

# Problem Diagnosis

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WSU Plant Pest Diagnostic Clinic

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## Course Goals

- Distinguishing Biotic from Abiotic
- Distinguishing Between Similar Diseases
- Diagnostic Resources at WSU



## Diagnostic Language

- **Normal/Healthy** = what we expect plant to look like
  - May be a relative term!
- **Chlorotic** = yellowing
- **Necrotic** = dead tissue (brown, black, grey, tan, white)
- **Wilted** = drooping or limp
- **Stunted/Poor Growth** = smaller than normal
- **Deformed/Distorted** = looks 'distinctly odd', no other terms fit the symptom description









## Diagnostic Terms

- **Abiotic** = damage caused by non-living factor
  - referred to as disorder rather than disease
- **Biotic** = damage caused by a living organism
- **Pest** = insect or arthropod
- **Disease** = virus, bacteria, fungi, nematodes, and parasitic plants
- **Sign** = physical presence of the (biotic) cause
- **Symptom** = the plants response







# Why is diagnosis based on symptoms difficult?

## Poor Stand

- Damping off pathogens
- Insects/pest
- Soil issues
- pH issues
- Machinery skips/planting issue
- Carryover

## Leaf Spots

- Fungi (which one?)
- Bacteria (which one?)
- Virus (which one?)
- Residue/drift
- Insects

## Yellowing

- Nutrient disorders
- Root compaction
- pH issues
- Soil issues
- Virus
- Foliar pathogens
- Vascular pathogens
- Root pathogens
- Foliar insects
- Girdling insects
- Root insects
- Nematodes
- Herbicides
- Looked at the plant funny





# Symptoms are a reflection of what plant process is interrupted!

- Whole plant yellowing
  - Vascular system interruption
    - Root rots
  - Not enough resources
- Yellow spots
  - Discrete damage to affected tissue
  - Reduction in photosynthetic tissue
- Stunting
  - Vascular system interruption
  - Not enough resources
- Deformation
  - Plant genetics interrupted
  - Physical distortion of affected tissues
- Necrosis
  - Rapid cell death
  - Increased severity of yellowing/chlorosis



# Disease Triangle





# Disease Triangle

## Susceptible host

Genetics/Breeding  
Age

## Virulent pathogen

Genetics  
Out-evolving plant defense

## Conducive environment

Influences severity and prevalence of disease

*\*Think Snow Mold!\**





# How does environment influence disease?

- Speckled snow mold
  - Previously thought to be winter kill
  - Long lived structures in wheat, turf, wild grasses
  - **REQUIRES** 100 days of snow cover with unfrozen soil
    - Snow insulates plants from the cold







# Plant Problem Diagnosis=Crime Scene Investigation

- Find a problem
  - What is wrong, what are the symptoms?
- Collect evidence
  - Is the culprit visible?
  - Circumstance
  - Physical
  - Background info
- Rule out suspects
- Build your case





# Plant Problem Diagnosis=Crime Scene Investigation

Find a problem

What is wrong, what are  
the symptoms? =

What is normal and how does  
this plant look abnormal







# Plant Problem Diagnosis=Crime Scene Investigation

Collect evidence = Signs, insects, plant growth stage, chemical history, weather, soil characteristics, planting dates, irrigation, cropping & site history, previous problems





# Plant Problem Diagnosis=Crime Scene Investigation

Rule out suspects = What do you NOT observe/recover, what has/has not been done or used.

Build your case = Pieces should fit together







# *Pythium and Rhizoctonia*

## *Pythium*

- Cool, wet
  - Fall through Spring
- Seedling stage
- Winter green-up
- Clay soils
  - Take longer to warm up
- Uniform-ish through field
- Low spots
- Poor growth, thin
- Yellowing (N deficient-like)

## *Rhizoctonia*

- Cool, wet
  - Fall through Spring
- Seedling stage
- Winter green-up
- Clay soils
  - Take longer to warm up
- Often circular, patchy, uneven height
- Green Bridge
- Poor growth, missing
- Yellowing (N deficient & drought-like)



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Credit: Tim Paulitz





# Fusarium Dryland Foot Rot and Take-all

## Fusarium Dryland Foot Rot

- Warm weather, drought stressed
- Wet, humid may lead to Fusarium Head Blight
- White heads
  - Sooty molds
- Chocolate brown discoloration under nodes
- Induced drought stress

## Take-all

- Prefers alkaline soil
- Stunted
- Few, brittle roots
- White heads
  - Sooty molds
- Black shiny leaf sheath



Credit:Tim Paulitz



# *Fusarium* Diseases

## **Fusarium Dryland Foot Rot**

- Drought stressed plants
  - Summer
  - High/exposed spots
- Four species
  - Three cause FHB

## **Fusarium Head Blight**

- Irrigation, high humidity
  - During head emergence through harvest
- Corn in rotation/nearby
- During heading
- Scout for premature head discoloration or odd tan florets while heads should be green!
- 17 species possible—3 common










# Early Root rots versus Cephalosporium Stripe

## *Rhizoctonia/Pythium*

- Infection both fall and spring
- Acidic maybe?
- Cooler, wetter encouraged
- Symptoms in roots
- *Rhizoctonia* slowed maturity (=no whitehead)
- *Pythium* whiteheads

## *Cephalosporium Stripe*

- Infection occurs in Fall
- Low, wet, acidic soil
- Cool weather
- Symptom Scouting
  - Later winter/early spring  
=ambiguous leaf symptoms
  - Jointing=classic yellow stripe  
extending through nodes
    - Brown discoloration in node
- Whiteheads



**What looks a bit like this?**

**What could we look for to distinguish?**





# Nematodes

## Cyst nematode

- Lemon shaped cysts on outside of roots
- Thin stands
- Fewer tillers
- Poor growing plants
- Roots look bushy
  - Distortion of cells

## Root Lesion

- Microscopic worm
- Reduced growth
- Often in complex
  - *Rhizoctonia*, *Pythium*, and *Fusarium*
- Roots are browned
  - Damaging outside

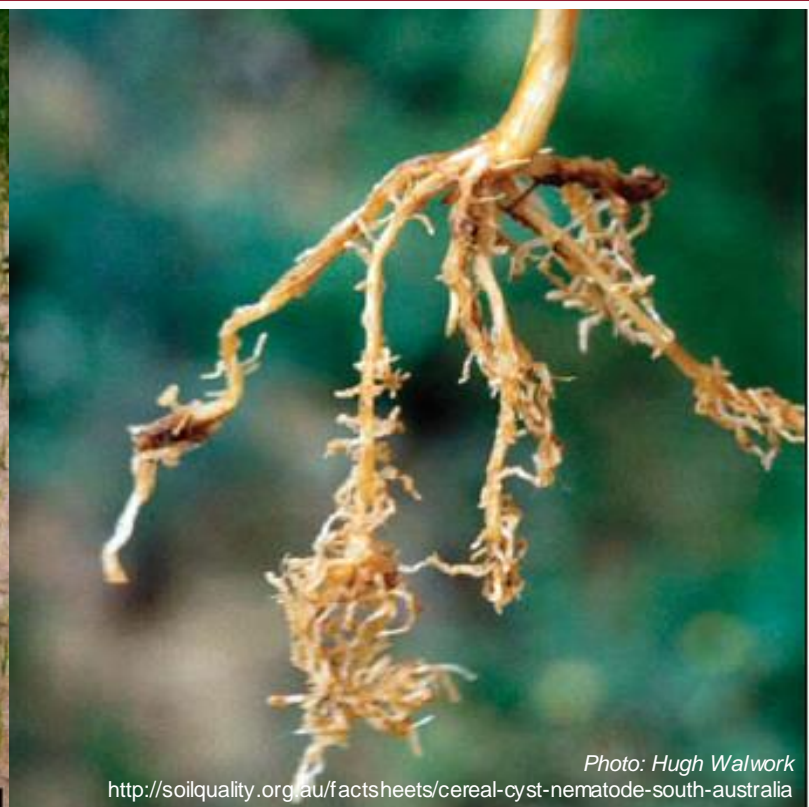


Photo: Hugh Walwork  
<http://soilquality.org.au/factsheets/cereal-cyst-nematode-south-australia>





# Aluminum vs Root Rots

## High Aluminum

- Bright white roots
- Same volume of roots
- Twisted, clubbed, distorted
- Low pH

## Root Rot

- Discolored
- Fewer roots
- Damaged roots
- No root hairs
- Cysts







# Stem Lesion

## Eyespot

- Reduced growth
- Lodging
- Not dead plants!
- Scout after jointing
- Whiteheads
  - Sooty head molds
- Infects fall through spring
  - Lots of water increases severity
  - Seen more severe, early last year!
- Diamond/football shape with brown and diffuse golden-yellow

## Sharp Eyespot

- Rhizoctonia
  - Not the same as root rot
- Dark brown diamond/football shape
  - Sharp border, no yellow
- Snow mold weather=sharp eyespot weather
  - May also see wet, matted appearance of snow mold











# Leaf Spotters

## Stagnospora Blotch

- Early Spring
- Lowest leaves
- Irregular ovals or flecks with yellow halo
- *Tiny* fruiting bodies
- Can discolor spiklets too
  - Looks like bacterial infection too

## Septoria Blotch

- Wet, cool weather
- Lowest leaves
- Streaks brown and yellow
- Fruiting bodies in necrotic tissue
- Two consecutive rain days increases likelihood

## Tan Spot

- Oval-ish spots
- brown surrounded by yellows
- No fruiting body on leaves (old straw in spring has fruiting bodies)
- Are you ***SURE*** it isn't physiological leaf spot?







Courtesy S. Wegulo



Courtesy S. Wegulo









# Soil-based Viruses

## Wheat Soilborne Mosaic

- Soil microorganism
- Patchy in field
  - Wet, low areas
- MUST catch leaf symptoms in late winter/early spring
  - After breaking dormancy

## Barley Yellow Dwarf

- Aphid vector
- Yellow flag leaf
  - Or red, or purple, or green, or brown, or orange
- Short internodes ('Dwarf')

## Wheat Spindle Streak

- Same soil microorganism
- Uniform-ish in field
  - May be worse in wetter areas
- MUST catch leaf symptoms in late winter/early spring
  - After breaking dormancy
- If cool long enough may turn necrotic
  - Looks very close to Stagnospora and Septoria!
    - How could we rule out Septoria?



## Symptoms of Soilborne Wheat Viruses

wheat spindle streak mosaic

wheat soilborne mosaic













# Why is the grain discolored?!?

## Sooty Head Molds

- Dead tissue vs pathogen
- Not on grain
- Associated with whitehead causing diseases
- 2015--rain when harvest should have happened

## Black Chaff

- Bacteria!
- Leaf may have glaze like ooze
- Random-ish florets (melanosis=regular)
- Irrigation
- Infrequent/seedborne
- Looks like *Stagnospora* infection too

## Smuts

- Pathogen controlled via resistance and fungicides
- Common/Stinking=smells like fish
- Smut on grain
  - Bunt balls vary based on smut type
    - Common=grain-shaped
      - Glumes distorted
    - Dwarf=round
    - Karnal=only one end bunted
      - Glumes not distorted















# Frost











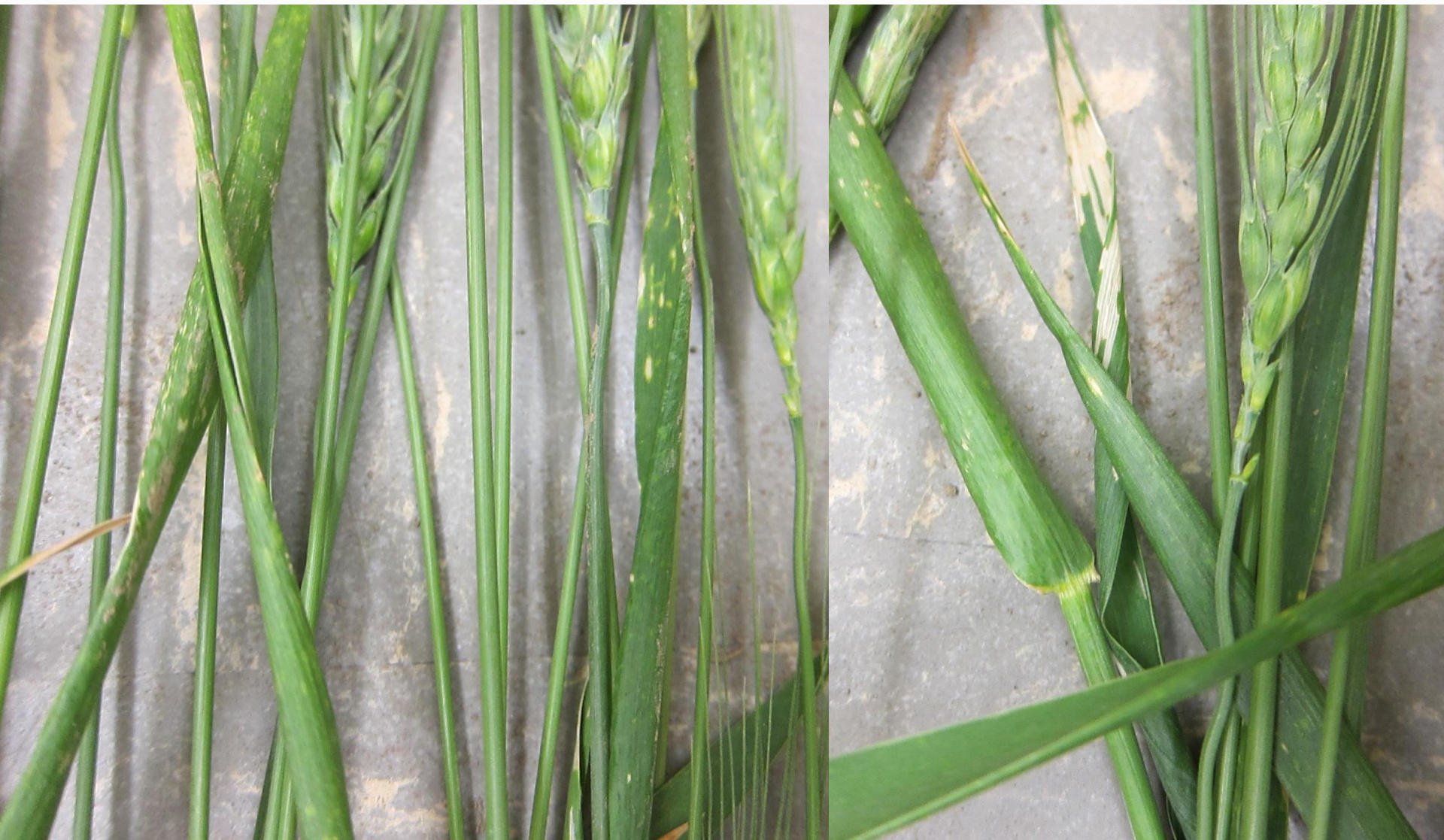








## Burning from nutrient application





## More Diagnostic Resources

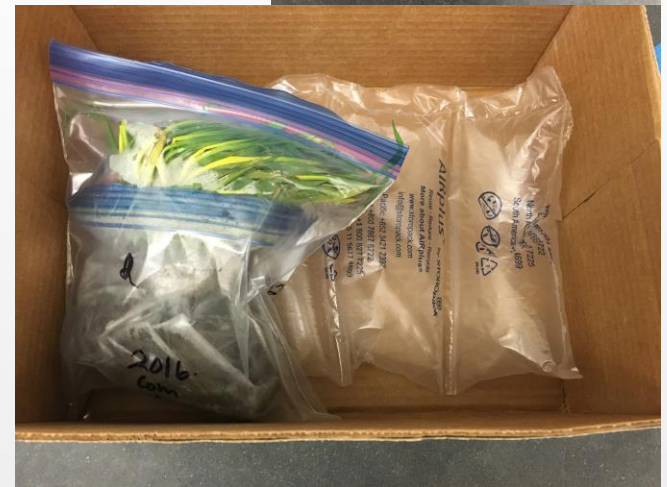
- Herbicide Resistance Testing Program
  - Completed Submission Form  
<http://smallgrains.wsu.edu/wp-content/uploads/2015/03/Resistance-Program-Sample-Submission-Form-2.pdf>
  - Several hundred seeds, grown out, then tested
  - See our Timely Topic:  
<http://smallgrains.wsu.edu/submit-samples-to-the-wsu-resistance-testing-program/>
- The USDA-ARS Western Regional Small Grain Genotyping Laboratory
  - <https://plantpath.wsu.edu/people/faculty/see/see-lab/>
  - Uses markers to determine the identity of the plants in question

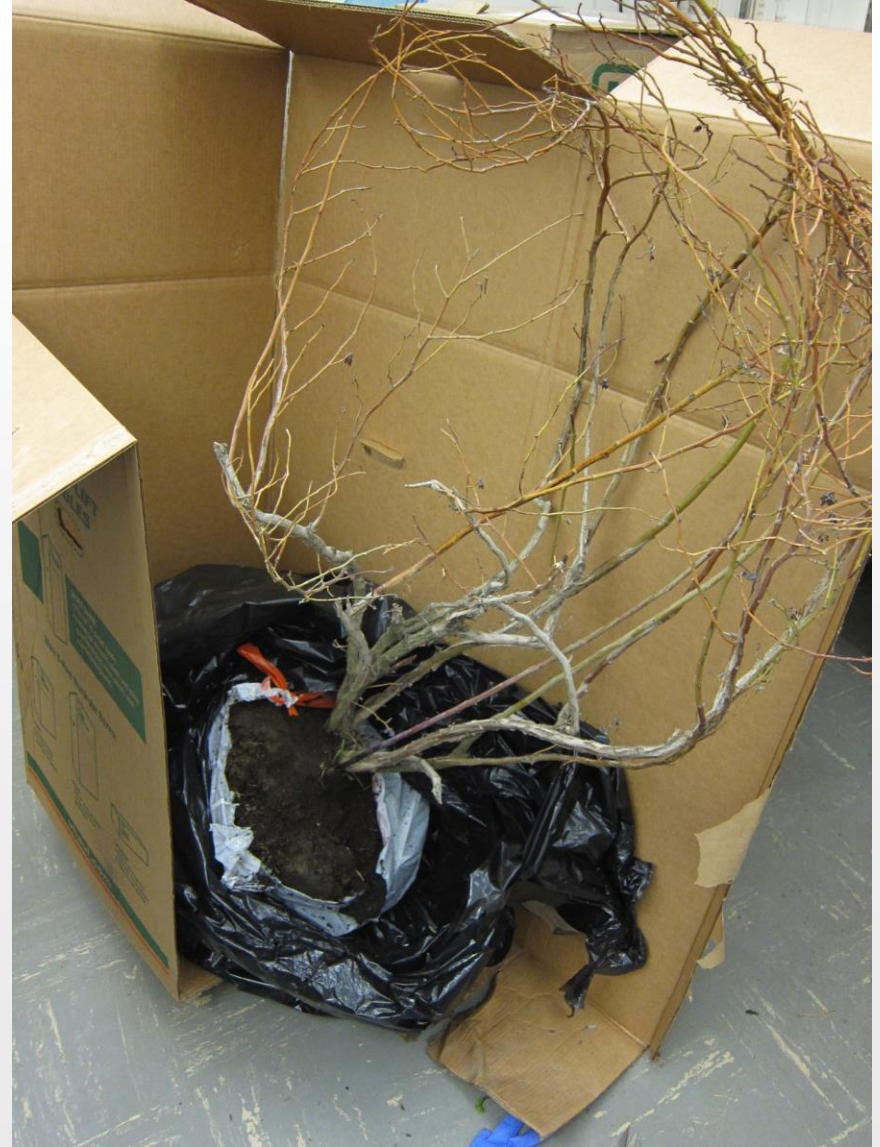




## Submitting Samples

- Whole plants whenever possible
- Range of symptoms
- Healthy plant too
- As many photos as needed
- Carefully packaged
- Kept cool until delivery (to mail or in person)
- Delay=decay
- Completely fill out submission form
  - Download online:  
[http://plantpath.wsu.edu/wp-content/uploads/2016/01/Commercial-Disease-Pullman\\_Dec2015.pdf](http://plantpath.wsu.edu/wp-content/uploads/2016/01/Commercial-Disease-Pullman_Dec2015.pdf)









## WHAT YOU SEE



## WHAT I SEE



Borrowed from Clarissa Balbalian Mississippi State University Plant Disease&Nematode Diagnostic Clinic



## Thank you!

- Questions?
- Contact me at:

[rachel.bomberger@wsu.edu](mailto:rachel.bomberger@wsu.edu)

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[plantpath.wsu.edu/diagnostics/](http://plantpath.wsu.edu/diagnostics/)





## Scenario #1







## Scenario #2







## Scenario #3





**Please turn in survey forms  
at end of day**