

Unit 1.9

Managing Plant Pathogens



“Plant pathology is the study of the organisms and environmental conditions that cause disease in plants”

Presentation Overview

A. Introduction

B. Description and Importance of Plant Disease (5 min)

C. Disease Diagnosis (20 min)

D. Evolutionary Ecology of Plant Disease (55 min)

Break

E. How Pathogens Cause Disease (10 min)

F. Causal Organisms (50 min)

G. Ecological Disease Management (35 min)



What is Plant Disease? “A disruption in normal physiology”

- Includes: infectious agents, nutrition, air pollution.
- Does *not* include: arthropods, genetic abnormalities.
- Most plant pathologists work with infectious agents.
- The three most important are *fungi*, *bacteria* and *viruses*.

A photograph of a tomato plant in a garden. The leaves are green but show significant yellowing and necrosis, particularly along the veins and at the tips, which is characteristic of a viral infection like Tomato Yellow Leaf Curl Virus. Several green tomatoes are visible on the plant, and one orange tomato is seen in the lower right. The background shows dark soil and other plants.

The Economic Importance of Plant Disease

Damage to plants and plant products —

- Crop failure, incremental loss from lower quality or failure to meet economic standards.
- Elimination of crop options (disease propagule buildup).
- Costs of control methods.
- Creation of new endeavors to manage diseases.

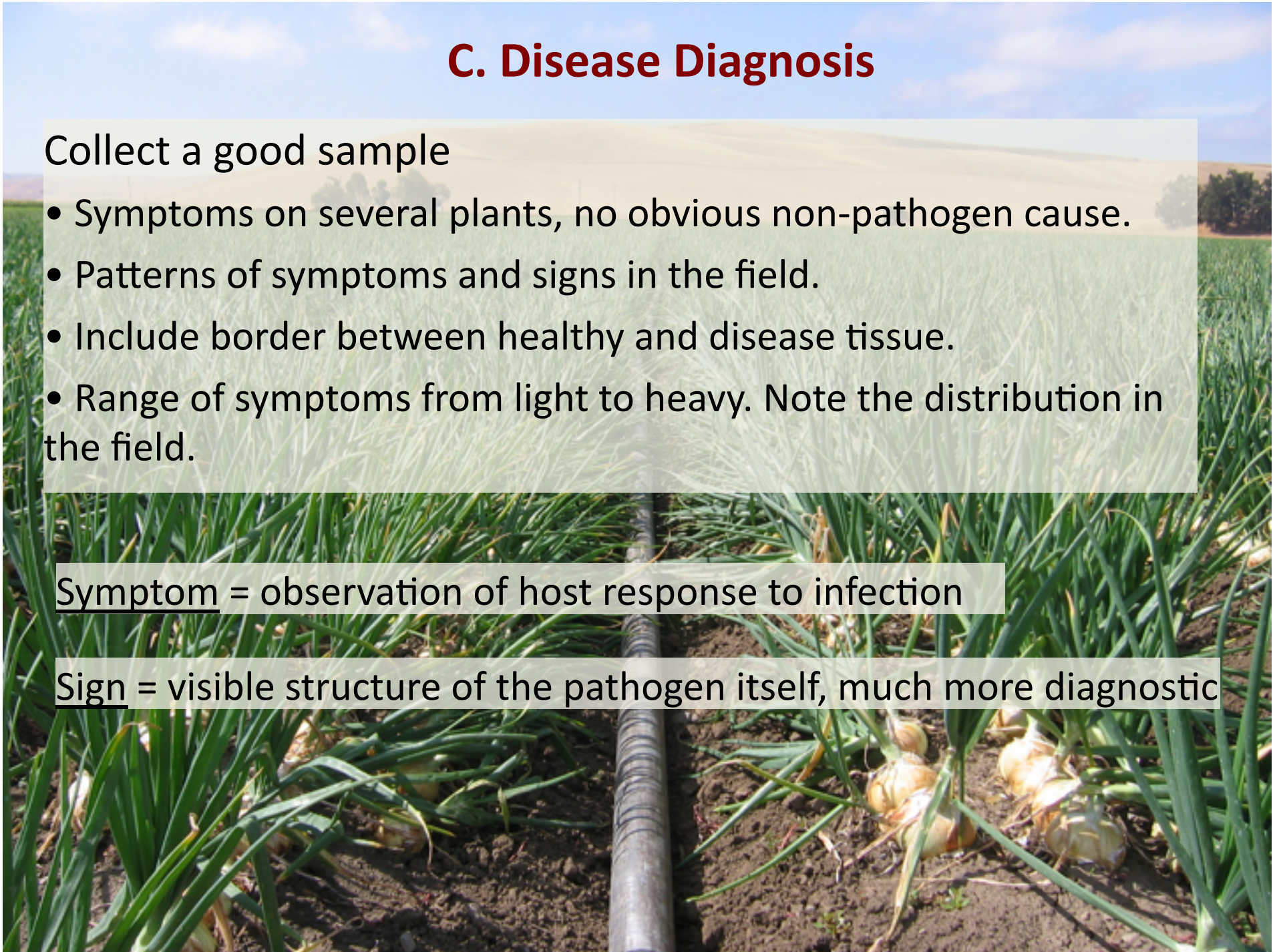
C. Disease Diagnosis

Collect a good sample

- Symptoms on several plants, no obvious non-pathogen cause.
- Patterns of symptoms and signs in the field.
- Include border between healthy and disease tissue.
- Range of symptoms from light to heavy. Note the distribution in the field.

Symptom = observation of host response to infection

Sign = visible structure of the pathogen itself, much more diagnostic

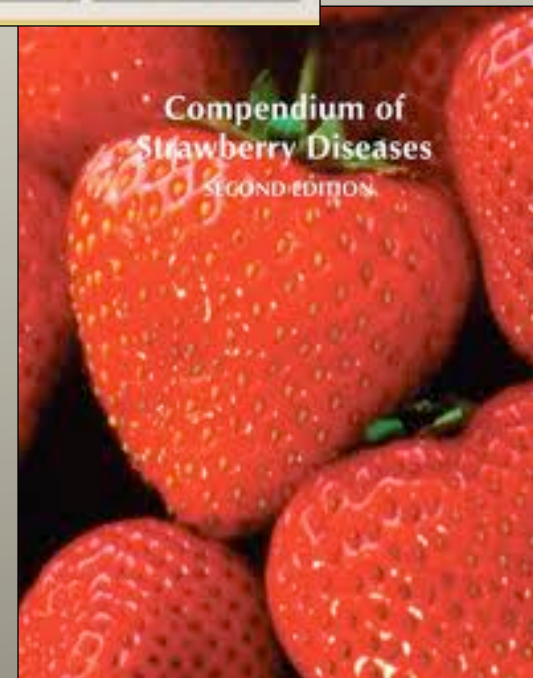


Resources for Disease Diagnosis

- Cooperative Extension
- Other professionals
- Pictorial disease guides, in print and online



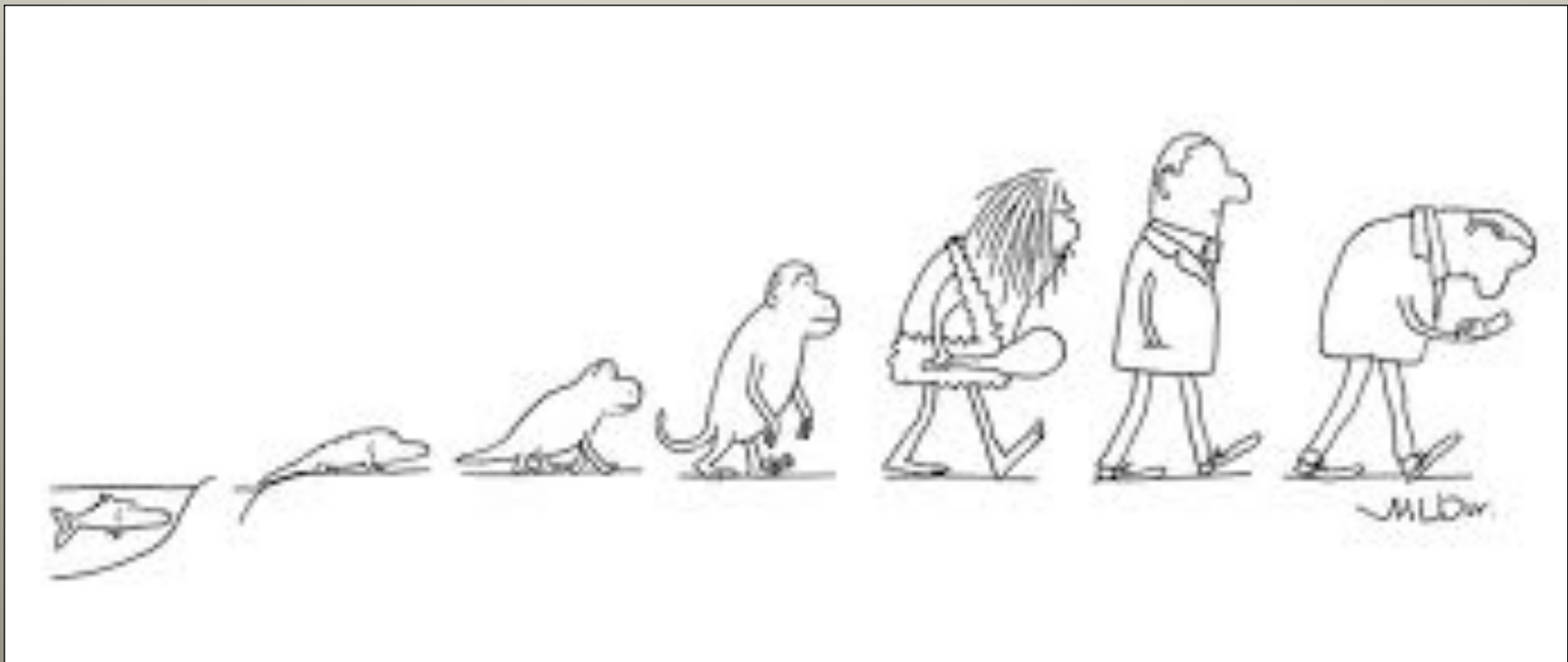
Remember —
It is easy to misdiagnose!
Be cautious!



D. Evolutionary Ecology of Plant Disease

Plant disease has an essential role in plant evolution and ecosystems.

Understanding this role helps us design more resilient farm systems.



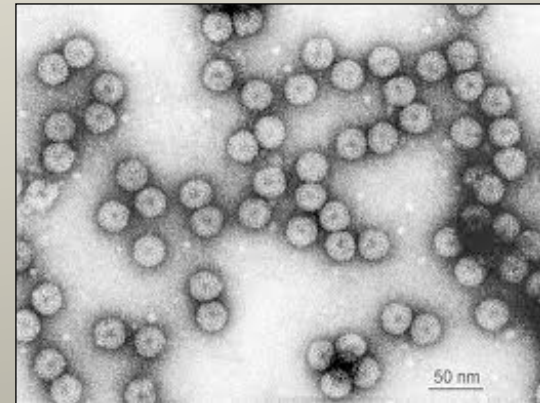
Virus evolution is special!

Living or not?

- Replicate, evolve quickly.
- Can't make their own proteins.
- No nutritional requirements.
- Most composed of only nucleic acids and proteins.

Unclear how they evolved:

- Remnants of earliest forms of 'life'?
- Viruses may lead to evolutionary changes in their hosts through transfer of genetic materials.
- "Hop" in and out of different hosts.
- Sometimes bring along bits of host DNA with them that is incorporated into the host's DNA.



Probable Evolutionary History of Non-virus Plant Pathogens

Range of nutritional strategies —

- Majority of fungi and bacteria are saprophytes (decomposers).
- Early life forms died and saprophytes evolved to ‘clean up’ and recycle their bodies.
- Gained ability to ‘feed’ on live plants --> pathogens.
- Further evolution: loss of saprophytic ability and became obligate plant pathogens (must have a living host).

Except...

Some pathogens, such as oomycetes, evolved from photosynthetic algae.

Obligate and Non-obligate Pathogens

Pathogens vary from completely obligate (e.g., powdery mildew) to completely non-obligate (e.g., botrytis rots).

Both are essential for ecosystem diversity, health.



Obligate Pathogens

- Can only live on a single plant species (or maybe a few)
- No saprophytic ability
- Can't be active without a live host

What about an extremely virulent, obligate pathogen?
-->kill all its hosts -->extinction of itself!

Survival of host and obligate pathogen depends on dynamic, genetic relationship of host resistance and pathogen virulence.

- Plants and pathogens have genetic flexibility: gene-for gene interactions.
- In natural, undisturbed ecosystems, obligate pathogens are common, but not much damage, except to the few plants that arise without resistance.

Non-obligate Pathogens

- Don't have or need close genetic relationship with host.
- Host genetics less important than environmental factors.
- In undisturbed ecosystems: environments vary widely = non-obligates can't do much damage + they help prevent single plant species or genotype from excluding others

Plant disease is Nature's reboot!

