

Unit D: Controlling Pests and Diseases in the Orchard

Lesson 5: Identify and Control Diseases in the Orchard

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Define plant disease and identify the conditions necessary for a plant disease to develop.
2. Describe the classification of plant diseases.
3. Explain the scouting, identification, and diagnosis of plant diseases.
4. Explain the control of plant diseases.
5. Identify strategies used in disease management.

Recommended Teaching Time: 3 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has been developed for use with this lesson plan
- <http://www.nysaes.cornell.edu/pp/extension/tfabp/disindx.shtml>

List of Equipment, Tools, Supplies, and Facilities

Writing surface

PowerPoint Projector

PowerPoint Slides

Diseased plants or pictures of diseased plants

Copies of Transparency Masters

Copies of Student Lab sheets

Books with information and pictures about various plant diseases and/or internet access

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

Abiotic disease	Infectious Diseases
Bacteria	Localized infection
Biotic diseases	Noninfectious disease
Cultural disease control	Pathogen
Disease avoidance	Plant disease
Disease resistance	Plant pathology
Disease tolerance	Systemic infection
Fungi	Viruses

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Obtain a healthy plant and a diseased plant. If live plants are not available pictures will work. Ask the students to raise their hand and point out one difference between the two plants. Lead into a discussion about plant health and fruit productivity.

Use this approach to move into Objective 1.

Summary of Content and Teaching Strategies

Objective 1: Define plant disease and identify the conditions necessary for a plant disease to develop.

(PowerPoint Slide #3)

I. A ***plant disease*** is a harmful alteration of the normal physiological and biochemical growth of the plant, or as a condition in which a plant differs from a normal (healthy) plant in appearance, structure, or function.

A. ***Plant pathology*** is the study of plant diseases.

(PowerPoint Slide #4)

1. Plant diseases differ from nonparasitic injury in the length of time during which they affect the plant.
 - a. A disease usually consists of a series of harmful processes that occurs over a fairly long period of time.
 - b. Injuries are disorders that occur over a short period of time.

(PowerPoint Slide #5)

2. Four conditions necessary for a plant disease to develop are:
 - a. A susceptible host plant, a disease-producing agent, a favorable environment, a time for the disease to develop.
 - b. If any one of these conditions is not met, a disease will probably not occur.

Show TM: D5-1 to the class or draw the diagram on the board to illustrate how the three factors are related to cause a disease to begin infection. Ask the students if they have ever seen a diseased plant before. Ask the students, “What can we do to cure a diseased plant?” Let the students answer this question and record their answers to compare them when the same question is asked at the end of the lesson.

Objective 2: Describe the classification of plant diseases.

(PowerPoint Slide #6)

II. Plant diseases can be divided into two broad categories.

- A. Plant diseases are classified as either noninfectious or infectious, depending on their cause.

(PowerPoint Slide #7)

1. **Noninfectious disease** or **abiotic disease** is not caused by a pathogen, but rather by elements in a plant’s environment that are damaging to it.
 - a. They cannot be transmitted from plant to plant.
 - b. They occur very quickly in a wide variety of plants and do not continue to damage the plant throughout the season.
 - c. They are caused by unfavorable growing conditions, such as extremes in weather, air pollutants, nutrient deficiencies or excesses, and toxic chemicals.

(PowerPoint Slide #8)

2. **Infectious diseases** or **biotic diseases** are caused by a living organism or pathogen.
 - a. A **pathogen** is a living, disease-producing agent.
 - b. The pathogen can multiply and be transmitted from plant to plant.
 - c. They may invade the entire plant (**systemic infection**) or only affect certain plant parts (**localized infection**).
 - d. Pathogen groups include bacteria, fungi, viruses, and parasitic seed plants.

(PowerPoint Slide #9)

3. **Bacteria** are microscopic one-celled organisms that reproduce by simple division.
 - a. Assuming cell division every 20 minutes, one bacterium can produce up to 70 billion offspring in hours.
 - b. Bacteria cannot move by themselves and depend on splashing rain, wind, animals, insects, farm implements, seed, and other means to get to host plants.
 - c. Bacteria usually enter through wounds in the plant and cause local or systemic infections.

(PowerPoint Slide #10)

- d. Symptoms of bacterial infection are wilting, soft rots, leaf blights, and spots.
- e. Mycoplasmas and spiroplasmas are bacterial forms that lack cell walls.
 - i. They are transmitted by leafhoppers or plant propagation, and are often the causal agents of the yellows and witch’s broom type of diseases, formerly thought to be caused by viruses.

(PowerPoint Slide #11) This is a picture of bacteria infecting a plant by entering through the plant's stomata.

(PowerPoint Slide #12)

4. Fungi are the most common causes of infectious plant diseases.
 - a. **Fungi** are small, many-celled plants that lack chlorophyll.
 - b. Most reproduce by spores.
 - c. Fungi enter the plant and destroy or disrupt parts of it, making it unsuitable for human use.
 - d. The organisms are spread by rain, wind, insects, seeds, farm implements, and runoff water or runoff soil.
 - e. Symptoms of fungal diseases included wilting, yellowing, blotching, spotting of leaves, and rotting of roots, stalks, stems, or fruit.

(PowerPoint Slide #13) This is a picture of powdery mildew on a plant. Powdery mildew is caused by a fungus.

(PowerPoint Slide #14)

5. **Viruses** are tiny pathogens that can be seen only with special microscopes.
 - a. Viruses usually enter plants and cause systemic infections.
 - b. Viruses cannot move on their own, and are commonly spread by insects and seed.
 - c. Symptoms of viral diseases include discoloration, stunted or unusual growth, and poor development of normal plant parts.

(PowerPoint Slide #15) This illustrates what a virus looks like. This drawing is magnified thousands of times. Viruses cannot be seen through a regular light microscope; rather an electron microscope is needed.

Provide the students with books or access to the internet and a copy of LS: D5-1. Put them into groups of 2 or 3 and have them find one example of a bacterium, a fungus, and a virus that attack fruit and nuts. All they need to do is find the name of the disease but will need to remember where they found the information as they will use it in a later objective. It is important that all groups try and choose different diseases so that a wide variety of diseases can be covered in class.

Objective 3: Explain the scouting, identification, and diagnosis of plant diseases.

(PowerPoint Slide #16)

III. Plants react to pathogens by producing symptoms, indications of disease that affect the external or internal appearance of the plant.

A. As an orchard is checked for insects, the severity of diseases can also be noted.

(PowerPoint Slide #17)

1. Examine roots, stalks, and leaves, and collect samples for positive identification.
 - a. Some pathogens cause localized infections; others may infect the entire plant.

- b. It is important to inspect the entire plant when diagnosing a plant disease problem.
2. Orchards are sampled depending upon the disease type.
 - a. Different fruit varieties are affected by different diseases and all will have a different economic threshold.

(PowerPoint Slide #18)

- B. Determine the severity of the disease and the percentage of plants displaying disease symptoms. Symptoms are used to help identify the pathogen and may ultimately help determine the exact cause of the disease.

(PowerPoint Slide #19)

1. Some common symptoms of plant pathogens are wilting, yellowing, leaf spots, blights, dropping leaves, and necrosis or death of plant tissue.
2. The pathogen itself may also produce signs. Signs of plant pathogens are structures or parts of the pathogen itself, the host plant does not produce them. Examples of signs may include fruiting or spore-producing structures, a mat of fungal tissue, overwintering structures, and bacterial exudates.

(PowerPoint Slide #20)

- C. To identify plant diseases correctly, you must carefully observe the symptoms of the disease and the signs of the pathogen itself. The symptoms are usually of three types.

(PowerPoint Slide #21)

1. Over-development of tissues: galls and swellings.

(PowerPoint Slide #22)

2. Underdevelopment of tissues: stunting, lack of chlorophyll, or incomplete development of organs.

(PowerPoint Slide #23)

3. Death of tissues: leaf or flower blights, leaf spots, root rots, cankers, wilting.

(PowerPoint Slide #24)

- D. Examine all parts of the injured or diseased plant. Root problems may produce wilting, stunting, dieback, or nutrient deficiencies. Determine whether the problem is localized or systemic.
 1. Some pathogens infect only certain parts of the plant. These diseases cause localized infections and include many leaf blights, leaf spots, stem cankers, galls, and root rot.

(PowerPoint Slide #25)

2. Diseases that affect the entire plant are called systemic infections.
 - a. Once inside the plant, the pathogen moves throughout and causes wilting, yellowing, and stunted growth.
 - i. Systemic diseases often kill the plant.
 - b. When diagnosing diseases the entire plant must be examined.
 - c. Notice where diseases occur in the orchard and how they have developed.

(PowerPoint Slide #26)

- E. Steps to follow for diagnosing diseases.
 1. Scout the orchard and note problem areas.
 2. Examine the plants and note the plant parts affected, symptoms of disease, and signs of pathogens.

3. Observe the orchard and note the infestation pattern, field conditions, field history, and weather conditions for the past 10 to 14 days.
4. Consult references to assist you in disease identification or consult the Extension Specialist.

Students should retrieve LS: D5-1. This time, they will fill in the description column. They should list characteristics of the specific disease and how to identify it. Once they have done this continue on to the next objective.

Objective 4: Explain the control of plant diseases.

(PowerPoint Slide #27)

IV. The cost of the treatment and life cycle of the pathogen must be considered when selecting a control measure.

- A. The methods used to control crop diseases are many but can be grouped into three main categories. Genetic control, or host plant resistance, is the most common and important method of disease control. Three general classes of disease resistance have been designated.

(PowerPoint Slide #28)

1. **Disease avoidance** is when crop plants may have morphological structures such as sunken stomata or a thick cuticle that discourages penetration of inoculum.
2. With **disease tolerance** an infection may occur, but the crop host is able to withstand the invasion, continue to grow, and produce satisfactory yields. There is no evidence of incubation and/or infection even though inoculation has occurred with true **disease resistance**.
3. **Cultural disease control** involves any change or manipulation of field operations that alters either the life cycle of the pathogen or the host, so that inoculation or infection does not occur.

(PowerPoint Slide #29)

- B. Optimum plant density, timely cultivation and fertilization, and proper water management are all practices that promote vigorous crop growth. Healthy plants are less disposed to disease while stressed plants are more likely to suffer disease infection and damage.

(PowerPoint Slide #30)

1. Choose fruit and nut varieties that are proven disease resistant.
2. Weed control of all kinds often eliminates the alternate disease host but always reduces the competition of weeds for light, water, and nutrients.
3. Chemical disease control may be effective but it is not always feasible in orchards.
 - a. Chemical control must be applied before inoculation and remain on the plant or be reapplied as long as there is a threat of inoculation.
 - b. Once a pathogen has entered the plant, chemical control is difficult, if not impossible.
 - c. Chemical control of plant diseases is strictly preventative.
 - d. There are no treatments to reduce the symptoms once a plant has the disease.

Students should again retrieve LS: D5-1. They will complete the last column “Control” for each disease. Once they have completed this, continue on to the next objective.

Objective 5: Identify strategies used in disease management.

(PowerPoint Slide #31)

V. Successful management of orchard diseases is based on a thorough understanding of factors influencing disease development and expression. Strategies should include measures to reduce losses in the current crop as well as considerations for future plantings.

(PowerPoint Slide #32)

- A. The interaction of four factors influences the development of all plant diseases. Plant disease management is directed toward disrupting one or more of these factors.
1. The presence of a susceptible host crop.
 2. A pathogen, disease-causing agent, capable of colonizing the host.
 3. An environment that favors the pathogen and not the host.
 4. Adequate time for economic damage and loss to occur.
- B. Measures used to manage plant diseases are crop rotation, genetic resistance, fungicides, and cultural or agronomic practices.

Discuss student's answers to the question, "What can we do to cure a diseased plant?" asked in Objective 1. Ask students if their answers changed and why they believe disease management is important in the orchard.

Review/Summary: Use the student learning objectives to summarize the lesson. Have the students explain the response to the anticipated problem of each objective. Student responses can be used to determine which objectives need to be reviewed. Questions on **PowerPoint Slide #33** can be used as review.

Application: Students should use LS: D5-1 and create a presentation about each of their diseases. They can create a PowerPoint, a poster, or a pamphlet. Once completed, each group will present their plant diseases to the class so that each student can learn about more plant diseases common to Afghanistan. Encourage them to take notes on the other diseases and provide them with more blank copies of LS: D5-1 if they would like one.

Evaluation: Evaluation should focus on student achievement of this lesson's objectives. A sample written test is attached.

Answers to Sample Test:

Matching

1. C
2. D
3. B
4. F
5. E
6. A
7. G

Short Answer

1. Susceptible host plant; disease-producing agent; favorable environment; time for the disease to develop.
2. Scout the field and note problem areas; examine the plants and note the plant parts affected, symptoms of disease, and signs of pathogens; observe the field and note the infestation pattern, field conditions, field history, and weather conditions for the past 10 to 14 days; consult references to assist you in disease identification or consult your county extension adviser.

Sample Test

Name _____

Test

Unit D Lesson 5: Identify and Control Diseases in the Orchard

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | | |
|-------------|------------------|------------------------|------------|
| a. Bacteria | b. Fungi | c. Infectious diseases | |
| d. Pathogen | e. Plant disease | f. Plant pathology | g. Viruses |

- _____ 1. Caused by a living organism or pathogen.
- _____ 2. A living, disease-producing agent.
- _____ 3. Small, many-celled plants that lack chlorophyll.
- _____ 4. The study of plant diseases.
- _____ 5. A harmful alteration of the normal physiological and biochemical growth of the plant.
- _____ 6. Microscopic, one-celled organisms that reproduce by simple division.
- _____ 7. Tiny pathogens that can be seen only with special microscopes.

Part Two: Short Answer

Instructions. Provide information to answer the following questions.

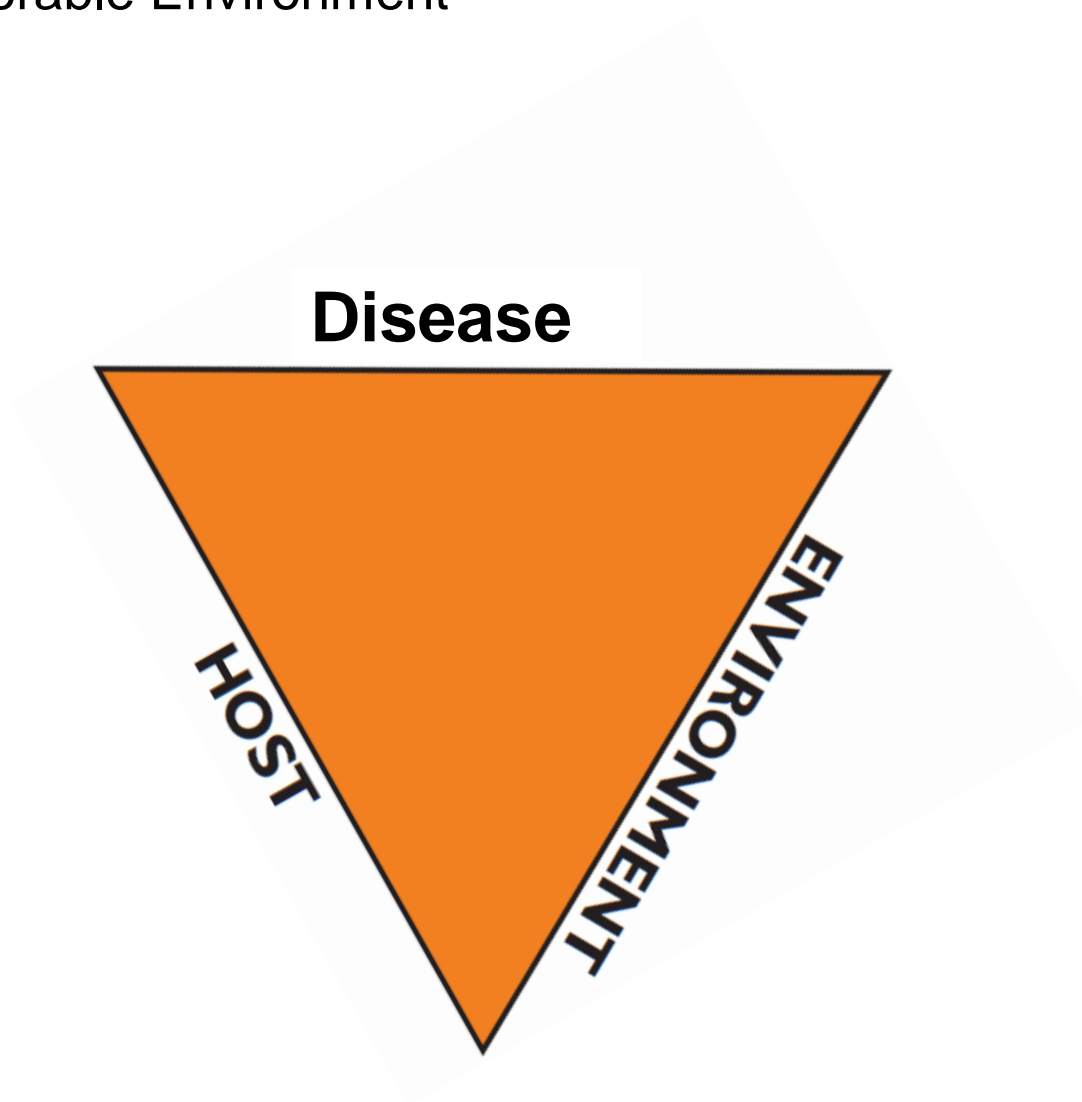
1. What four conditions are necessary for a plant disease to develop?

2. What steps should be followed for diagnosing plant diseases?

Favorable Conditions for Disease Growth

Disease problems develop when three conditions are present:

- Disease
- Host (plant)
- Favorable Environment



LS: D5-1

Common Orchard Diseases of Afghanistan

Name	Bacteria, Fungi, or Virus?	Description	Control