

# Understanding narrow brown leaf spot host resistance and pathogen population dynamics

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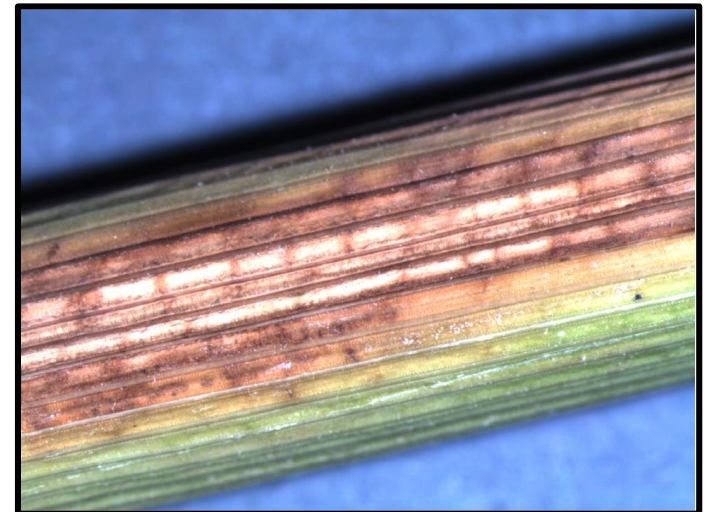
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# Outline

1. *CRSP2.1* major gene resistance
2. Sheath resistance: the new frontier
3. Has *CRSP2.1* been overcome?
4. Pathogen population dynamics
5. New problems to tackle

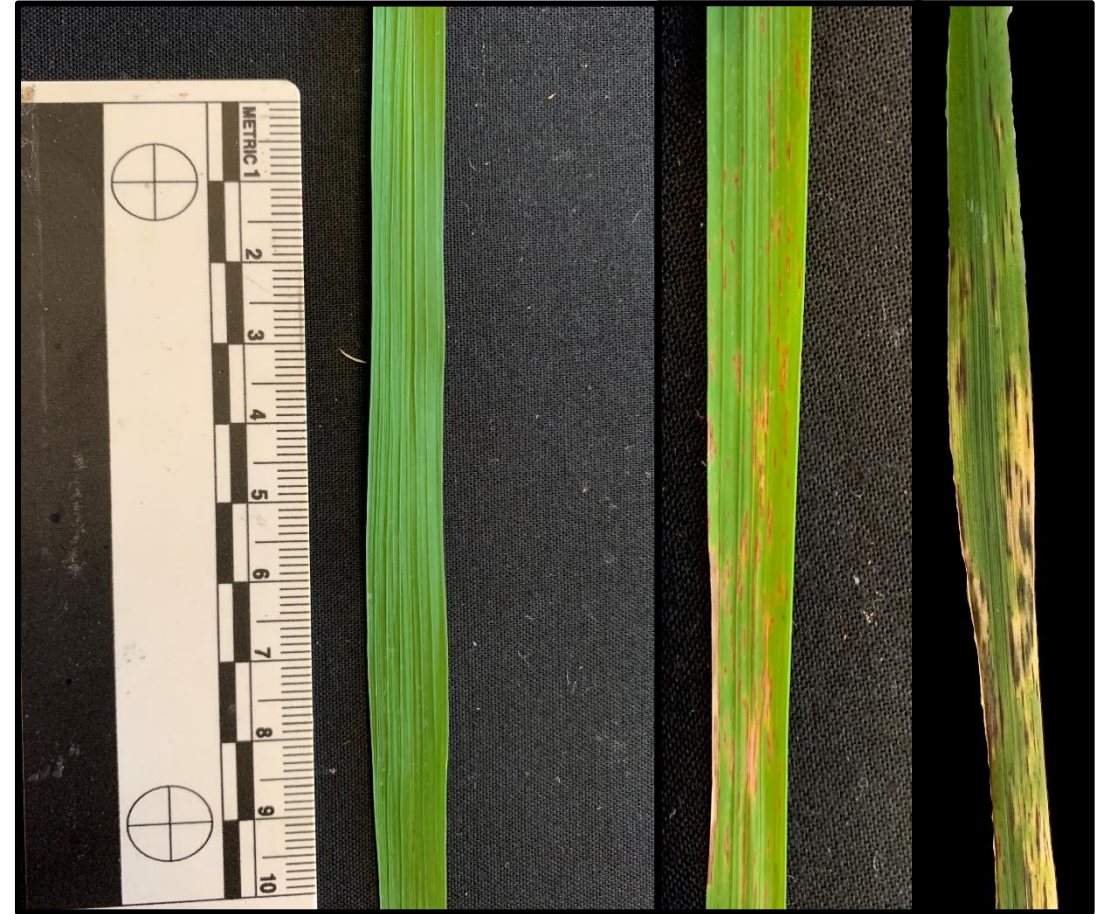
# Narrow Brown Leaf Spot

- *Cercospora janseana*
- Narrow brown lesions on leaf tissue
- Net blotch pattern on sheath/stem
- Yield losses up to 40%
- Fungicide applications
  - Widespread QoI resistance (75%)
  - Propiconazole
- Host resistance is a viable strategy



# *CRSP2.1*-mediated resistance

- Goal: identify causal gene
  - Collaborative project with Drs. Famoso and Angira
- High level of foliar resistance
- Identified three candidate genes
- Gene identification/validation aids effective deployment



***CRSP2.1* +**

***CRSP2.1* -**



# Stem/sheath symptoms are 'different'

- *CRSP2.1* provides broad spectrum resistance in leaf tissue
- Discovered that *CRSP2.1* does not provide sheath/stem resistance
- Do different genes control resistance in sheath/stem?
- Are different races involved?
- Need to look for symptoms beyond the leaf
- Currently phenotyping in GH
  - Identify sheath/stem resistance



# Developing sheath phenotyping protocol

- Previous phenotyping protocol focused on leaves
- No published rating scale

Score	Symptom Description
0	No visible lesions
1	Pinpoint lesions, little to no expansion
2	Expanding lesions, longitudinal and transverse
3	Larger net blotch pattern
4	Large, dark, coalesced lesion
5	Completely dead tissue, collapse

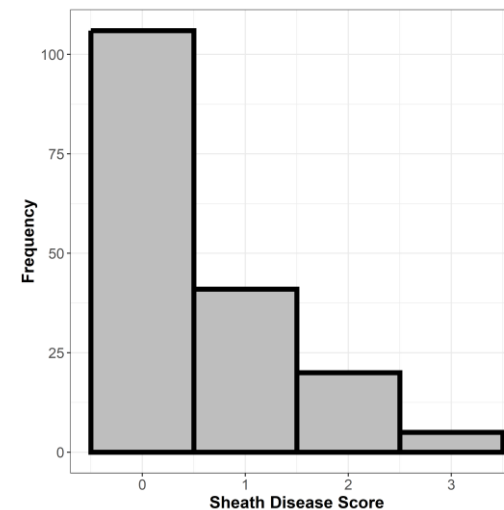
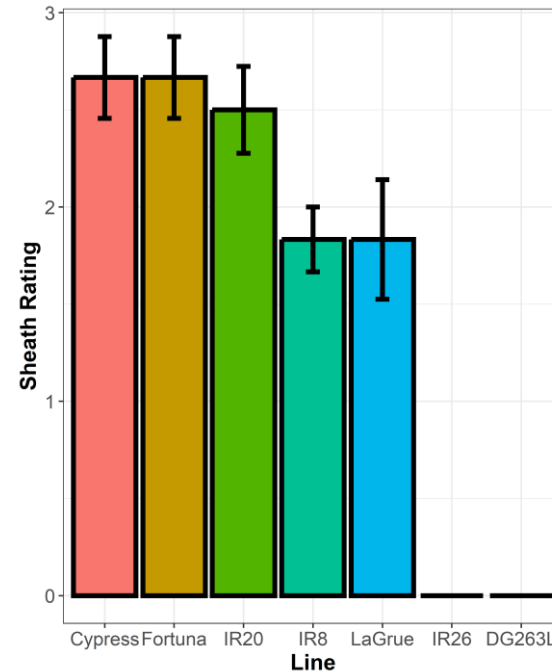
**Impact: New protocol and rating scale can be used in controlled greenhouse evaluations**



# Identifying sheath NBLS resistance

- Sixteen varieties were evaluated in greenhouse trials
- DG263L identified with potentially broad-spectrum sheath/stem resistance
- Phenotyped F<sub>2</sub> population
  - DG263L x breeding line
- Segregated as single gene

**Impact: Identification and initial genetic screen lays foundation for mapping and use in breeding**



LaGrue (S)

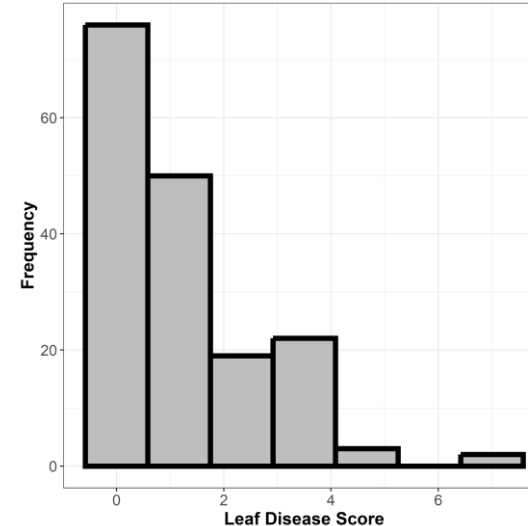
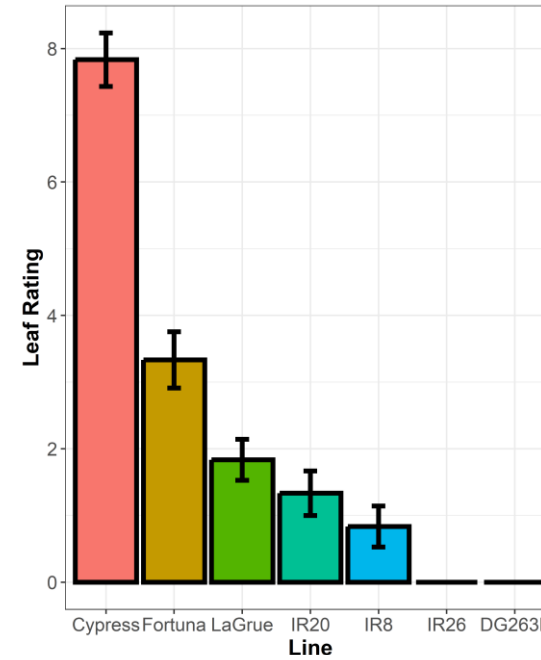
Cypress (S)

DG263L (R)

# Bonus: leaf resistance in DG263L

- DG263L also has great leaf resistance
- Same F<sub>2</sub> population evaluated for leaf disease
- Segregated as single gene
- Appears that different genes control leaf and sheath resistance

**Impact: If leaf resistance is different than *CRSP2.1*, brings another gene that can be used to control NBLs**



Cypress (S)

DG26L (R)



# Has *CRSP2.1* been overcome?

- Leaf lesions observed on Lakast and PVL03 in 2023
- Highly resistant in previous years
- Different resistant haplotypes exist and appear effective
- Collected over 20 isolates from Lakast and PVL03 in 2023

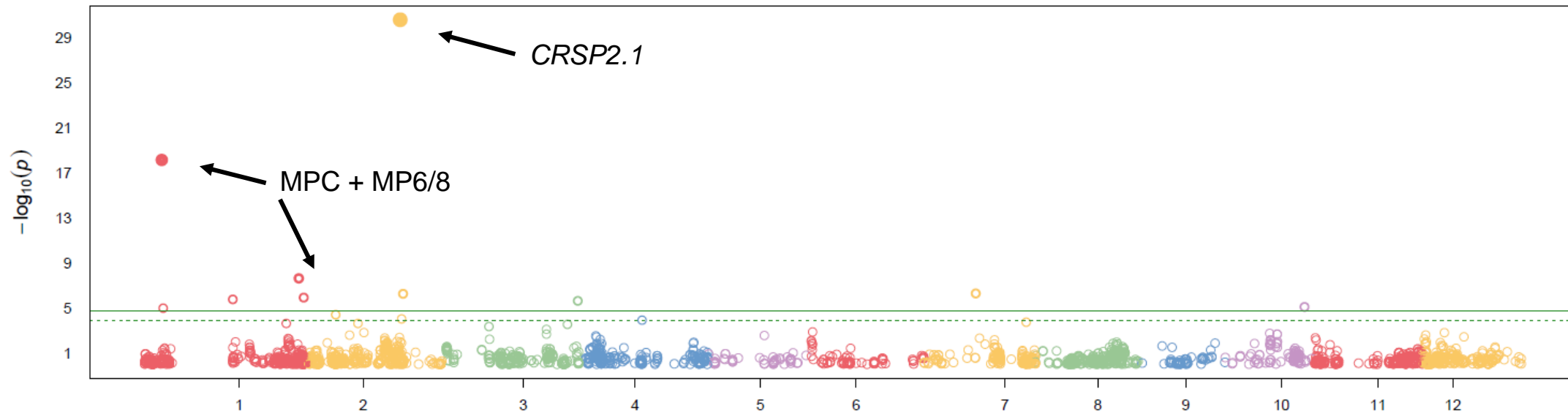
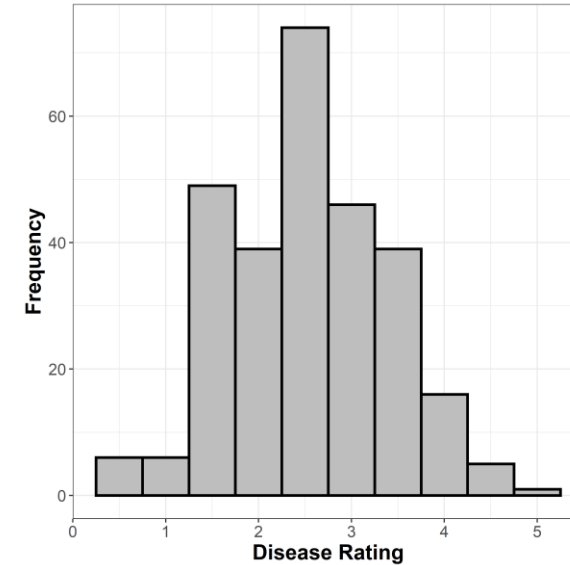
**Impact: Isolates collected will help determine the extent of virulence and if *CRSP2.1* haplotypes have been defeated.**



Photo: S. Gaire

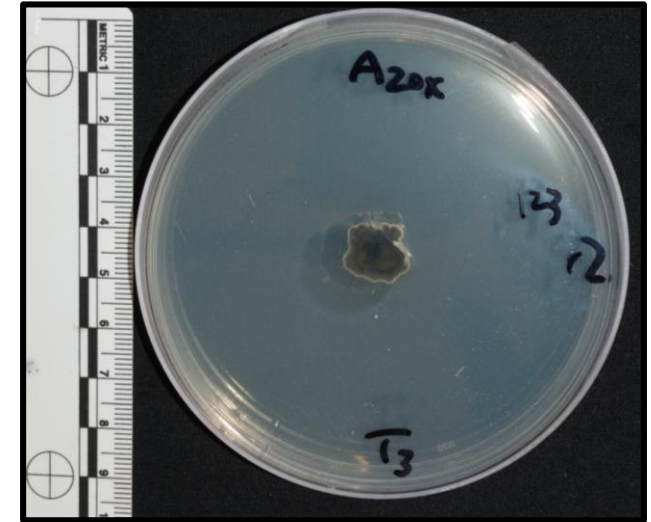
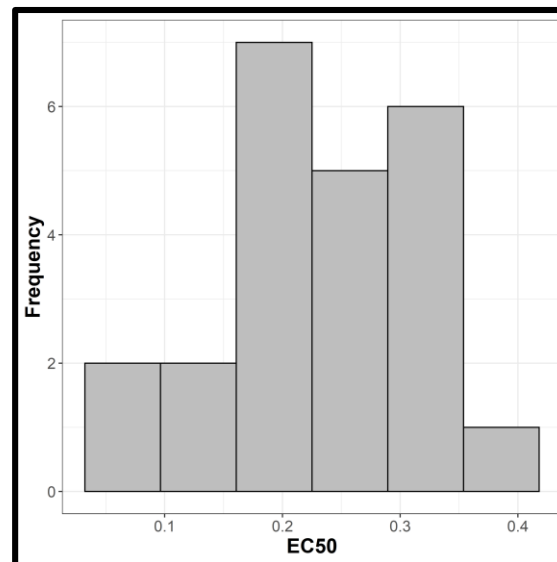
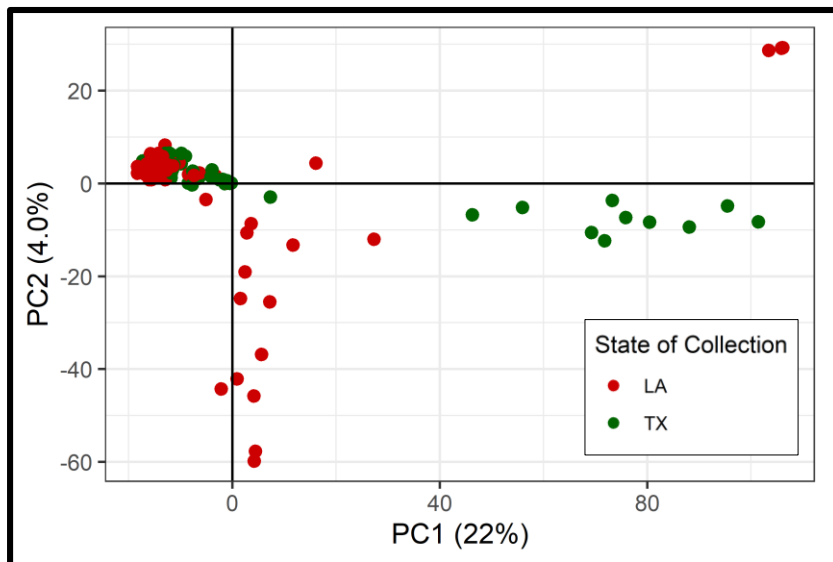
# Quantitative Resistance

- Complements major gene resistance
- Increases durability (harder to overcome)
- MPC and MP6/8 evaluated in field and/or greenhouse in 2021-2023

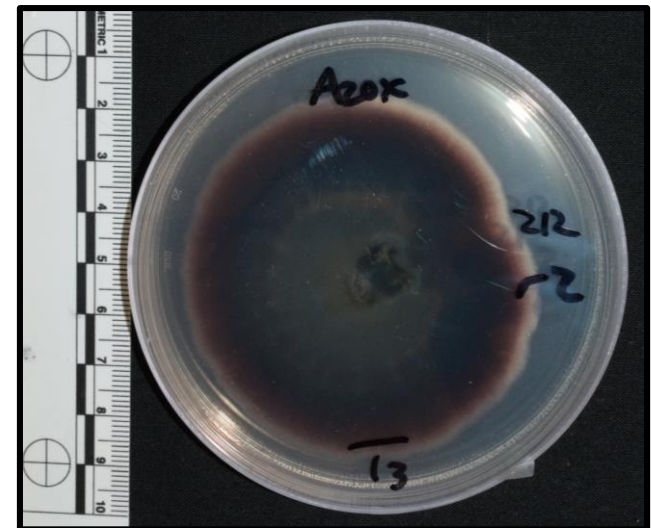


# Pathogen Population Dynamics

- Collected over 500 pathogen isolates
- Migration occurs between LA and TX
- High standing genetic variation
- Pathogen can sexually reproduce
- High prevalence of QoI resistance
- No detected resistance to propiconazole



Sensitive

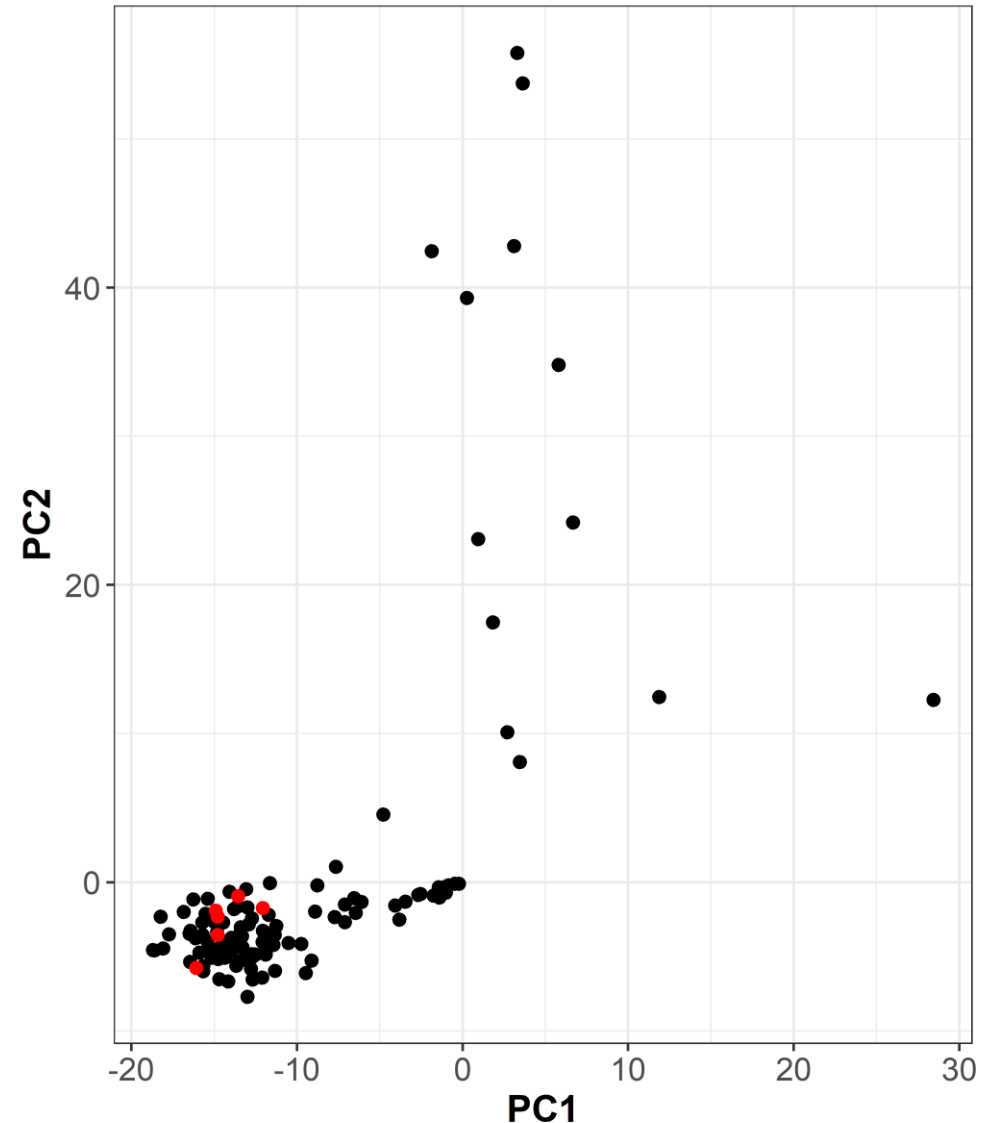


Resistant (G143A)

# Genetic relatedness of sheath isolates

- Eighteen isolates collected from sheaths/stems in 2021
- Six isolates from sheaths in 2015
- Whole-genome sequencing underway
- Analyses suggest no differentiation among leaf/sheath isolates

**Impact: Same population that infects leaves can infect stems/sheaths.**

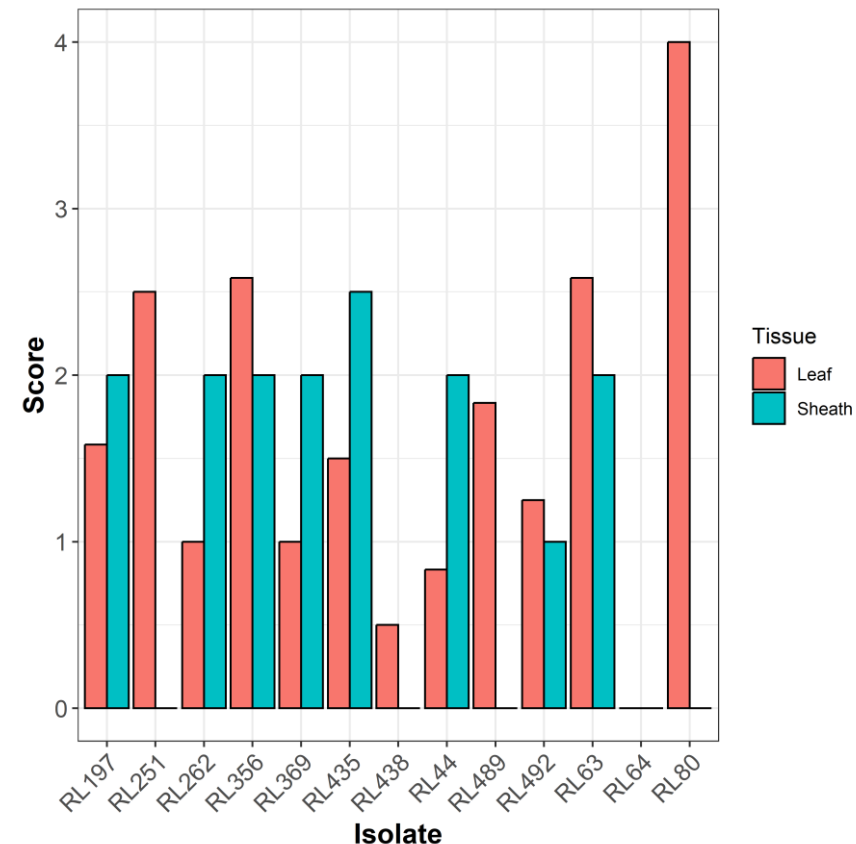
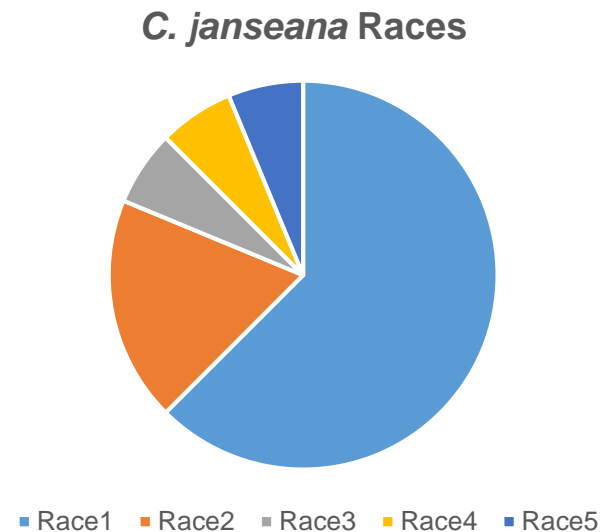




# Race structure of *C. janseana*

- Race structure hadn't been evaluated since 1980s in LA
- Phenotyped 16 isolates on 14 rice varieties varying in resistance
- One predominant race (62.5%)
- One race with broad virulence, low prevalence
- Race typing will continue in 2024

**Impact: First glimpse into race diversity in over 30 years. Knowing prevalent races guides variety selection.**



# New problems to tackle in 2024 and beyond

1. What is the genetic control of sheath resistance?
2. Has the pathogen overcome *CRSP2.1*?
3. How can we efficiently incorporate quantitative resistance into elite varieties?

**Main focus: Sheath/stem resistance and potentially novel race**

# Acknowledgements

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