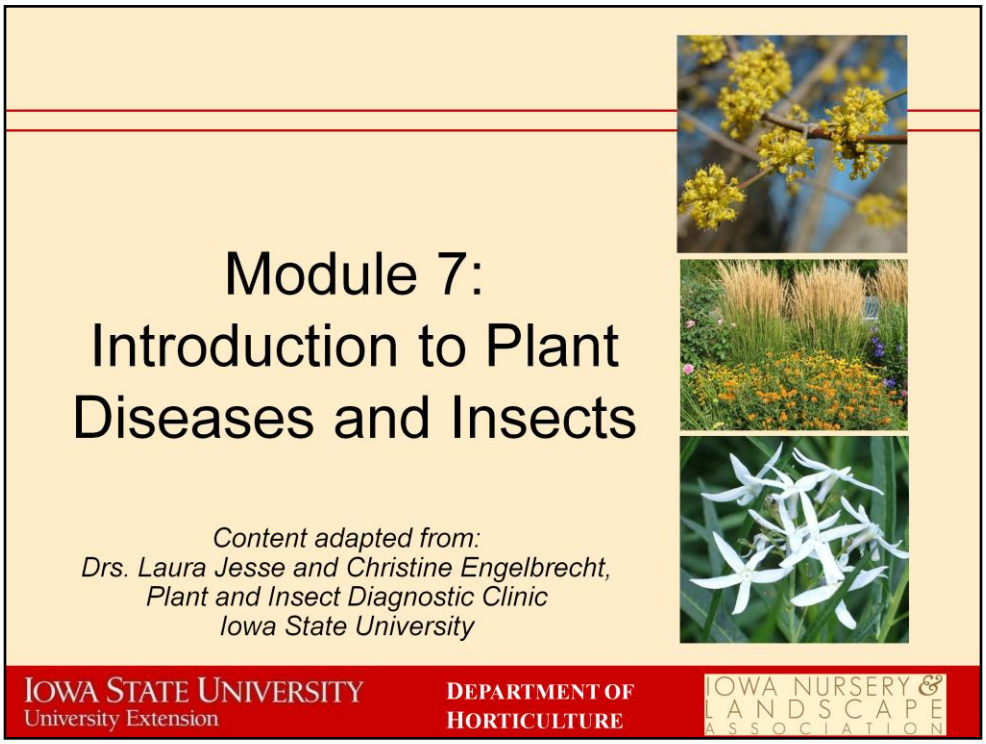
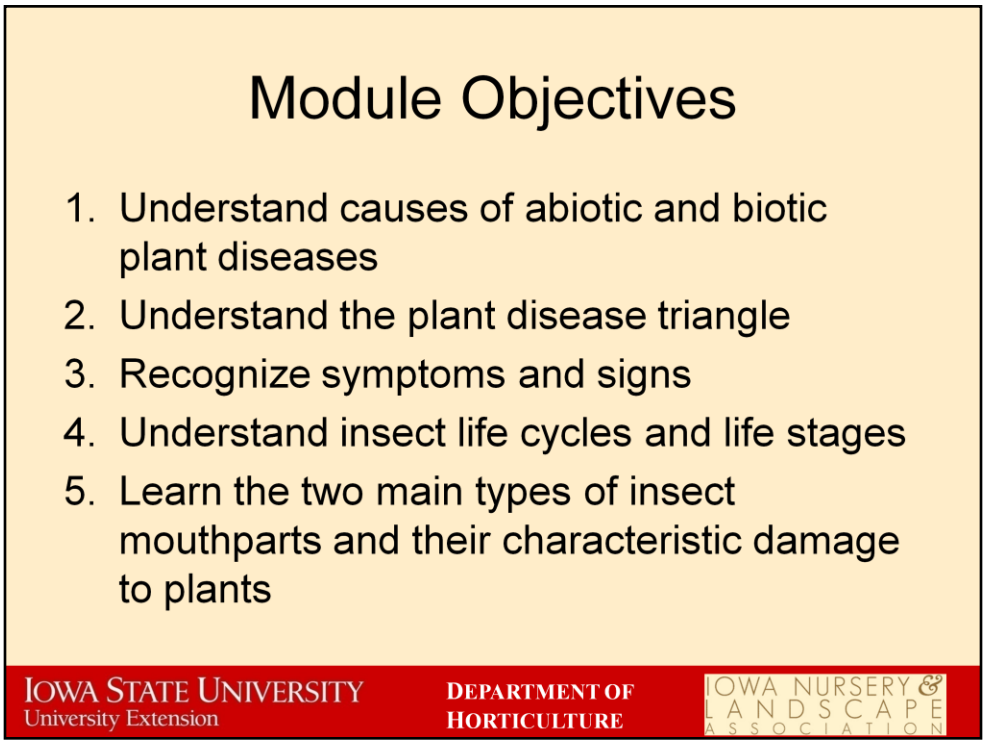


Welcome to the Iowa Certified Nursery Professional Training program Module 7: Introduction to Plant Diseases and Insects.



After completing this module you should:

1. Understand the causes of abssiotic and biotic plant diseases;
2. Understand the plant disease triangle;
3. Recognize symptoms and signs;
4. Understand insect life cycles and life stages;
5. Learn the two main types of insect mouthparts and their characteristic damage to plants.

Defining Plant Disease

A plant disease is:

Any deviation from normal growth that is pronounced and permanent and impairs the quality or value of the plant.

Blossom end rot of tomato

Aster yellows on coneflower

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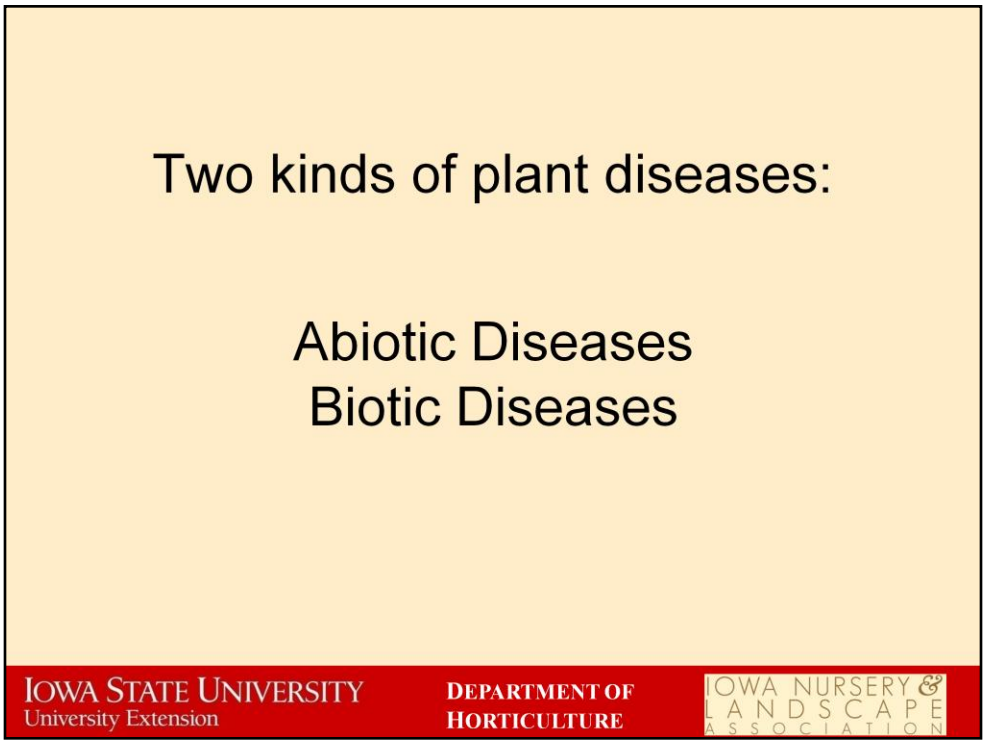
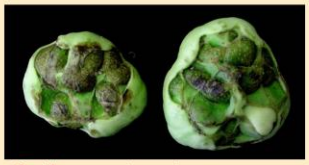
A plant disease is defined as any deviation from normal growth, that is pronounced and permanent, and impairs the quality or value of the plant. The value of the plant may be monetary, aesthetic, or both. For example, the tomatoes on the left have a condition called blossom end rot, which makes them unsalable. The coneflower on the right is distorted by a disease called aster yellows, which impairs the aesthetic value of the plant.



Plant diseases are traditionally split into two broad groups: abiotic diseases, and biotic diseases.

Abiotic Diseases

- Caused by non-living agents
- Cannot spread from plant to plant
- Examples: temperature or moisture extremes, air pollution, nutrient imbalances



Catface on tomato

Iron deficiency on pin oak

Herbicide damage on redbud

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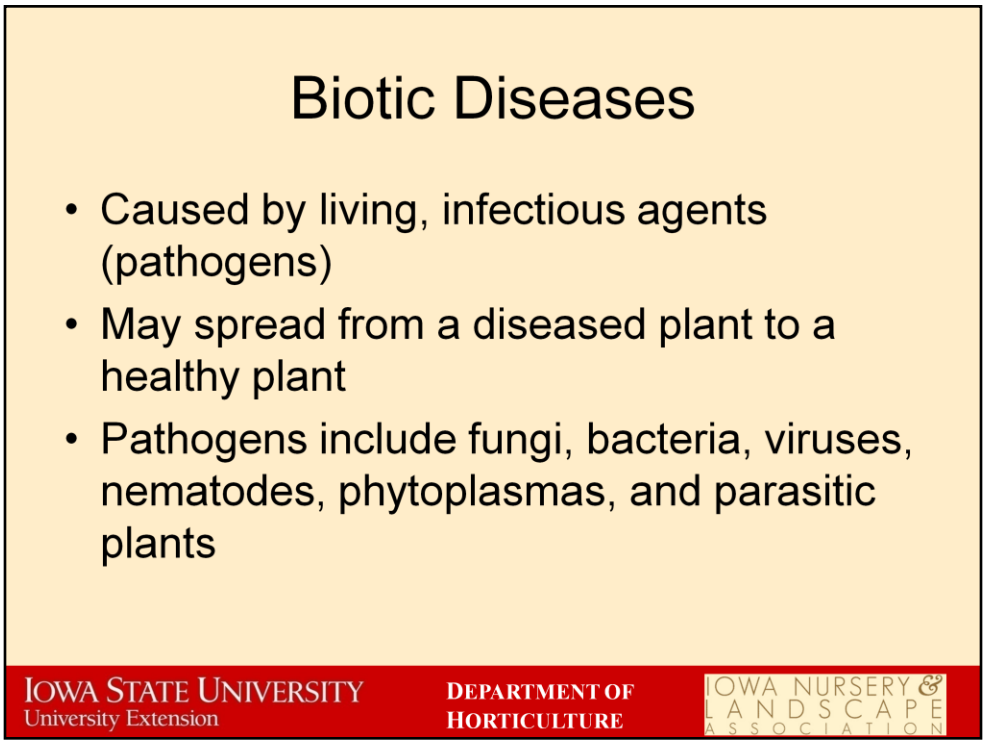
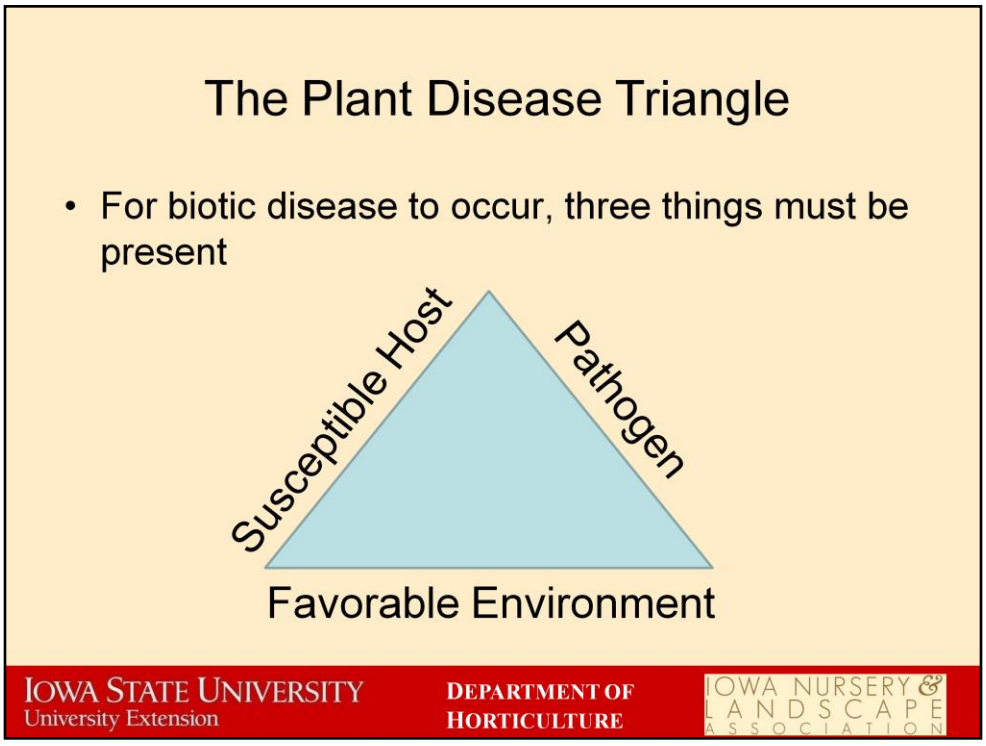
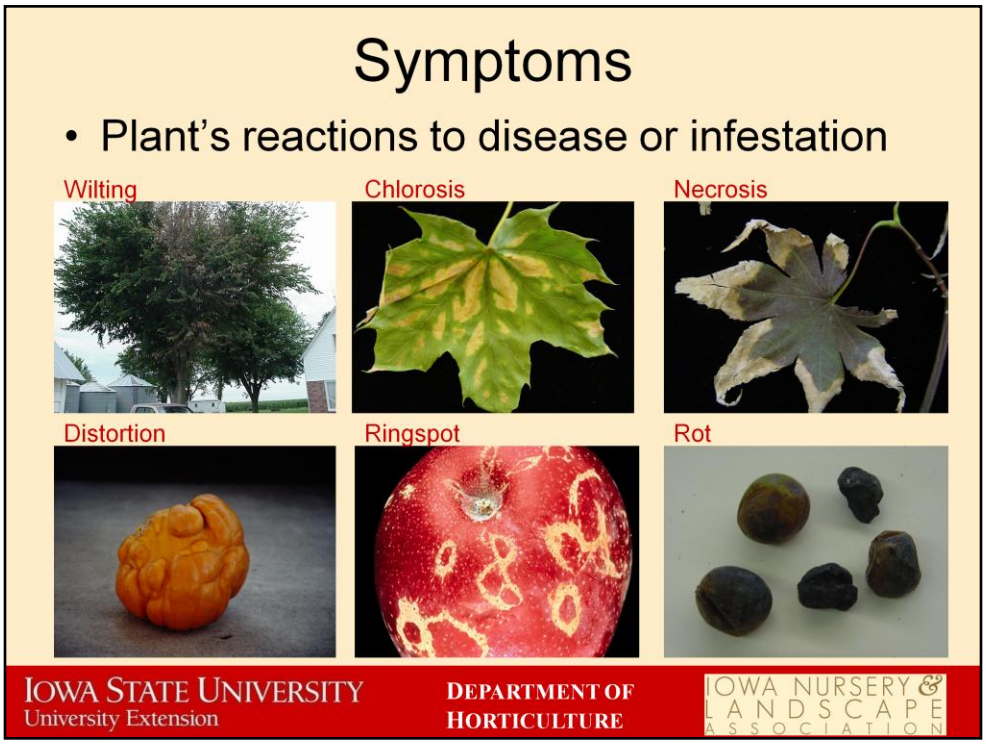
Abiotic diseases are those that are caused by non-living agents. They are not contagious, so they cannot spread from a sick plant to a healthy one. Sometimes they are called noninfectious diseases. Some examples of agents that can cause abiotic diseases include extreme temperatures, too much or too little water, air pollution or chemicals, nutrient or pH problems, or mechanical damage. The redbud on the right has curled, cupped leaves as a result of damage by herbicides. The tomatoes on the left have a condition called catface, where cold temperatures during the blossoming period result in distorted fruits. The pin oak leaf in the middle is pale green with darker green veins, which is typically caused by lack of iron in the leaves, a result of growing in a high pH soil. These are all examples of abiotic diseases.



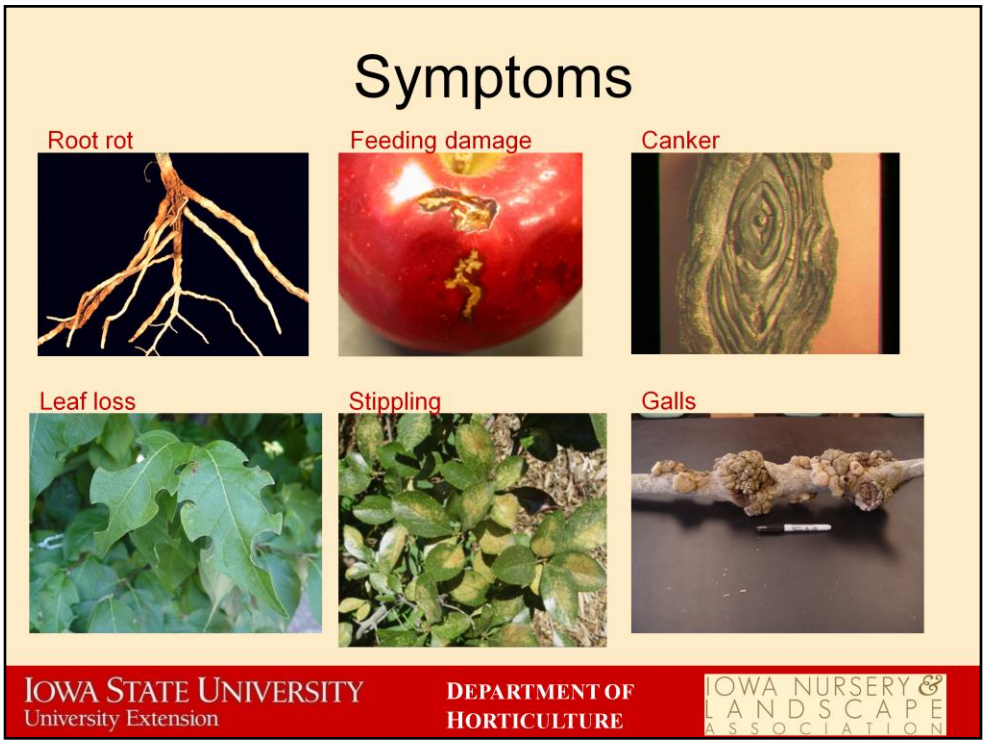
Biotic diseases are what most people think of when they think of plant diseases. Biotic diseases are caused by living, infectious agents that are called pathogens. Biotic diseases are contagious, so they can spread from a diseased plant to a nearby healthy plant. Examples of pathogens that cause biotic diseases include fungi, bacteria, viruses, nematodes (which are tiny worms), phytoplasmas (which are similar to bacteria), and parasitic plants such as mistletoe and dodder.



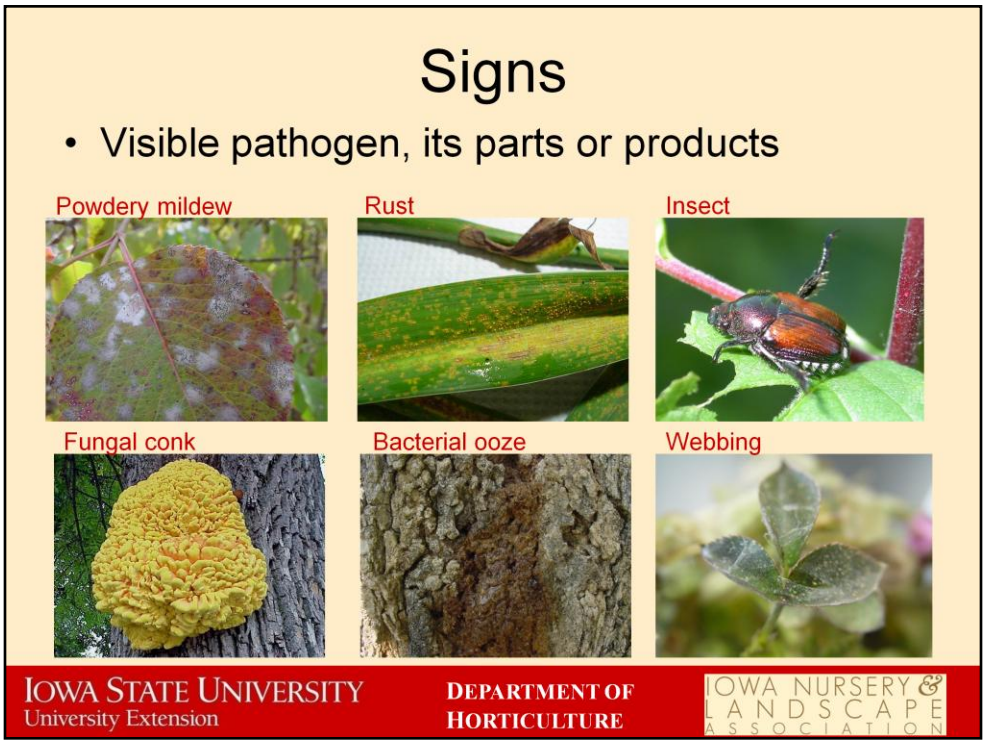
In order for biotic disease to occur, three things must be present. First, obviously, there must be a susceptible host plant—a plant that is able to be diseased. Secondly, a pathogen must be present. Some fungus, bacterium, or other pathogen that can infect the susceptible host must be present in order to have disease. However, it is not sufficient to have only the susceptible host and the pathogen. These two factors must interact within a favorable environment in order to have biotic disease. Most pathogens require a particular temperature, moisture level, and sometimes pH level in order to cause disease. Many of the fungi that cause disease prefer warm, wet conditions. Since three things are required to have biotic disease, we call this the Plant Disease Triangle.



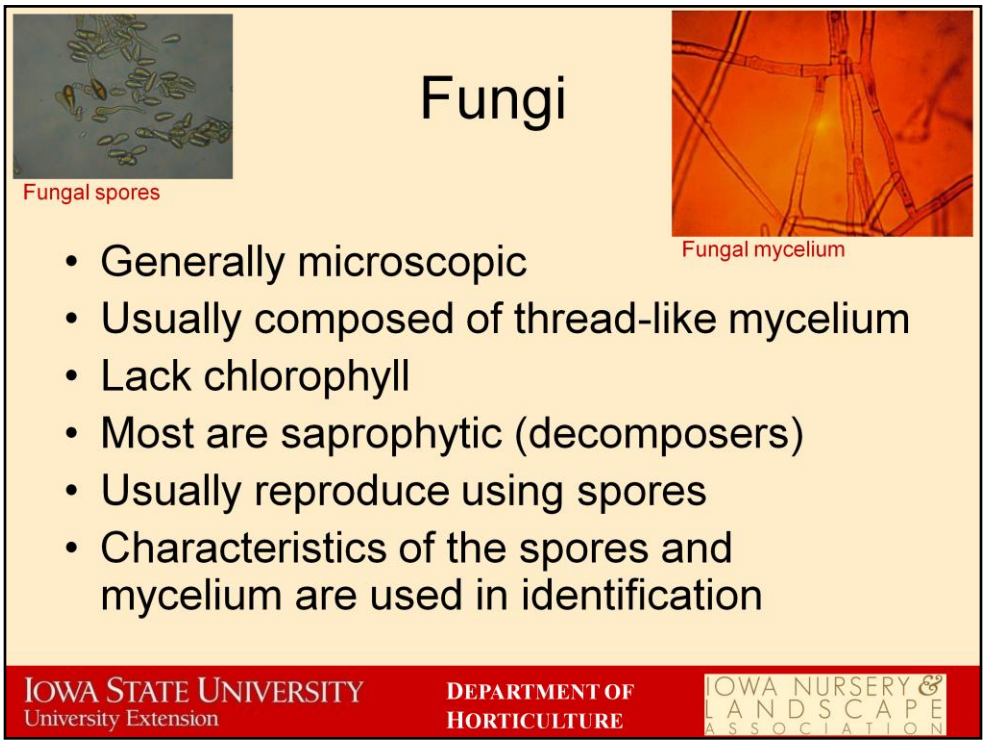
We can tell a plant is sick because it shows symptoms and signs. Symptoms are the reactions of a plant to being diseased or infested. Some common symptoms you may see include wilting, yellowing which is called chlorosis, browning and death of tissue, called necrosis, distortion of leaf or fruit tissue, ringspots on leaves or fruits, and rotting of fruits.



Additional symptoms you may see include browning of root tissue indicating root rot, missing tissue from insect feeding, cankers, which are areas of dead bark on a tree or shrub, defoliation or leaf loss, small yellow specks called stippling caused by insect feeding, and outgrowths of plant tissue called galls.



Signs are another way that we can tell that a plant is sick. While a symptom is a plant's reaction to being diseased, a sign is the actual pathogen or insect or its parts or products visible on the host plant. Examples of signs you may see include powdery mildew and rust, two fungal diseases where the fungus is visible growing on the plant tissue. Sometimes you can find an actual insect causing damage to a plant. Fungal conks or shelf fungi growing from the side of a tree usually indicate internal decay in the tree. Bacterial ooze seeping out of a tree is an indication of internal bacterial infection. Spider mites create fine webbing that is visible on infested plants. These are all examples of signs.



It's important to know the characteristics of the different types of pathogens, so you can effectively manage them. Most biotic plant diseases are caused by fungi. Fungi are organisms that are usually microscopic, and composed of a thread-like body called a mycelium. The picture on the right shows an example of a fungal mycelium. Fungi don't contain chlorophyll, so they can't make their own food. Most fungi are saprophytic, which means that they get their nutrients by decomposing dead organic matter. Most fungi reproduce by producing tiny structures called spores, such as those in the left-hand picture. We can identify fungi under a microscope by looking at their spores and mycelium.

Bacterial culture

Bacteria

- Very small microorganisms
- Usually a single cell
- Multiply rapidly by dividing in half
- Enter plant through natural openings or wounds

Bacterial cell with flagella

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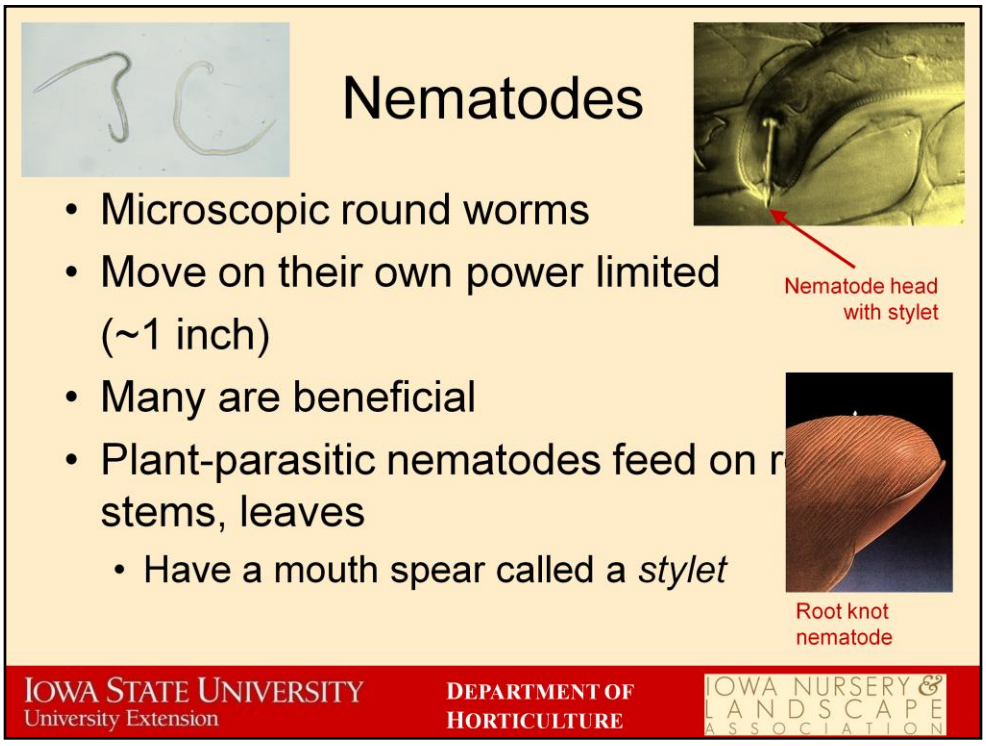
Some plant diseases are caused by bacteria. Bacteria are very small microorganisms with only one cell. They can multiply very rapidly by dividing in half. Bacteria tend to appear slimy when they grow in culture, as in the picture on the left. Many bacteria are able to swim through water films by using whip-like extensions called flagella, which you can see in the picture on the right. Bacteria that infect plants cannot force their way into the plant, but must have an opening to enter. They frequently enter through wounds or natural openings, such as stomates.



Some plant diseases are caused by nematodes, which are microscopic round worms. Nematodes are very small. One of the larger nematodes is the root-knot nematode, which swells to a spherical shape that you can see on the tip of the finger in the lower picture. Nematodes are mobile and can swim, but only short distances, an inch or less. Nematodes can live in the soil or water, and many of them are beneficial, helping to break down dead organic matter. Nematodes that cause disease on plants are plant-parasitic, and they can feed on roots, stems, or leaves of the plant. All plant-parasitic nematodes have a special mouth spear called a stylet, which they use to pierce plant cells.

Distortion of zucchini

Viruses

- Genetic material surrounded by protein coat
- Multiply only in living cells
- No energy source of their own
- Too small to be seen with a light microscope
- Rod, sphere-like, or bullet shaped
- Rarely affect conifers
- Many are carried by insects (aphids, leafhoppers)

Ringspots on hosta

Mosaic on bean

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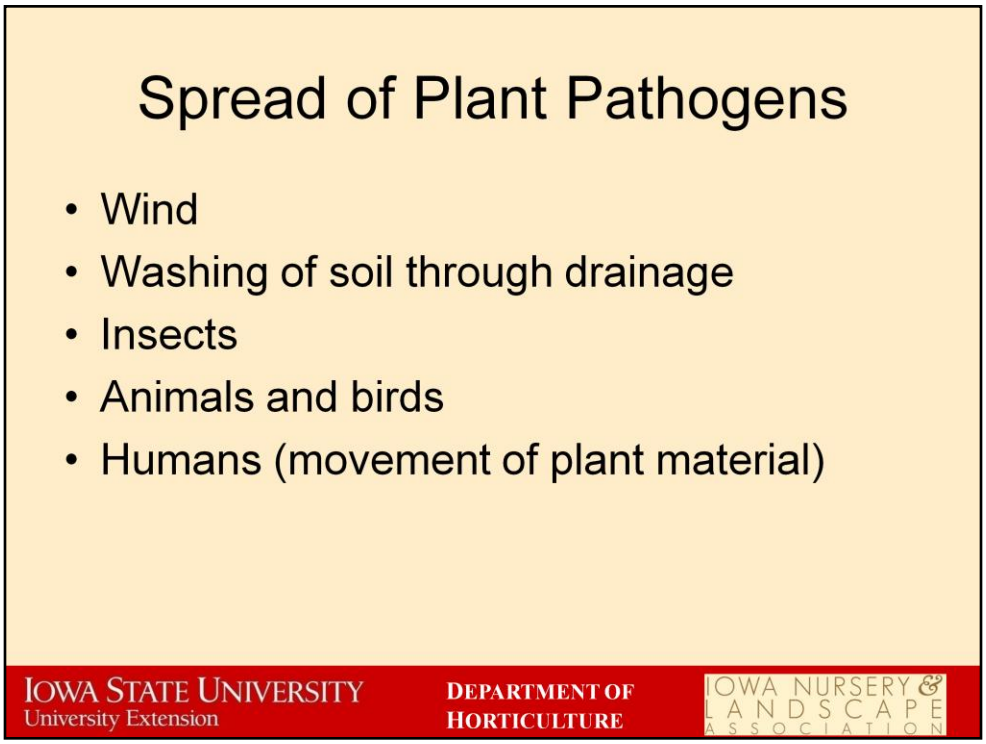
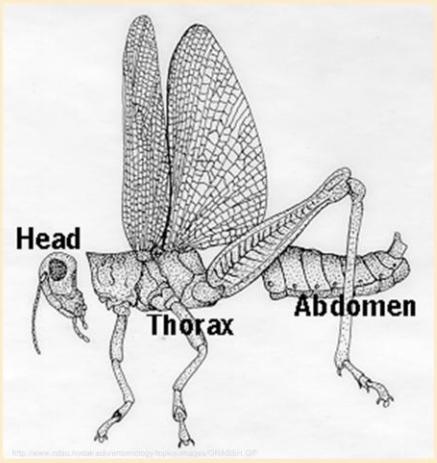
Viruses are another group of plant pathogens. A virus is a very tiny piece of genetic material (such as DNA or RNA) that is surrounded by a protein coat. Viruses can multiply only in living cells. A virus has no energy source of its own, so it is not technically "alive". Viruses are so tiny that they cannot be seen with the normal light microscopes we use in the lab. But, under the very high magnification of electron microscopes, they are often shaped like rods, spheres, or bullets. Almost all plants can be attacked by viruses, but, oddly, they very rarely affect conifers. Many viruses are carried from plant to plant by insects, such as aphids, thrips, or leafhoppers, so in order to manage virus problems, we often need to manage insects.



Plant pathogens can spread from plant to plant in a variety of ways, depending on the pathogen. Many pathogens, especially fungi that attack the leaves, travel in air currents. Some fungal spores can travel miles between plants. Soilborne pathogens, such as some nematodes and fungi that attack roots, spread primarily by washing through the soil. Many viruses, as well as some fungi, bacteria, and nematodes, travel with insects that feed on plants. Animals and birds also sometimes spread pathogens. Finally, humans are the most effective way for plant pathogens to travel over large distances. When we move infected cuttings, seeds, plants, or plant products, pathogens can be spread across continents.

What is an insect?

- Characteristics of an insect:
  - –Exoskeleton
  - –3 body parts
  - –6 legs
  - –2 antennae



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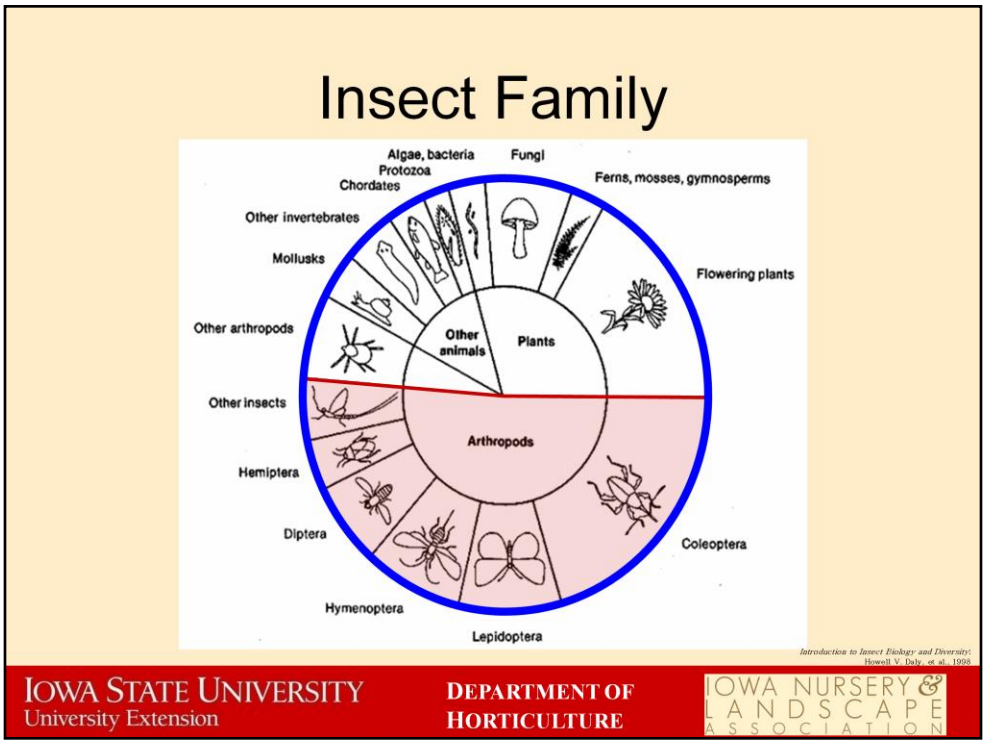
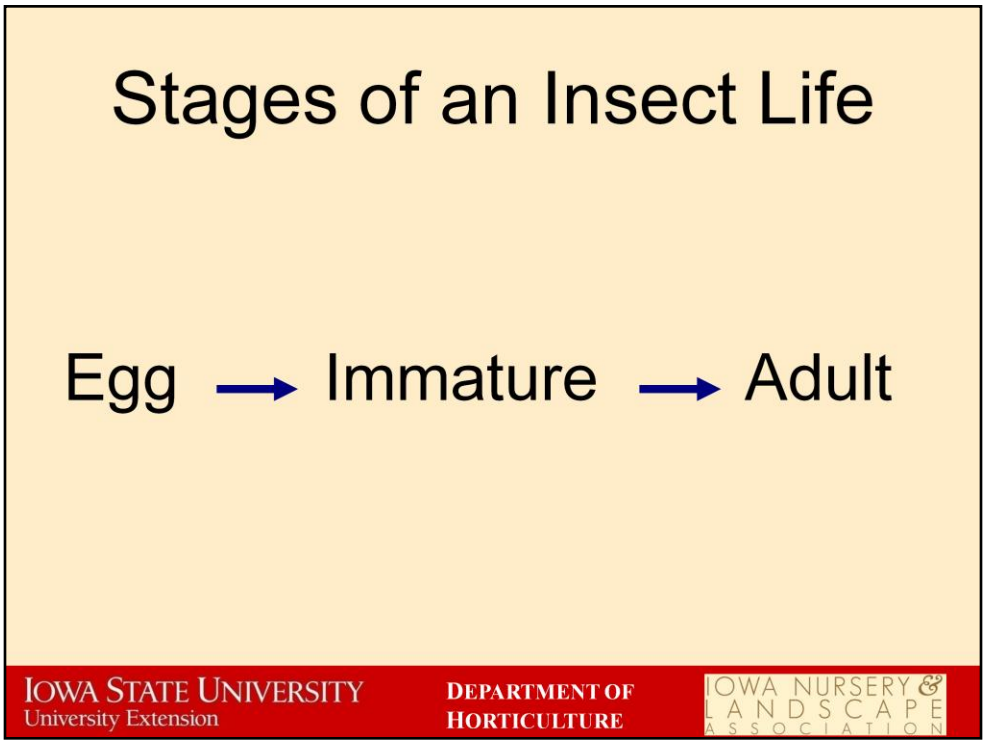
Now let's shift from talking about diseases to talking about insects….

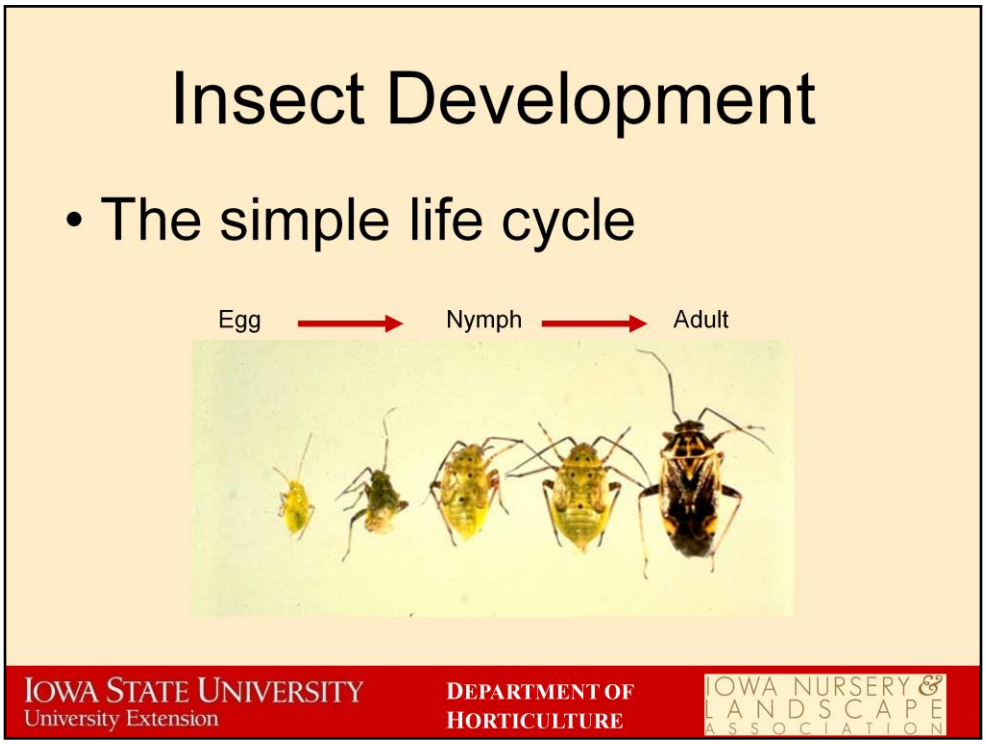
Insect have an exoskeleton, meaning that their skeleton it on the outside of their body. Insects all have three body parts, the head, thorax and abdomen. Insects have 6 legs and two antennae.



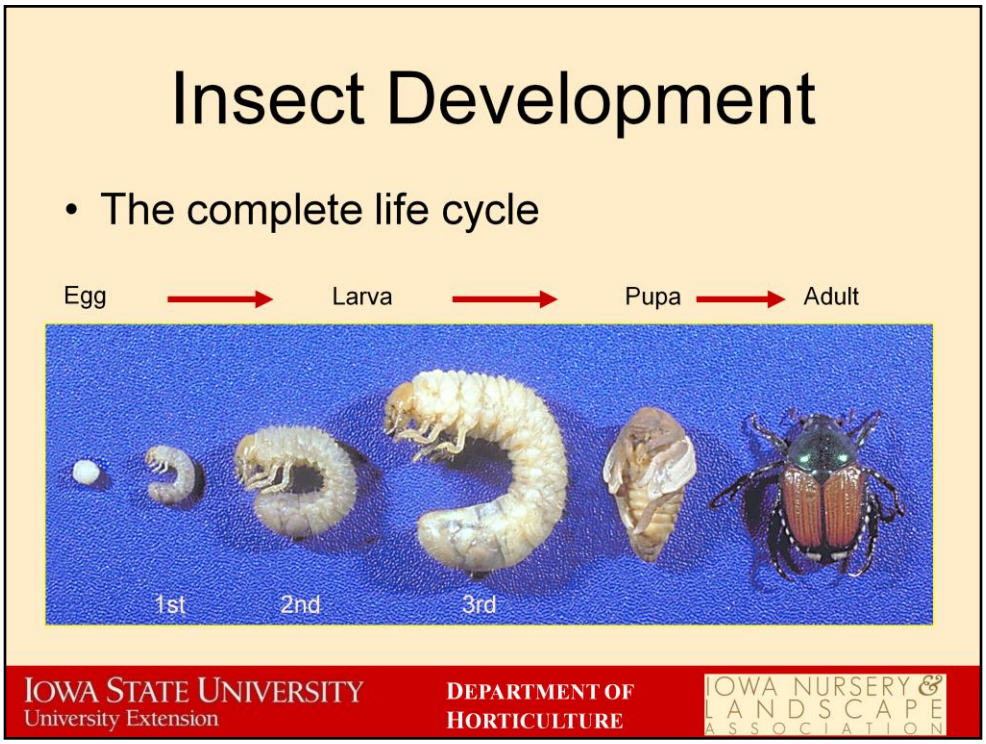
A majority of the described species on earth are insects. The described insect species outnumber described species of plants and all other animals.



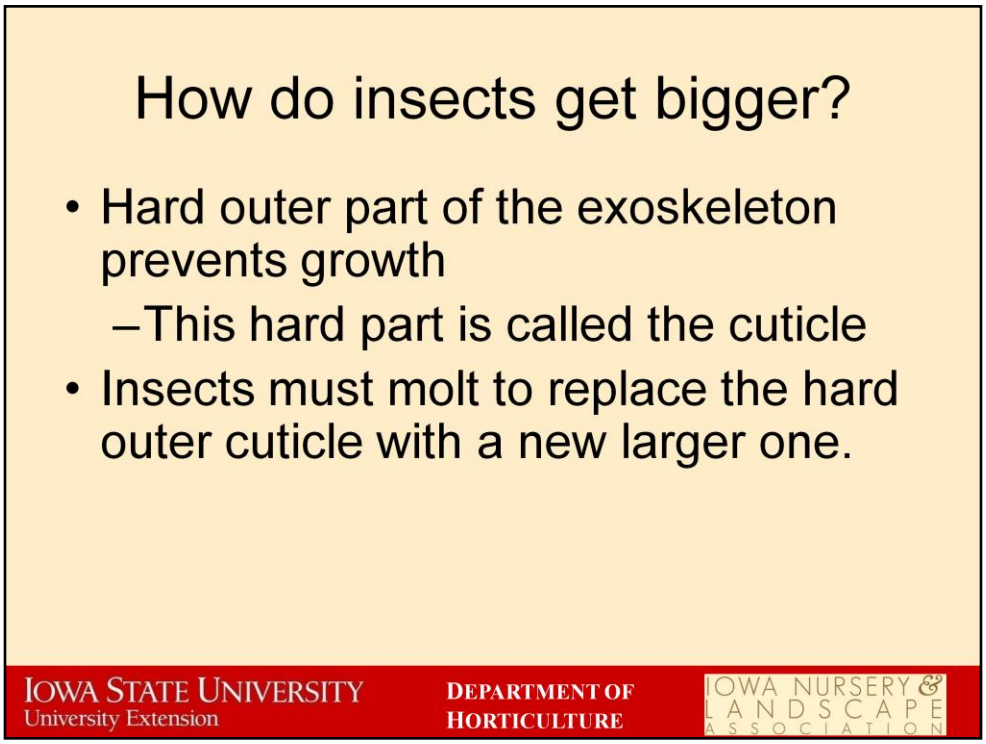
The basic stages that an insect goes through are egg, immature and adult.



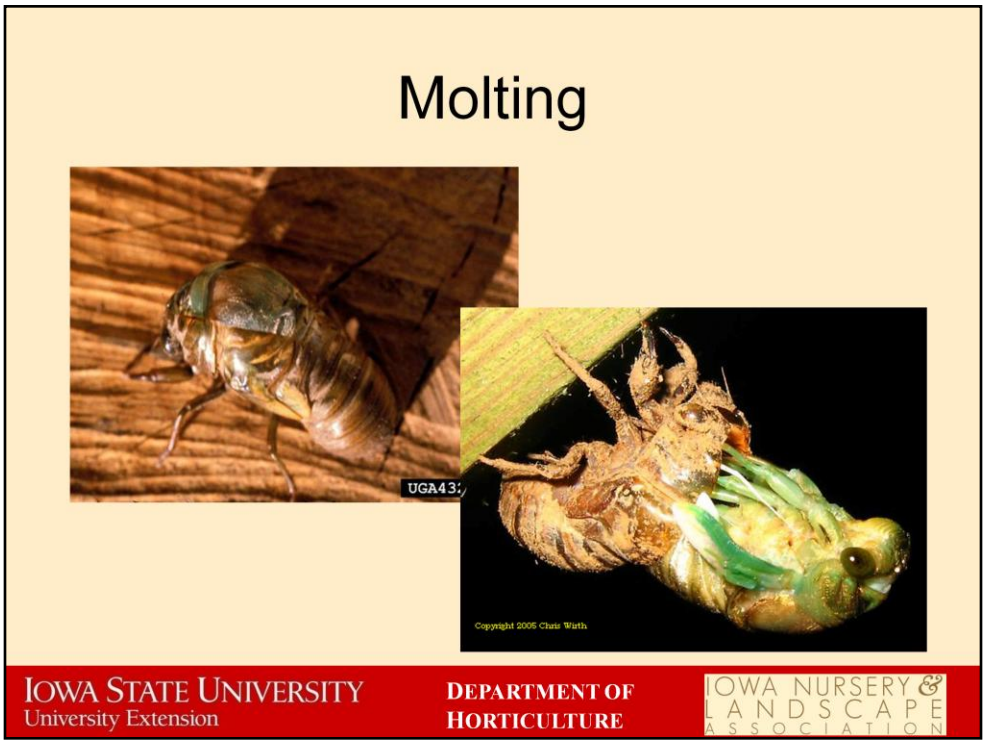
The stages in a simple life cycle are egg, nymph, and adult. The nymphs look similar to the adult insects, but the nymphs will not have fully developed wings. Only adult insects will have wings (if that species of insect has wings) and only adult insects can reproduce.



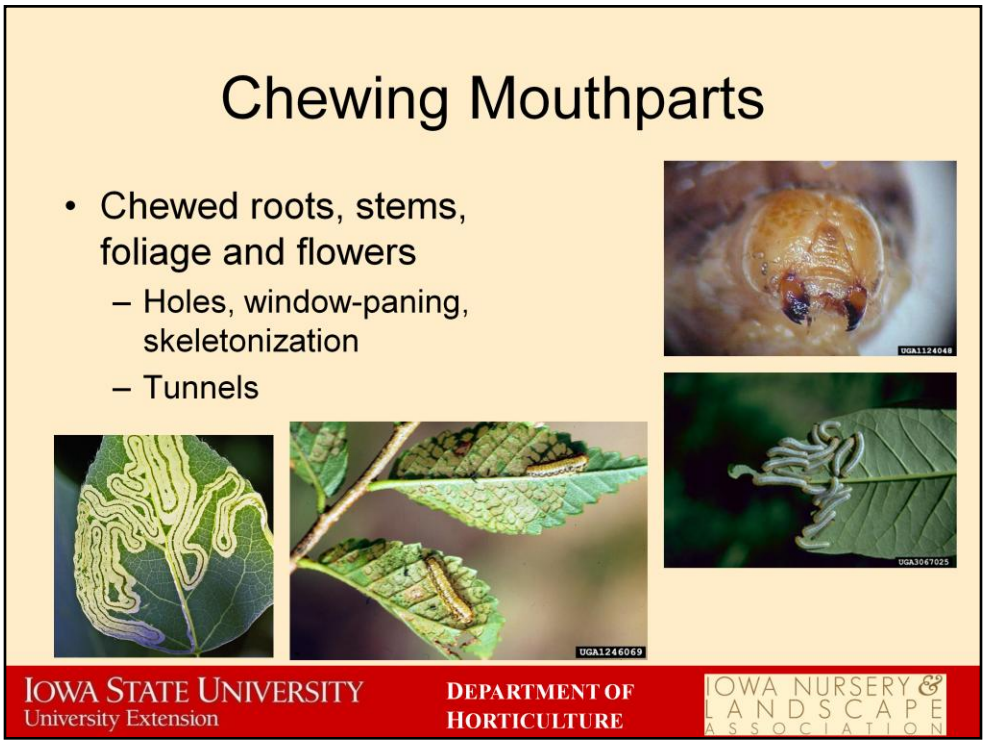
Insects with a complete lifecycle have a pupal stage between the larval and adult stages. It is during this pupal stage that the insect can completely change into a different body type, for instance a caterpillar changes into a butterfly with wings. The complete life cycle is one of the reasons insects are so successful. The adult insects can take advantage of food and space resources that the larvae cannot. So in essence the adults are not competing with their children for food.



The hard outer exoskeleton of insects provides excellent protection, but a hard outer shell can make it hard to grow. Insects have to actually shed their hard outer skeleton in order to grow. This is a complicated process called molting.



In these pictures you can see a cicada molting from the final nymphal stage into the adult stage. The new exoskeleton has been formed, but is still soft, allowing the insect to emerge and expand its body. Once the new exoskeleton is fully expanded it hardens.



Knowing what sort mouthparts an insect has can help you narrow down who did the damage to your plants. Insects with chewing mouthparts, like caterpillars, sawflies, and beetles, will consume leaf tissue. Damage can appear as holes, window-paning, skeletonization, and tunnels.

Piercing-sucking mouthparts

- Discoloration: bleaches, bronzed, silvered, stippled, speckled, streaked
- Distortion: swelling, twisting, cupping, curling
- Wilting, stunting
- Galls

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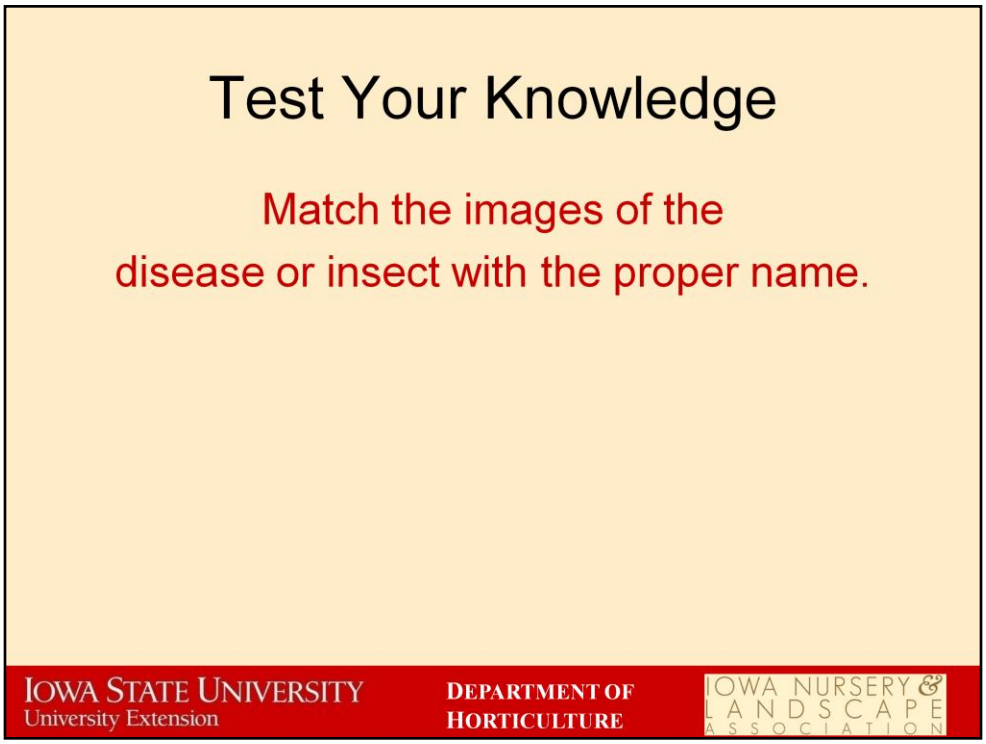
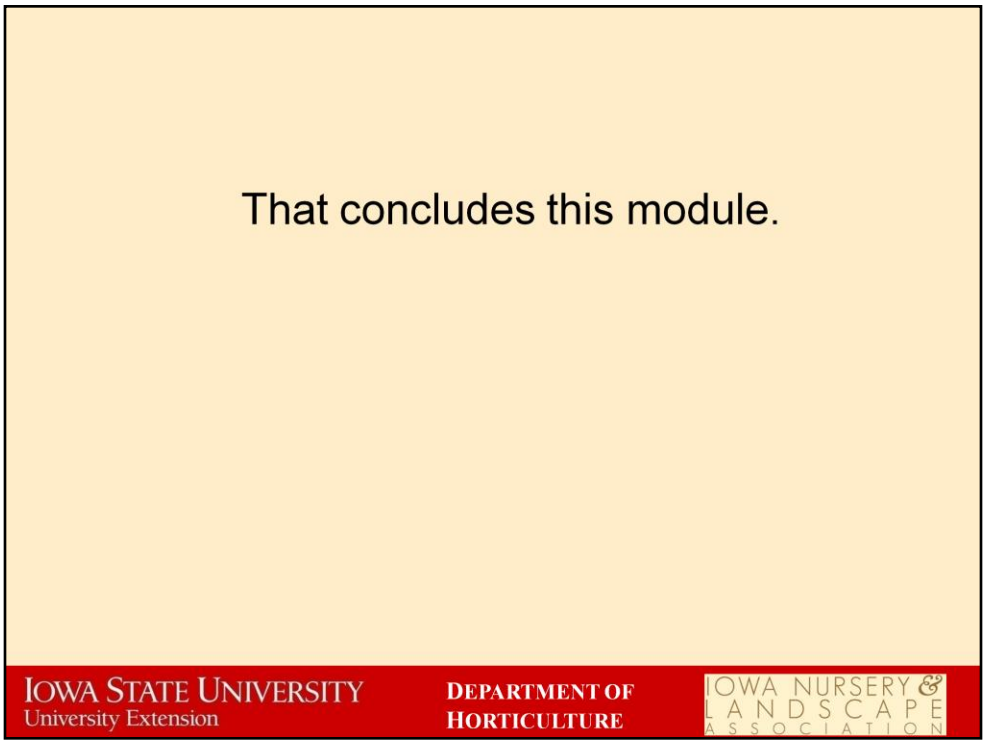
Insects with piercing-sucking mouthparts are some of the worst plant pests. For example aphids, thrips, scales, true bugs, mites, all have piercing-sucking mouthparts. Damage to plants will be a loss of coloration. Feeding damage can lead to distortions of leaves.



Match the images of the disease or insect with the proper name.



That concludes this module on plant diseases and insects.