



B. Gugino

for new farmers

Plant Disease Basics

WHAT IS A PLANT DISEASE?

A plant disease is a dynamic process where a living or nonliving entity interferes with the normal functions of a plant over a period of time. Things that happen just once, like lawnmower blight or lightning strikes, are not considered diseases, but rather injuries. Plant diseases result in visible symptoms that can help diagnose the disease or disorder.

WHY ARE PLANT DISEASES IMPORTANT?

Usually, farmers are worried about the financial losses that plant diseases can cause because of reduced quantity and/or quality of the product. For example, in 1970 U.S. farmers lost \$1 billion to an epidemic of southern corn leaf blight. Disease epidemics can also threaten entire plant species. Historical examples of destructive plant disease epidemics include American chestnut blight and Dutch elm disease (Agrios 1997).

WHAT CAUSES PLANT DISEASE?

Pathogens like bacteria, fungi, nematodes, viruses, and phytoplasmas, as well as abiotic problems, can all cause plant diseases.

Abiotic problems are caused by adverse extremes in the environment, such as nutrient deficiency, prolonged water stress, and air pollution.

Bacteria are single-celled organisms with no nucleus. Most bacteria associated with plants are saprophytic (feed on dead organic debris) and do no harm to plants. But a few—around 100 species—can cause plant diseases (Jackson 2009). Under favorable conditions, they reproduce very quickly, some doubling their population in just 9.8 minutes (Eagon 1972). Think of the pink goo that grows on rice left in the refrigerator for too long. These are bacteria. Bacteria can cause blights, leaf spots, fruit rots, vascular wilts, and galls. They typically enter the plant through natural openings, such as hydathodes and lenticels, or wounds created by wind-swept sand, hail, heavy rain, and/or mechanical damage. They can be spread by infected seed or from plant to plant by water splashing, insects, and humans.

Fungi usually grow as threads or strands called hyphae. A single hypha can be only a few inches long or miles long. Mushrooms are one type of fruiting body that some fungi form to reproduce. Fungi reproduce via the production of spores. These spores may be spread long distances by air or water, or they may be soilborne. Certain fungi are also able to produce structures that enable them to survive in the soil for many years. They can cause root and stem rots, shoot and leaf blights, leaf spots, cankers, vascular wilts, and postharvest storage rots (Agrios 1997).

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Nematodes are tiny microscopic round worms that generally live most of their lives in the soil. Plant-pathogenic nematodes comprise only a very small subset of all the nematode species. These nematodes have a needlelike mouthpart called a stylet used to pierce the plant cells and feed on the cell contents. Feeding either kills the plant cells, leading to the development of lesions, or causes galls to develop on the roots, reducing the ability of the plant to take up water and nutrients.

Phytoplasmas are specialized bacteria without a cell wall that depend on the host plant to survive. Typically transmitted by insects during feeding, they live in the plant sap and clog up the vascular system, reducing the ability of the plant to move water or nutrients. A typical symptom is phyllody, the production of leaflike structures instead of flowers, or a witch's broom or bushy appearance.

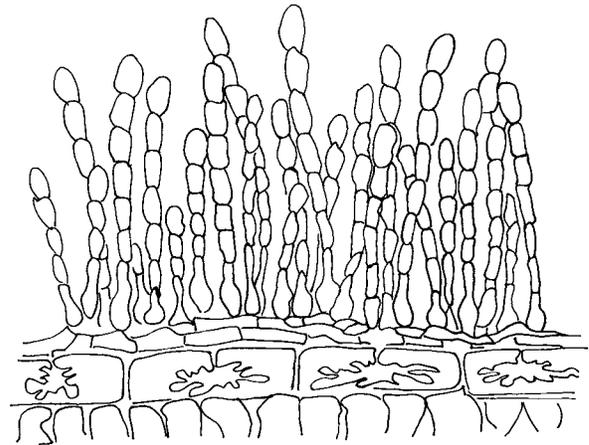
Virus particles are pieces of RNA or DNA with a protein coat. They multiply by inducing host cells to form more virus particles. Viruses are spread through vegetative propagation (cuttings, grafting, etc.), seed, insects (most common), or nematodes. Typical symptoms include stunting, mosaic, or ring spot patterns on leaves and fruit.

HOW DO PATHOGENS CAUSE DISEASE?

Pathogens use a number of different strategies to enter their host and capture the plant's energy for their own use. Some enter through natural openings or wounds created by mechanical damage or from severe weather events (i.e., hail, wind-swept sand). Others, such as some fungi or nematodes, can directly penetrate through the plant tissue, while viruses rely primarily on insects for transmission. Once inside the plant, some pathogens use enzymes that break down the tissue of the plant just like the enzymes in our stomachs break down food. Others have toxins that actually kill the plant tissue before the enzymes break it down. Still others secrete hormones that change the way the plant grows. For example, the hormones may tell the plant to move more nutrients to the area where the pathogen is lodged. All viruses and a few bacteria force the plant to produce pathogen gene products. Since the plant is putting most of its energy into making more viruses, the cells starve (Miles and Brown 2007).



Some bacterial diseases, like bacterial wilt (above), affect the phloem of plants, clogging the tubes that move water and nutrients. Photo courtesy of Beth Gugino.



Fungi form chains of cells. They can grow like tiny threads through the soil or plant cell walls. Most consume dead plant material, but some can use enzymes to dissolve and digest living plant tissue. Drawing courtesy of Lenore Gray.



Microscopic worms called nematodes can attack plant roots. Root knot nematode affects lettuce (pictured above), tomatoes, carrots (pictured on p. 1) and many other crops. Photo courtesy of B. Gugino.

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This fact sheet was adapted from A. Miles and M. Brown, *Teaching Organic Farming and Gardening* (Santa Cruz: University of California Farm and Garden, 2007).

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This publication was supported in part by funding from the Beginning Farmer and Rancher Development Program of the National Institute of Food and Agriculture, USDA, Grant #2009-49400-05869.

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An OUTREACH program of the College of Agricultural Sciences

Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

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Produced by Ag Communications and Marketing

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CODE # EE0036 5M6/12payne5131

