Unit G: Pest Management

Lesson 2: Managing Crop Diseases

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: 2 hours

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

- A PowerPoint has been developed for use with this lesson plan

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters
Copies of Lab Sheets for students

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

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

Display to the students a healthy plant and one that has a disease problem. Ask students to identify differences between the two. Lead a discussion that introduces the lesson.

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 disease usually consists of a series of harmful processes that occurs over a fairly long period of time. 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 susceptible host plant, a disease-producing agent, a favorable environment, a time for the disease to develop.

****If any one of these conditions is not met, a disease will probably not occur. Use TM: G2-1 and TM: G2-2 as visual material for lecture and discussion.**

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. They cannot be transmitted from plant to plant. They occur very quickly in a wide variety of plants and do not continue to damage the plant throughout the season. They are caused by unfavorable growing

conditions, such as extremes in weather, air pollutants, nutrient deficiencies or excesses, and toxic chemicals.

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

(PowerPoint Slides 8 and 9)

3. ***Bacteria*** are microscopic one-celled organisms that reproduce by simple division. Assuming cell division every 20 minutes, one bacterium can produce up to 70 billion offspring in hours. Bacteria cannot move by themselves and depend on splashing rain, wind, animals, insects, farm implements, seed, and other means to get to host plants. Bacteria usually enter through wounds in the plant and cause local or systemic infections. Symptoms of bacterial infection are wilting, soft rots, leaf blights, and spots. Mycoplasmas and spiroplasmas are bacterial forms that lack cell walls. 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 Slides 10 and 11)

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

(PowerPoint Slides 12 and 13)

5. ***Nematodes*** are microscopic roundworms that live in the soil and feed in the root system of plants. Nematodes are obligate parasites in that they can survive only on or in living plants. They reproduce by eggs and are spread by anything that moves nematode- infected plant parts or nematode-infested soil. Plant-parasitic nematodes have a hollow feeding tube, called a stylet, that is inserted into roots to draw out plant juices. This weakens the plant, causing it to turn a yellowish color and stunting its growth. Nematodes do not usually kill the plant; they reduce plant vigor and growth. They may also interact with soil-inhabiting fungi to cause a root-disease complex, which results in a more severe disease than either the nematode or fungus could cause when acting alone.

(PowerPoint Slide 14 and 15)

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

seed plants such as dodder, the true mistletoes, and witchweed are obligate parasites. They reproduce by seed and are spread by animals, wind, soil, water, or equipment.

****Use TM: G2-3 and TM: G2-4 as visual material for lecture and discussion. PowerPoint Slide 16 can also be used. Ask the students if they have noticed any diseases on plants in their area. Encourage them to explain what it looked like and where they have seen it. Ask if anyone is able to identify what disease is being talked about.**

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

(PowerPoint Slide 17)

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

(PowerPoint Slide 18)

A. As a field is spot-checked for insects, the severity of diseases can also be noted.

1. Examine roots, stalks, and leaves, and collect samples for positive identification. Some pathogens cause localized infections; others may infect the entire plant. It is important to inspect the entire plant when diagnosing a plant disease problem.
2. Fields are normally spot-checked in five different areas. In those areas, carefully examine all plants within a 6 meter section of random selected row for row crops or within a 1/2 by 3 meter area for forage and small grain crops.

(PowerPoint Slide 19)

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.

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, over-wintering structures, nematode galls or cysts, 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.

1. Over-development of tissues: galls and swellings.
2. Underdevelopment of tissues: stunting, lack of chlorophyll, or incomplete development of organs.
3. Death of tissues: leaf or flower blights, leaf spots, root rots, cankers, wilting.

(PowerPoint Slide 21)

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.
2. Diseases that affect the entire plant are called systemic infections. Once inside the plant, the pathogen moves throughout and causes wilting, yellowing, and stunted growth. Systemic diseases often kill the plant. When diagnosing diseases the entire plant must be examined. Notice where diseases occur in the field and how they have developed. Some diseases are more severe in low areas, while others can be found throughout the field.

(PowerPoint Slide 22)

E. Steps to follow for diagnosing diseases.

1. Scout the field and note problem areas.
2. Examine the plants and note the plant parts affected, symptoms of disease, and signs of pathogens.
3. Observe the field and note the infestation pattern, field conditions, field history, and weather conditions for the past 10 to 14 days.

****PowerPoint Slide 23 can be used to illustrate the stages of disease development.**

Objective 4: Explain the control of plant diseases.

(PowerPoint Slide 24)

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.

1. ***Disease avoidance*** is when crop plants may have morphological structures such as sunken stomata or a thick cuticle that discourages penetration of inoculum. Crops escape disease inoculation by reaching maturity before the level of inoculum is great enough to infect a large area.
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. The degree of parasitism is so slight that no detectable loss of dry matter production occurs. While in other tolerant crops the infection is limited by mechanical or chemical exclusion. There is no evidence of incubation and/or infection even though inoculation has occurred with true ***disease resistance***.

(PowerPoint Slide 25)

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 26)

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 27)

1. Crop rotations change the crop host and also reduce the level of the primary inoculum.
2. A change in planting date, either earlier or later, often helps a crop escape or withstand disease infection.
3. Tillage and cultivation reduce the source of primary inoculum of some diseases by burying crop residues.
4. Weed control of all kinds often eliminates the alternate disease host but always reduces the competition of weeds for light, water, and nutrients.

(PowerPoint Slide 28)

5. Chemical disease control may be effective but it is not always feasible on field crops. Chemical control must be applied before inoculation and remain on the plant or be reapplied as long as there is a threat of inoculation. Once a pathogen has entered the plant, chemical control is difficult, if not impossible. Chemical control of plant diseases is strictly preventative. There are no treatments to reduce the symptoms once a plant has the disease.

****Use TM: G2-5 as visual material for lecture and discussion.**

Objective 5: Identify strategies used in disease management.

(PowerPoint Slide 29)

V. Successful management of field crop 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.

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. The presence of a susceptible host crop. A pathogen, disease-causing agent, capable of colonizing the host. An environment that favors the pathogen and not the host. 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.

****When finished presenting the information have students complete LS:G2-1. Student's could also go out to a couple fields and look for diseases on the plants.**

Review/Summary: Use the student learning objectives as a guide to summarizing the lesson. Have students explain terms, processes outlined in the lesson, and the content associated with each objective. Student responses can be used in determining which objectives require greater review or whether further instruction is necessary. Question on PowerPoint Slide 30.

Application: The accompanying lab sheet will be helpful to students in applying the lesson's content.

Evaluation: Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.

Answers to Sample Test:

Part One: Matching

1 = c, 2 = e, 3 = b, 4 = g, 5 = f, 6 = a, 7 = d, 8 = h

Part Two: Completion

1. Noninfectious disease
2. Plant disease
3. rotation, genetic, agronomic

Part Three: 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.

Sample Test Name_____

Test

Unit G Lesson 2: Managing Crop Diseases

Part One: Matching

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

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

_____ 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. Microscopic roundworms that live in the soil and feed in the root system of plants.
_____ 8. Tiny pathogens that can be seen only with special microscopes.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. _____ _____or abiotic disease is not caused by a pathogen, but rather by elements in a plant's environment that are damaging to it.
2. _____ _____ management is directed toward disrupting one or more of the factors.
3. Measures used to manage plant diseases are crop _____, _____ resistance, fungicides, and cultural or _____ practices.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

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

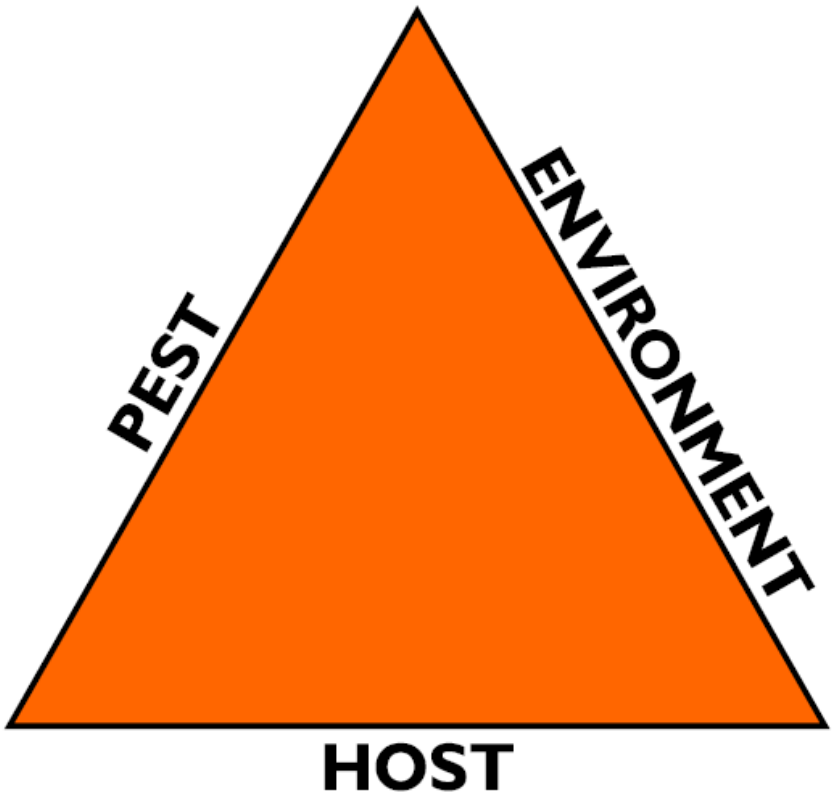
2. What steps should be followed for diagnosing plant diseases?

TM: G2-1

CONDITIONS FOR PESTS

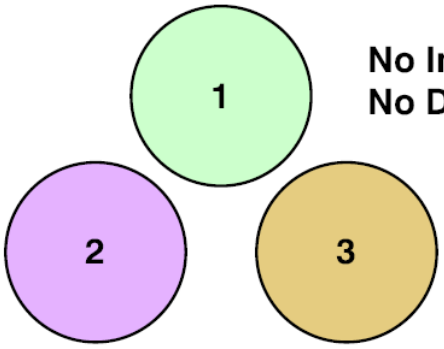
Pest problems develop when three conditions are present:

- **pest (insect, weed, disease, etc.)**
- **host (susceptible plant)**
- **favorable environment**



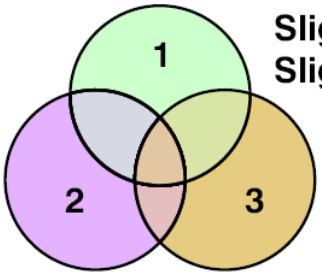
TM: G2-2

INTERACTION IN A DISEASE COMPLEX

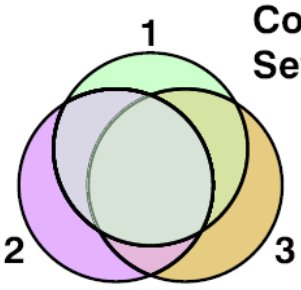


No Interaction
No Disease

1 Causal organism
2 Susceptible host
3 Favorable environment



Slight Interaction
Slight Disease Development



Complete Interaction
Severe Disease Development

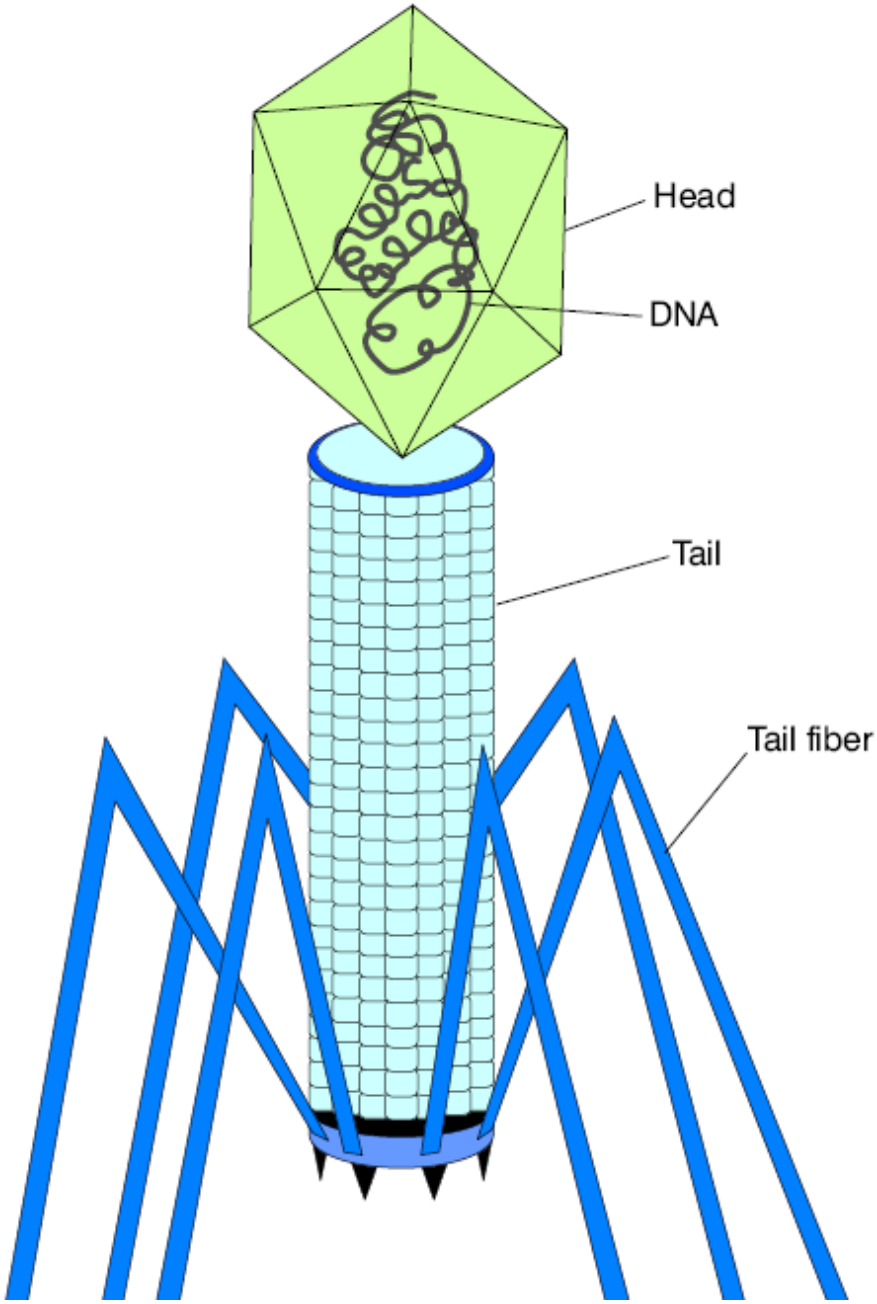
TM: G2-3

EXAMPLES OF BIOTIC DISEASES

BACTERIA	
wilt (bacterial)	**corn, alfalfa, tomato, potato**
gall	**crown gall in trees and many crops**
infection	**angular leaf spot of cotton**
FUNGI	
anthracnose	**cotton, cucumber, cantaloupe, watermelon**
downy mildew	**grain crops, grape, onion, spinach, lettuce, cucumber**
powdery mildew	**grain, cucumber**
wilt (fusarium and verticillium)	**cotton, tomato, sweet potato, watermelon**
VIRUSES	
mosaic	**tomato, potato, sugarcane**
stunt	**corn**
streak	**sugarcane**

TM: G2-4

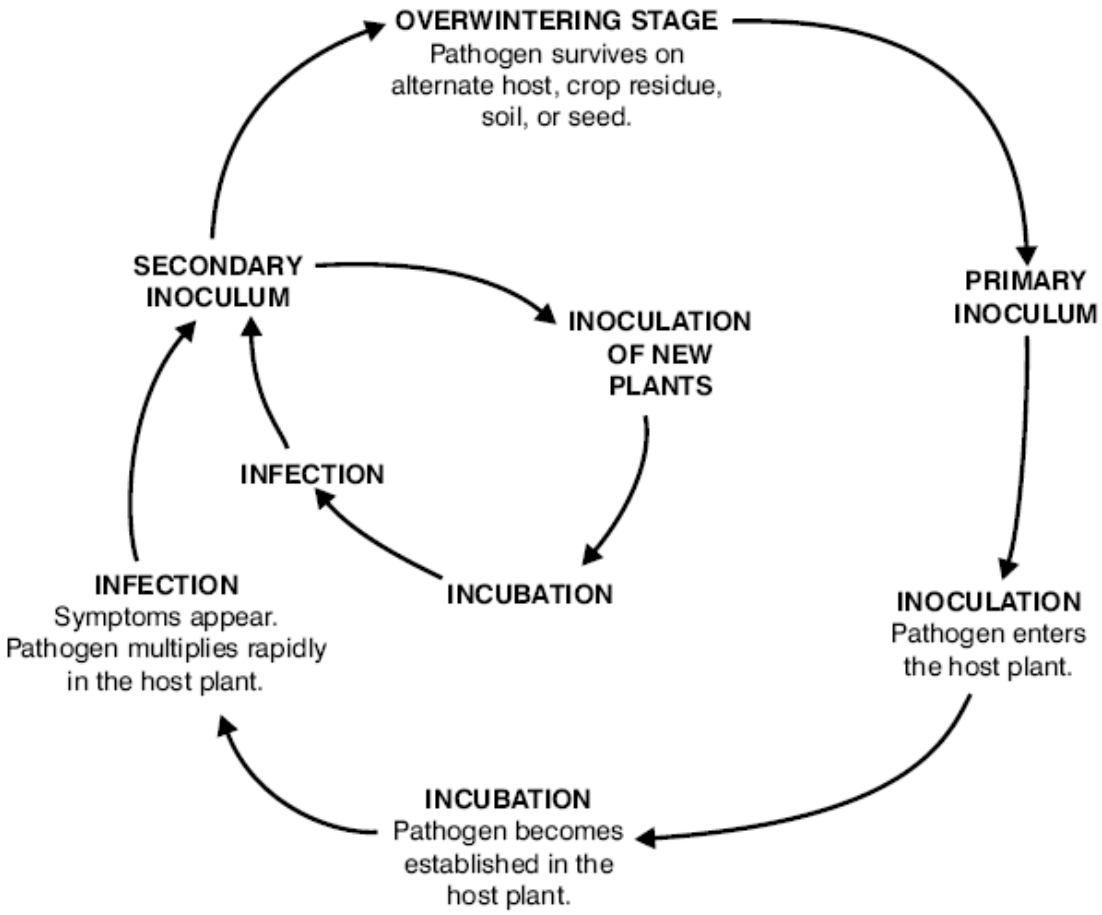
EXAMPLE OF A VIRUS



TM: G2-5

STAGES OF DISEASE DEVELOPMENT

There are three pathogenic stages in the development of a disease that may occur only once or many times in the seasonal cycle of the disease. These stages are illustrated below.



LS: G2-1 Name_____

Lab Sheet

Determining the Diseases of Crops

Materials:
Clip board, paper, pencil, and crop scouting guide or class notes, field or plant samples

Procedure for corn:
Using the specimen provided, determine the plant disease that is present.

Procedure for cotton:
Using the specimen provided, determine the plant disease that is present.

Procedure for wheat:
Using the specimen provided, determine the plant disease that is present.