

# Climate Change and Crop Diseases

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# SoyFACE





# Atmospheric Changes and Disease

CO <sub>2</sub>	
↑ plant growth	↑ plant vigor ↑ infectable tissue ↑ canopy humidity
↑ carbohydrate ↓ nitrogen	alters pathogen growth and reproduction
↑ leaf wax layer	slows infection
↓ stomatal opening	inhibits stomatal infecting pathogens
↑ plant residue	↑ overwintering of some pathogens

Ozone	
↓ plant growth	↓ plant vigor ↓ infectable tissue ↓ canopy humidity
↓ carbohydrate	alters pathogen growth and reproduction
↑ leaf wax layer	slows infection
↓ stomatal opening	inhibits stomatal infecting pathogens
↑ plant defense responses	slows infection

# Soybean Diseases



Septoria brown spot

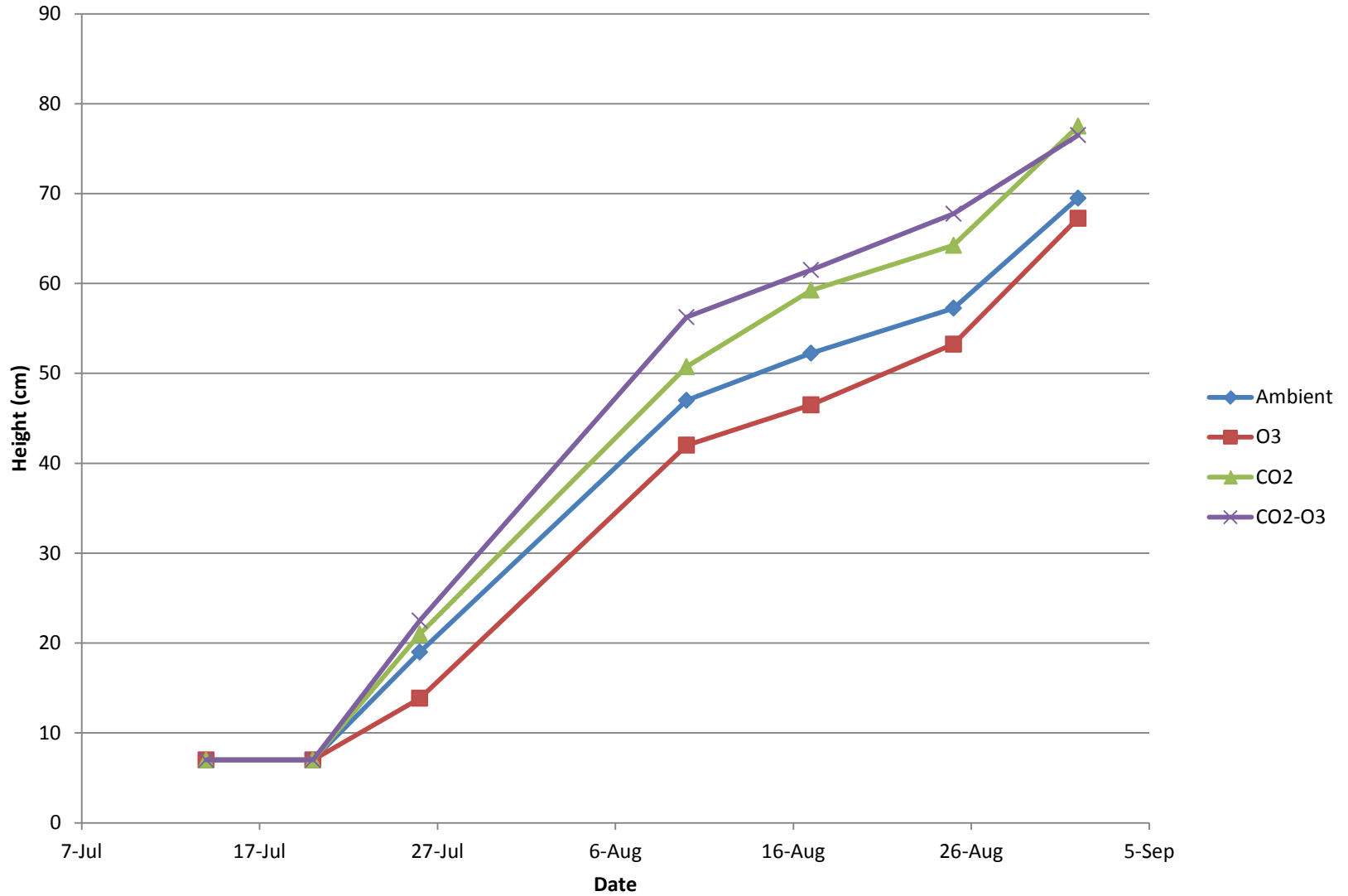


Downy mildew

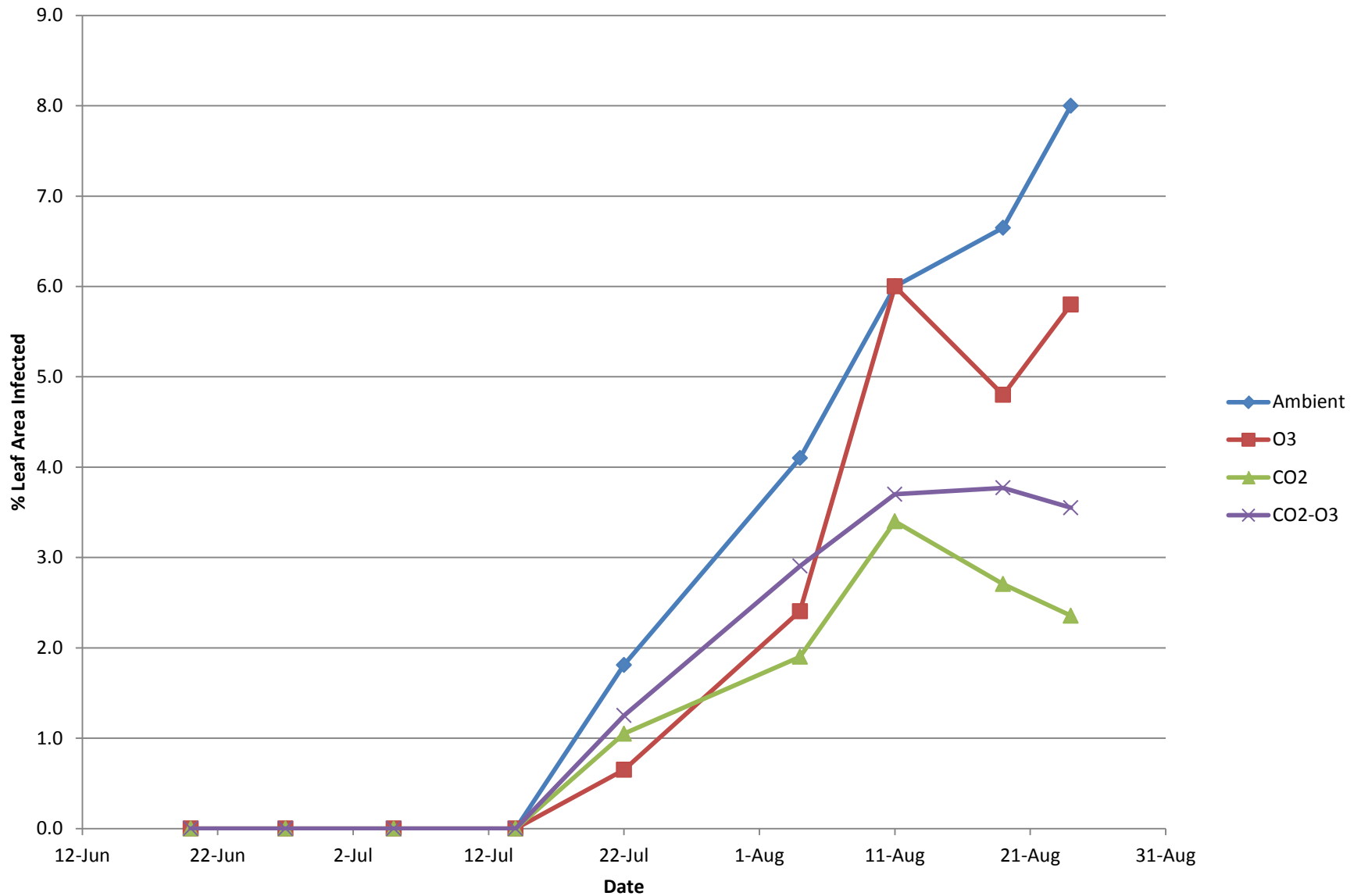


Sudden death syndrome (SDS)

# Septoria - height in canopy 2005



# Downy Mildew Severity 2006



# SoyFACE Disease Summary

- Brown spot
  - Larger plants, denser canopies
  - More severe under elevated CO<sub>2</sub>
- Downy mildew
  - Less severe under elevated CO<sub>2</sub> (O<sub>3</sub>)
- Sudden death syndrome
  - No significant treatment effects
- Soybean mosaic
  - Slower development with increased O<sub>3</sub>
  - Enhanced defense gene expression

# Corn – Ozone Project

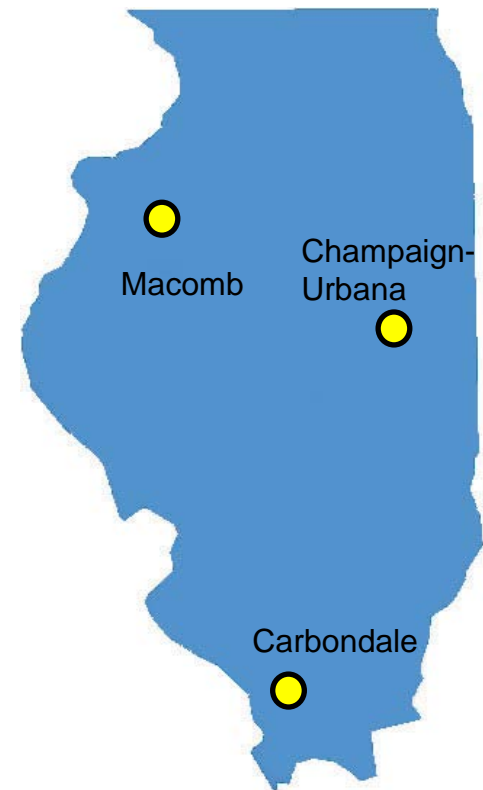
- Corn NAM lines and selected crosses
- Elevated and ambient ozone levels
- Rating disease levels mid and late-season





# Suppression of Soybean Diseases Through the Use of Cover Crops

- Three year study
- Three areas of Illinois
  - On station
  - On farm
- Four cover crop species
  - cereal rye
  - rape seed
  - canola
  - mustard



# Parameters Evaluated

- **Field parameters**
  - Cover crop biomass (spring)
  - Soybean stand
  - Early (V3-V4) and late (R7-R8) season foliar and root diseases
  - Yield
- **Soil collection for**
  - Greenhouse disease bioassay
  - SCN egg counts
  - Pathogen population counts
  - DNA analysis



# Soybean Stands

## Rhizoctonia inoculated plots, UIUC 2011



Fallow

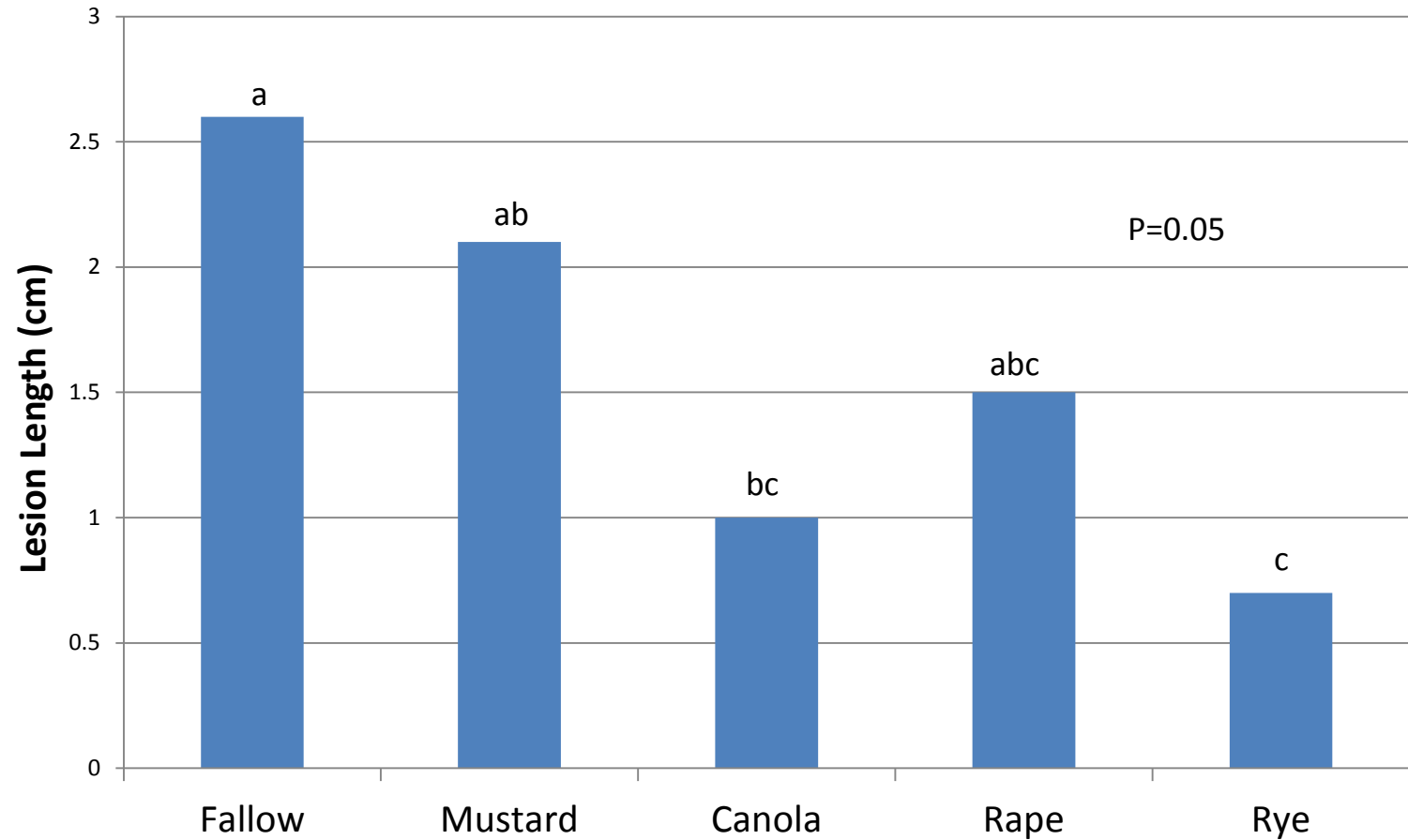


Rape



Rye

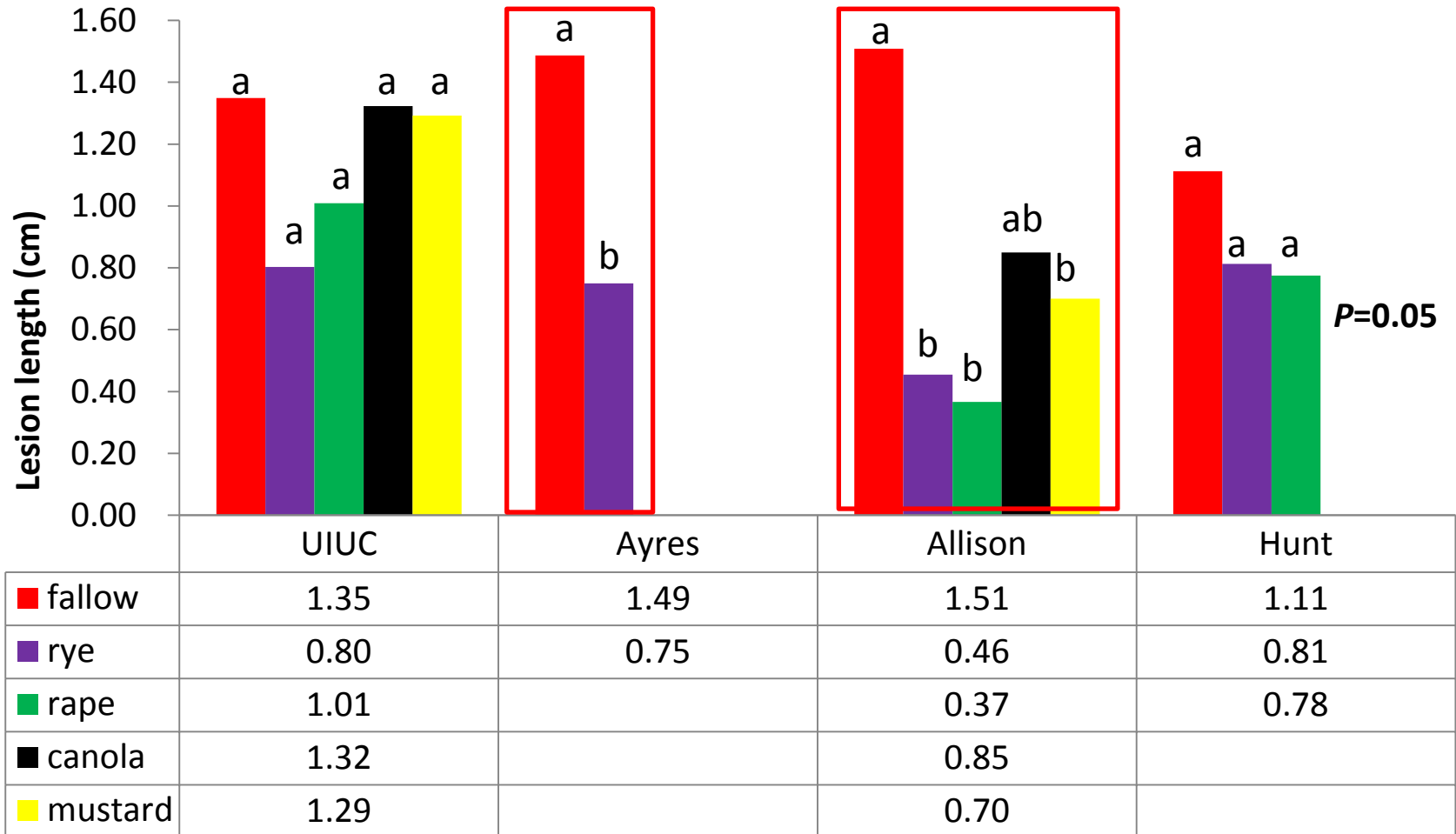
# Rhizoctonia root rot, UIUC 2012





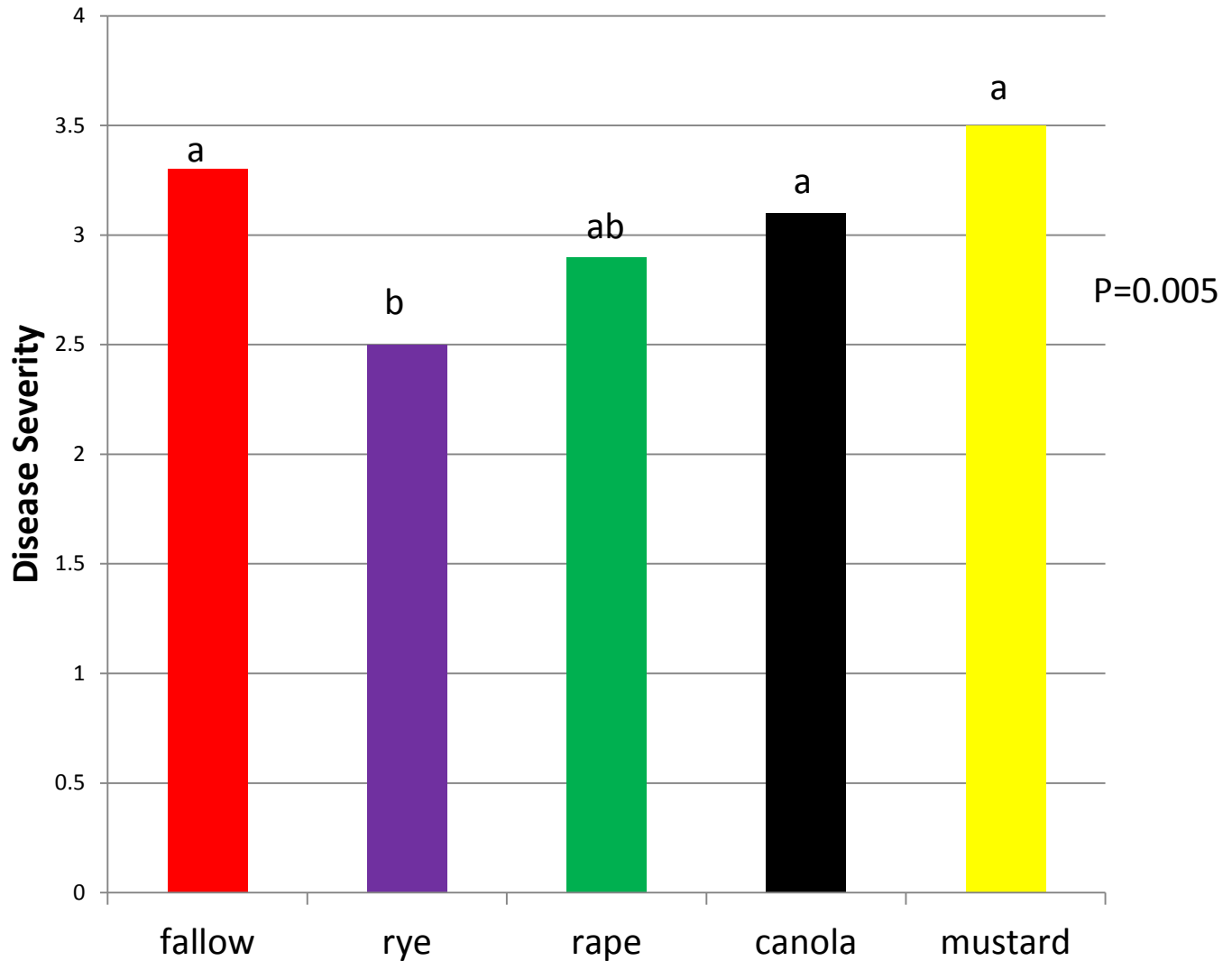
# Greenhouse suppressive soil assay

## *R. solani*, 2012 soils

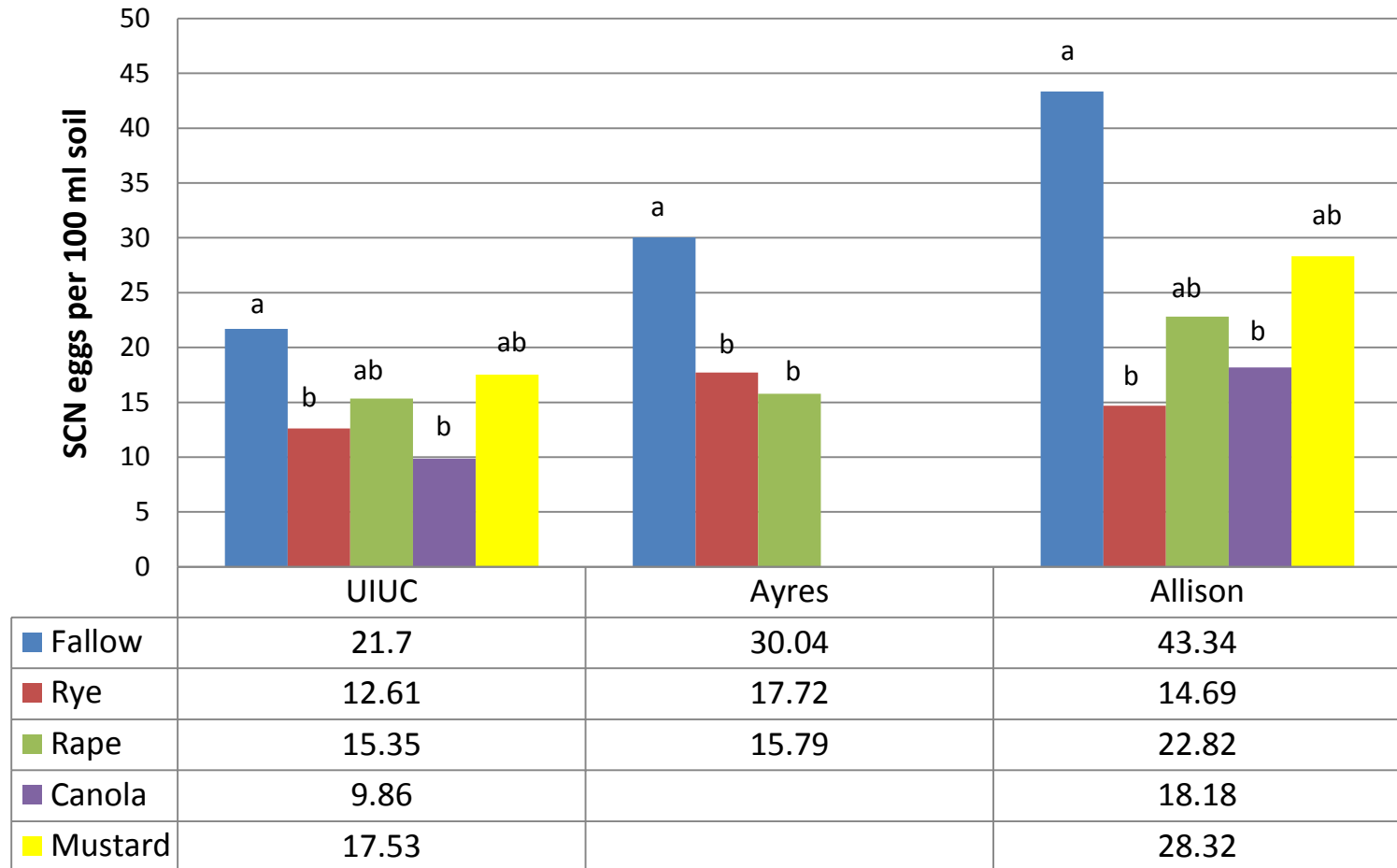


# Greenhouse suppressive soil assay

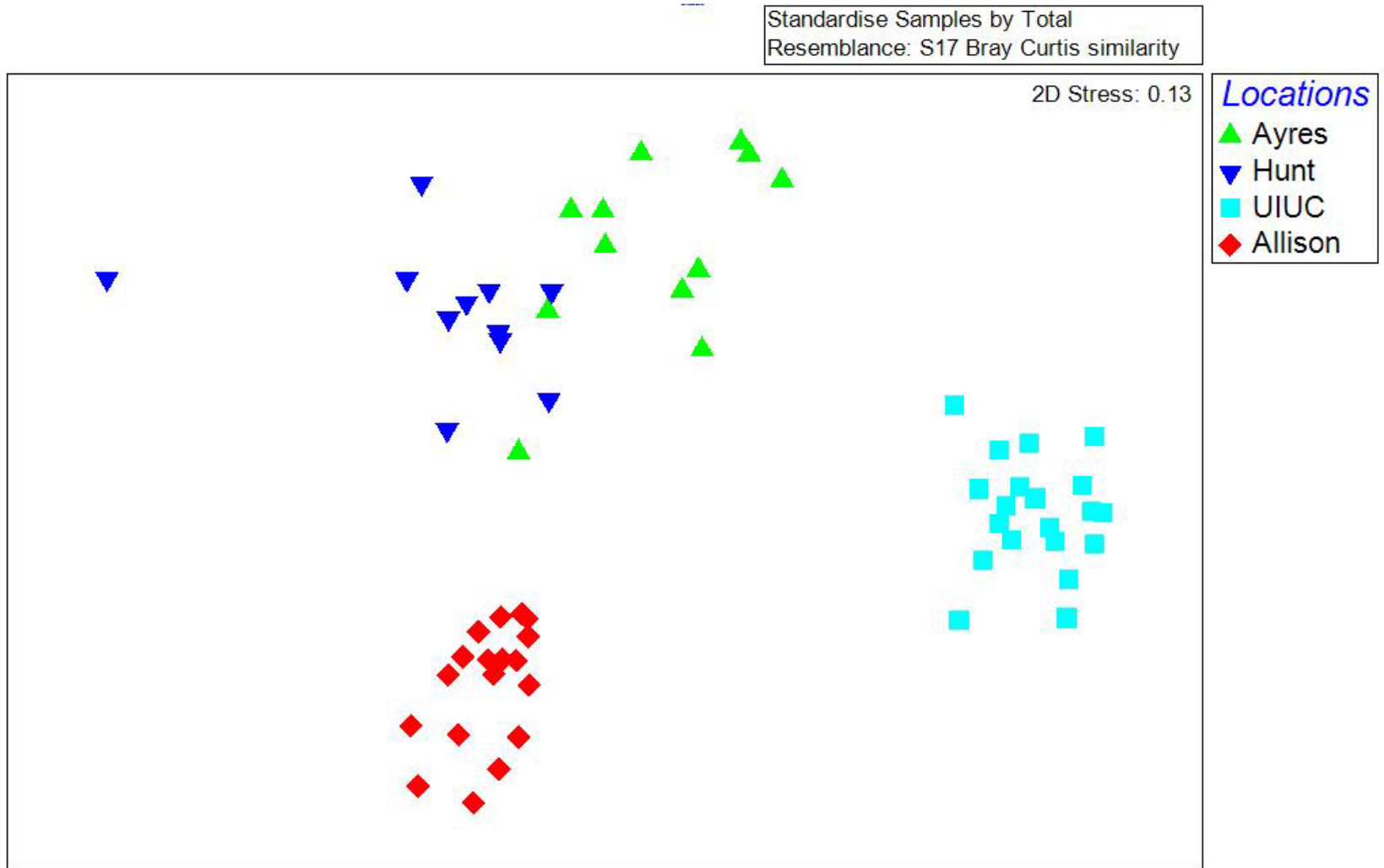
## *F. virguliforme* (SDS), 2013 WIU soils



# Soybean Cyst Nematode 2011 soil samples

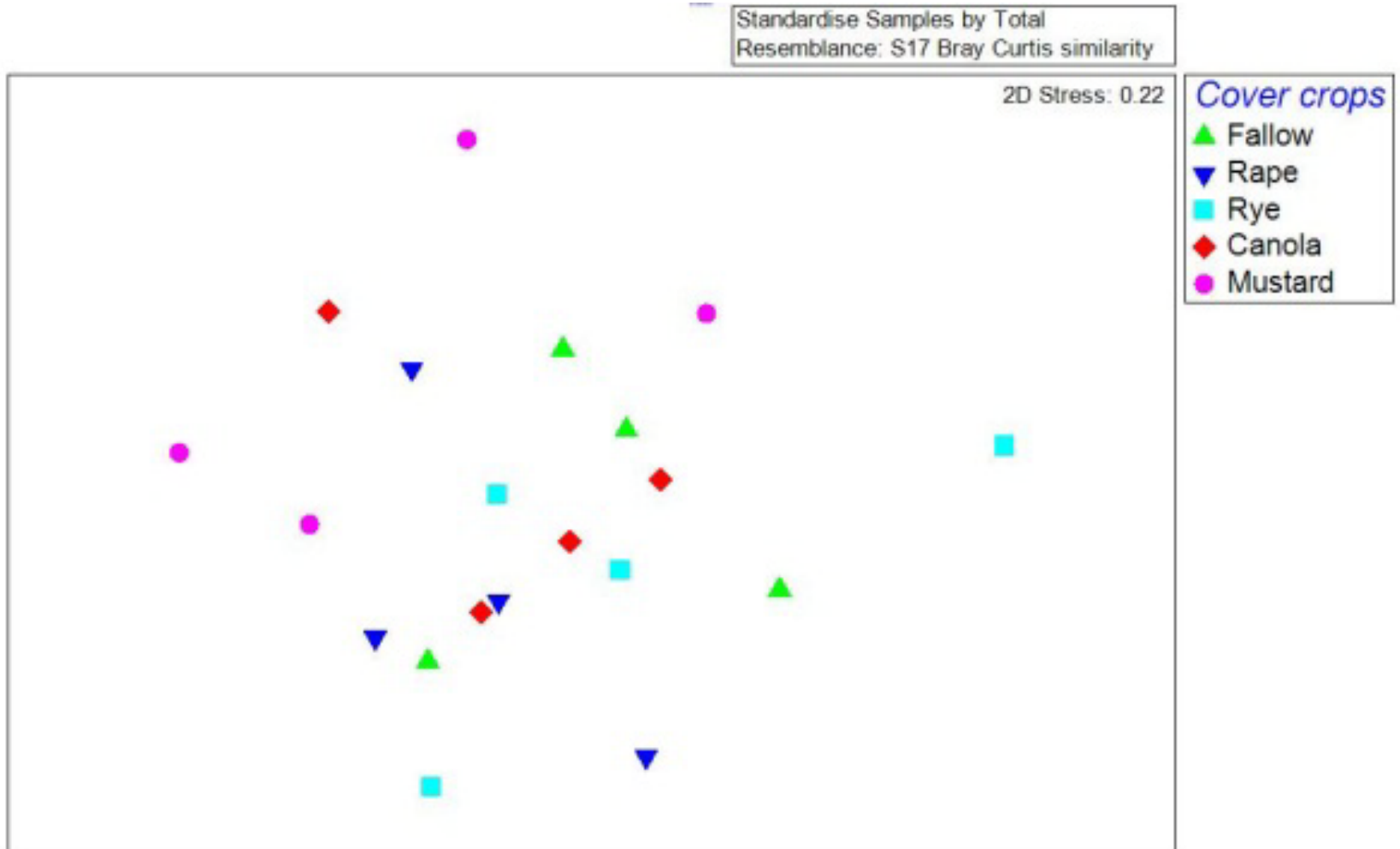


# ARISA Community Analysis





# ARISA Community Analysis



# Cover Crops and Disease Summary

- Rye and rape resulted in the highest soybean stands, but results were not consistent among locations.
- Rye and rape have the potential to induce soil suppressiveness to Rhizoctonia rot and SDS.
- Rye, rape, and canola can significantly decrease SCN egg counts.
- Other pathogen populations were not significantly affected by cover crops.
- Cover crops did not result in significant differences in microbial community structure.

# **Combining Integrated Pest Management with Climate Change, Mitigation, and Adaptation in Soybean-Corn Cropping Systems**

Objective 1: Collect IPM-based data on diseases and insects for the original USDA NIFA CAP proposal

Objective 2: Evaluate the impacts of crop management practices on soybean production

Objective 3. Continue to evaluate the impacts of CSCAP crop management practices on weeds, insects and diseases

# Cover Crops and Soybean Diseases

## CSCAP-USB Project

### **Treatments:**

- Ridge-till vs. chisel plow
- Cover crops
  - rye
  - mustard
  - vetch
  - rye/vetch
  - fallow

### **Evaluations:**

- Disease severity (mid and late season)
- Pathogen populations
- Microbial community structure (rhizosphere)