# Suppression of soybean diseases through the use of cover crops


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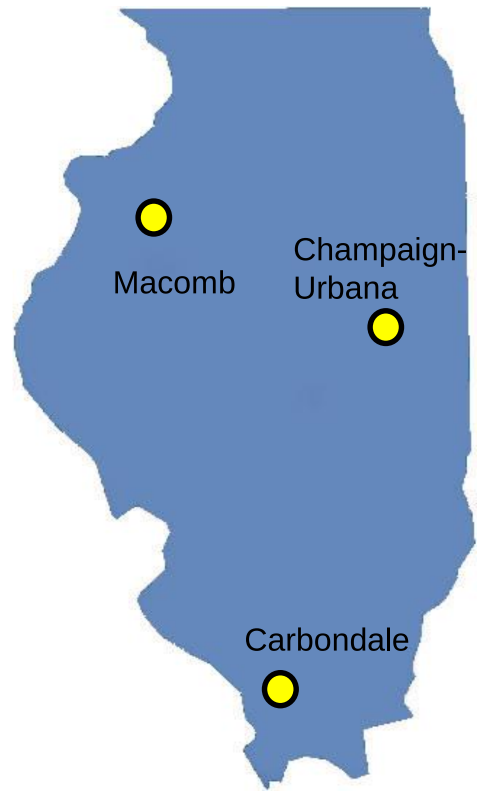
NORTH CENTRAL SARE
Sustainable Agriculture Research & Education



# Benefits of Cover Crops

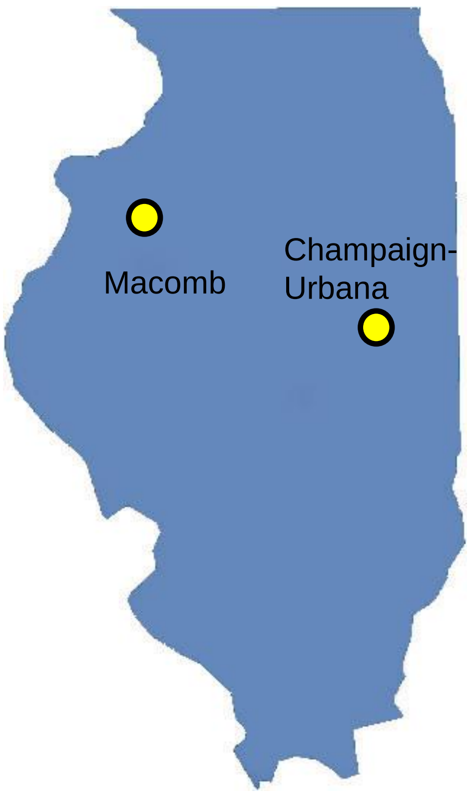
- ✓ Reduce soil erosion
- ✓ Reduce soil compaction
- ✓ Nitrogen scavenging
- ✓ Increase soil organic matter
- ✓ Weed management
- ✓ **Disease management ?**

# Disease Suppressive Soil

- Suppressive soil occurs when a pathogen does not become established or persistent, or may become established but causes little or no damage.
- All soils have some natural level of disease suppression.
- In most soils long term management can either reduce or increase this level of suppression.

# Evaluating the 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



# Collaborators

- Darin Eastburn – University of Illinois
- Loretta Ortiz-Ribbing – U. of Wisconsin
- Joel Gruver – Western Illinois University
- Steve Ayres – Aryes Farms
- Brad Hunt – Hunt Farms

# Cover Crops

- On-station – 10 x 40 foot plots
  - Cereal rye (cv. Rymin)
  - Mustard (cv. Pacific Gold)
  - Rapeseed (cv. Dwaf Essex)
  - Canola (cv. Sumner)
  - Winter fallow
- On-farm – 60 x 1000 foot plots
  - Cereal rye
  - Rapeseed
  - Winter fallow

# Rye

# Rye

# Soybeans in standing rye

# Rape and Canola

# Rape and Canola

# Mustard

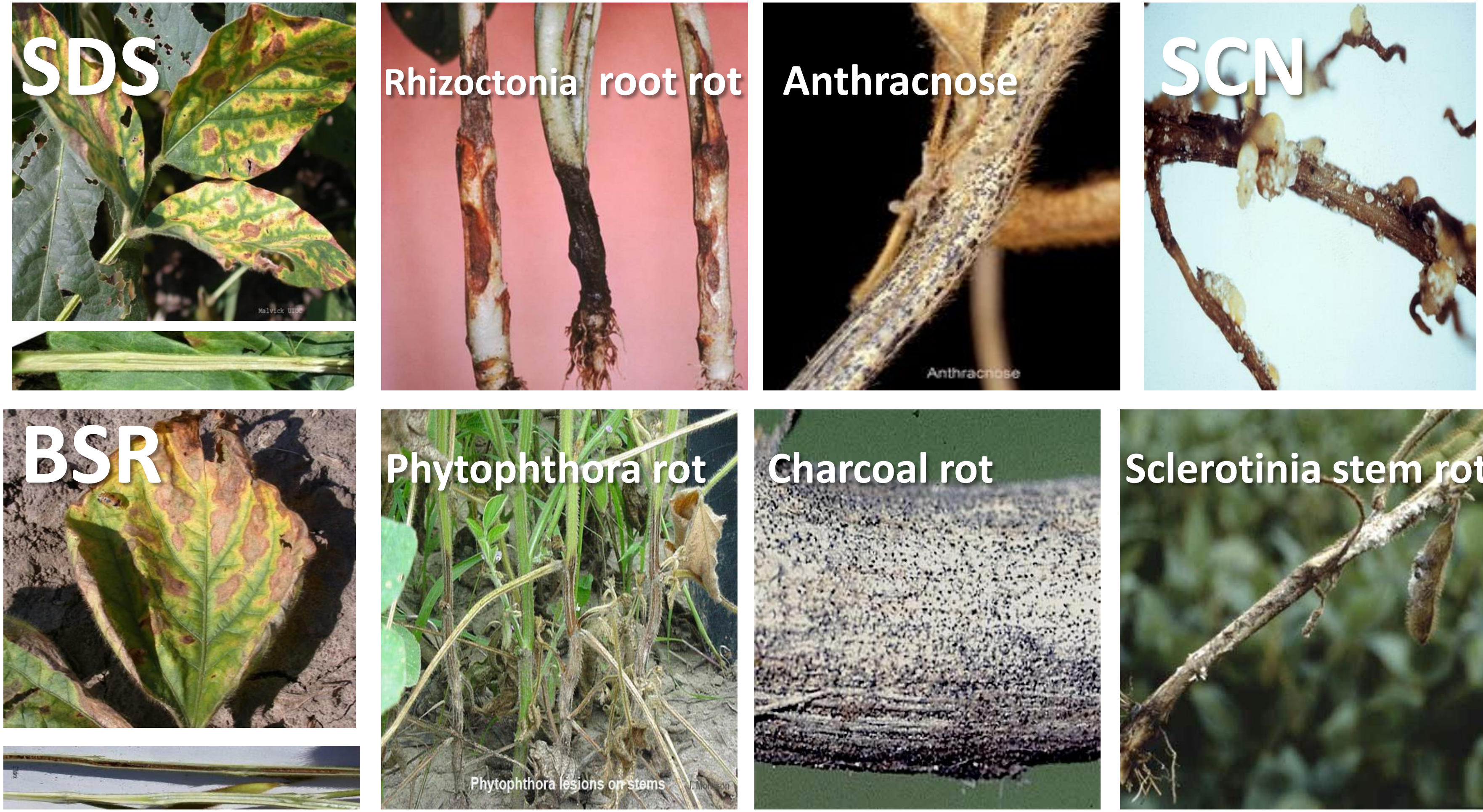
Spring 2011

Spring 2012

# 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

# Common soybean diseases caused by soilborne pathogens




-----D. Malvick University of Minnesota Jan 2012

-----Laboratory for Soybean Disease Research

# Diseases Rating

**Foliar diseases incidence:**

- Septoria brown spot
- Bacterial blight

**Root disease severity:**

- Sudden death syndrome
- Rhizoctonia root rot

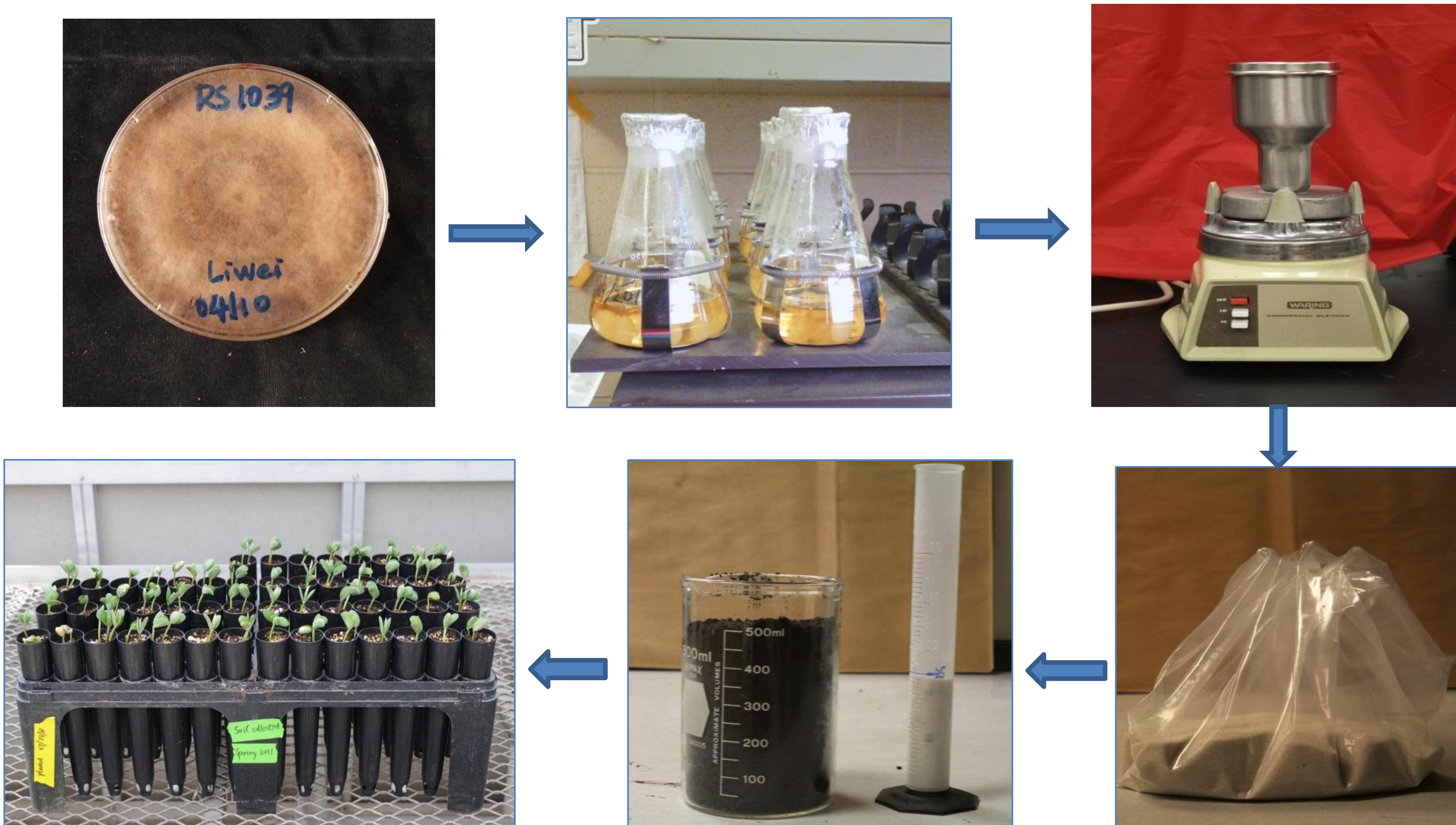
Courtesy Alison Robertson—© APS

# Greenhouse Bioassay

- **Cover crops**
  - soil collected from each cover crop plot
- **Soybean pathogens**
  - soils infested with *Rhizoctonia solani* (Rhizoctonia root rot) or *Fusarium virguliforme* (cause of SDS), or control
- **Measured resulting disease severity**

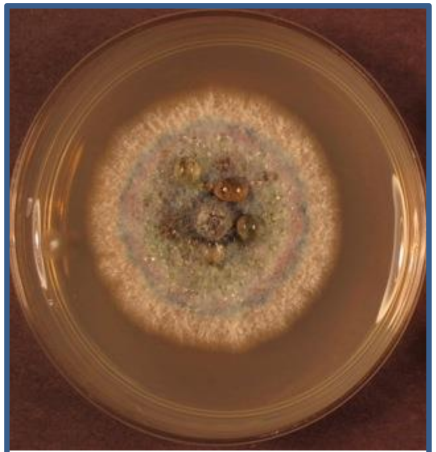
# Greenhouse bioassay

- Soil suppressiveness to *R. solani* was tested in greenhouse with 2011 spring and 2012 spring soil



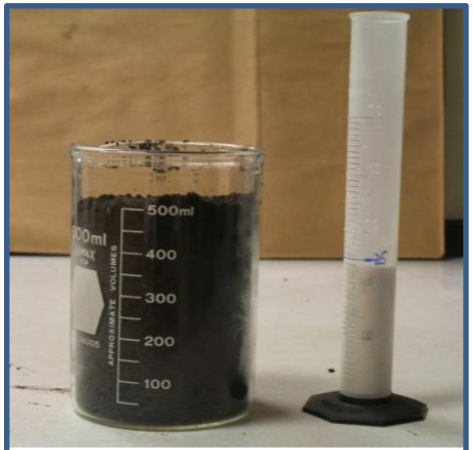
# Greenhouse bioassay

- Soil suppressiveness to *F. virguliforme* was tested in greenhouse with 2011 spring  and 2012 spring soil.



Fv was grown on PDA for 3 weeks


Fv plugs were transferred to cornmeal, grown for 3 weeks




10ml infested cornmeal was mixed with 500 soil

Soybean was planted with infested soil in conetainers

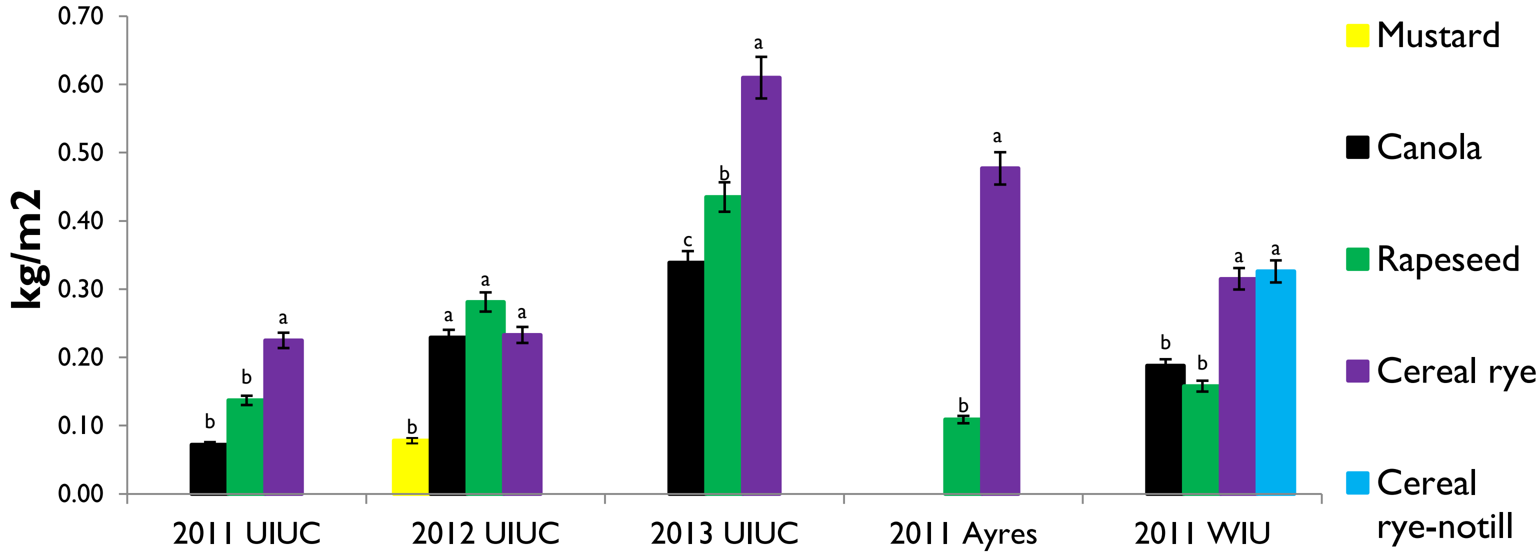
# Soil DNA Analysis

- Populations of various soybean pathogens

| | Disease | Pathogen |
|---|---|---|
| | Anthracnose | *Colletotrichum truncatum* |
| Suite 1 | Brown stem rot | *Phialophora gregata* |
| | Charcoal rot | *Macrophomina phaseolina* |
| Suite 2 | Soybean cyst nematode | *Heterodera glycines* |
| | Sudden death syndrome | *Fusarium virguliforme* |
| | Phytophthora root rot | *Phytophthora sojae* |

- General microbial community structure
    - Contribute to soil disease suppessiveness

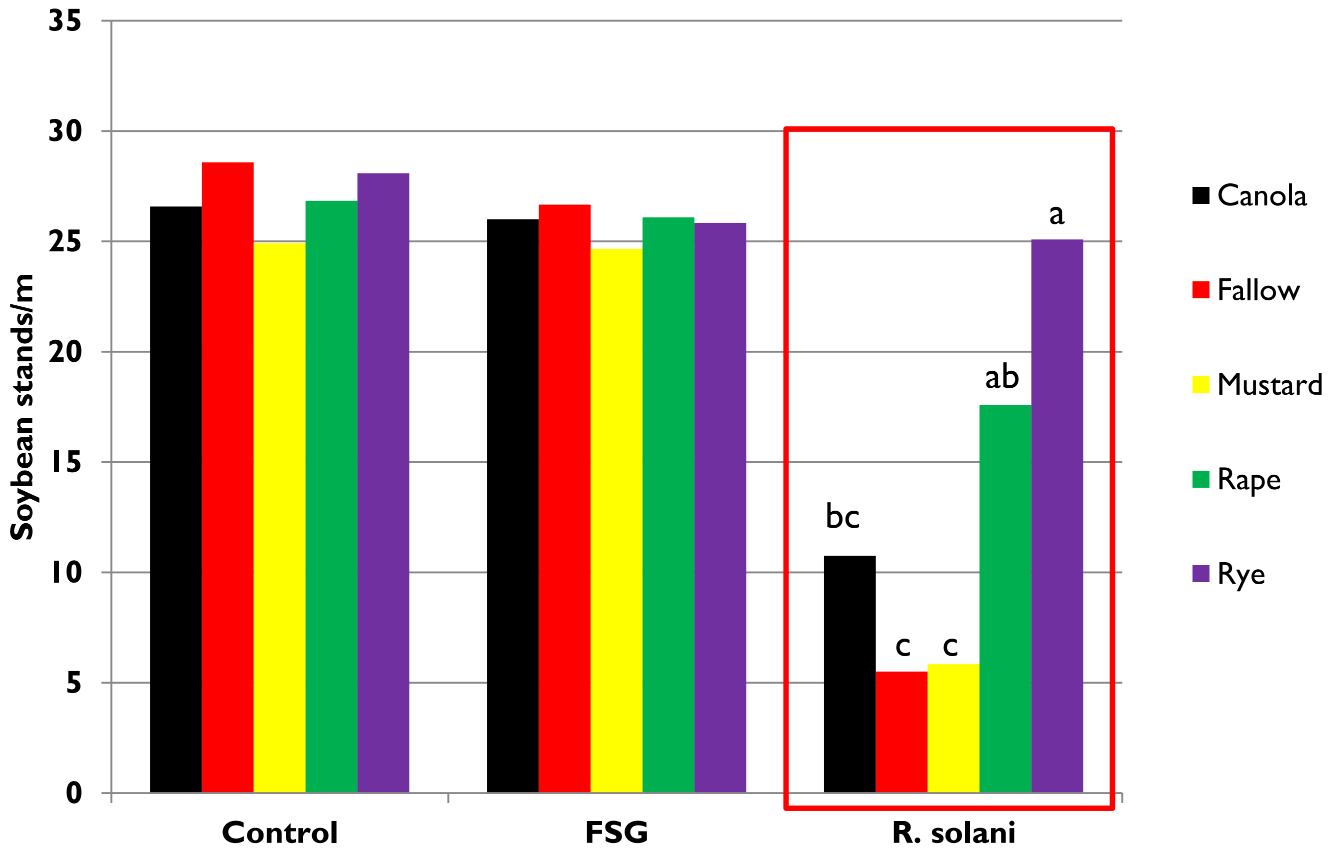
# Cover crop biomass



## Results: Stand Counts

- No significant difference over cover crop treatments at three locations (2011 and 2012)
- In *R. solani* infested plots (UIUC) counts were significantly greater in plots previously planted with rye and rape in 2011 and 2013, but no difference in 2012

# Soybean stand counts in different cover crop plots with diffferent pathogen inoculations, UIUC, 2011



# Soybean Stands
# Rhizoctonia inoculated plots, UIUC 2011

Fallow

Rape

Rye

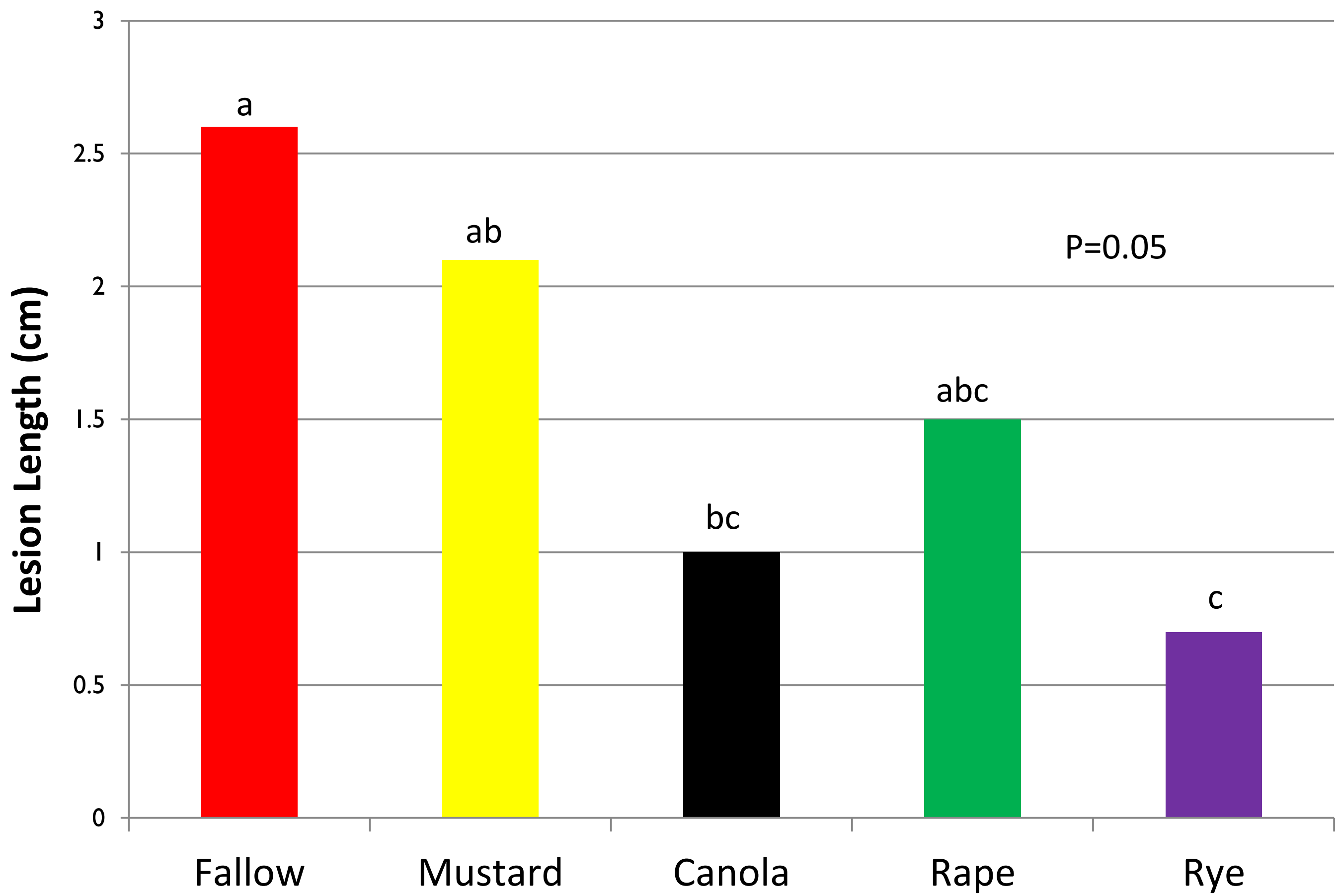
# Results: Cover Crops and Stand Counts

| Location | 2011 | 2012 | 2013 |
|---|---|---|---|
| Ayres Farm | ns | ns | ns |
| UIUC - Rhizoc | $P<0.0001$ | ns | $P<0.037$ |
| Hunt Farm | ns | ns | ns |
| WIU | ns | ns | $P<0.007$ |

| | % Stand Count | | |
|---|---|---|---|
| | UIUC – Rhizoctonia plots | | WIU |
| Cover Crop | 2011 | 2013 | 2013 |
| Fallow | 5.5 c | 71.2 c | 79.5 ab |
| Mustard | 5.8 c | 78.8 ab | 64.6 b |
| Canola | 41.5 bc | 77.6 ab | 81.0 ab |
| Rape | 67.7 ab | 72.8 bc | 98.8 a |
| Rye | 96.2 a | 79.8 a | 94.2 a |

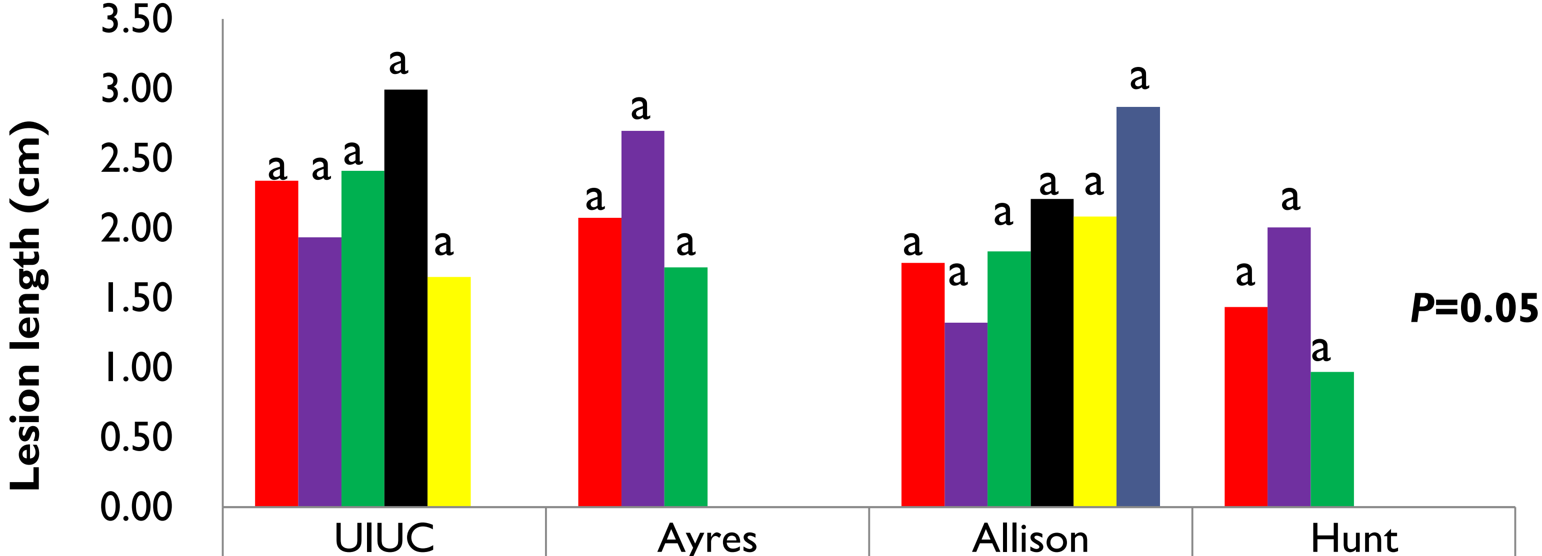
# Disease Rating - Rhizoctonia

# Rhizoctonia root rot, UIUC 2012



# Greenhouse suppressive soil assay

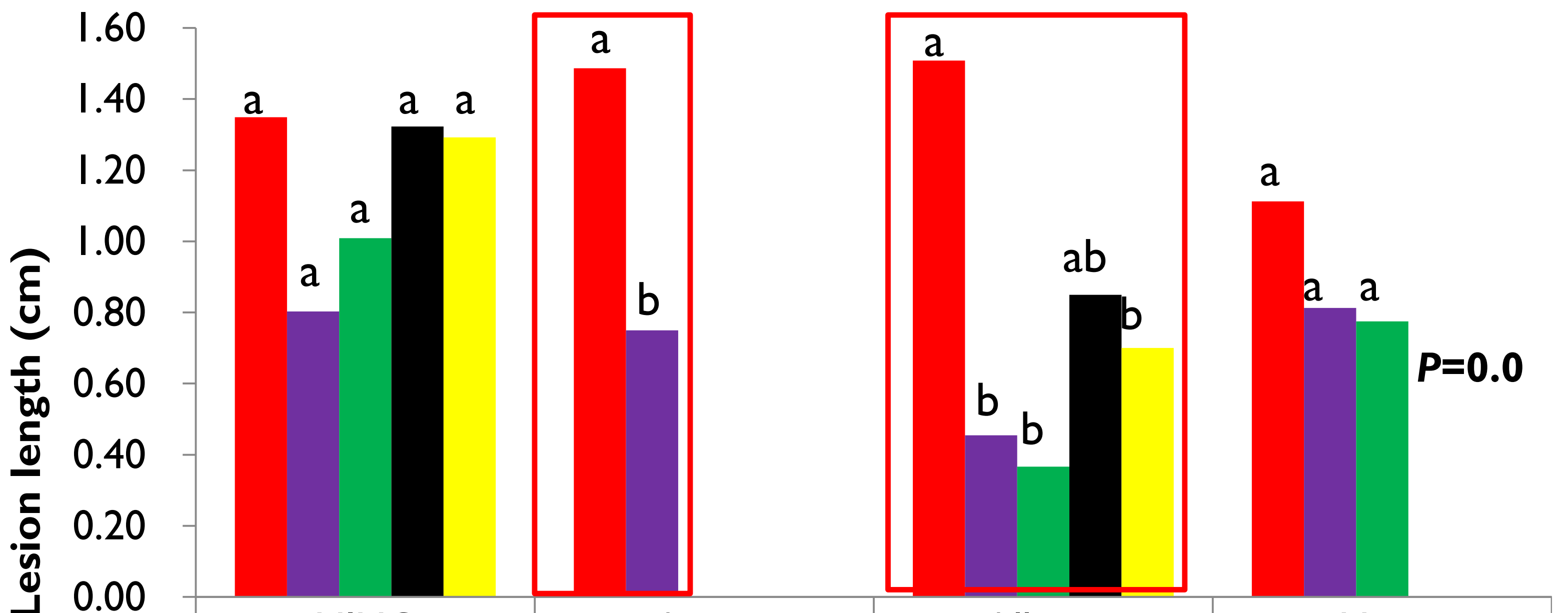
## *R. solani*, 2011 soils




| | UIUC | Ayres | Allison | Hunt |
|---|---|---|---|---|
| Fallow | 2.34 | 2.08 | 1.75 | 1.43 |
| Rye | 1.93 | 2.70 | 1.32 | 2.00 |
| Rape | 2.41 | 1.72 | 1.83 | 0.97 |
| Canola | 2.99 | | 2.21 | |
| Mustard | 1.65 | | 2.08 | |
| Rye-notill | | | 2.87 | |

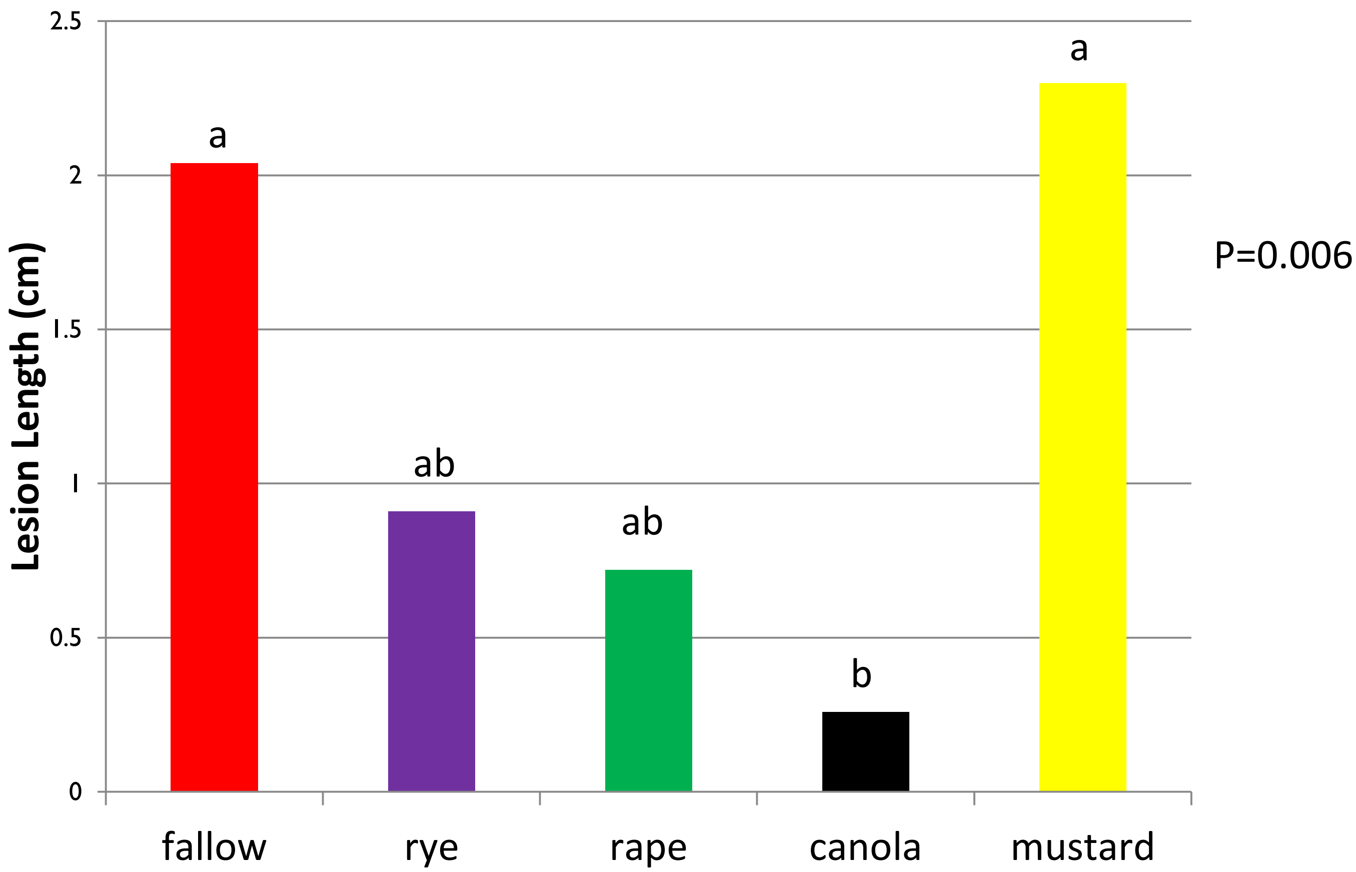
# Greenhouse suppressive soil assay

## *R. solani*, 2012 soils



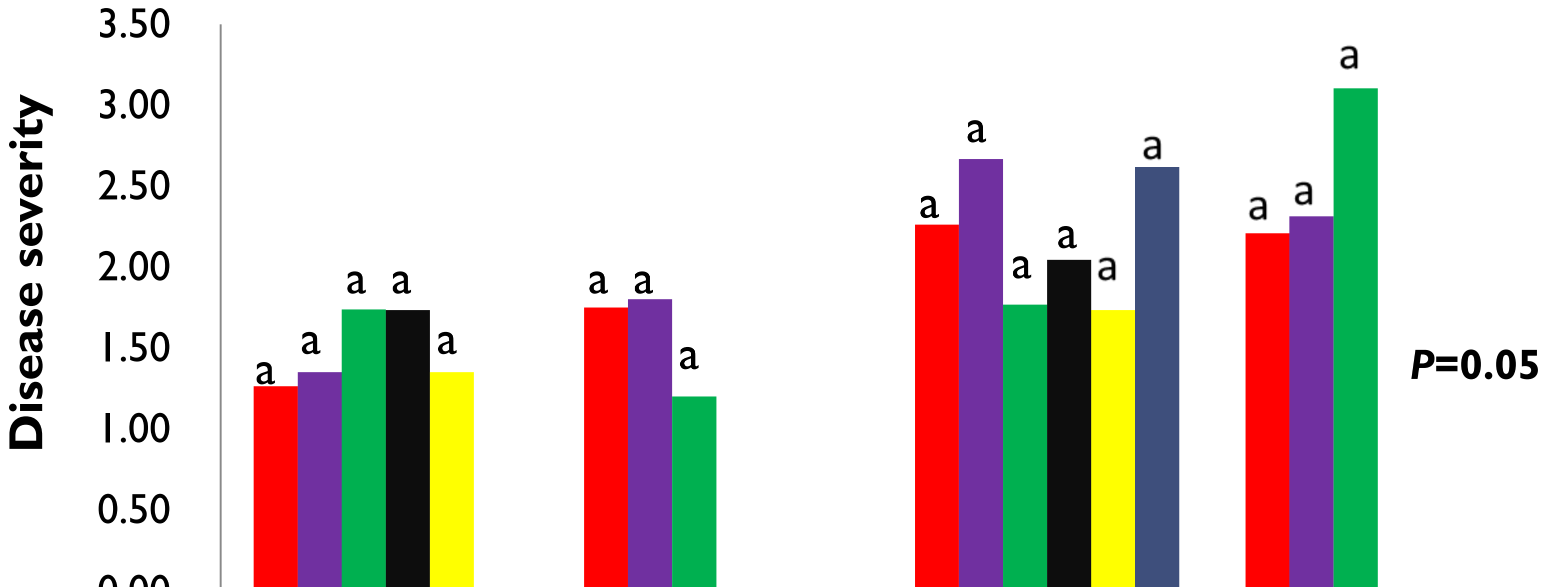

| | UIUC | Ayres | Allison | Hunt |
|---|---|---|---|---|
| fallow | 1.35 | 1.49 | 1.51 | 1.11 |
| rye | 0.80 | 0.75 | 0.46 | 0.81 |
| rape | 1.01 | | 0.37 | 0.78 |
| canola | 1.32 | | 0.85 | |
| mustard | 1.29 | | 0.70 | |

# Greenhouse suppressive soil assay
## *R. solani*, 2013 UIUC soils



# Greenhouse suppressive soil assay

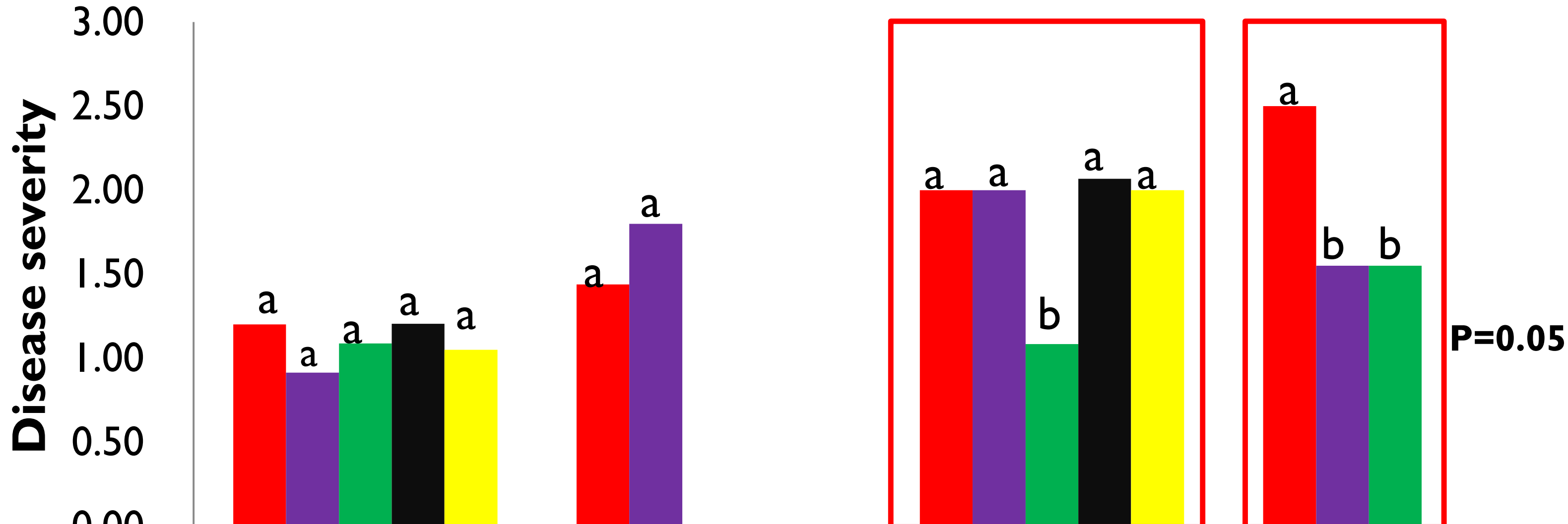
## *F. virguliforme* (SDS), 2011 soils




| | UIUC | Ayres | Allison | Hunt |
|---|---|---|---|---|
| Fallow | 1.26 | 1.75 | 2.26 | 2.21 |
| Rye | 1.35 | 1.80 | 2.67 | 2.31 |
| Rape | 1.74 | 1.20 | 1.77 | 3.10 |
| Canola | 1.73 | | 2.04 | |
| Mustard | 1.35 | | 1.73 | |
| Rye-notill | | | 2.62 | |

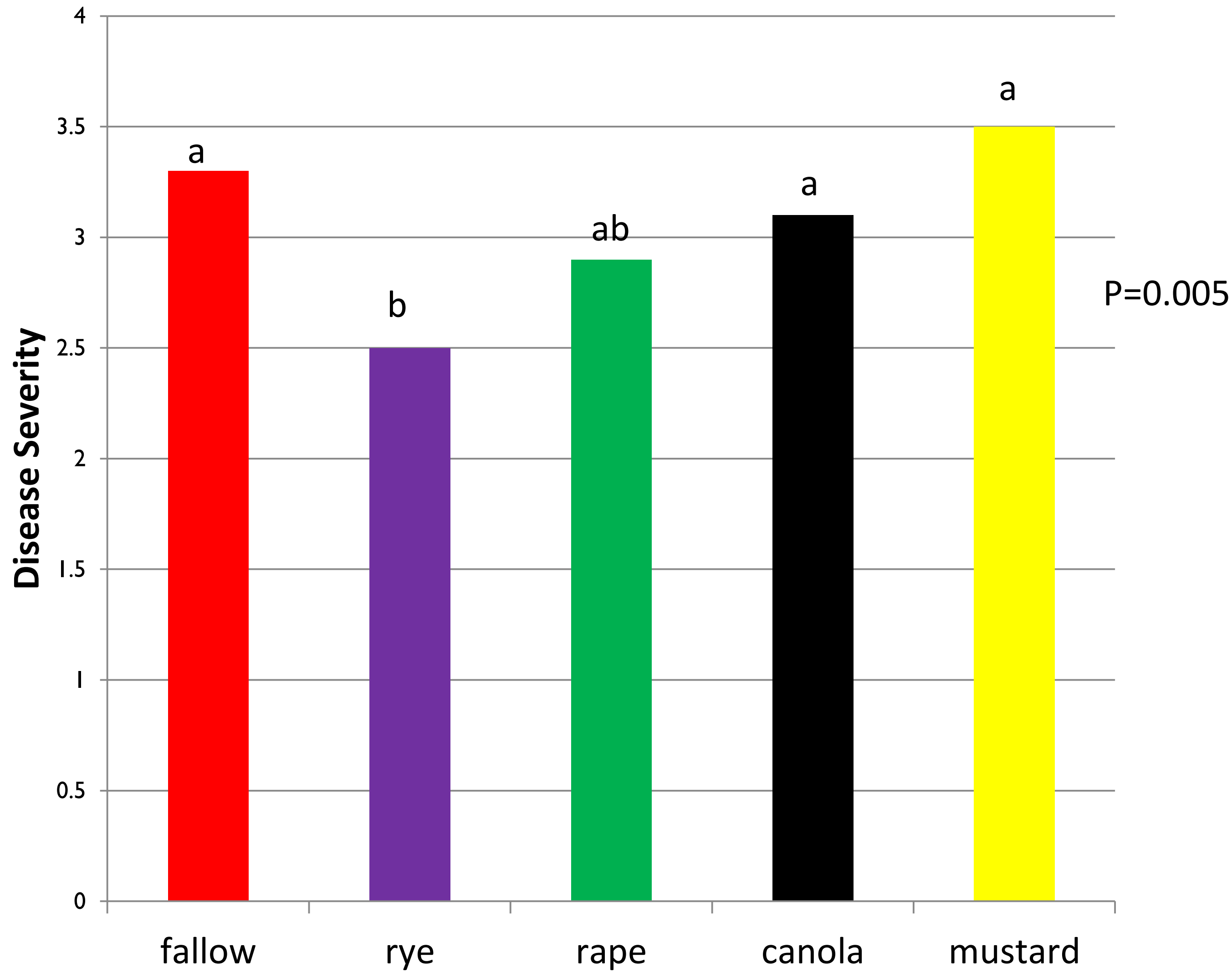
# Greenhouse suppressive soil assay

## *F. virguliforme* (SDS), 2012 soils

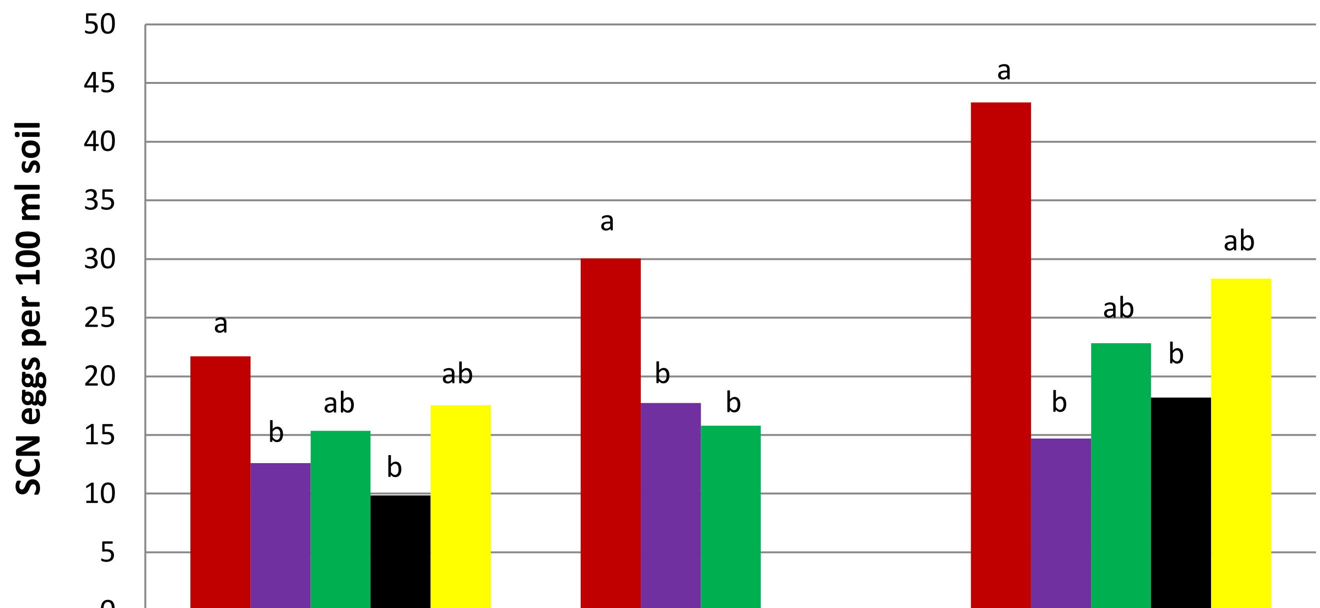



| | UIUC | Ayre | Allison | Hunt |
|---|---|---|---|---|
| Fallow | 1.20 | 1.44 | 2.00 | 2.50 |
| Rye | 0.91 | 1.80 | 2.00 | 1.55 |
| Rape | 1.09 | | 1.08 | 1.55 |
| Canola | 1.20 | | 2.07 | |
| Mustard | 1.05 | | 2.00 | |

# Greenhouse suppressive soil assay
## *F. virguliforme* (SDS), 2013 WIU soils

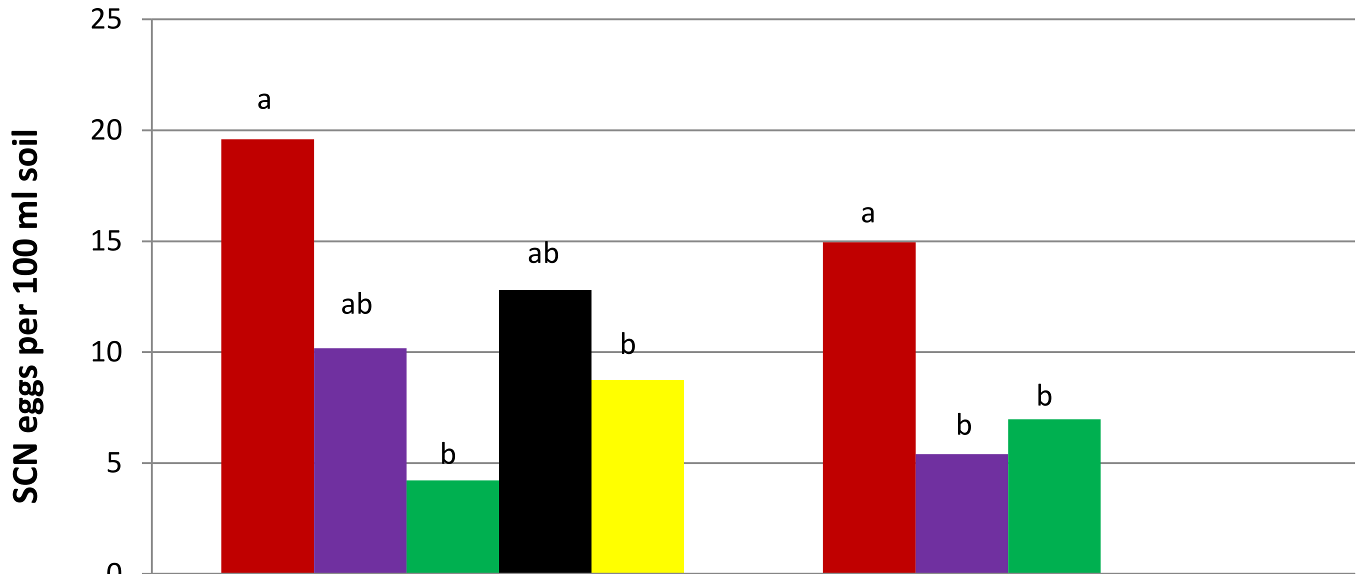


# Soybean Cyst Nematode
## 2011 soil samples



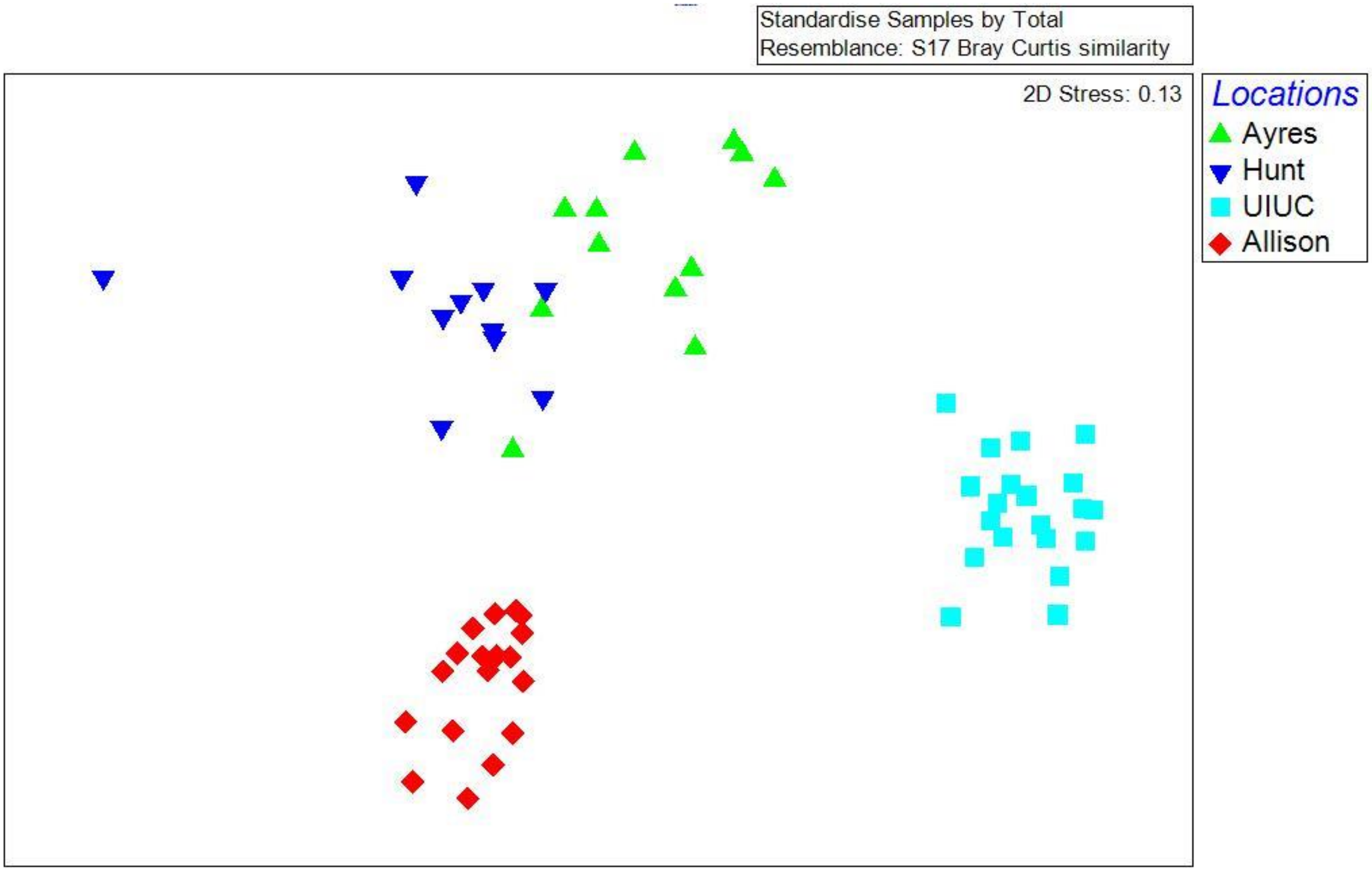

| | UIUC | Ayres | Allison |
|---|---|---|---|
| Fallow | 21.7 | 30.04 | 43.34 |
| Rye | 12.61 | 17.72 | 14.69 |
| Rape | 15.35 | 15.79 | 22.82 |
| Canola | 9.86 | | 18.18 |
| Mustard | 17.53 | | 28.32 |

# Soybean Cyst Nematode
## 2012 soil samples

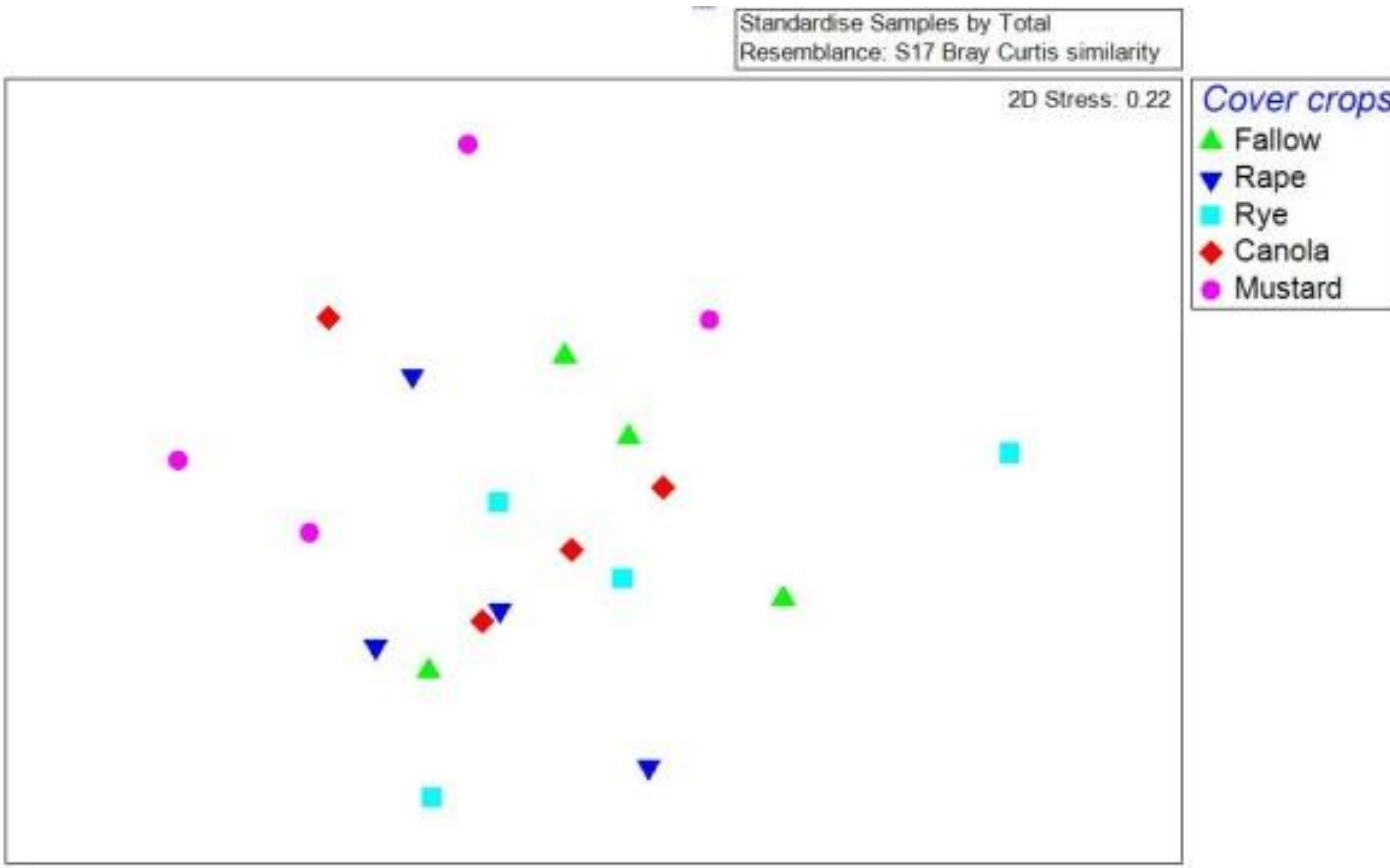



| | Allison | Hunt |
|---|---|---|
| Fallow | 19.59 | 14.95 |
| Rye | 10.18 | 5.4 |
| Rape | 4.22 | 6.98 |
| Canola | 12.78 | |
| Mustard | 8.74 | |

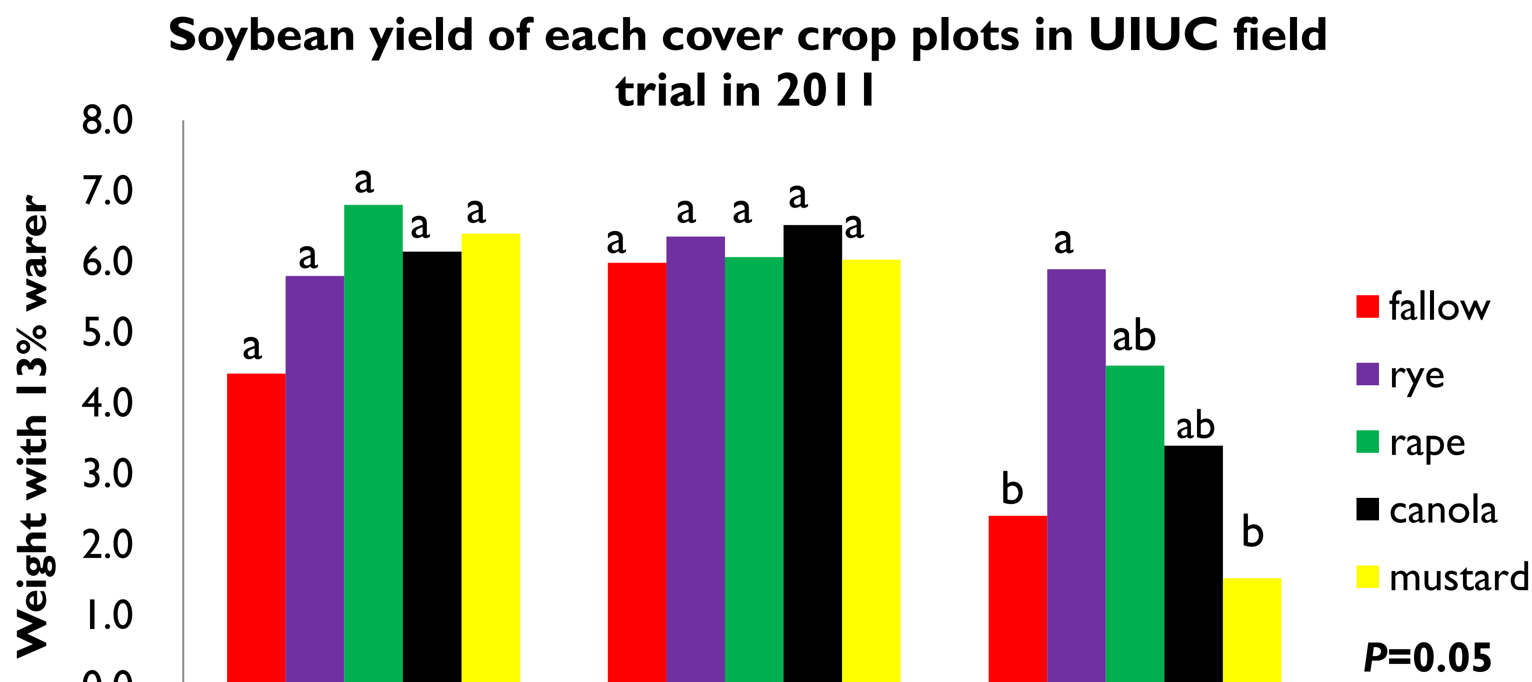
# ARISA Community Analysis



# ARISA Community Analysis



# Yield, UIUC 2011




| | Control | Fsg | R.solani |
|---|---|---|---|
| fallow | 4.4 | 6.0 | 2.4 |
| rye | 5.8 | 6.4 | 5.9 |
| rape | 6.8 | 6.1 | 4.5 |
| canola | 6.1 | 6.5 | 3.4 |
| mustard | 6.4 | 6.0 | 1.5 |

# Conclusions

- 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 root rot and sudden death syndrome.
- Rye, rape, and canola can significantly decrease soybean cyst nematode egg counts.
- Other pathogen populations were not significantly affected by cover crops.
- Cover crops did not result in significant differences in microbial community structure.