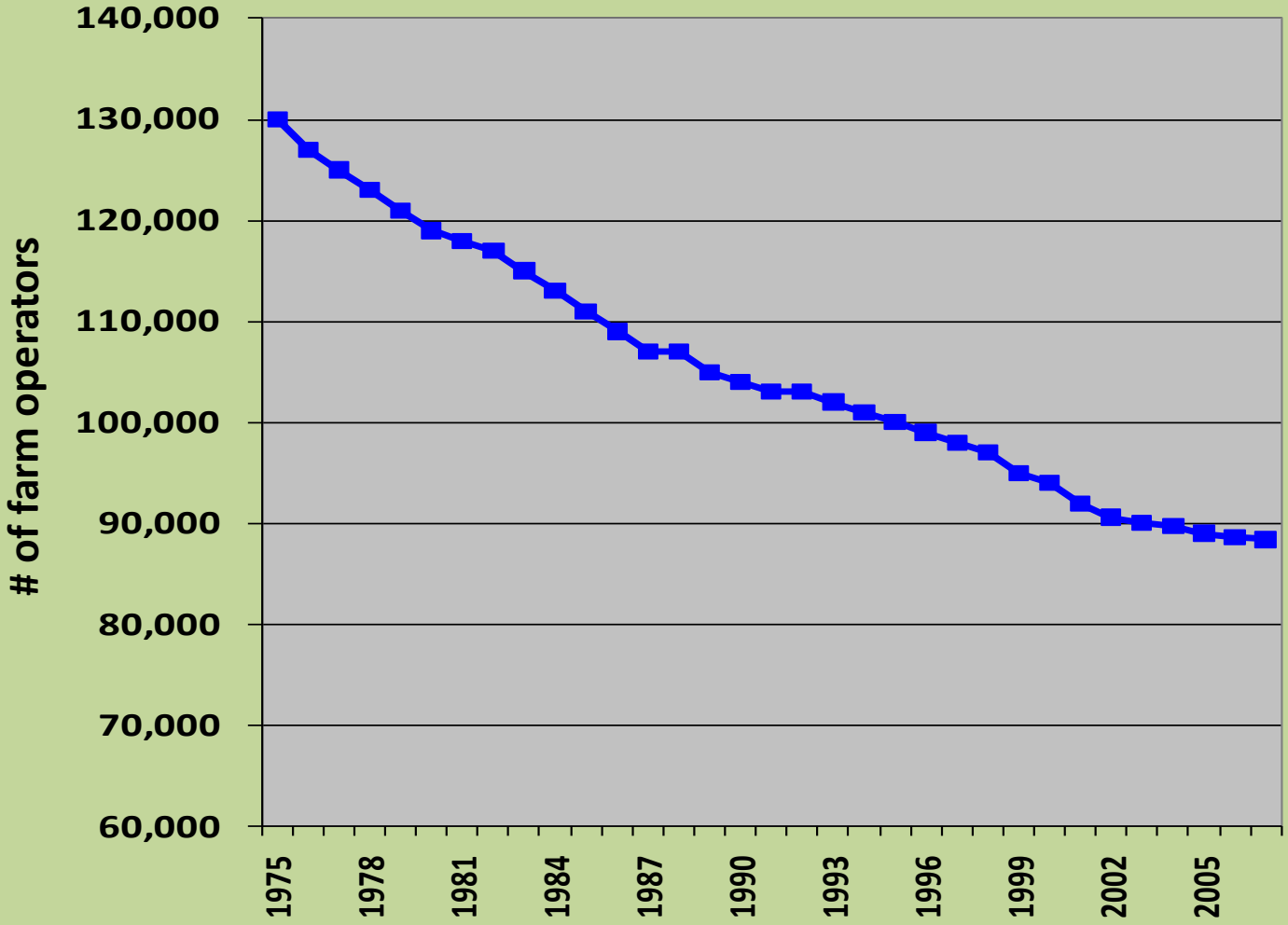
Benefits

- Yield (economic)
- Quality (economic)
- Appearance (aesthetics)
- Human/livestock health
- Legal issues
- Acceptance of resultant commodity by end users
- Ease of mind

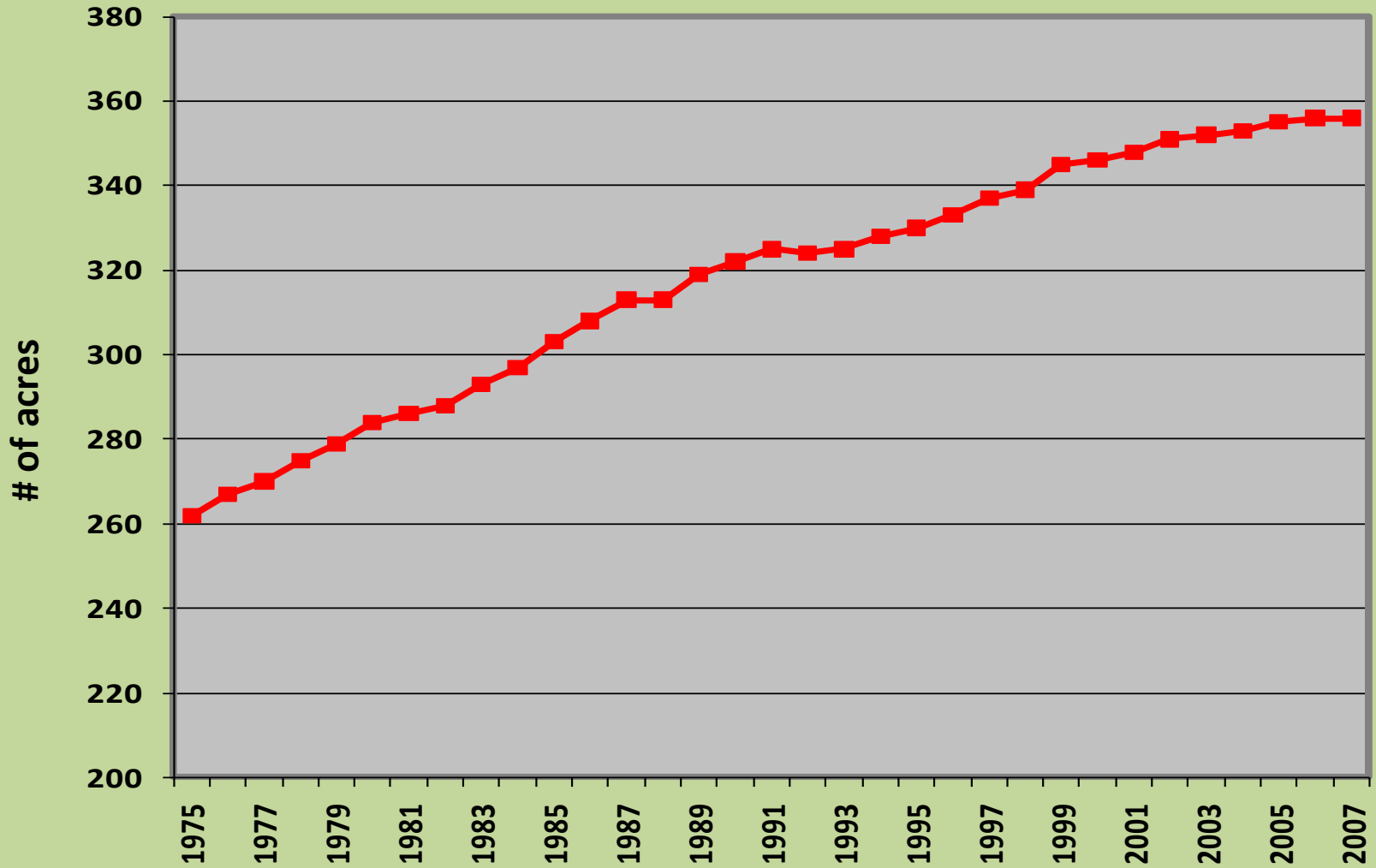
What has changed in Iowa?

- Fewer farm operators, yet the same acreage
- Fewer ag retailers, yet the same acreage
- Increased decision-making by someone *other* than the grower or pesticide applicator
- Rapidly emerging crop alternatives and demands (biofuels, special-purpose crops)
- Increased community and regulatory pressure
- Increased options (products/formulations)
- Greater concern about product availability and future costs

Iowa Farm Operators



Average Iowa Farm Size



What hasn't changed?

- **Ultimate goal of IPM**: Increase responsible pesticide use.
  - Don't apply when it isn't needed
  - Apply effectively when it is needed
  - Weigh and apply alternative treatments wisely
  - Know what happened afterward

What hasn't changed?

- **Economics is important**, and always will be
  - Farming success is based on making a profit, and if you don't, your operation isn't sustainable.

- **Habits of growers and applicators**
  - Change is difficult and scary.
  - Even inefficient practices can be comfortable – we know how they work!

What hasn't changed?

- **Knowledge gaps**: may have changed but they still exist—and always will

- Example: Does spraying a fungicide on corn that has no disease symptoms produce an economic benefit?

What hasn't changed?

- **Knowledge gaps**: may have changed but they still exist—and always will

- Yield saved by management isn't known—you don't know what you prevented happening!
  - Leaving check strips to test management effectiveness answers questions.
  - Observing effects if you don't have test strips also can answer questions.

What hasn't changed?

- **Knowledge gaps**: may have changed but they still exist—and always will

- Trust and relevance of "information sources"
  - What makes a good advisor good?
  - Can you believe everything you hear equally?
  - Are there ethical concerns?
  - Just because it is in print doesn't make it correct.

Summary

- **Several factors drive decision-making on farms**
  - ⇨ Habits
  - ⇨ Experience
  - ⇨ Fears
  - ⇨ Environment
  - ⇨ Access to information
  - ⇨ Aesthetics (looks)
  - ⇨ Peer pressure
  - ⇨ Time
  - ⇨ Economics
- By identifying and learning about a pest, more focus can be applied to the environmental and economic considerations