Identification, Assessment and Management of Soilborne Plant Pathogens in Vegetable Production Systems

Sampling and Assessing for Soilborne Pathogens

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Project LNE10-296

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Outline

- Why sample and assess?
- Field scouting
- Plant and soil sample collection
- How to submit a sample to a plant disease clinic
- Baiting/isolation techniques
- Assessment tools

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Why sample & assess for soilborne pathogens?

Because disease management begins with an accurate diagnosis!

Which is Fusarium wilt and Verticillium wilt?

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How to scout fields for soilborne pathogens

- Know what a healthy crop looks like
- Know what soilborne pathogen are mostly likely to be a problem on your crops
- Learn to identify symptoms and signs of these diseases and what environmental conditions favor disease development

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How to scout fields for soilborne pathogens

- Physically **scout plants regularly**

- Monitor temperature, dew periods and other environmental parameters favorable for pathogens.

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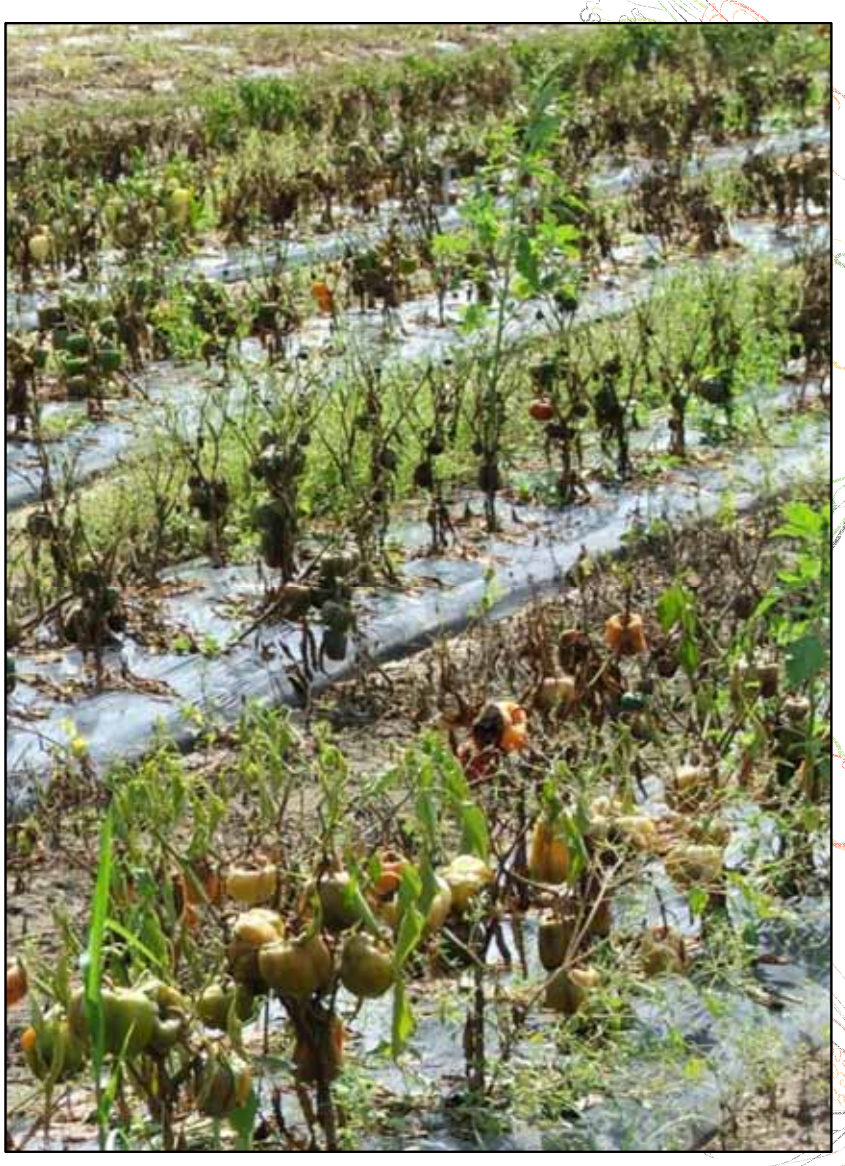
Field scouting…

- **Observe patterns** to determine prevalence of problem



All plants in a large area or scattered and localized?

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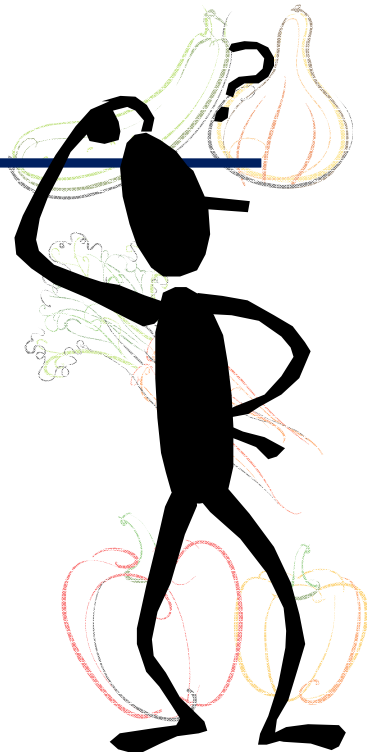
Field scouting….



Ask questions

- ✓ When was the problem noticed?
- ✓ Was the damage sudden or gradual?
- ✓ How old are affected plants?
- ✓ Are the symptoms on one variety? Multiple crops?
- ✓ Percentage of plant affected?
- ✓ What cultural practices have been employed?
- ✓ Environmental conditions? Extreme temps, excessive rain?

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Field scouting…

Herbicide drift damage

2,4-D – commonly used in lawn care

Field scouting…

Walnut Wilt
(juglone)

Field scouting…

Check for symptoms and signs

- ✓ **Symptoms** – plant reactions or alternations of a plant's appearance due to a disease of disorder
- ✓ **Signs** – actual pathogen, parts or by-products seen on a diseased host plant

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Collecting plant samples for diagnosis

- Representative sample – varying levels of severity of all plant parts

Dead plants tell no tales!

Fusarium wilt of tomato

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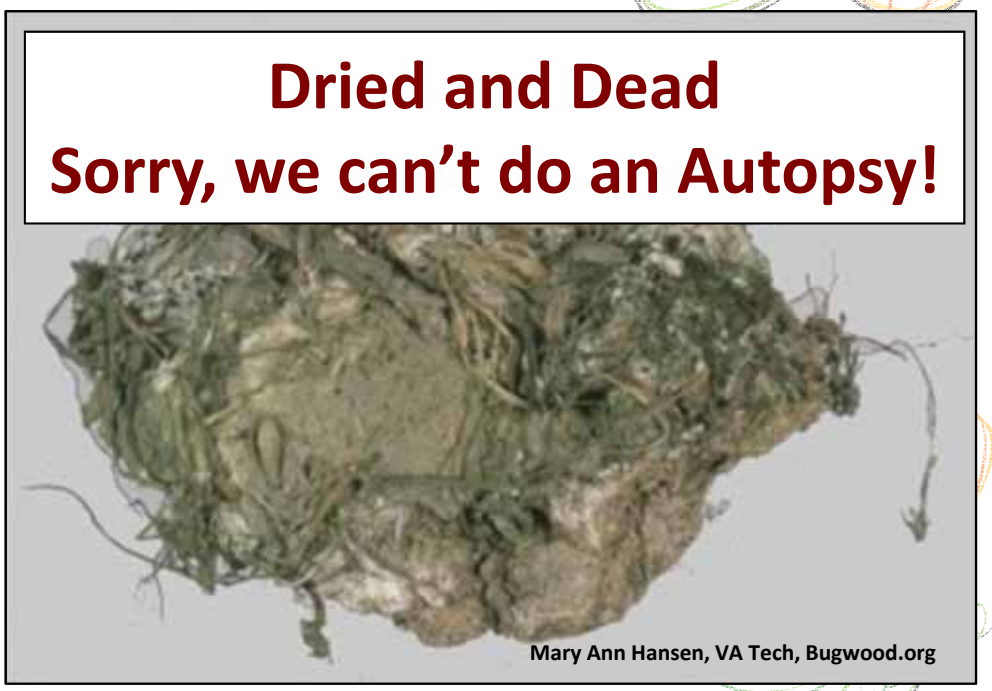
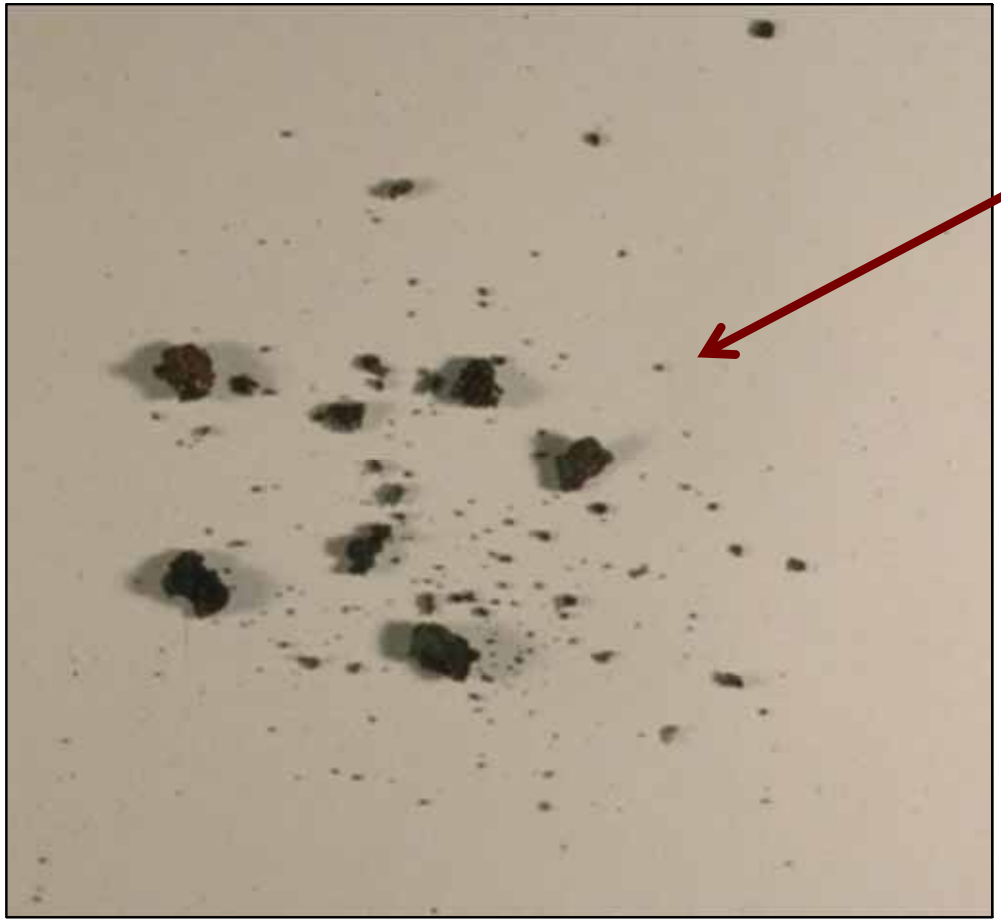
Speaking of sample condition…

Speaking of sample condition…



Speaking of sample condition…



PSU Clinic has received samples as small as this and smaller!

Mary Ann Hansen, VA Tech, Bugwood.org

Still too small! Not enough material to culture or test

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Submitting a sample to a Plant Disease Clinic

- ✓ Fresh sample in good condition
- ✓ Rapid delivery may be critical
- ✓ Keep soil on roots
- ✓ No extra water
- ✓ Wrap in dry paper then double bag in plastic
- ✓ Disinfest exterior of bags
- ✓ Strong crush-proof box, tape all seams

Photos: Tom Creswell, North Carolina State University, www.forestryimages.org

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Plant Disease Clinic Specimen Information Form

PENNSTATE

Lab Specimen No. _____

Specimen Information Form — **Plant Disease Clinic, Department of Plant Pathology**

220 Buckhout Laboratory
University Park, PA 16802

Please Complete All Sections of this Form

Client Information

Name _____

Address _____

City, State, Zip _____ County _____

Phone _____ Fax _____ E-Mail _____

Submitter information

- ☐ Cooperative Extension Office for Commercial Grower/Company
- ☐ Cooperative Extension Office for Homeowner
- ☐ Homeowner
- ☐ Commercial Grower/Company
- ☐ Certified Organic

Specimen Information

Plant _____ Variety _____ Date Collected _____

Describe the problem and explain what concerns you:

_____

_____

_____

Plant Part Affected

- ☐ Leaves
- ☐ Roots
- ☐ Stems, branches
- ☐ Flowers

Symptoms

- ☐ Yellowing: ___ Interveinal ___ General ___ Marginal
- ☐ Browning: ___ Interveinal ___ General ___ Marginal
- ☐ Wilting ☐ Distortion ☐ Mottling ☐ Leaf Spots
- ☐ Other _____

Type of Planting

- ☐ Garden
- ☐ Yard
- ☐ Indoor/house
- ☐ Field
- ☐ Forest
- ☐ Greenhouse
- ☐ Other _____
- ☐ Nursery
- ☐ Orchard
- ☐ Plantation
- ☐ Vineyard
- ☐ Golf course
- ☐ High Tunnel

Disease Distribution

- ☐ General
- ☐ Scattered plants
- ☐ Dry areas
- ☐ Wet areas
- ☐ Shaded areas
- ☐ Sunny areas
- ☐ Other _____
- ☐ High areas
- ☐ Low areas
- ☐ Foundation
- ☐ Next to drive or road
- ☐ Near vents/fans
- ☐ End/Edge of planting

Soil Type

- ☐ Sandy
- ☐ Clay
- ☐ Loam

Soil Moisture

- ☐ Excessive
- ☐ Adequate
- ☐ Deficient

Drainage

- ☐ Good
- ☐ Moderate
- ☐ Poor

Terrain

- ☐ Sloped
- ☐ Level
- ☐ Low

When did the symptoms first appear? _____

Has the problem occurred before? _____ When? _____

please continue on page 2

Size of Planting _____ Acres _____ Number of plants

Extent of Problem _____ Percentage of plants affected *or* _____ Number of plants affected

Previous Crop (name): _____

Trees/Shrubs: Approximate age: _____ Height: _____
How long has the plant been growing in the present site? _____

Treatments Applied This Season and Previous Year: (Fertilizer, Fungicide, Insecticide, Herbicide, Other)

Material	Rate	Date applied	Material	Rate	Date applied

Disturbances

- ☐ High winds
- ☐ Hail recently
- ☐ Frost
- ☐ Excavation, _____ ft away
- ☐ Construction nearby
- ☐ Gas or sewer lines
- ☐ Other _____
- ☐ None

Turfgrass: If sample is turfgrass, please describe the infection center:

- ☐ Grass killed
- ☐ Grass thinned
- ☐ No distinct pattern; irregular areas
- ☐ Definite pattern to affected areas:
  - ☐ Circular areas Size _____
  - ☐ Rings Size _____

Size of affected area: _____

Greenhouse Specimens: If sample is a greenhouse specimen, please complete the following:

- ☐ Raised beds
- ☐ Ground beds
- ☐ Pots or containers
- ☐ Growth regulators applied (list materials and date): _____
- ☐ Fertilizer used (list type and analysis):

Heating system: _____
Irrigation system: _____
Soil mixture: _____

Fertilizer application technique:

- ☐ soil incorporation ☐ foliar spray ☐ dry on surface ☐ liquid on surface

Temperature in production area: Days: ____ to ____°F Nights: ____ to ____°F

Additional Comments:

_____

_____

_____

_____

_____

_____

_____

Diagnostic Lab Use Only:
Sample Condition Information Received Photo or digital image

February 2011

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Plant Disease Clinic Specimen Information Form

Submit one form per sample

Many different diagnostics tests are used to determine the cause of symptoms

Easier to keep track of important information

Information on the form provides diagnostic clues

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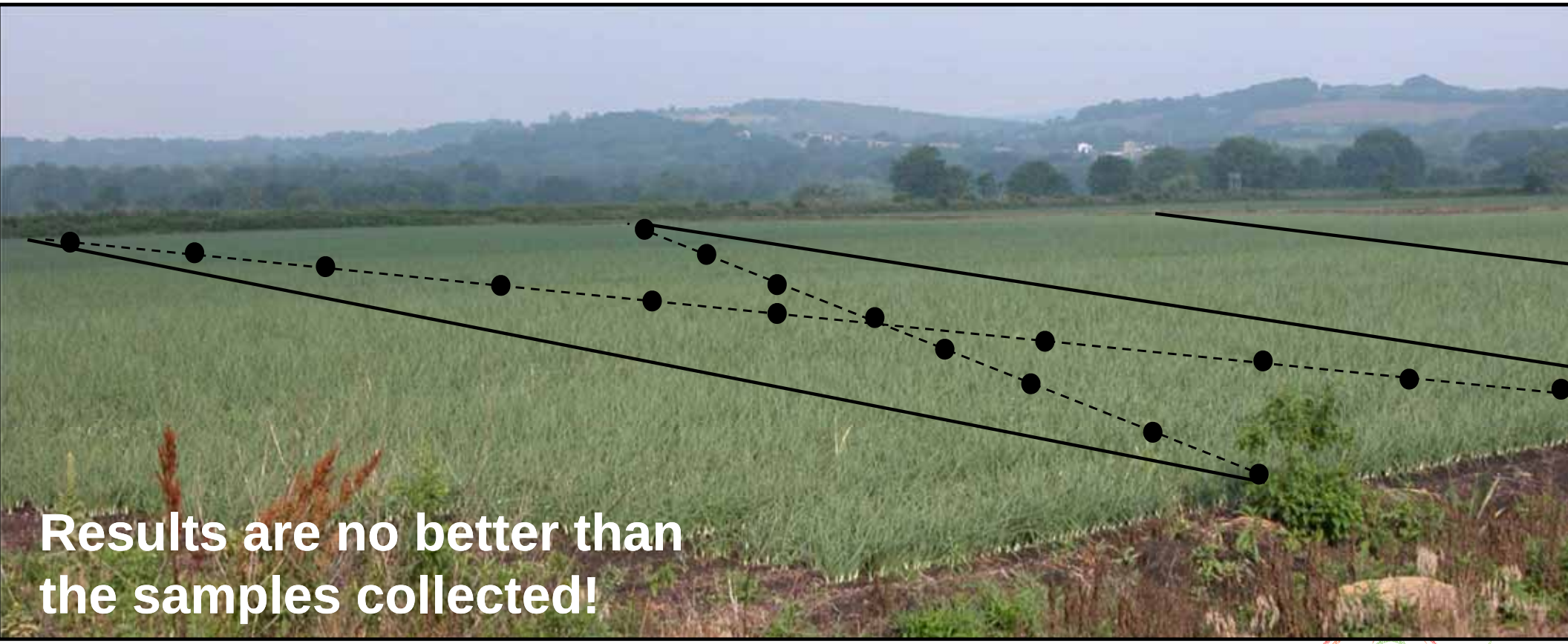
Collecting soil samples for assessment



- Sample following harvest or in early spring
- Divide field into at least 4 quadrants - variability
- Collect 15 to 20 sub-samples following an ‘X’ or ‘V’ pattern

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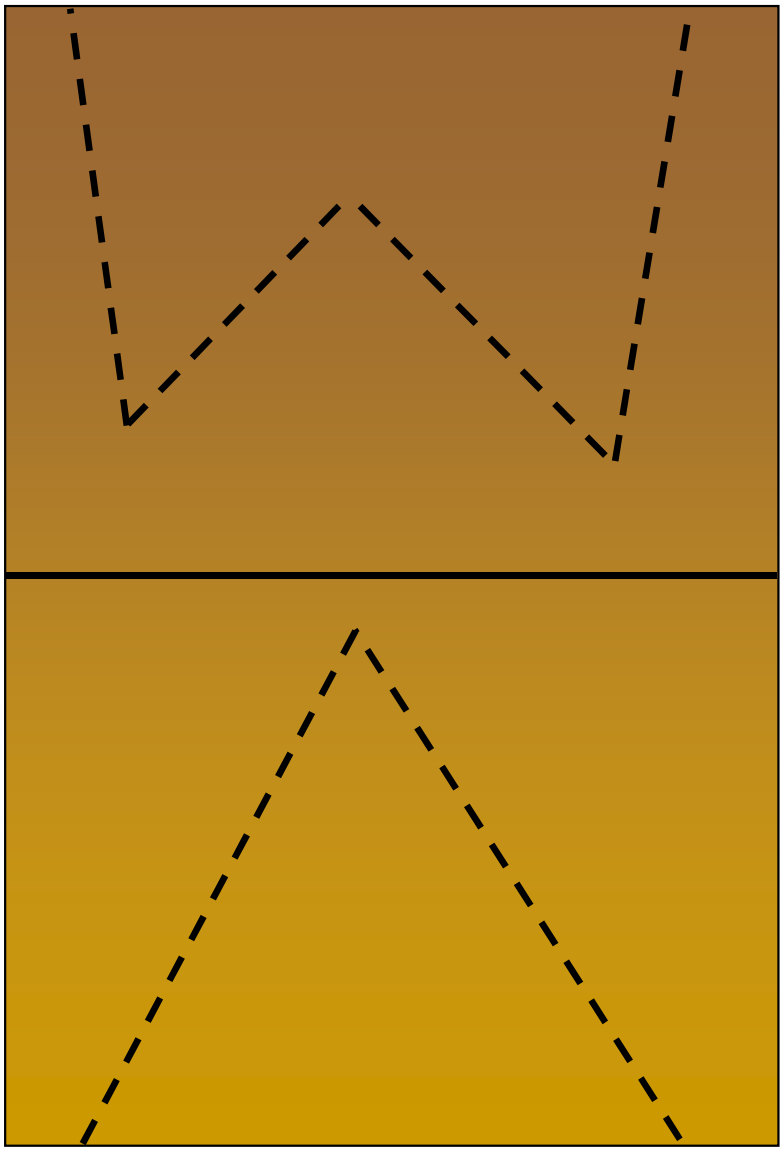
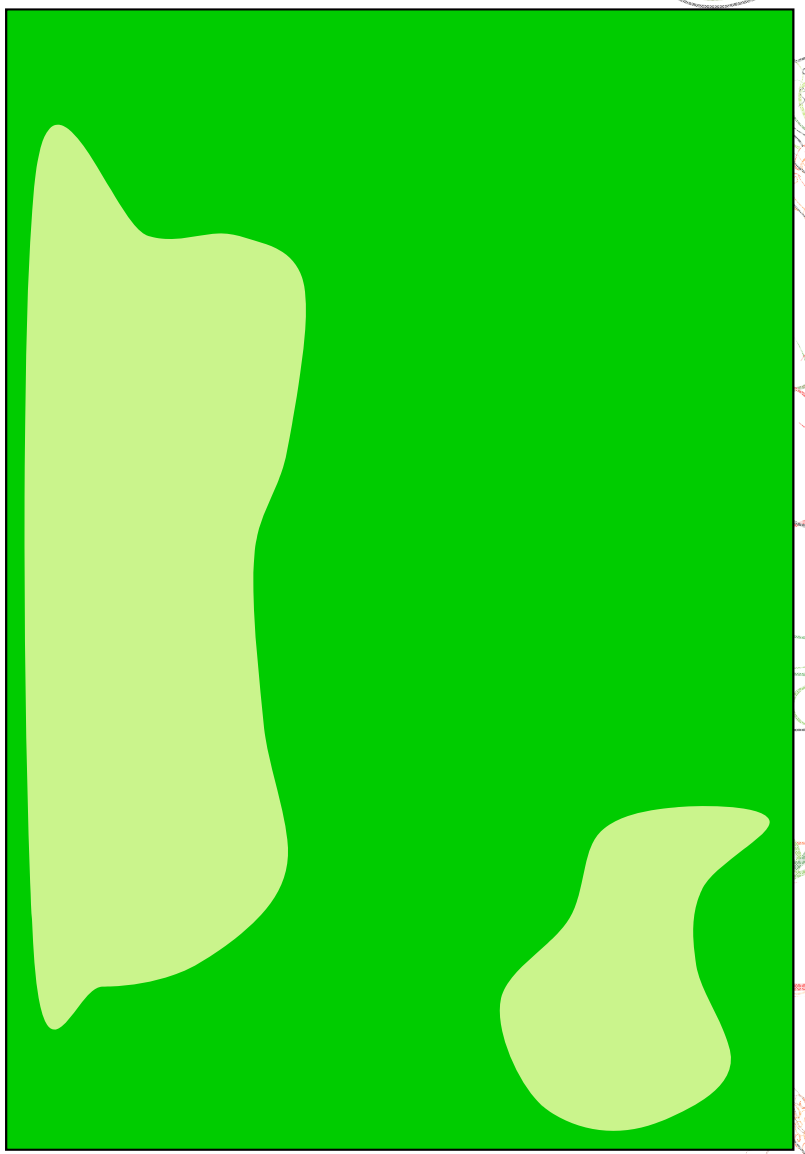
Collecting soil samples for assessment



10 acre field with two soil types



5 acre field with patches of poor crop growth

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Collecting soil samples for assessment

- Highly dependent on production practices and cropping history

Impacts scouting and sampling

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Collecting soil samples for assessment

- Uneven and patchy distribution within and between fields
- Variability at depth
- Seasonal fluctuations in nematode populations (in roots vs in soil)

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Collecting soil samples for assessment

Strip-tilled beans 2007 then strip-tilled carrots 2008

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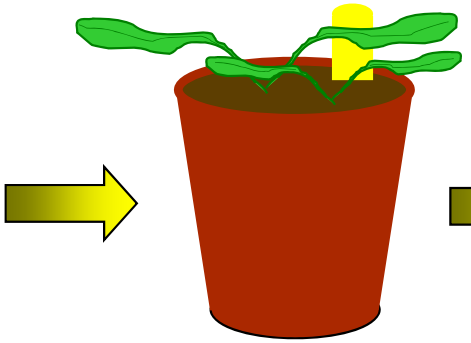
Bioassay techniques…root-knot nematode

Soil collection



2 lettuce seedlings
planted in field soil

Lettuce grown in greenhouse
5 to 6 weeks

Lettuce roots are washed

Root galling severity rating
(1 = healthy to 9 = severely galled)

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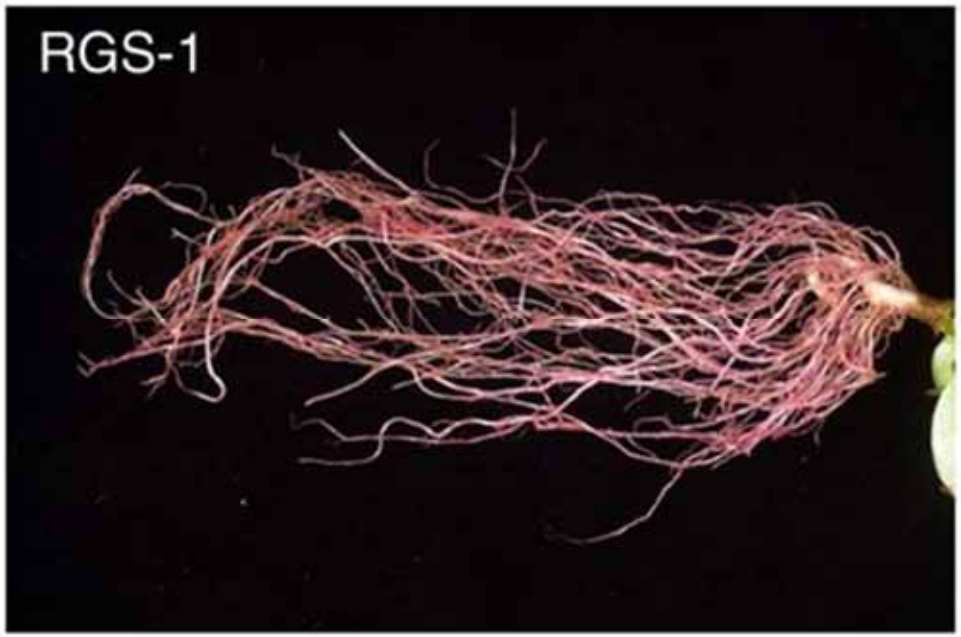

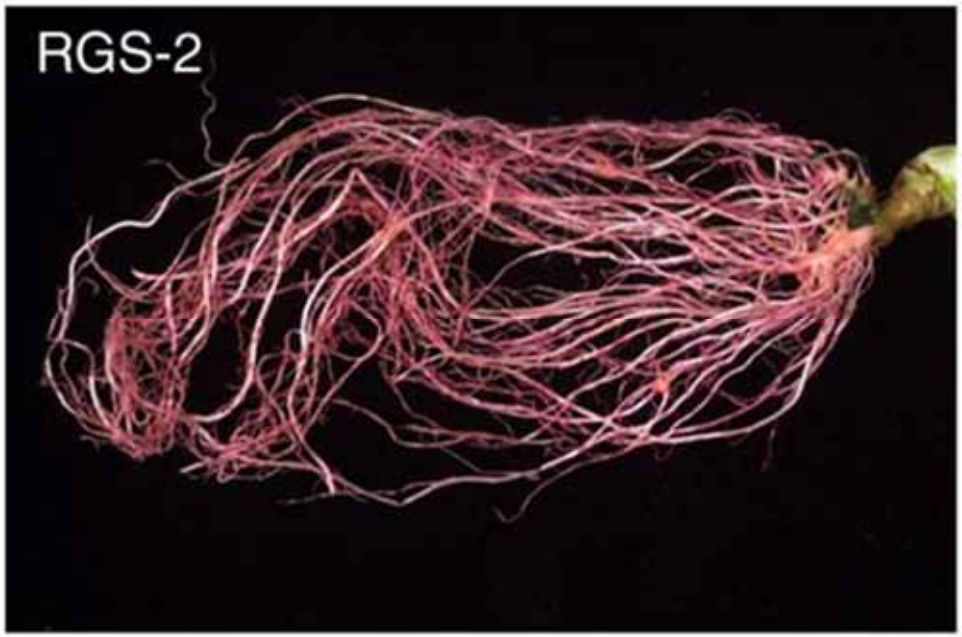

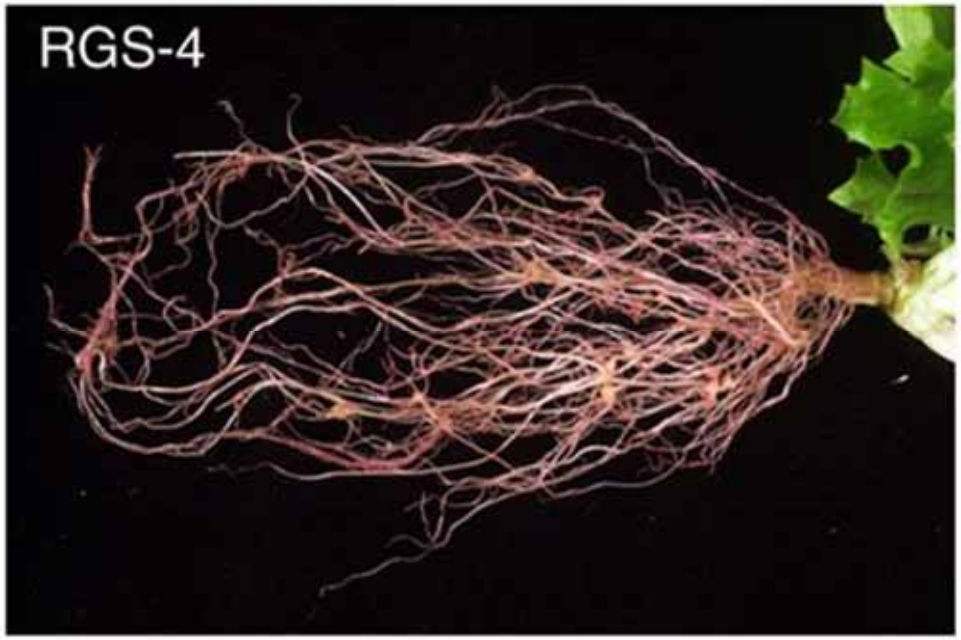

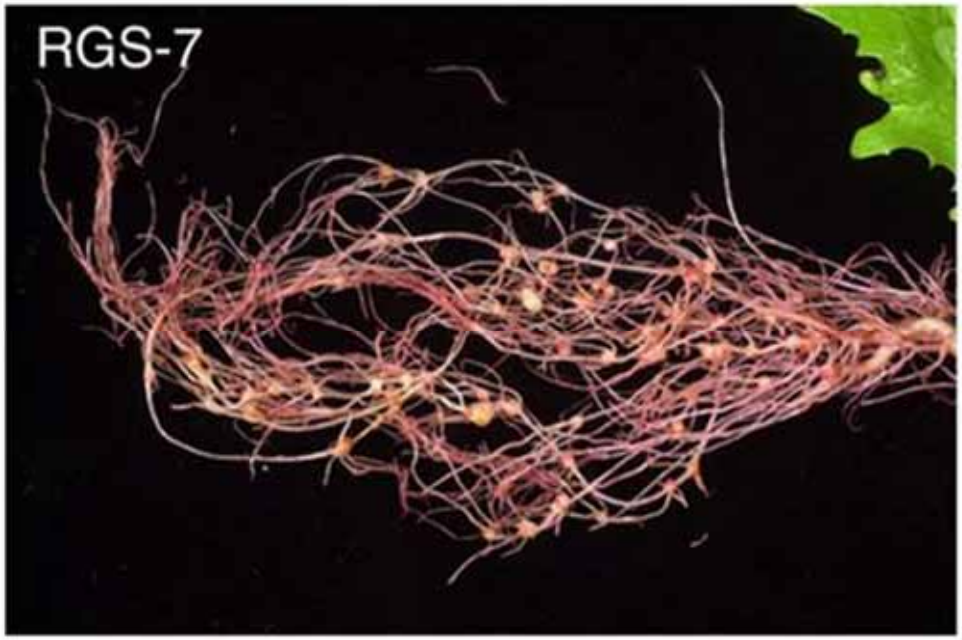

Lettuce roots illustrating a portion of the root-galling severity scale of 1 - 9. The scale values shown are 1 = no observable galls (healthy), 2 = 1-3% roots galled (one gall is shown in the photo), 3 = 4-10% roots galled, and 7 = 50-65% roots galled.

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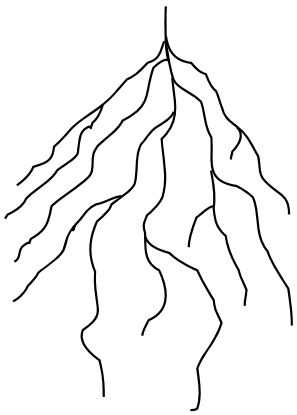
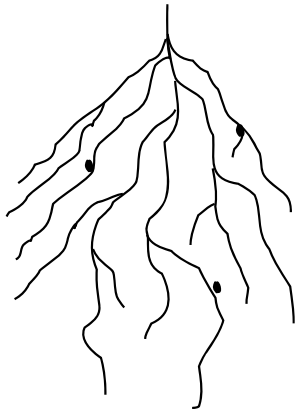
Visual Assessment of Root-Knot Nematode Soil Infestation Levels using a Lettuce Bioassay

Cornell University
New York State Agricultural Experiment Station

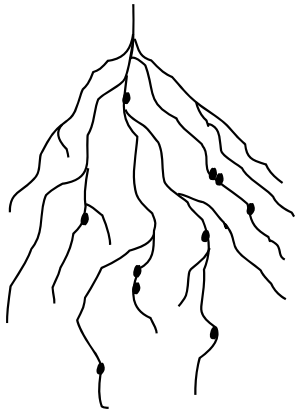
Modified root-galling severity scale for on farm



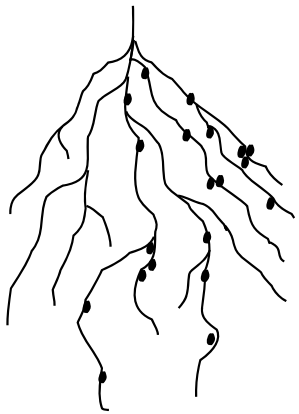
RGS 1 = no galls



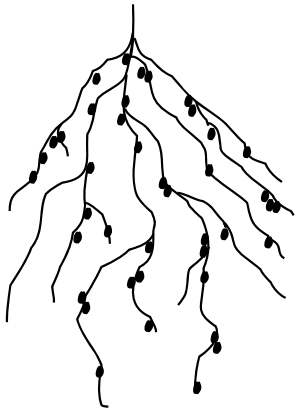
RGS 2 = 1 - 4 galls



RGS 3 = 5 - 12 galls



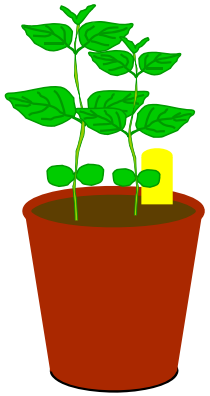
RGS 4 = 13 - 40 galls



RGS 5 = >40 galls

Bioassay techniques…lesion nematode

Soil collection



Field soil is planted with soybean seed

Plants grown in a growth chamber for 2 to 3 weeks

Roots are washed under running tap water

Lesion severity is assessed based on the number of lesions on the main taproot

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Bioassay techniques…lesion nematode

Soybean bioassay roots

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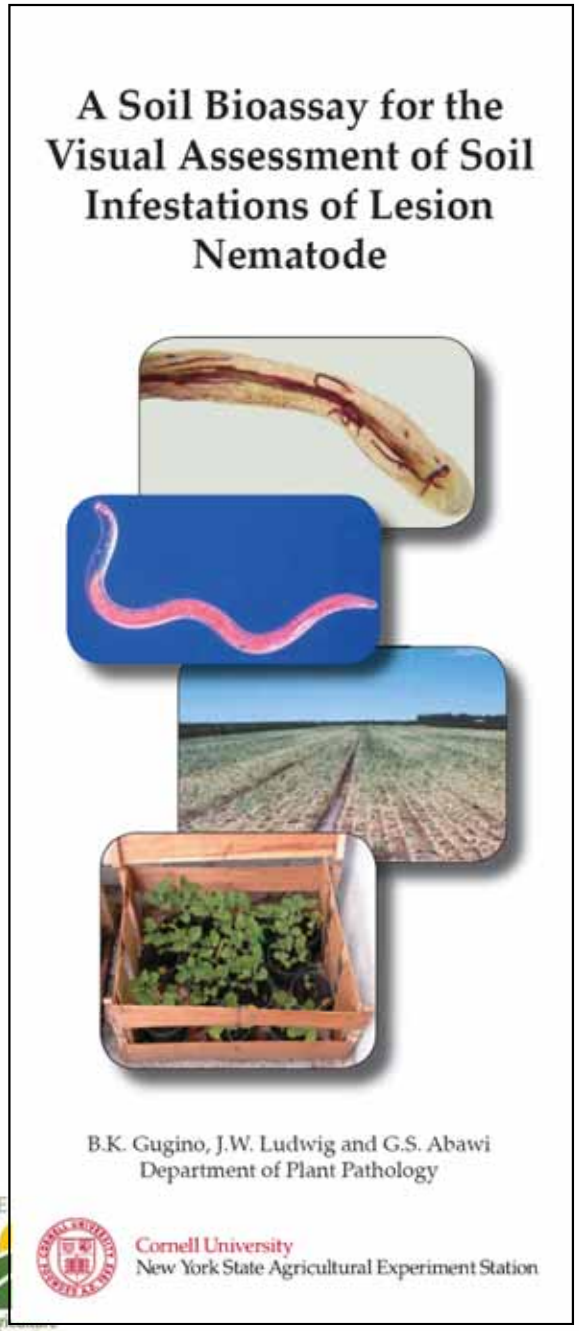
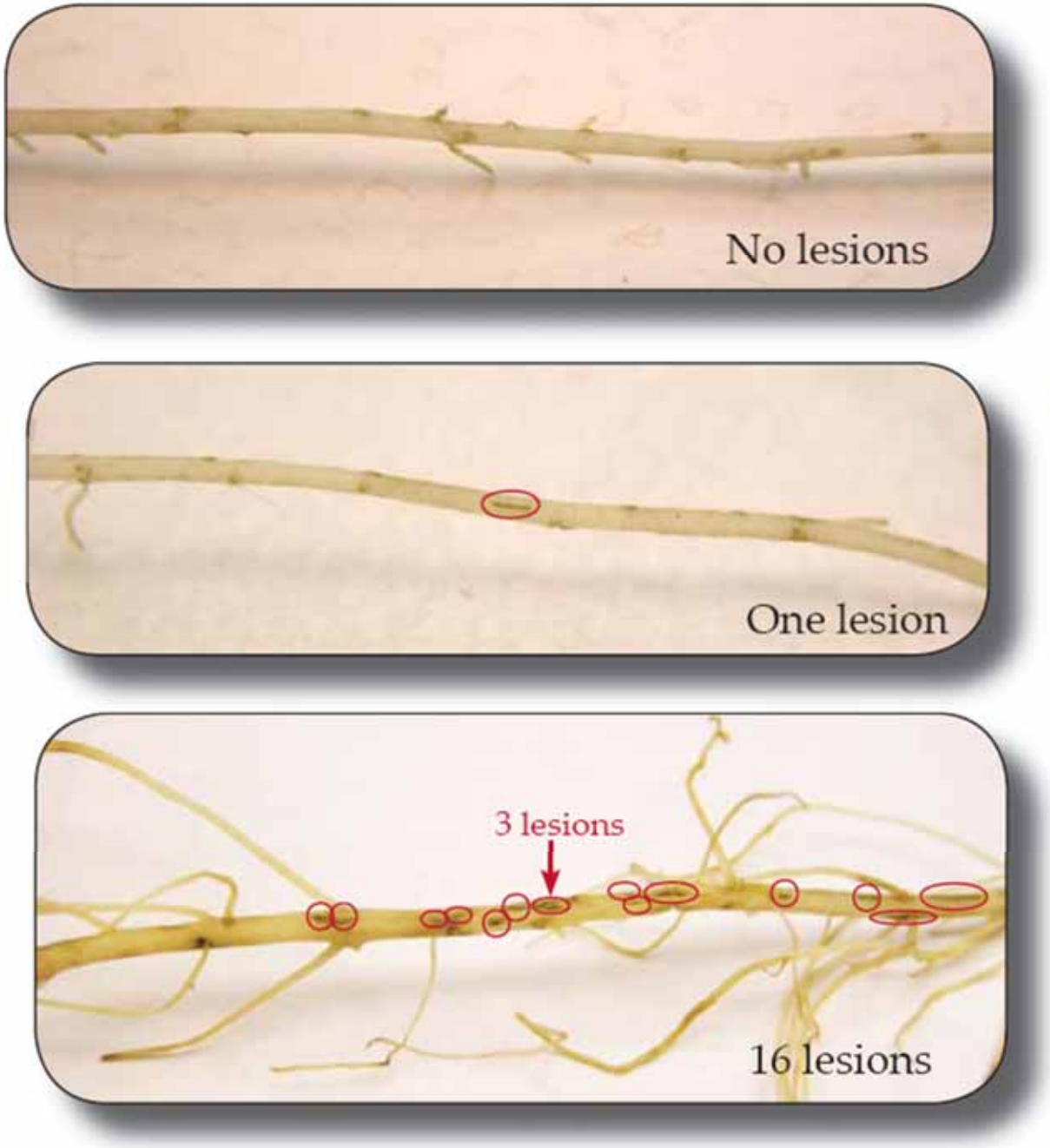
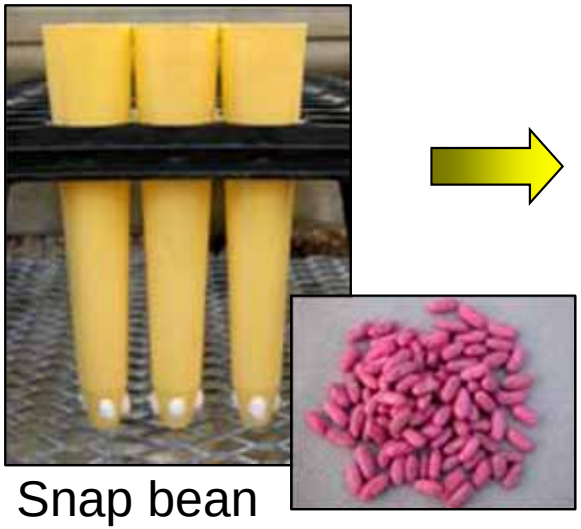
Bioassay techniques…lesion nematode





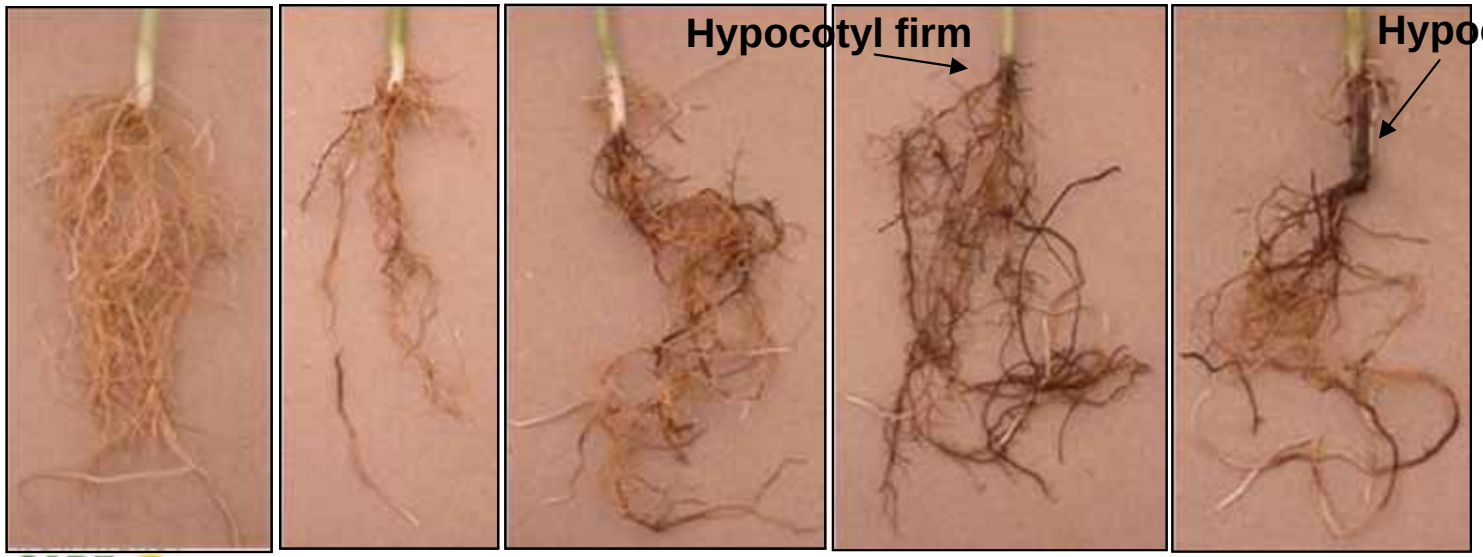
Bioassay techniques…fungal root pathogens

Soil collection



Snap bean seed ‘Hystyle’ planted in field soil (7 reps)

Beans grown in greenhouse 4 weeks



Overall root health rating
(1 = healthy to 9 = hypocotyl collapsed & primary roots rotted)

Bean roots are washed

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Isolation techniques…

Thieviopsis isolation on carrot disks

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Baiting techniques…

Phytophthora baiting from irrigation water

Phytophthora "trap" baited with immature pears and a cucumber

Trap deployed in irrigation pond for 5-7 days to attract *Phytophthora* species

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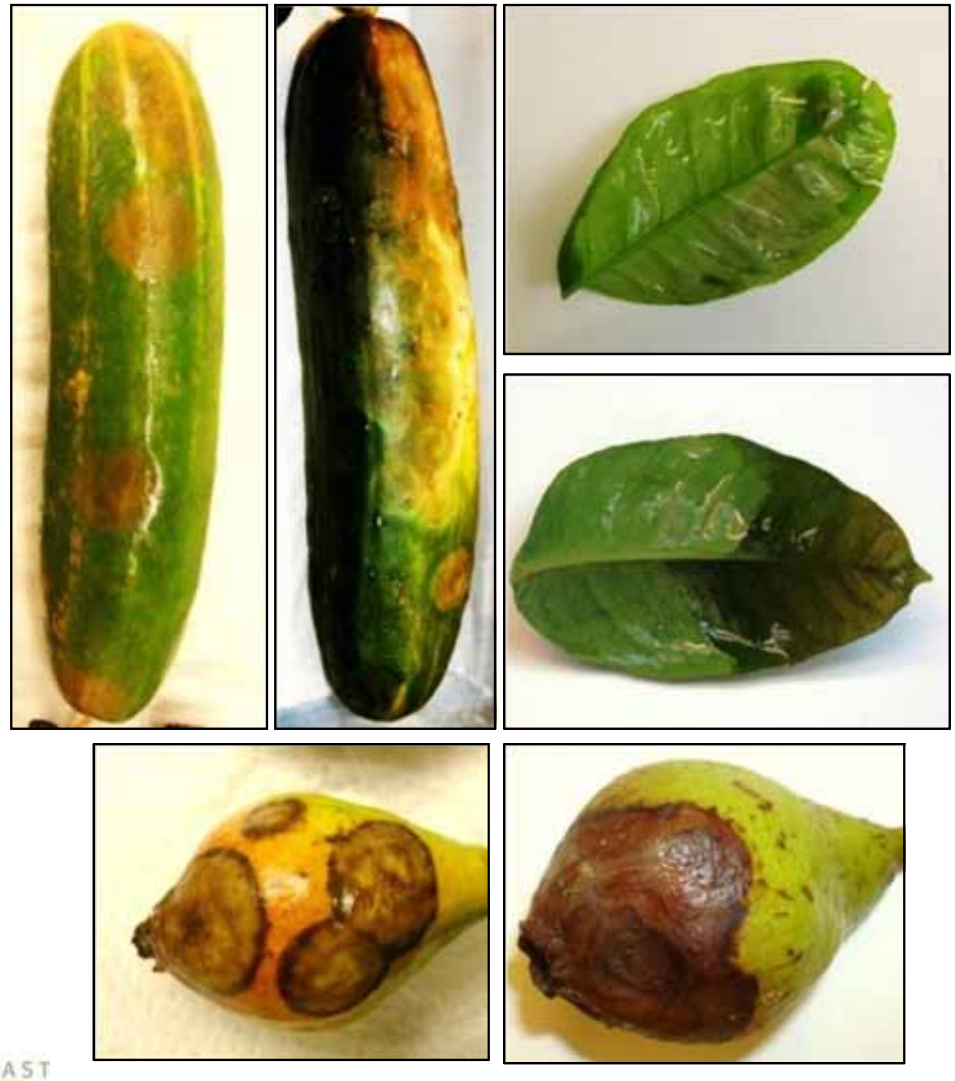
Slide courtesy of Chris Smart, Cornell

Baiting techniques…

Phytophthora baiting from irrigation water



Baits with lesions

Phytophthora **isolated from bait tissue**

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Slide courtesy of Chris Smart, Cornell

Baiting techniques…

Phytophthora baiting from soil

Fig. 26. A green tomato used to recover *Phytophthora* from soil. If the bait is successful, lesions like those on the tomato on the right will develop in 4 to 6 days.

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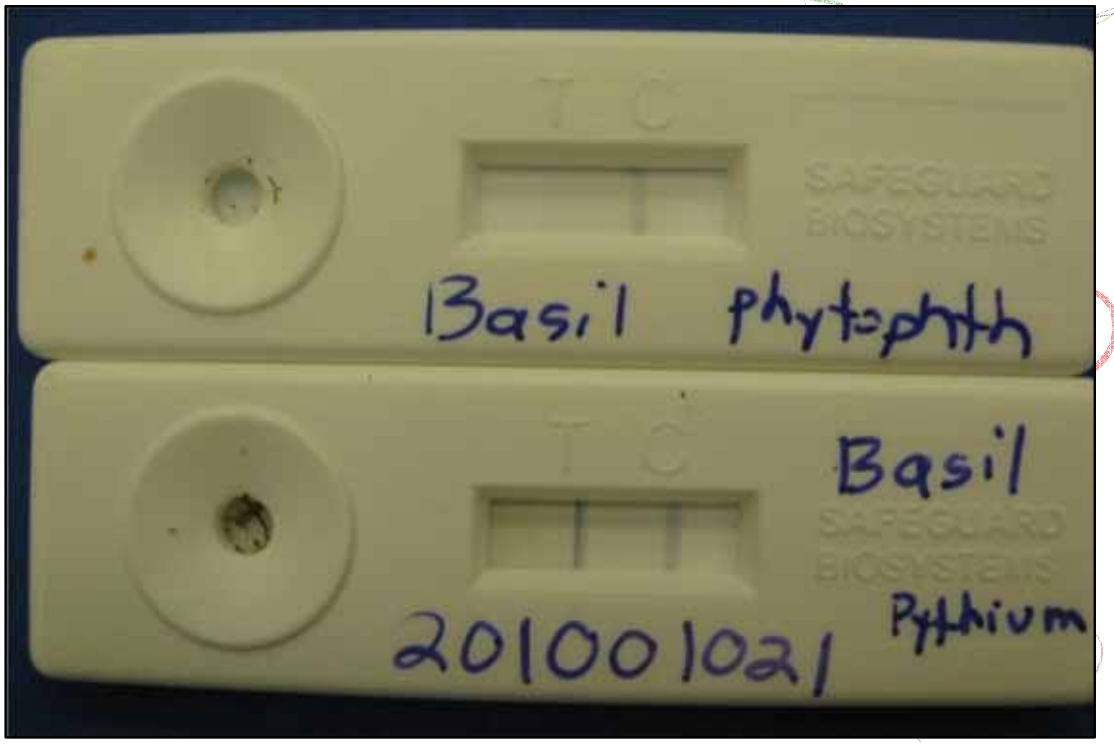
From Rob Wick, UMass

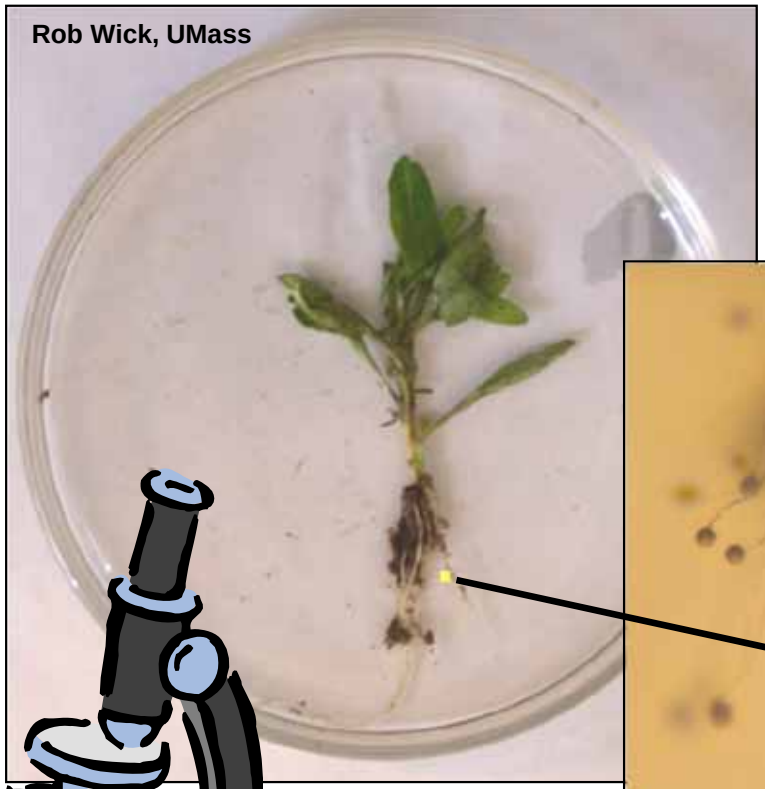
Serological techniques…

Field test kits for Pythium and Phytophthora

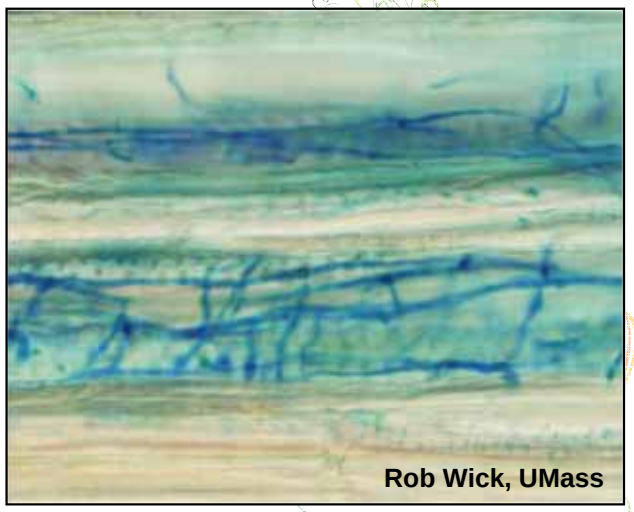


Microscopy techniques…

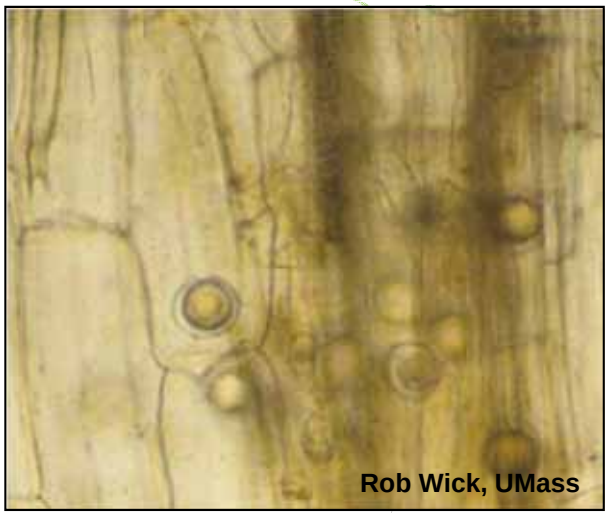
- Direct observation for signs of the pathogen (staining)
- Incubation in a moist chamber then observation



Sporangia of *Phytophthora* after incubation for 24hr



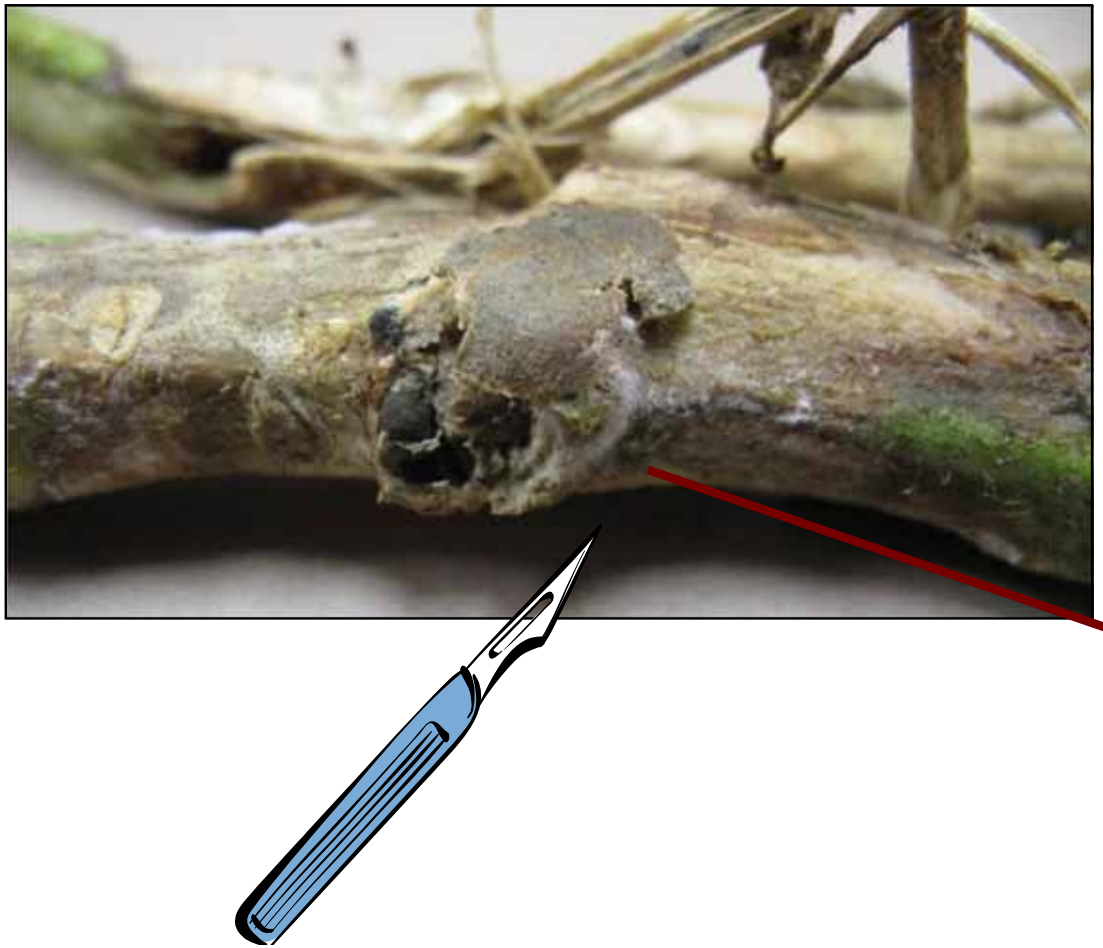
F. oxysporum in vascular tissue stained with aniline blue



Pythium oospores in root tissue

Microbiological techniques…

- Isolation and culturing on selective agar media



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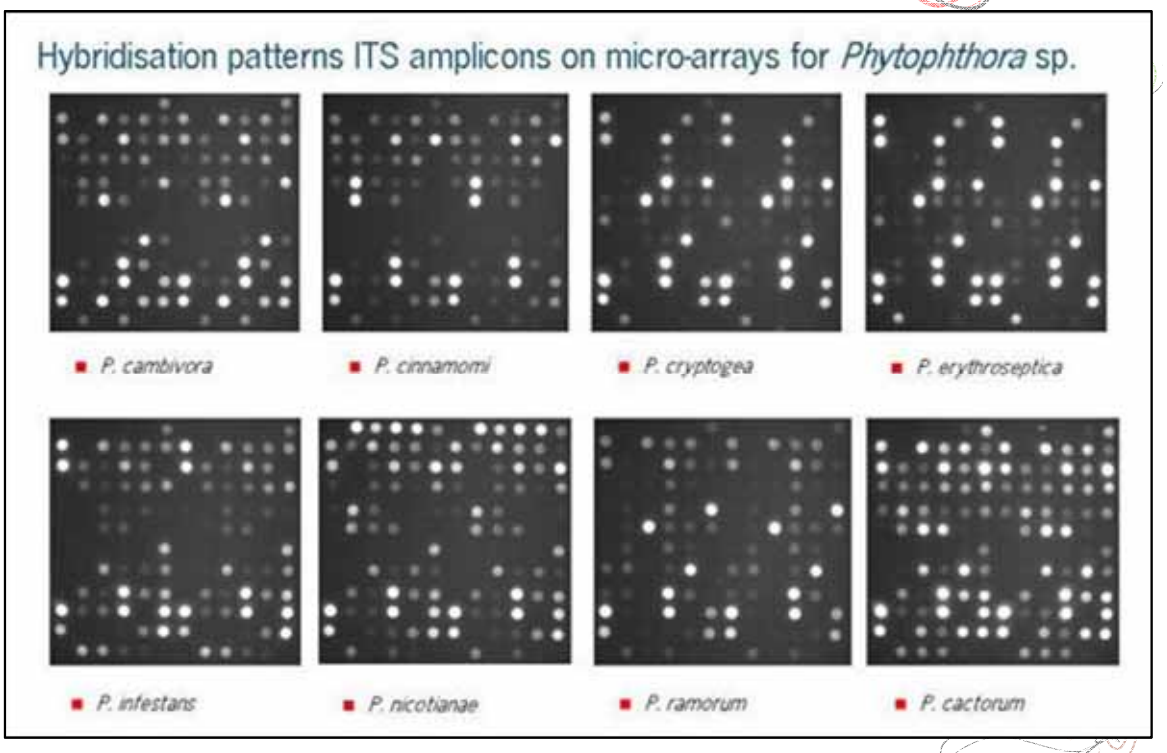
Molecular techniques…

Benefits

- ✓ Don’t rely of ability of organism to be cultured
- ✓ Less time consuming and labor intensive
- ✓ Less taxonomic/morphological identification skills needed

Drawbacks

- ✓ Target specific pathogens so difficult to ID complexes or screen for numerous pathogens



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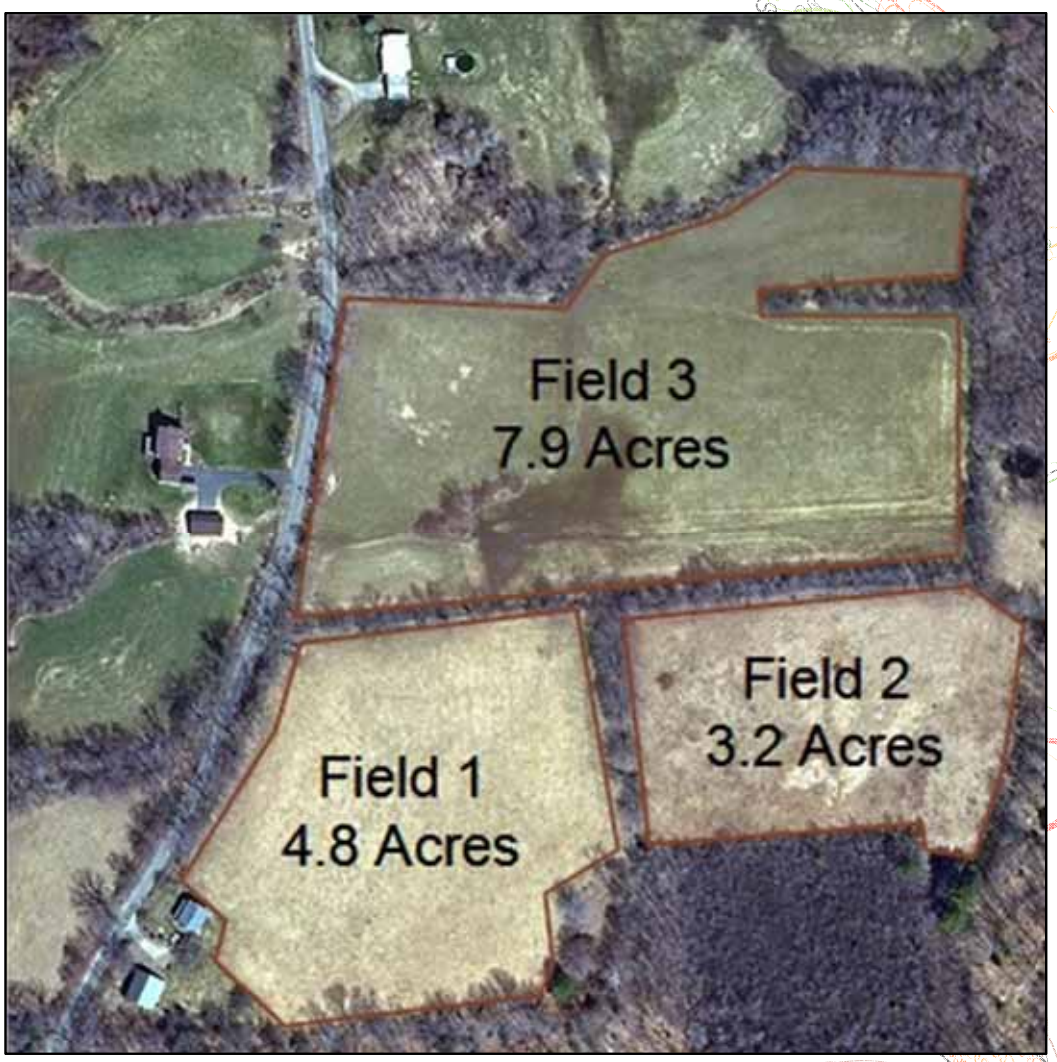
Plant International Research Wageningen UR

Field history disease maps…

➡ Map locations of areas most affected by disease outbreaks

- ✓ Monitor these areas more closely – target scouting efforts
- ✓ Use to inform disease management decisions



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Questions about sampling and assessing for soilborne pathogens?

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