

# Plant Pathology

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## In a nutshell...

- Plant diseases involve the interaction between a plant and a disease-causing microorganism under the appropriate environmental conditions.
- Disease diagnosis is not an easy process and only a handful of diseases are recognizable by eye. Most disease diagnoses will require the assistance of a plant disease expert.
- Proper disease management often times involves using multiple strategies (e.g., use of resistant varieties, proper disposal of diseased plant material, modification of environmental conditions in a garden).
- Check the resources at [hort.extension.wisc.edu](http://hort.extension.wisc.edu) for issues not covered in this chapter.



## Introduction

**P**lant pathology is the study of diseases of plants and the organisms that cause these diseases. The subject of plant diseases is a daunting topic for many people. Disease problems tend to strike fear in the hearts of gardeners because they seem to come from nowhere and often lead to the death of a treasured plant. Unlike insect pests, the organisms that cause plant diseases typically cannot be seen with the naked eye. This seems to make plant diseases all the more mysterious and certainly makes them more difficult to identify correctly.

Some plant diseases have had an enormous impact on human history. A prime example is the great Irish potato famine in mid-19th century. Millions died or were forced to leave their country when a fungus-like organism devastated Ireland's staple food crop, the potato. Fortunately, the impact of plant disease typically isn't as dramatic in home gardens.

This chapter will help you learn about how susceptible plants, disease-causing organisms, and environmental conditions interact to cause disease, and how these factors can be managed to prevent disease. You will also learn how to gather the appropriate information to diagnose some diseases, where to go for additional diagnostic support, and methods for plant disease management.

## Learning objectives

- 1 Be familiar with the major types of pathogens that cause disease in plants.
- 2 Be familiar with the signs and symptoms related to plant diseases.
- 3 Understand that a sample is needed to confirm most plant disease diagnoses.
- 4 Learn how to manage plant diseases.

## Disease development

Disease is the interaction between a susceptible host, a disease-causing organism, and a favorable environment. For disease to occur, an appropriate combination of these three factors must occur simultaneously. The "disease triangle" is a convenient way of visualizing this interaction (figure 1). If one or more of these factors is missing, disease will not occur. The genetic makeup of a plant determines its susceptibility to disease. In addition, plants may be more or less susceptible to particular diseases during certain developmental stages. **Pathogens** (i.e., disease-causing organisms) differ in their ability to survive, spread, and reproduce. Environmental conditions including temperature, light, or moisture can influence disease

development. In particular, cool, moist conditions are ideal for development of many plant diseases caused by fungi.

Disease management focuses on modifying the disease triangle by reducing or eliminating one of the corners of the triangle.

- If you use resistant ornamental or vegetable varieties in your garden—such as a powdery mildew-resistant variety of phlox—you are eliminating the susceptible host and can reduce or prevent disease.
- You can reduce or eliminate some diseases by removing any diseased plant material (e.g., raking up and disposing of infected leaves as they fall from a tree in the autumn) because you are eliminating the pathogen.
- You can reduce or eliminate a favorable environment for disease by doing something as simple as not overwatering your garden or thinning plants to increase airflow and promoting more rapid drying of leaves.

### Causes of plant disease

There are five major groups of microorganisms that can be involved in plant diseases. These include fungi (and fungi-like organisms called water molds), bacteria, viruses, nematodes, and phytoplasmas. In addition, many plant disorders look like plant diseases, but no microorganism is involved. These disorders are oftentimes referred to as **abiotic disorders**.

### Fungi

Fungi (as well as the fungi-like water molds) are by far the most important group of plant pathogens. There are over 200,000 known species of fungi. Some studies suggest that there may actually be over 5 million fungal species worldwide, many of which have not yet been discovered and described. Over 8,000 species of fungi can cause plant diseases.

The majority of fungi are NOT plant pathogens. These fungi, called **saprophytes**, derive nutrients by feeding on dead organic material. They are major players in the decomposition of organic material (e.g., dead leaves) and the recycling of nutrients back into the environment. Many fungi can be seen with the naked eye, but the visible part of the fungus is often just a reproductive structure, such as a mushroom. The non-reproductive “body” of fungi is called its **vegetative phase**.

Most fungi are composed of a mass of fungal threads called **hyphae** (singular = hypha), as shown in figure 2. Most hyphae have **septa**, or partitions dividing the tube-like hyphae into individual cells. The presence, absence, or location of septa can be important in distinguishing and identifying some plant pathogenic fungi. A mass of **hyphae** is called a **mycelium** (plural = mycelia). While an individual hypha is microscopic, mycelia are often visible with the naked eye. Bread mold is a visible mycelium commonly found in our kitchens.

FIGURE 1. The disease triangle

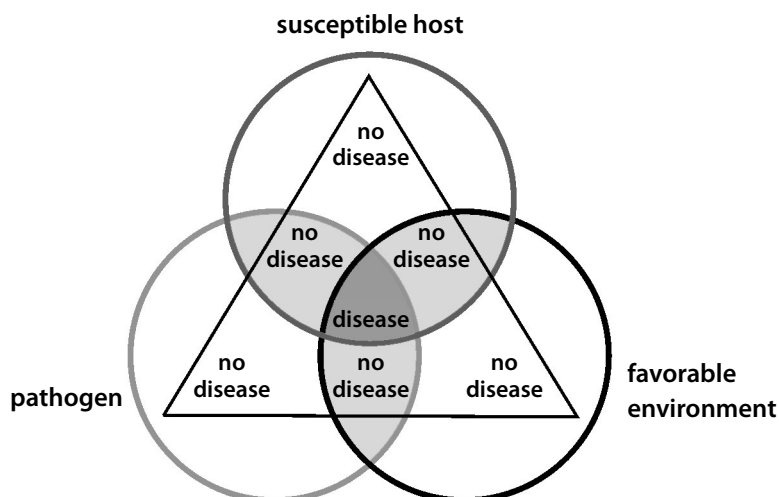
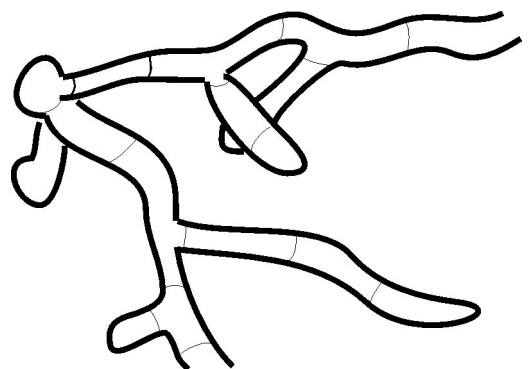


FIGURE 2. Fungal hyphae





Fungi reproduce by **spores** (seed-like structures). Spores are often (although not always) produced in reproductive structures generally called **fruiting bodies**. Fruiting bodies come in a wide variety of sizes and shapes. Most fungal plant pathogens form fruiting bodies that are microscopic in size, although a few produce macroscopic fruiting bodies such as mushrooms.

- Some fruiting bodies are produced sexually, with spores resulting from the recombination of genes from two fungal parents. When these spores germinate, they produce “offspring” that are genetically different from both parents.
- Other fruiting bodies are asexual (not the result of recombination of genes from more than one fungal “parent”). The spores are produced by a single fungal parent and thus, when these spores germinate, they produce offspring that are genetically identical to the parent fungus.

Fungal spores and fruiting bodies are used to identify fungi, so accurately diagnosing a fungal disease without a microscope can be difficult, if not impossible. Fungal spores come in all shapes and sizes (figure 3). They can have one or more cells. While many spores are colorless, some have dark pigments. This pigmentation is thought to enhance the ability of spores to survive exposure to adverse environmental conditions, such as exposure to ultraviolet light and to ward off attack by other parasitic fungi and bacteria. Although spores typically function as a means of reproduction and dispersal (i.e., they can help the fungus move from place to place), they can

also serve as a means of survival during periods of unfavorable environmental conditions. Some spores are resistant to dessication (water loss), extreme temperatures, other abiotic stresses, and attack by other microorganisms; others are fragile and readily die under stress.

Some common examples of fungal diseases include black knot, cedar-apple rust, and powdery mildew.

### Bacteria

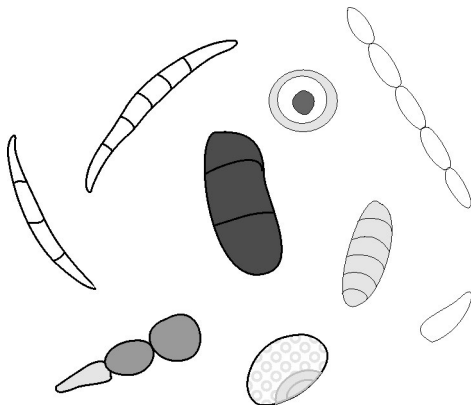
Bacteria are arguably the second most important group of plant pathogens. There are approximately 200 pathogenic species. Bacteria are very small and can only be seen at very high magnification (1,000 times their normal size) using a microscope. Often special stains are required to see bacterial cells.

Compared to fungi, bacteria are extremely simple. They are single-celled, although certain bacteria form long chains of cells that are physically (but not functionally) similar to fungal hyphae. Bacterial cells contain a bacterial chromosome, surrounded by a membrane, and a rigid cell wall that gives most bacteria either a spherical or rod shape. Some bacteria have **flagella** that help them move around in their environment.

Reproductively, bacteria are also very simple. They do not form complex fruiting bodies, but reproduce by the process of **binary fission**. In this simple process, existing cells enlarge, the bacterial chromosome duplicates, a copy of the chromosome ends up at each end of the cell, and finally each cell pinches off in the middle to form two cells that are genetically identical to each other and to the parental cell from which they have arisen.

Bacterial diseases are virtually impossible to identify definitively based on symptoms. Typically the bacterium must be recovered from diseased tissue and then grown on specialized media. Alternatively, bacteria can be identified with immunological techniques similar to those used in home pregnancy tests. If you suspect your plant has a bacterial infection and you have access to a microscope, you may be able to confirm your suspicion by looking for **bacterial streaming**. To observe streaming, cut out a piece of the leaf at the edge of the diseased area and

FIGURE 3. Fungal spores



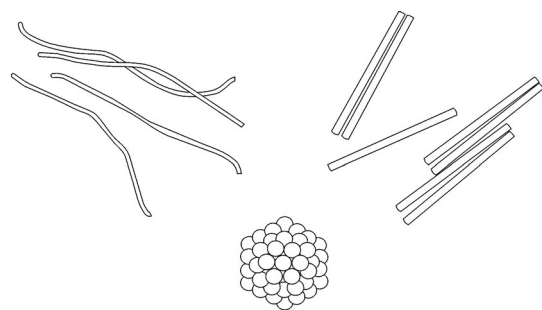
place it on a microscope slide in a drop of water. Slice through the tissue with a razor blade. If bacteria are present, they will ooze out from the cut edges of the tissue. Often large numbers of streaming cells will be particularly visible where veins have been cut. While this technique will not identify exactly which bacterium is involved in the disease, it can provide a useful clue that the disease is bacterial in nature.

Some common examples of diseases caused by bacteria include fire blight, bacterial blight of lilac, bacterial brown spot of green beans, and soft rot of potato tubers.

### Viruses

If bacteria are small, viruses are even smaller. Bacteria can be seen with a light microscope, but viruses can typically only be seen using an electron microscope that magnifies the particles about 10 to 100,000 times their normal size. Plant viruses can be spherical or they can be rigid or flexuous (flexible) rods (figure 4). Viruses are also much simpler structurally than bacteria. Most viruses are composed only of a piece of genetic material (either DNA or RNA) with a protein coat. Because viruses are so simple, they do not have everything they need to reproduce on their own. Thus after infecting a cell, plant viruses “hijack” the cell and force it to produce viral particles.

**FIGURE 4. Viruses**



Viruses can be transmitted (moved from plant to plant) in several ways.

- Many are mechanically transmitted. These viruses can be moved about by handling an infected plant, then handling a healthy plant, or simply by two plants rubbing together.
- Other viruses are transmitted by insects (e.g., aphids, thrips). These viruses are picked up by insects as they feed and then are moved from plant to plant as the insects move around. Some insect-transmitted viruses actually reproduce in the insect vector as well as in the plant host.
- Other viruses can be transmitted by seed, pollen, and grafting.

Not all viral infections are necessarily bad—at least from a human standpoint. In fact, some viral infections in tulips—called tulip breaking viruses—have at least historically been highly desirable, because they led to interesting flower colorings and shapes.

Common viral diseases that occur in Wisconsin include cucumber mosaic virus (CMV), tobacco mosaic virus (TMV), impatiens necrotic spot virus (INSV), and tomato spotted wilt virus (TSWV).

- CMV is a common virus of vegetables that is transmitted by aphids.
- TMV can infect a wide variety of plants and is mechanically transmitted. People who smoke can inadvertently pick up this virus from tobacco products such as cigarettes and then infect garden plants as they handle them.
- INSV and TSWV are transmitted by thrips, a common greenhouse insect pest, and can infect a wide range of ornamental and vegetable plants.

### Phytoplasmas

At one time, **phytoplasmas** were called mycoplasma-like organisms (MLOs) because they resemble organisms (mycoplasmas) that cause diseases in animals. The name phytoplasma was coined to describe mycoplasmas that specifically cause plant diseases.



Phytoplasmas are rather odd bacteria-like organisms. They differ from true bacteria in that they are smaller and lack a cell wall. Because of their small size and because of the symptoms they produce, diseases caused by phytoplasmas (often called “yellows” diseases) were, for a long time, thought to be caused by viruses.

Phytoplasmas live and reproduce in the plant’s food-conducting tissue, or **phloem**. As is the case with bacteria, phytoplasmas reproduce by binary fission. Phytoplasmas are transmitted by insects, especially leafhoppers, that are phloem-feeders.

Like viruses, phytoplasmas are most easily seen using an electron microscope. However, phytoplasmas also can be seen using a light microscope by staining tissue with special dyes that bind to DNA and glow when exposed to UV light. Phloem cells do not contain DNA under normal circumstances and using this staining technique, phytoplasmas can be seen in this tissue as bright dots.

Probably the best example of a disease caused by a phytoplasma is aster yellows, which infects numerous ornamental and vegetable plants.

### Nematodes

**Nematodes** are tiny unsegmented, round worms (figure 5). The majority of nematodes do not attack plants, but feed on bacteria, fungi, or other nematodes. Nematodes typically cannot be seen with the naked eye, but require use of a light microscope. However bloated females of a group of plant pathogenic nematodes called the cyst nematodes may be visible by eye.

**FIGURE 5. A nematode**



Nematodes are multicellular and have sensory, digestive, and reproductive organs. Plant parasitic nematodes have a hollow mouthpart, called a **stylet**, that is used to puncture cells and obtain nutrients. The stylet also distinguishes pathogenic from most non-pathogenic nematodes. Nematode reproduction occurs sexually (i.e., by combination of an egg and sperm) or parthenogenically (i.e., by egg without fertilization) in species that have no males. Nematodes eggs hatch yielding juveniles that molt several times prior to becoming adults.

The feeding of some nematodes (called root knot nematodes) causes **galls** to form on roots. The nematodes (particularly females) tunnel into roots and, as they feed, their saliva stimulates the plant root cells to divide excessively and expand to larger-than-normal size, thus forming a gall.

All plant-parasitic nematodes live at least part of their life in the soil and are found in the greatest abundance in the top 6 to 12 inches of soil, especially in the root zone. Some nematodes, called foliar nematodes, can also live on leaves. Nematodes can be spread by water, wind, cultivation, on equipment, or in soil.

Some nematodes that you might encounter in Wisconsin gardens include root knot nematodes and foliar nematodes.

## Disease identification

Identifying the cause of a disease includes identifying the pathogen and/or the environmental factors that are contributing to disease. Once the cause of a disease has been identified, then appropriate management measures can be implemented to help prevent additional disease from occurring.

Diagnosing plant diseases is not an easy task. There is no one best technique for identifying a disease and its causes. In general, however, the following steps are typically useful in diagnosing plant disease problems:

1. Look for signs and symptoms.
2. Refer to pertinent references or experts to identify the disease.

## Look for signs and symptoms

Signs and symptoms are very important in diagnosing plant diseases.

### Signs

Signs are physical evidence of the pathogen that is causing a disease. Signs can include fungal hyphae, fruiting bodies (e.g., mushrooms) or spores, bacterial ooze, or the presence of nematodes.

Two groups of diseases that can easily be identified based on signs are the powdery mildews and rusts.

- Powdery mildew-affected plants look as though someone has sprinkled the surface of the plant with talcum powder or powdered sugar. The white powdery substance is a combination of fungal hyphae and asexual spores.
- Rusts produce rusty-orange-colored spores that are produced in **pustules** (a type of fruiting body). You can readily wipe these spores from the plant surface with your fingers.

### Symptoms

Symptoms are the physical characteristics of disease expressed by the plant. Symptoms of a given disease are often expressed differently on different plant parts and also can change as a plant ages. Most of the time symptoms will NOT definitively tell us the exact cause of a disease problem, but often symptoms can be used to give us a sense of what type of pathogen may be involved in a particular disease.

Symptoms can be grouped into five major categories: necrosis, overdevelopment, underdevelopment, discoloration, and wilting. Diseases often exhibit symptoms from more than one category at the same time.

### Necrosis

Necrosis involves death of plant tissue—whether that death is of individual plant cells, more extensive plant tissues or organs, or the entire plant. Common examples of necrotic symptoms include spots, lesions, blights, cankers, and rots.

**Spots and lesions** are common symptoms of both fungal and bacterial pathogens that infect leaves. Spots and lesions are well-defined

relatively small dead areas. While these terms can be used interchangeably, the term lesion is often used for slightly larger, more irregularly-shaped dead areas

Spots and lesions caused by bacteria often look watery, have straight edges, and have a yellow halo. The angular appearance of bacterial spots or lesions is due to the fact that bacterial pathogens often colonize tissue between leaf veins, which they cannot cross. The leaf veins form the edge of the spot or lesion. Fungal spots and lesions can also be angular, but more often are not. Fungal spots can be circular or irregular shape, and on occasion, will also have a yellow halo.

Few nematodes cause foliar symptoms, but lesions caused by foliar nematodes are typically angular. This nematode can be a problem on herbaceous ornamentals such as hostas.

**Blights** are generally caused by fungi or bacteria and affect large sections of a leaf, or even an entire leaf or plant. Bacterial blights on leaves often have a wedge shape initially, with the widest part of the wedge at the leaf edge. Fungal blights on leaves tend to have very irregular shapes. The most common blights home gardeners encounter are the tomato blights, Septoria leaf spot, and early blight. These diseases eventually defoliate plants from the bottom, working their way up.

**Cankers** are necrotic areas that occur on stems, branches, or trunks. They can be caused by a wide variety of fungi as well as some bacteria. Cankers are often sunken and discolored, and the outer bark layer may fall away.

A common canker of honeylocust (as well as other woody ornamentals) is nectria canker. The fungal pathogen that causes this disease often infects through pruning cuts and can eventually girdle branches or even the trunks of trees.

**Rots** involve the wholesale destruction and disintegration of plant tissue. Rots can affect any plant part—roots, crowns, fruits, and tubers are commonly affected—and are typically caused by fungi or bacteria. Fungal rots tend to be “dry rots,” where tissue disintegrates but is not wet and slimy. Bacterial rots tend to be “soft rots,” where disintegrated tissue is watery and slimy. Often



soft rotting bacteria invade tissue that has been initially infected by a fungal dry rotter, leading to secondary soft rot and making diagnosis difficult.

Bacterial soft rot of potato tubers is a classic example of a soft rot. This disease is caused by the bacterium *Pectobacterium carotovorum*, which produces enzymes that degrade pectin, the substance that holds plant cells together. Once pectin is degraded, the potato tuber becomes a squishy, disgusting mess. The bad smell typically associated with rotted potatoes is not due to *P. carotovorum* but to other bacteria that invade the rotted tissue after the pathogen has done its work.

### Overdevelopment

The term overdevelopment is used to describe symptoms of plant diseases where plant parts are overly large or are produced in larger-than-normal numbers. Common examples of overdevelopment symptoms include galls, warts, and brooming.

**Galls** are cancer-like growths that can occur on any plant part. Galls are caused most frequently by insects, but fungi, bacteria, and nematodes commonly cause galls as well.

The most common bacterial gall is crown gall, caused by the bacterium *Agrobacterium tumefaciens*. This bacterium often infects the stems or trunks of woody ornamentals, causing abnormal growth at, or near, the soil line.

Nematodes typically cause galls on roots. The most common gall-causing nematode is the root knot nematode (*Meloidogyne* spp.). The most common fungal gall is black knot (affectionately known as “poop-on-a-stick”), which occurs on branches of plum and cherry trees.

The term **wart** is typically used to describe a bump-like growth on a fruit. Wart symptoms are often caused by viruses, such as cucumber mosaic virus on melons and squash.

**Brooming** involves the production of excessive branches from a single point, giving a plant a “powder puff” appearance. Brooming can be caused by certain fungi (e.g., certain rust fungi), but is most commonly associated with infections by phytoplasmas. Aster yellows, a disease that

affects a wide range of herbaceous ornamentals, is the most common phytoplasma disease encountered by most home gardeners.

### Underdevelopment

The term underdevelopment is used to describe symptoms of plant diseases where plants—or plant parts—are smaller than normal. The most common underdevelopment symptom is **stunting**, where an entire plant is smaller than its expected size. Stunting can be caused by any type of pathogen and often is the result of an attack on a plant’s root system. Destruction of root tissue leads to a reduction in water and nutrient uptake and thus impaired plant growth.

Some symptoms are a combination of overdevelopment and underdevelopment. In particular, leaf **distortion** symptoms tend to be a combination of both types of symptoms. Plants with distortion symptoms may have leaves that are curled, cupped, or twisted or may have leaves that are narrow, “strappy,” and thicker and more leathery than normal. Leaf distortions are most frequently caused by viruses or phytoplasmas but exposure to certain herbicides can cause them as well.

### Discoloration

As the name implies, **discoloration** symptoms involve abnormal color changes. They can be caused by any type of pathogen. Discoloration symptoms are often the result of infections from pathogens (particularly fungi and nematodes) that adversely affect root growth and development or of nutrient abnormalities.

Common discoloration symptoms include **yellowing** (or **chlorosis**) and **reddening** (or marooning). The pattern of yellowing or other discoloration can sometimes aid in diagnosis.

Viral infections usually produce distinct discoloration patterns. A classic symptom of a viral infection is called **mosaic** or **mottle**, a blotchy light and dark green coloring of foliage. Some virus infections lead to line patterns on leaves. Others lead to **ringspots**, or concentric ring patterns on leaves or fruits. Viruses can also cause a (oftentimes white) striping or streaking symptom of flowers, referred to as **color break**.



Infection by phytoplasmas often leads to a distinct discoloration called **virescence**, where plant parts that are normally colored—such as the flowers—become green.

Often discolorations are caused not by true diseases but by abiotic disorders. For example:

- General yellowing of foliage may indicate a lack of nitrogen or may be caused by a variety of pathogens, particularly those that attack the roots of plants.
- Interveinal yellow (i.e., leaf veins remain green while leaf blades turn yellow) can indicate an iron or manganese deficiency (often the result of an overly high soil pH).
- Certain yellowing symptoms can indicate an overabundance of a particular nutrient (e.g., copper), which can become toxic.
- Reddening of foliage may indicate a phosphorus deficiency, but in evergreens can be a typical symptom of drought stress.

### Wilting

Wilted plants are those where leaves or an entire plant have a droopy appearance. **Wilting** indicates that a plant is not getting enough water—there are several reasons why this may be the case.

The most common cause of wilting is abiotic: drought stress or inadequate water. If there is plenty of water in the soil and a plant has been faithfully watered (or more likely over-watered), then root rots may be the cause of the wilting. Root rots cause wilting by destroying roots and preventing plants from taking up adequate water.

**Vascular wilt** pathogens are another cause of wilt symptoms. These pathogens invade the **xylem** (i.e., water-conducting tissue) of the plant and reduce water movement from the roots to the stems, branches, and leaves. These pathogens either cause blockages in the xylem themselves or the plant itself blocks off the xylem in an effort to prevent the pathogen from spreading. Vascular wilt diseases should be considered when a wilted plant has been watered adequately and has an intact root system.

Both bacteria and fungi can cause vascular wilts. Bacterial wilt of cucurbits (cucumbers, melons, pumpkins, squash, etc.) is a common vascular wilt caused by the bacterium *Erwinia tracheiphila*. This bacterium is transmitted (vectored) by the cucumber beetle, which introduces it into plants as it feeds. Common fungal vascular wilt diseases include Dutch elm disease (caused by *Ophiostoma ulmi*), oak wilt (caused by *Ceratocystis fagacearum*), and Verticillium wilt (caused by *Verticillium* spp.). In addition to wilting, vascular wilt pathogens often lead to discoloration (e.g., browning) of the vascular tissue.

## Access experts and references to identify a disease

You should be extremely cautious about diagnosing plant health issues. Only a few diseases (table 1) can readily be diagnosed by eye. Often several diseases will look very similar and these diseases will not be distinguishable without the help of a trained professional such as your county Extension horticulture or agriculture educator. Or, contact the Plant Disease Diagnostics Clinic (PDDC); for a small fee, staff at the PDDC can examine a plant, determine the cause of the disease (or abiotic) problem, and provide information on control or prevention.

## Disease management

Understanding the disease cycle is important when trying to manage plant diseases. Knowledge of the host, pathogen life cycle, environmental factors, and the chain of events that contribute to a disease can suggest the most effective management measures to interrupt the cycle.

Visit your garden regularly to assess the health of your plants and take steps to reduce the impact of disease when appropriate. Early intervention is the key to any health management strategy. Understand how much disease is tolerable and when control measure should be implemented to avoid losses (see chapter 4, Pest Management).



**TABLE 1. Plant diseases and disorders that are easily identified by eye**

Disease	Pathogen	Symptoms	Affects
Black knot	Fungus <i>Apiosporina morbosa</i>	Dark swellings on branches enlarge to black tumors on Prunus trees	Deciduous trees, fruits
Blossom end rot	Abiotic; lack of or poor absorption of calcium	Spots resembling bruises appear on blossom end of tomatoes; spots enlarge to become black, sunken, and leathery	Vegetables
Cedar-apple rust	Several fungi in genus <i>Gymnosporangium</i>	Irregular brown galls on junipers that produce orange, gelatinous slime in spring; circular, yellow-orange spots on rosaceous hosts leaves	Conifers, deciduous trees, fruits
Chlorosis	Abiotic nutritional disorder, often lack of or poor absorption of iron	Affected leaves turn yellow except along the veins; usually occurs with high pH that limits nutrient absorption	Conifers, deciduous trees, herbaceous plants, fruits
Powdery mildew	Several fungi (species depends on the plant)	Leaf surfaces have a white, powdery appearance	Deciduous trees, fruits, herbaceous plants, turf, vegetables
Tar spot	Several fungi in genus <i>Rhytisma</i>	Starts as small yellow leaf spots that enlarge and develops a raised, black center; primarily cosmetic	Deciduous trees, turf
Turf rust	Various fungi in the genus <i>Puccinia</i>	Rust-colored pustules and spore masses on leaves and stems; shoes, pet feet, etc. turn orange after walking through infected areas	Turf

**Note:** For more information on these and many other plant diseases and disorders, visit the Wisconsin Plant Disease Diagnostic Clinic and the Wisconsin Horticulture website.

There are numerous management options to consider. Chemical control is often thought of as the first and only option, but, for economic and environmental reasons, should be the last resort for most diseases. Chemical intervention can be appropriate in some situations, but generally should not be the first control strategy that you consider. A combination of cultural controls, plant resistance, and chemical protection will typically provide optimal control for most plant diseases. See chapter 4, Pest Management, for more information on control options.

## Conclusion

Diseases of plants are the result of a complex interaction of the pathogen, host plant, and environmental conditions. With proper integrated pest management—including proper sanitation in the garden, healthy and resistant plants, and good cultural practices, including right plant for the right place—plant disease can generally be reduced. If a disease does occur, remember only a small number can be easily diagnosed at home. The vast majority need to be identified by the experts for 100% confirmation.



## Resources

Wisconsin Horticulture  
publications are available at  
[hort.extension.wisc.edu](http://hort.extension.wisc.edu).



## FAQs

### ? Why does my plant have...?

First answer some basic questions. What kind of plant do you have? What are the symptoms and when did it start? What is the environment like? You need basic information to narrow the possibilities. You may not be able to pinpoint the problem without more information or special testing.

### ? What's wrong with my tomato (oak tree) etc.?

What are the symptoms? Is it wilting? Are the leaves falling off? Is it changing color? Many things can negatively affect your plants, so make sure to pay attention to the signs, symptoms, and environmental factors to determine potential causes.

### ? Will my other plants get this too? Will it kill the plant?

Some diseases can be spread between different plants, but most affect a single species. While some plant diseases can kill the plant, many others are only cosmetic. It's important to know what specific disease you're dealing with.

### ? If my plant has a disease, can I eat the crop?

In general, if the fruit or vegetable does not have broken skin and is not rotting, it is safe to eat. However, use common sense! If it tastes or smells off, toss it.



# Plant pathology (diseases) practice exam questions

(Answers below)

1. **For a plant disease to occur**
  - a. The weather must be conducive
  - b. The host plant must be susceptible
  - c. An infecting pathogen must be present
  - d. All of the above
2. **Which of the following is an abiotic disorder?**
  - a. Fungal hyphae
  - b. Mold on leaves
  - c. Frost damage
  - d. Bacterial streaming
3. **Which of the following is true?**
  - a. The majority of fungi are plant pathogens
  - b. Fungi are single celled organisms
  - c. Fungi reproduce by binary fission
  - d. A mushroom is a reproductive structure produced by some fungi
4. **Which is a symptom of a plant disease?**
  - a. Wilted leaves
  - b. Discolored bark
  - c. Dead roots
  - d. All of the above
5. **Which of the following can easily be spread on infested pruning tools?**
  - a. Fungal diseases
  - b. Bacterial diseases
  - c. Abiotic diseases
  - d. A+B
6. **A cultural method for controlling a foliar disease such as Septoria leaf spot would be to:**
  - a. Wet the surface of the leaves to wash off fungal spores
  - b. Give plants adequate spacing to allow airflow and light penetration
  - c. Leave infested and dead materials under the plant
  - d. Use copper fungicide after an infection occurs to cure the plant
7. **A mechanical method (sanitation) for controlling disease would be:**
  - a. Raking and removing infested leaves on the ground
  - b. Pruning and removing cankerous branches
  - c. Choosing disease-free planting materials
  - d. A+B
8. **Wilting may be caused by:**
  - a. Overwatering
  - b. Underwatering
  - c. Vascular pathogens
  - d. All of the above

## Answer key

1. (d) Think of the disease triangle. 2. (c) A nonliving causal agent is an abiotic disease. 3. (d) 4. (d) Keep in mind these can be symptoms of other things, too! 5. (d) A+B There are many fungal and bacterial disease spread by infected pruning tools. 6. (b) 7. (d) 8. (d) Lack of water and a pathogen blocking the plant's plumbing may be obvious; overwatering may cause root rots thus preventing water from being absorbed into the plant.

