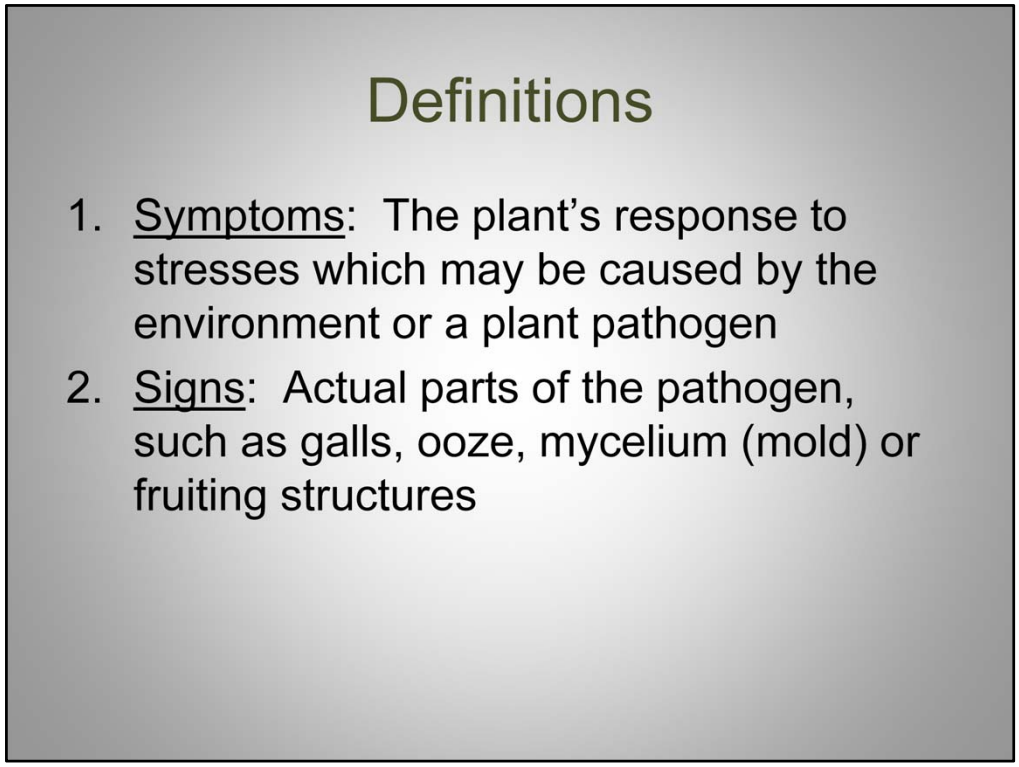
This presentation provides basic tips on diagnosing plant diseases for farmers and others involved in crop production. It does not provide detail on specific crops or diseases, but focuses on the diagnostic process.



When plant disease is suspected, look for symptoms and signs. "Symptoms" refers to the way a plant responds to stresses caused by the disease or perhaps by the environment. "Signs" are actual parts of the pathogen visible to the eye. Signs might include abnormal plant growth called 'galls', ooze caused by bacteria, visible mold, or fruiting structures of fungal pathogens.

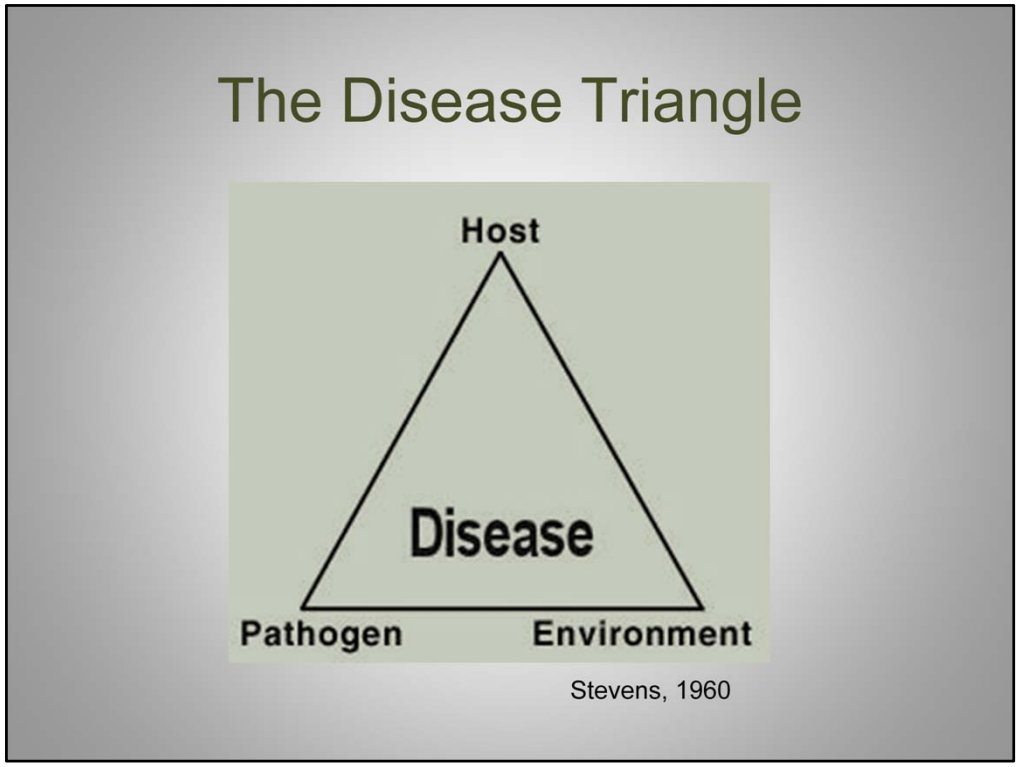
Symptom of fusarium head blight on wheat: *wheat heads that become partly or completely discolored*

Photo credit: Phil Wharton

Sign of loose smut of wheat: *kernels and glumes (chaff) are converted into black fungal spores which blow away, leaving only a sooty appearing rachis or spike.*

Photo credit: Donald Groth, Louisiana State University AgCenter, Bugwood.org

These examples on wheat show a symptom and a sign. The discoloration of the wheat head by *Fusarium* is a symptom, while the visible dark fungal spores caused by loose smut, or *Ustilago tritici*, are a stage of the fungal pathogen itself and are therefore a sign.



The 'disease triangle' is a widely accepted concept among plant pathologists. Plant disease can only occur when all three sides of the triangle are present: A plant pathogen (or disease organism), a susceptible host, and an environment conducive to disease development. Diseases can be prevented or controlled by removing one of these critical factors.

Basic tools for field diagnosis:

(No product endorsements intended)

1. Hand lens
   - at least 10X magnification
   - $10 - $30

2. Pocket knife
   - Sharp!
   - $10 - $50

3. Camera
   - Digital
   - Hi quality preferred

$100 - $500+

To successfully diagnose plant disease problems, a few simple tools are useful, including a good hand lens, a sharp knife and a camera capable of taking acceptable close-up digital photos.

Tools (cont.)

4. GPS unit
   - In addition to traditional location description
   - $150 – 700

5. Soil probe, shovel or trowel (+ziploc bags and marking pen)
   - For collecting soil samples for lab analysis, or digging up intact root systems

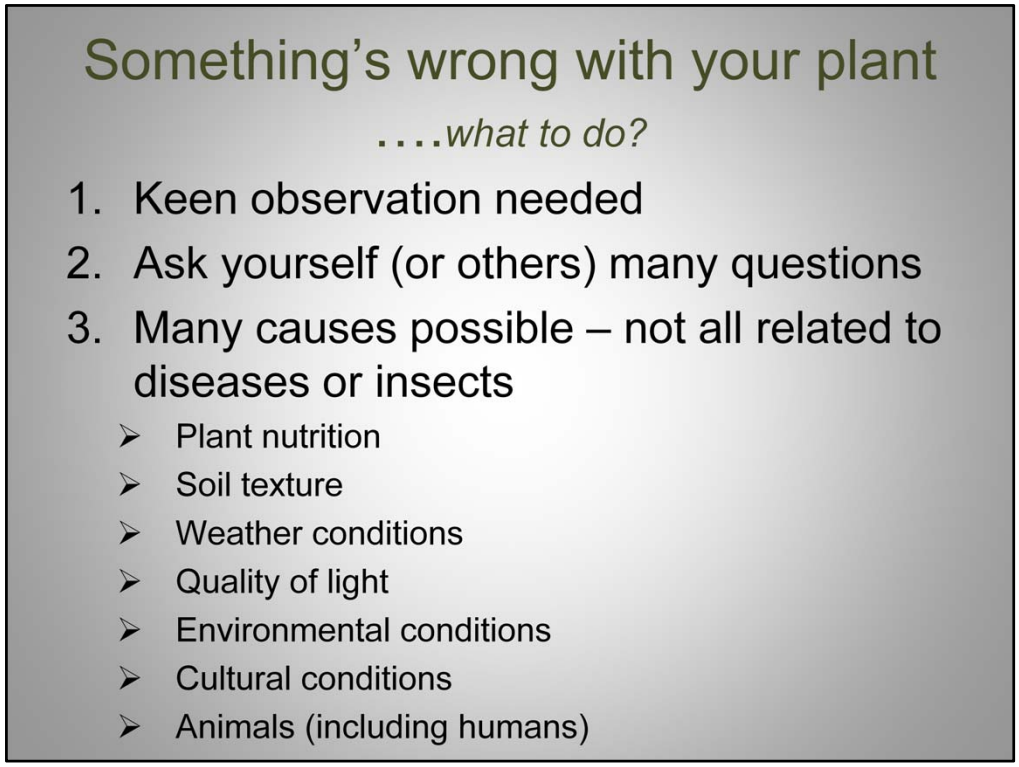
$70

$15-30

$5-15

A GPS unit will allow for pinpointing the location of diseased plants or problem areas. Visiting the same location in following years can help manage more persistent disease problems. Your notes should also include a traditional description based on nearby road intersections and convenient landmarks, or something similar.

A suitable tool for collecting soil samples and digging up plant roots is also needed.



When a plant problem is first noticed and disease may be the cause, it is important not to jump to conclusions. Careful observation of the affected plants, the surrounding plants and the general environment is needed. There are many possible causes for the problem and many questions to answer.
Could plant symptoms be caused by a plant nutrient problem?
Could drainage or compaction issues caused by soil texture be a factor?
How might recent or seasonal weather events be involved in the problem?
Could light quality, such as nearby woodlines, be involved?
Environmental conditions such as drought, excessive moisture or temperature are often very important factors.
Cultural conditions including tillage, planting, cultivation and chemical practices should also be considered.
What types of animals could be damaging your crop?

Know what questions to ask…

1. Brown, dry edges on the leaves of plants…

AP Photo

Drought damage – *What were recent rainfall patterns?*

2. Brown, dry edges on the leaves of plants…

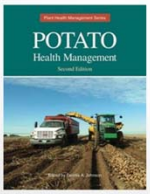
University of Wisconsin Extension

Urea application into corn whorl – *What was the fertilization schedule?*

Similar symptoms can be caused by very different things. Sometimes the cause is obvious, but sometimes it can be subtle.

First steps…

1. Identify the affected plant
2. Determine what diseases have been reported on the plant being examined



3. Compare the diseased plant with healthy plants growing nearby

A simple, 7-step plan for basic plant disease diagnosis follows.

Step 1: Be sure you know about the crop plant you are inspecting. Not only its basic genus and species, like a corn plant, *Zea mays,* but any specific variety or hybrid characteristics, like Roundup Ready, leafy gene or BMR (brown midrib) properties.

Step 2: Become familiar with the more common disease problems which can affect your crop in your growing area. There are many publications and internet sites available to help you with this. A few will be discussed later in this presentation.

Step 3: Carefully compare those plants with symptoms or signs to others growing nearby. This will help you describe the differences observed more accurately.

4. Determine the distribution of the disease within a field.
   - Uniformly distributed in a low spot?...or along a field edge? - - possibly a soil, water or chemical problem
   - Disease rarely infects 100% of plants in an area
   - Do 100% of plants show symptoms? - - possibly soil, nutrient, drought, frost, hail, chemical or air pollution problem

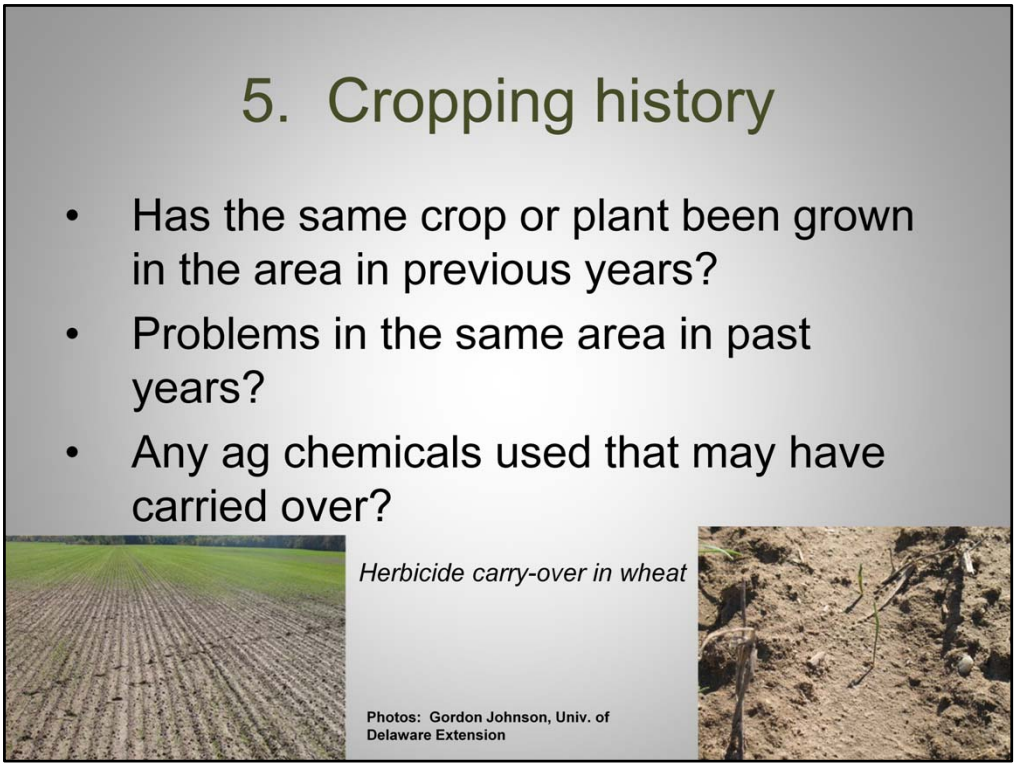
If sypmtoms show up 'overnight', or over 1 or 2 days, suspect a climatic factor or toxic chemical

Farm Industry News web photo

Step 4: Look over your field. Do you see the problem in particular areas over the field? Maybe only in a lower spot, or along a field edge? If to, the problem could be something other than disease, like a drainage or herbicide problem.

If it appears that all, or nearly all the plants in a field are affected, then causes other than disease should be considered carefully. Disease rarely infects all the plant in an area. Soil nutrient, frost, hail or chemical damage could explain it.

Disease infection takes time. If symptoms appear very quickly, be careful to explore other causes.



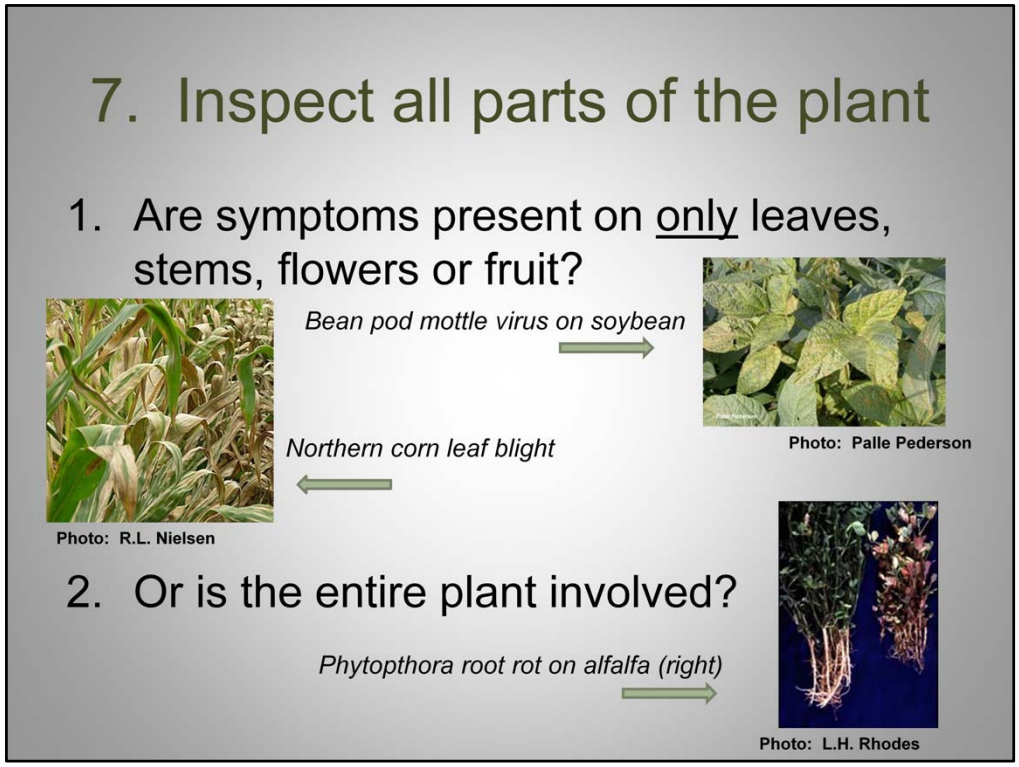
Step 5: Review the cropping history of the affected area. Could disease have carried over because the same crop was grown here previously? Has the problem occurred in this area before? Or maybe an herbicide carry-over problem could exist.

6. Check for root rot

- Many above-ground symptoms are the result of root rots
- If leaves are small, yellow or wilting…
- If terminal growth and flower/fruit production is poor…
- …then dig problem plants and inspect roots
- Healthy roots should be white or cream color

Photo: S.R. Koenning, NC State University

Step 6: Root rot diseases cause above ground symptoms and should not be overlooked. Small, yellowing leaves, poor terminal growth and flower or fruit production can be associated with root disease. Affected plants should be dug up carefully and their roots examined. Healthy roots will be white or cream-colored. Diseased roots will appear darker.



Step 7: The entire plant must also be inspected carefully. Note whether the entire plant, or only parts like stems or flowers, have symptoms.

With the information you have collected, you can return to your reference material. The American Phytopathological Society has many excellent references on specific crops available for purchase. They are not cheap, ranging from $50 - $75 each, and sometimes much more. Internet resources can be reviewed by utliziing a good search engine such as Google. By adding the words "site:.edu", you can limit your search to university materials. Or by specifying "site:.msu.edu", you can further refine your search to only Michigan State University materials.

Plant pathogen types:

Fungal – round leaf spots, stem rots with dry/papery texture, concentric rings, discoloration, wilt. Small fungal fruiting structures may form on affected tissue

Sclerotinia stem rot on sunflower

Photo: Howard F. Schwartz

Lets look at the 4 major plant pathogen types.

First, fungal pathogens are the most common crop disease problems. Both signs and symptoms may be present. Round leaf spots, stem rots with dry or papery texture, concentric rings on leaves, tissue discoloration and plant wilt can indicate fungal infections. Signs of fungal disease can include small fruiting bodies on affected tissue.

Bacterial disease – galls (swollen areas), irregularly shaped leaf spots, wilting (then yellowing and dying) or rot (often a wet rot)

- Not many bacterial diseases in agronomic crops.

Black leg on potato

Photos: NDSU PP-756

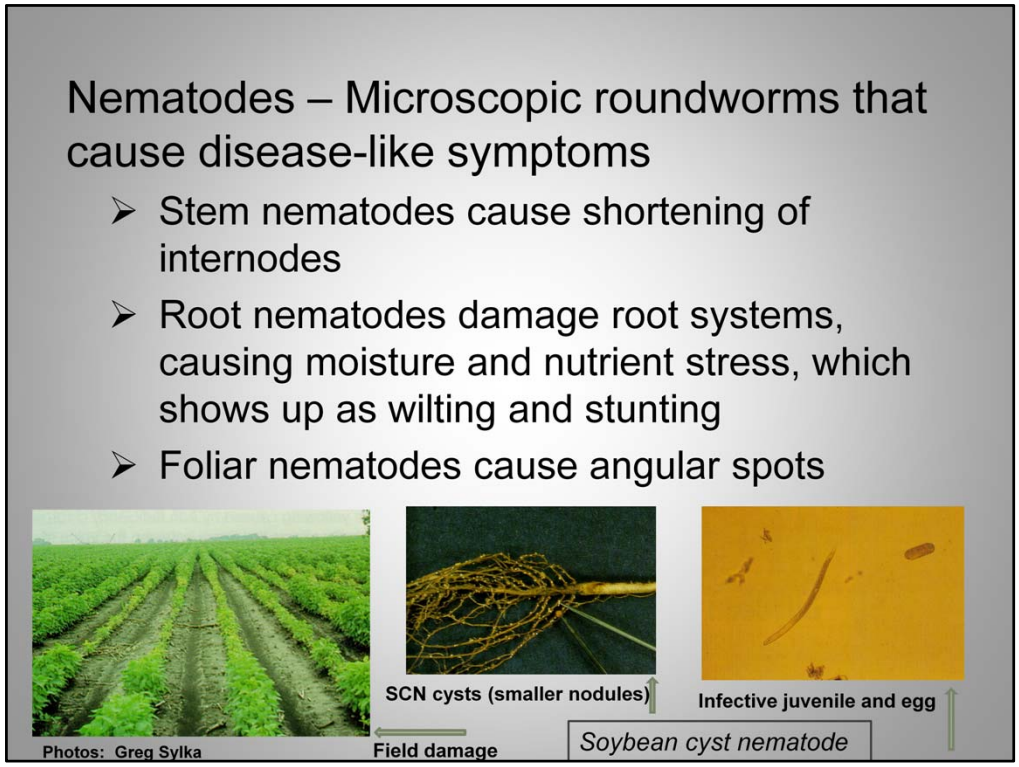
A few field crop diseases involve bacteria. On some plants, bacteria can cause gall formation, irregularly shaped leaf spots, wilting followed by yellowing and tissue death, or wet rots. Potatoes are vulnerable to bacterial infection, including black leg caused by *Erwinia sp.* bacteria.

Viral pathogen – chlorophyll formation inhibited causing yellowing or mottling, stunting, distortion, or dieback. Viruses usually debilitate rather than kill

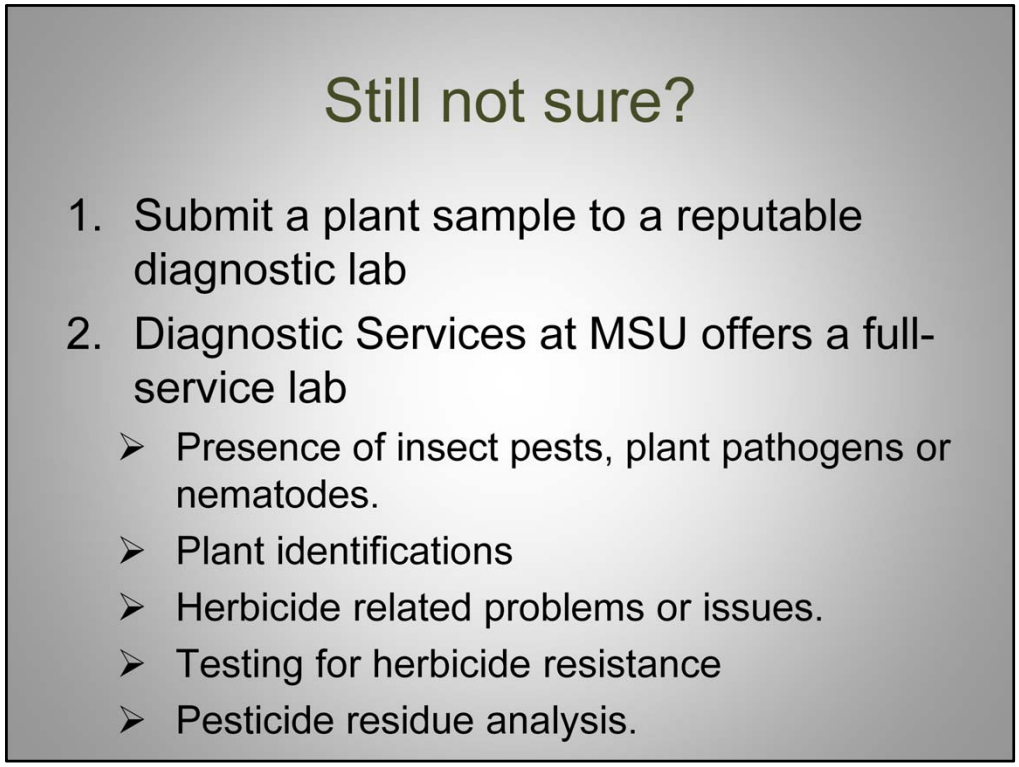
Common mosaic virus on dry bean

Photo: MSU Saginaw Valley Research and Extension Center

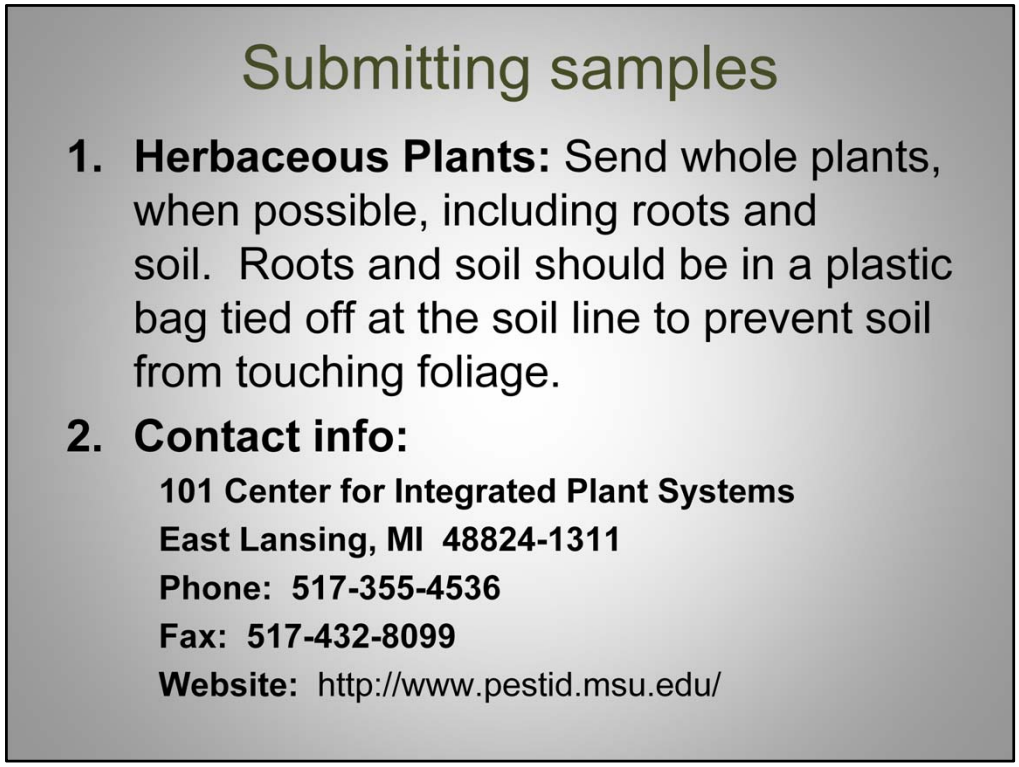
Viruses are usually transmitted by insect or nematode vectors, are seed borne or transferred by sap when plants are physically damaged. These diseases result in poor performance, but usually don't kill plants outright. Yellowing or mottling of leaves, stunting or distortion of plant form, or tissue dieback can result.



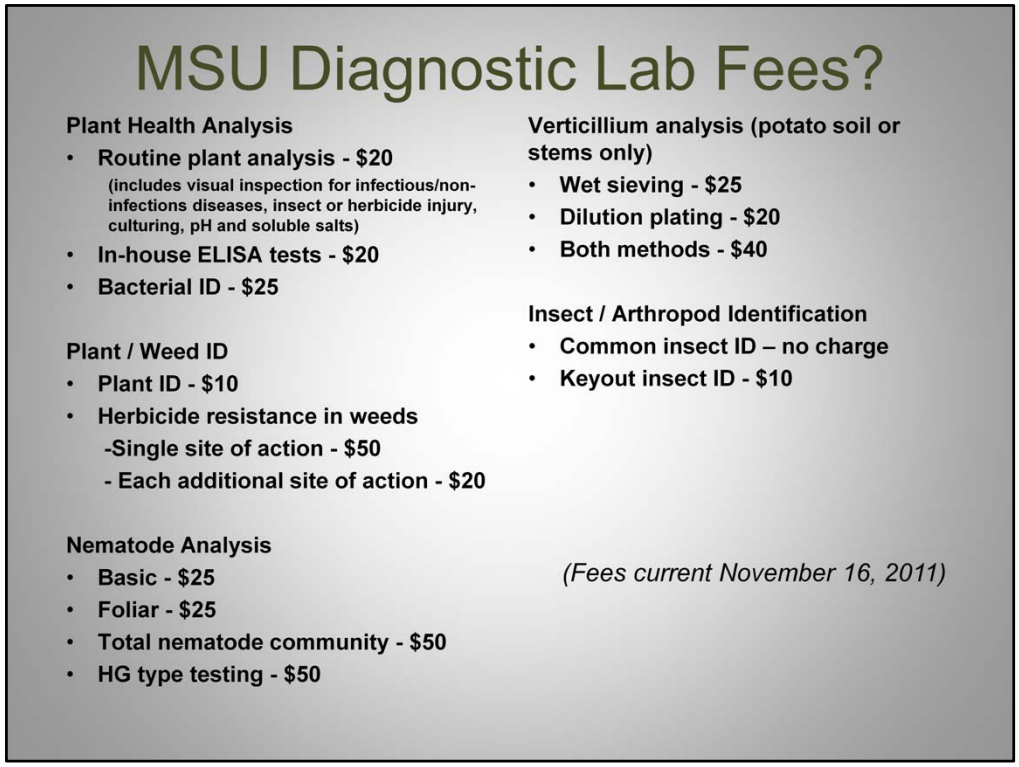
Nematodes are microscopic roundworms. The vast majority of nematodes do not cause plant disease and are either non-harmful or beneficial to the plant's soil environment. However, there are a small number of serious plant pathogenic nematodes including stem, root and foliar nematodes. The soybean cyst nematode, Northern root knot nematode, stem and lesion nematodes can affect Michigan crops. The photos show soybeans affected by soybean cyst nematode and the egg and infective juvenile stage of the nematode.



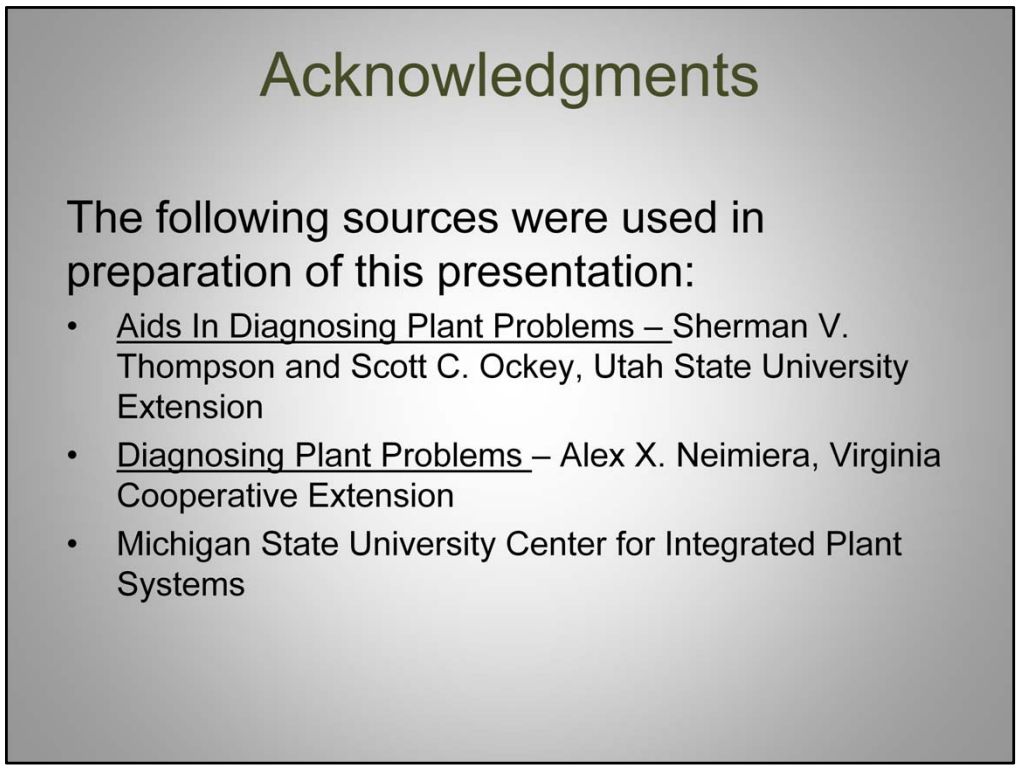
If your efforts don't bring you to a firm conclusion, consider submitting a plant sample to a good diagnostic lab for evaluation. Michigan State University's diagnostic services lab offers such services. General plant health evaluation will diagnose for pests, disease and nematodes. More comprehensive nematode testing services are also available. The lab will identify plants, such as weeds, evaluate herbicide damage, test for herbicide resistance and herbicide residues.



Proper sample submission is essential for the lab to make the best diagnosis possible. Herbacious, or annual, plants should be sent whole, including roots and as much soil around the roots as practical. The roots should be wrapped up in a plastic bay and tied off at the soil line to prevent contact with the rest of the plant. It is best to submit samples early in the week to avoid having your sample waiting, and deteriorating, over a weekend before it can be looked at by lab staff. Contact MSU diagnostic services at the information listed on the slide for more information, or visit their website.



Fees for services at the MSU lab, current as of November 16, 2011, are listed on this slide.



The sources listed were used in preparing this presentation.

Thank you

Corn smut

Photo: Nancy Rose

Jim Isleib
U.P. Crop Production Educator
MSU Extension
E9526 Prospect Street, Suite 1
Munising, MI 49862
Phone: 906-387-2530
Email: isleibj@anr.msu.edu

Thank you for viewing this presentation. Please feel free to contact me for any further information.