Insect Pest Management

1

Objectives

1. Define the term "Pest" and discuss how it is subjective.
2. Describe two categories of pests.
3. Differentiate between exponential and logistic growth.
4. Differentiate between K and r strategists.
5. Define EIL, ET and Characteristic Abundance.
6. Define Pest Resurgence and Secondary Pests and explain how they can be caused by pesticide use.

2

Introduction

Insects compete with humans for:
- Food (pre and postharvest)
- Clothing
- Shelter

Let's start this unit by having you answer a seemingly straight forward question: "**What is a pest?**"

Bean weevil

3

What is a Pest?

Now that you have had a chance to think about what a pest is, let's look at the question more closely.

The answers students often give when asked what an insect pest is usually an answer like:

"A pest is something that damages crops."
or
"A pest is something that bothers us."

These are both correct answers. A good definition of a pest that includes both of these thoughts is "**a species that interferes with human welfare or aesthetics**."

4

Subjectivity

What is unacceptable to one person may be of no consequence to another.
- Some feel a single ant is unacceptable.
- Others assume their is no problem until their is a resident colony.

This subjectiveness regarding pests can even extend to pests that are causing real damage.

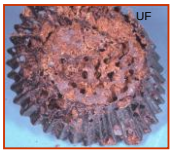
Most people in our society feel that a tiny blemish on any fresh fruit or vegetable is unacceptable.

5

Why are there so few pests?

- Approximately one million insect species named.
- 500,000, are herbivores that eat plants and compete with us.
- 3500 (0.7% of herbivores) cause us problems.
- 200 insect species are serious pests in the U.S.

That's approximately only 0.04% of all herbivores. If we have 500,000 species of insects eating plants why aren't there more insect pests?



Yes, even cigarette beetles like chocolate.

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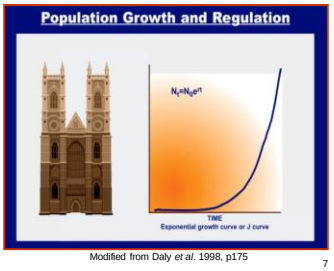
Population Growth and Regulation

Malthus figured out the **exponential growth curve** (or **J curve**):

The population at the beginning is not very high.
But grows indefinitely at a very fast rate.



Modified from Daly *et al.* 1998, p175

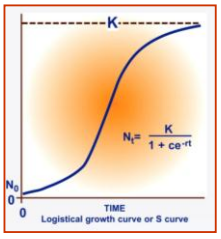
Logistic Growth Curve

As it levels out, the 'J' growth curve becomes an **'S' growth curve,** also known as the **logistic growth curve.**

The point at which the population is no longer growing is called the **carrying capacity (or K)**.

Carrying capacity refers to how many numbers of one species the habitat can support.

Malthus didn't factor in carrying capacity.



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Reproductive Strategy

R strategists produce a lot of offspring with relatively little parental care.
Ex: frogs, fish, mice.

Insects that tend to be r strategists are grasshoppers or aphids.

When trying to decide r strategist or K strategist you have to consider:
1. Its reproductive rate.
2. Survival rate.
3. Parental care.
4. How many generations in a season.

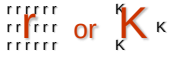
aphids

K Strategist

High reproductive rate and several generations in a season = **r strategist**.
Few young and high parental care with few generations = **K strategist**.

K strategists invest great resources into few young. These young are more likely to survive and reproduce.

Ex: humans, whales, elephants, bears, horses.



"r strategist" comes from the population growth variable 'r'.

"K strategist" comes from the carrying capacity variable 'K'.

Growth Factors

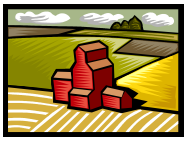
What do you think a pest of a monoculture (one crop type) field is? 'r' or 'K' strategist?

- Bare ground → Abundant but ephemeral resource
- Need high reproduction to take advantage

Different pests are different strategists, depending on the resources.

Density-dependent and **density-independent** growth factors are those that affect growth in a population.

These are a couple of terms used relative to pest control and the whole idea of integrated pest management (IPM).



Density Factors

Density-dependent factors:
- ❑ Deal with how much population is present.
- ❑ Intensify as the population increases.
- ❑ Regulate the population through reproduction and death rate in crowded situations.
  Ex: Available food, predation, parasites, diseases

Density-independent factors:
- ❑ Include weather and the physical environment
- ❑ Are unrelated to the population size.
  Ex: freezing weather (frost), insecticide spraying

Evaluating Pests and Pest Impact

How do humans handle insects?

$

Tools:
Economic Injury Level (EIL) = C/VDK
= Cost / (Crop Value)(Loss per Pest)(Control per Application of Chemical)

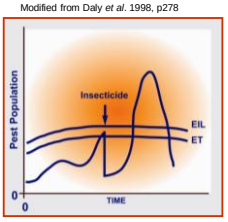
Economic Threshold (ET) / action level.

The EIL is the point at which the damage caused by the insect equals the cost of preventing that damage.

If it's going to cost you more to kill the insect pest than the money you would receive for the crop, then it's not worth trying to kill the pest.

Economic Threshold

Modified from Daly *et al*. 1998, p278



How do humans handle insects?

Tools:
Economic Injury Level (EIL)

Economic Threshold (ET) / action level.

The ET is the point at which the damage caused by the insect exceeds the EIL.

If you don't act before your pest population reaches EIL, then you are going to lose money.

It is difficult to determine the economic threshold and economic injury level because you have to understand how much damage one pest is doing to a plant, and you have to make sure you take accurate samples.

Characteristic Abundance

Characteristic abundance (CA) = long-term average population size in a given area.

Ex: 1-2 deer/ acre; 9 sparrows/ acre; 320 insects/ acre

If the CA doesn't reach the EIL, then you won't need to treat for it .

This would be classified as a non-economic pest because it is still causing damage, but not enough where it would be cost effective for you to try and get rid of it.

Many insects fall within this non-economic category.

Ex: the alfalfa caterpillar in central Iowa. It defoliates the alfalfa but densities are low enough that it doesn't cause enough economic damage to treat.

Economic Pests

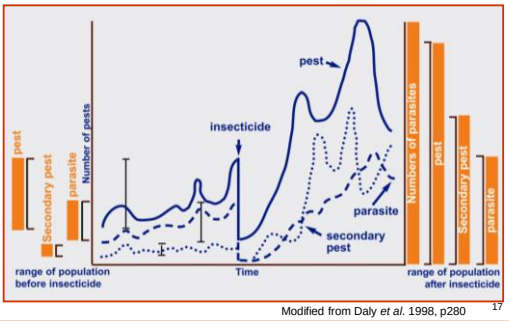
Economic pests have a CA above the EIL at various times during the year.

Ex: the green cloverworm defoliates soybeans in the midwestern United States. In early spring it is a problem. However, it isn't a pest during the late season because a fungus attacks and kills it.

When this happens, you need to monitor this pest in your crop throughout the year and treat when ET is met.

Secondary Pests and Pest Resurgence

- **Pest resurgence** = an organism's population rebounds after elimination of natural enemies or competitors
- **Secondary pest** = a previously insignificant population becomes damaging after elimination of natural enemies or competitors.



Modified from Daly *et al*. 1998, p280

Secondary Pests and Pest Resurgence (Continued)

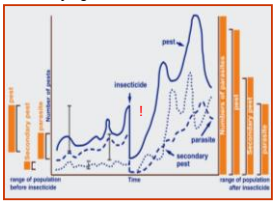
The long dashed line is a parasite of the pest. Its numbers fluctuate with the pest population.

Notice! when the insecticide is sprayed the parasite population crashes also.

The insecticide was more effective in killing off the parasite than it was in killing off the pest.

Since the parasite numbers are so low, it doesn't keep the pest population down. This large jump in the pest population after the insecticide is sprayed is called **pest resurgence**. This often happens because you wiped off the pest's natural enemies while you were trying to control it.

Modified from Daly *et al*. 1998, p280



Pest Question

Think about this for a moment, in the previous example, is the *parasite* going to be an r strategist, or a k strategist?

The parasite would more of a K strategist because it tends to be something like a wasp that is a parasitoid. The wasp only lays a single egg in the caterpillar.

But what kind of strategist is the *pest* in this figure? It's an r strategist because notice how it is able to reproduce very quickly, even if there are only a few of the population left.

Secondary Pests

A **secondary pest** was in such small numbers previous to pesticide application that it was not a significant pest.

It became an economic pest after the insecticide application. After application, this secondary pest's population numbers shoot up (if needed, refer back to the graph). This can be for various reasons, but it's probably because you eliminated its natural enemies, just as you did with the pest's parasites.

Attempts were made to eradicate the pink bollworm on California cotton. After insecticides were sprayed the bollworm was effectively reduced, but so were the natural enemies of the secondary pests called the cotton leaf perforator and spider mites. Soon after pesticide application their populations rose drastically and the outbreaks of these two secondary pests proved costly.

Learning Game Placeholder

Learning Game: Choices

Title: Review Quiz

Conclusion

Society must use caution with insecticide use for reasons such as secondary pests and pest resurgence.

The competition for food between insects and humans continues.

Hopefully we all come out winners in the end.

Remember to review the unit objectives and see that you know each one.