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 plant's response
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 60+ 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
- 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)
## 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
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 soil (maybe?)
- Cooler, wetter encourages
- 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
• Poorly growing plants
• Roots look bushy
  – Distortion of cells

Root Lesion

• Microscopic worm, cannot see with naked eye
• Reduced growth
• Often in disease complex
  – Rhizoctonia, Pythium, and Fusarium
• Roots are browned
  – Damaging outside
Jonathan D. Eisenback, Virginia Polytechnic Institute and State University, Bugwood.org


Photo: Hugh Walwork
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-if cause
Snow Molds

**Pink Snow Mold**
- *Microdochium*
- All grasses affected
- Requires wet, cold conditions
  - Frost, rain, fog, ect.
- Wet, matted appearance
- Cottony mycelium
- Orange-red-pink coloring
- Patches of damaged plants

**Typhula Snow Molds**
- Speckled/Grey snow molds
- All grasses affected
- Require snow cover for extended time
- Wet, matted appearance
- Cottony mycelium
- Color is off yellow
- Patches of damaged plants
- Sclerotia embedded in tissue
Stem Lesion

Eyespot
- Reduced growth
- Lodging
- Plants not dead!
- 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
Stagnospora Blotch
• Early Spring
• Lower leaves
• Irregular ovals or flecks with yellow halo
• Tiny fruiting bodies
• Can discolor spikelets too
  - Looks like bacterial infection too

Septoria Blotch
• Wet, cool weather
• Lower 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?
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

Courtesy G.C. Bergstrom
Wheat Streak Mosaic Virus

- Mite transmitted
- Mite moves from harvested cereal to seedlings
  Associated with late harvest and irrigated fields

Edges may cup or roll to center

Mite may be seen at a curled center leaf.
NOT VIRUS!!!
Why is the grain discolored?!

**Sooty Head Molds**
- Dead tissue vs pathogen
- Not on actual grain
- Associated with whitehead symptoms
- 2016--rain when harvest should have happened

**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

**Black Chaff**
- Bacteria!
- Leaf may have glaze like ooze
- Random-ish florets (melanosis=regular)
- Irrigation
- Infrequent/seedborne
- Looks like *Stagnospora* infection too
Herbicide vs frost
Burning from nutrient application
More Diagnostic Resources

• Herbicide Resistance Testing Program
  - Completed Submission Form
  - 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:
Borrowed from Clarissa Balbalian Mississippi State University Plant Disease & Nematode Diagnostic Clinic
Thank you!

• Questions?
• Contact me at:
  rachel.bomberger@wsu.edu
  (509)335-0619
  plant.clinic@wsu.edu
  (509)335-3292
  plantpath.wsu.edu/diagnostics/
Scenario #1
Scenario #2
Scenario #3