

# KNOW YOUR ENEMY - DISEASE DIAGNOSIS

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**Why should anyone wait for an accurate disease diagnosis?** The most important reason is that choice of the best control strategies, including pesticides, cannot be made in the dark. If the correct controls are not chosen, the disease will not be controlled with the obvious loss in the number of salable plants, plant quality, bench space, fertilizer, water, pesticides and labor. Each of these losses translates directly into increased expense to produce the crop. Finally, if you are not sure what the disease is caused by and you apply a pesticide that does not work you have acted irresponsibly and can blame no one but yourself if the crop is damaged or lost.

## WHAT KIND OF DISEASE IS IT?

The most important distinction to make is whether the disease is caused by a pathogen (biotic) or an environmental (abiotic) factor. When typical symptoms of a disease or signs of the pathogen are present, it is fairly easy for an experienced person to determine not only whether the disease is caused by a pathogen or an environmental factor but also by which one. Comparing the symptoms with those shown in "identification" books containing full color pictures in addition to books or articles that report the known diseases and their causes can often help identify the cause of the disease. In most cases, however, a detailed examination of the symptoms and an inquiry into other factors such as culture of the plant, crop history and recent weather conditions are necessary.

Isolation of microorganisms is the second step in disease diagnosis. Fungal and bacterial pathogens must be induced to grow from the symptomatic plant tissue onto the artificial culture media employed. Plant tissues are usually surface-disinfested with alcohol or bleach solutions to kill most superficial contaminants (microorganisms other than the pathogen). In addition, a variety of specialized culture media is selected for specific fungal or bacterial plant pathogens. Eventually the pathogen must be produced in pure culture (in the absence of the plant tissue and any other microorganism). This step is needed to fulfill Koch's Rules (see next section).

Identification of fungal pathogens is usually accomplished through direct examination using a microscope, sometimes up to 100 times magnification. Fungi produce characteristic sizes, shapes and types of fruiting structures such as spores as well as particular pigments on certain culture media and they can be readily identified. Since microscopically all plant pathogenic bacteria appear similar in culture other methods must be used. Identifying bacteria depends upon a wide variety of special media to determine tolerance to antibiotics, production of enzymes, and utilization of carbon sources. Most recently, analysis of cellular fatty acids, genetic materials and antibody responses are being used to identify these plant pathogens.

Identifying viral pathogens depends upon different steps. Currently, viruses are tested using a series of antibodies that have been prepared from the most common viruses known to attack

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plants. It was more common, in the past, for viruses to be identified first based on the symptoms they caused and second on symptoms they caused on special "indicator" plants.

## **IDENTIFICATION OF A PREVIOUSLY UNKNOWN DISEASE - KOCH'S RULES**

There are several rules used to prove the cause of a new disease. These rules were originally described by Koch and are followed by scientists who want to prove the causal relationship between a microorganism and symptoms of a new disease. Once these rules have been fulfilled, the disease is described and other workers do not need to repeat these steps each time they recover a pathogen from a sick plant.

- 1) The pathogen must be found associated with the disease in all the diseased plants examined.
- 2) The pathogen must be isolated and grown in pure culture if possible. This cannot be done with viruses since they cannot be cultured on artificial media.
- 3) The characteristics of the pathogen are described on the host plant.
- 4) A pure form of the pathogen must be inoculated on healthy plants of the same species or variety on which the disease originally appeared, and it must produce the same disease symptoms on the inoculated plants only (control plants must remain symptom-free and healthy).
- 5) The pathogen must be isolated in pure culture again (where possible), and its characteristics must be exactly like those observed when it was inoculated onto the plant. These steps can take many years for certain diseases, although usually the process is less than two months long.

Nevertheless, a two-month delay is hardly acceptable for producers waiting for a diagnosis. Most diseased plants sent to diagnostic clinics are not suffering from new diseases and Koch's rules are not routinely employed. An accurate diagnosis can take as little as one hour for samples with diseases such as powdery mildew, downy mildew or rust diseases that can be directly observed under magnification. Diagnosing bacterial diseases routinely takes as long as three weeks due to the many time-consuming culture methods employed. Virus identification can be completed in a few hours if the correct antibody is available. If the antibody is not available an accurate diagnosis may be years away.

Responsible plant producers insist on accurate diagnoses before choosing the methods that will most effectively control the disease. When cultural and chemical controls are not available or effective, discarding diseased plants is the best control method. Indeed it may be the only way to stop the disease from spreading throughout your crop and even your entire operation. Knowing your enemy is the only way to find its Achilles heel.