

# Charcoal Rot Disease Development in Soybean

2013 Soybean Breeders Meeting

John Rupe

University of Arkansas



**DIVISION OF AGRICULTURE**  
**RESEARCH & EXTENSION**

*University of Arkansas System*

# What is Charcoal Rot?

- Soil borne fungus, *Macrophomina phaseolina*
- Infects roots, stems and seed
- Associated with drought stress
- Premature death of plant
  - Usually during reproductive development
  - Can be earlier
- Wide host range
  - Infects over 284 species
  - Dicots and monocots
  - Annuals and perennials

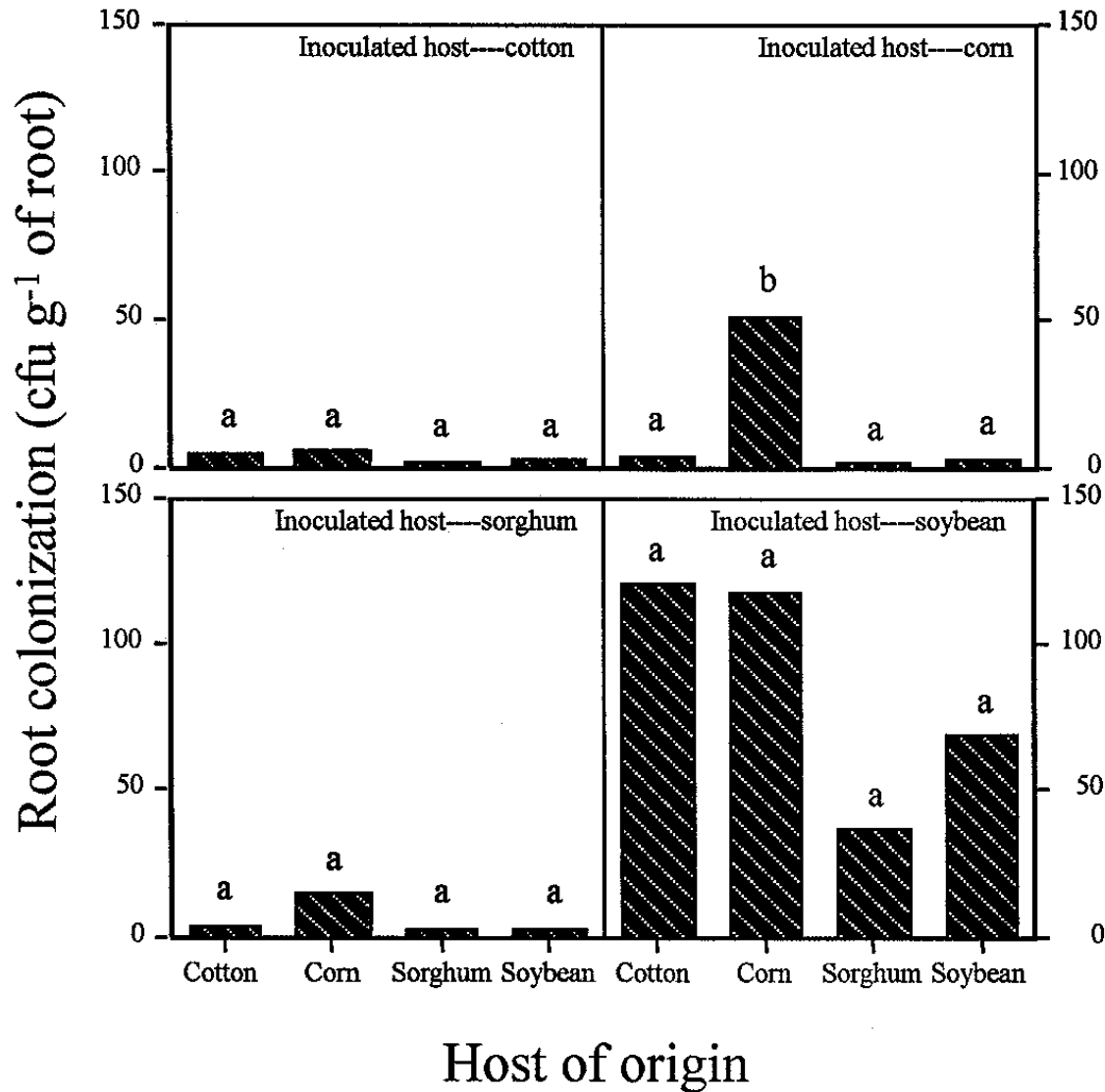


# *Macrophomina phaseolina*

- Asexual
  - Microsclerotia
  - Pycnidia
- Limited work on diversity
  - Chlorate sensitivity-Pearson *et al.* 1986
    - Sensitive-soybean and soil
    - Insensitive-corn and sorghum
  - Some host preference
    - Soybean better host than corn or sorghum
    - Pearson *et al.* 1987, Cloud and Rupe 1991



# Isolate Specificity

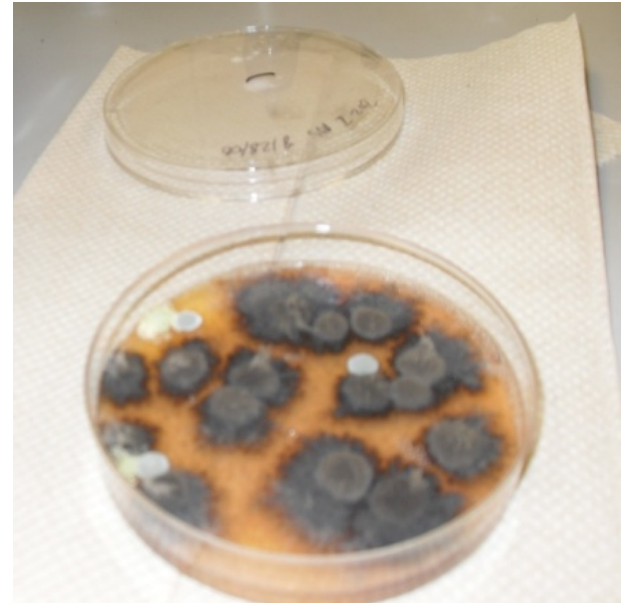


# Molecular Diversity

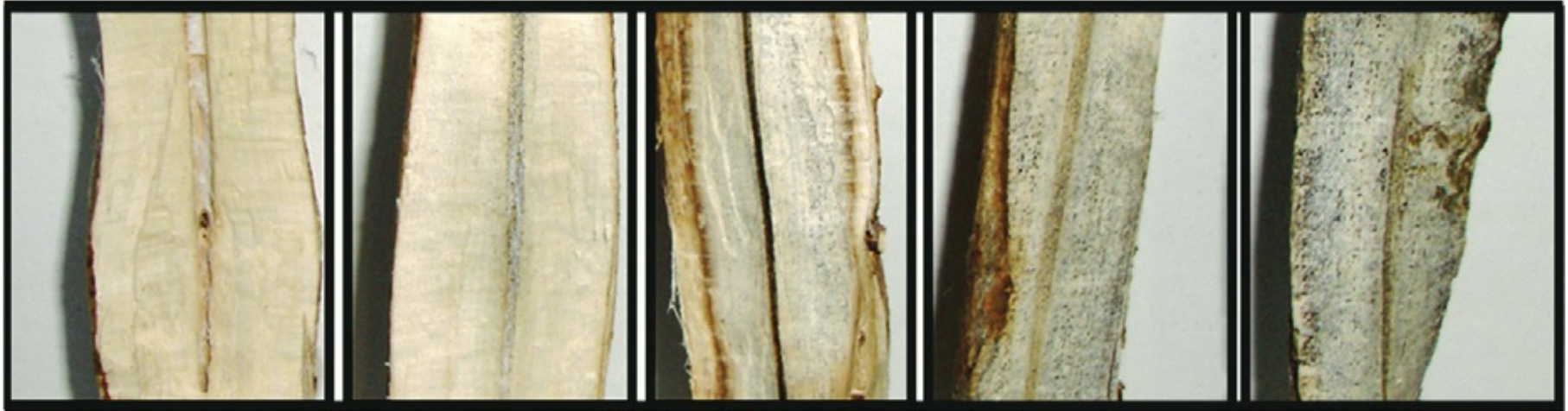
- Arias, et al. 2011
  - 24 isolates from seven plant species
  - 120 SSR's polymorphic
  - Soybean isolates mostly in one clade
- Babu, et al. 2010
  - 50 isolates from different regions and hosts
  - RAPD marker OPB-08 most polymorphic
  - Geographical separations
- Genome sequence-Islam *et al.* 2012

# Disease Assessment

- Colony forming units (cfu/g)
  - Plating
    - Roots or soil
    - Air dried
    - Ground-Wiley mill
    - Plated on selective medium
    - Incubated at 30°C
    - Determine CFU's
  - Densities
    - Plants 0 to 60,000 cfu/g
    - Soil 0 to 10,000 cfu/g



# Root and Stem Rating



- 1 = no microsclerotia visible
- 2 = very few microsclerotia visible
- 3 = vascular tissue is partly discolored and microsclerotia have partially covered the tissue;
- 4 = vascular tissue is discolored with numerous microsclerotia embedded in the tissue, microsclerotia are also visible under the outside epidermis in stem and root sections
- 5 = vascular tissue darkened due to high numbers of microsclerotia both inside and outside of the stem and root tissues.”

# Cut Stem Technique

- V-2 plants cut 2.5 cm above unifoliate node
- 10 to 200  $\mu$ l pipette tip with inoculum
- Incubate at 28°C
- Measure lesion every three days for 15 days
- Good correlations with field tests





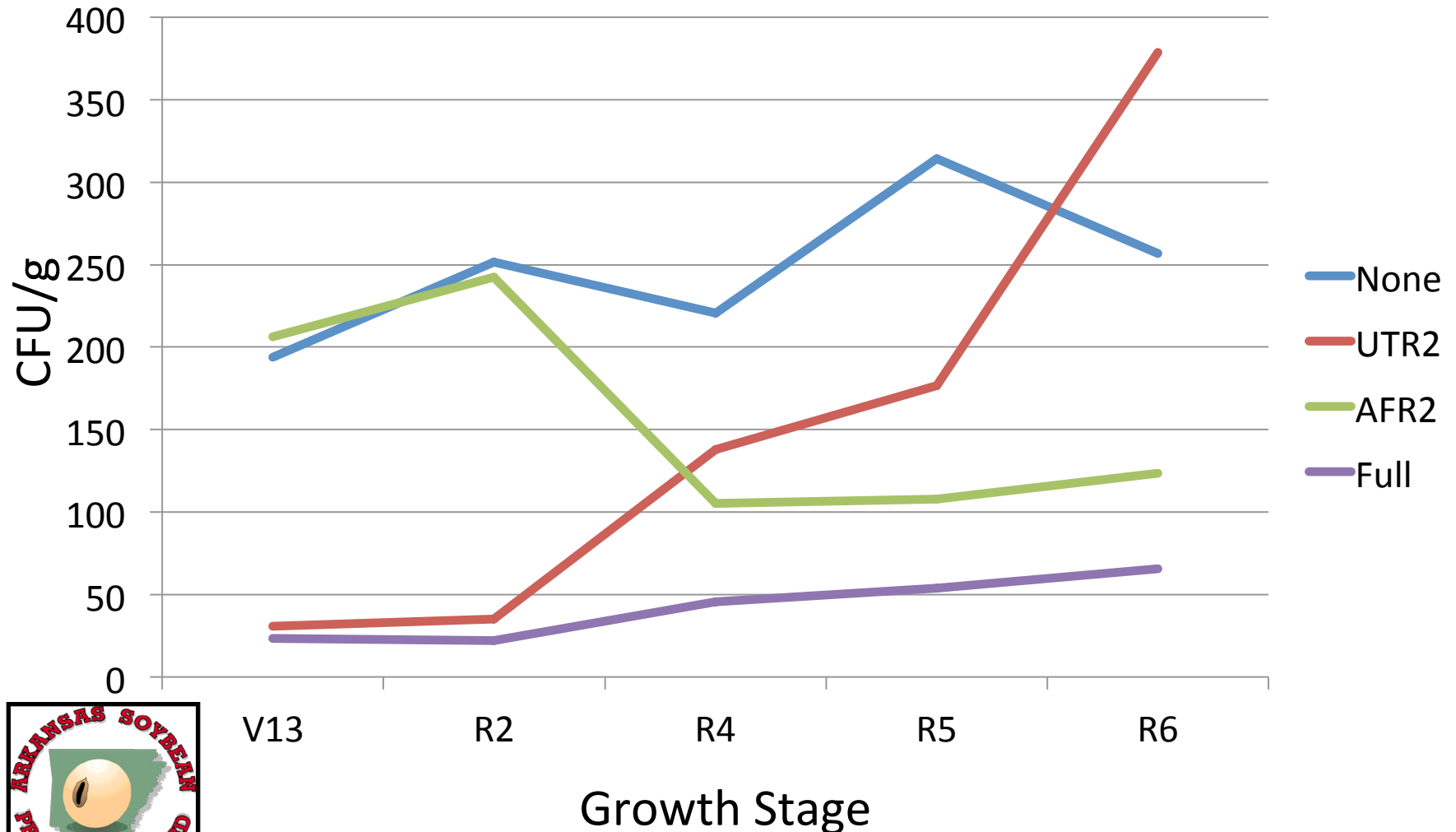


# Toxin Assay

- In development
- Fahkoury, at SIU
- Toxin: Phaseolinone
- Tests for one possible resistance mechanism
- Inconsistent

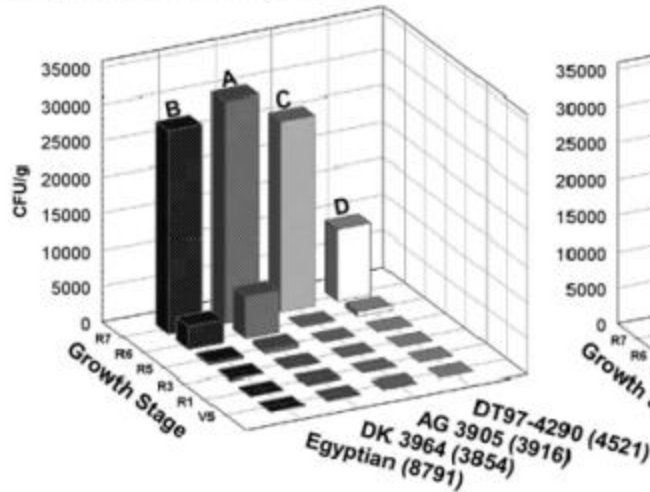


# Irrigation and Charcoal Rot: Davis

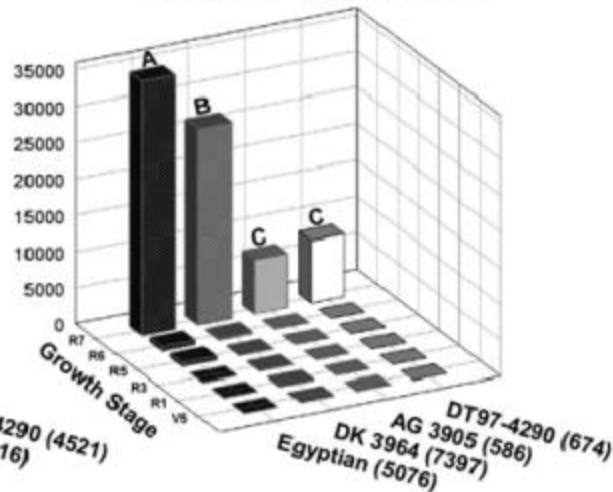


# Irrigation and Infestation

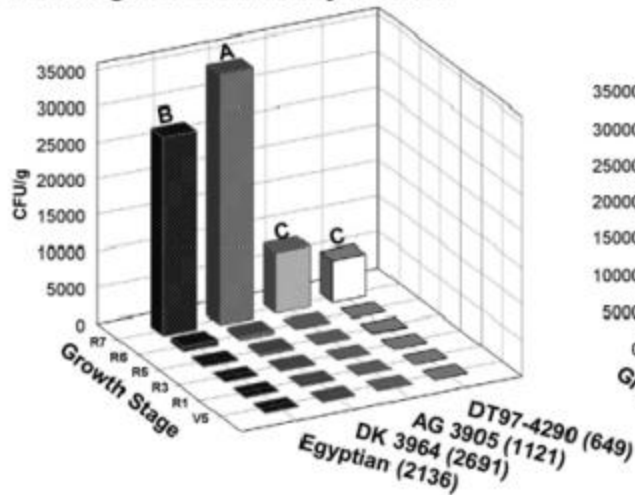
**A- Irrigated & artificially infested**



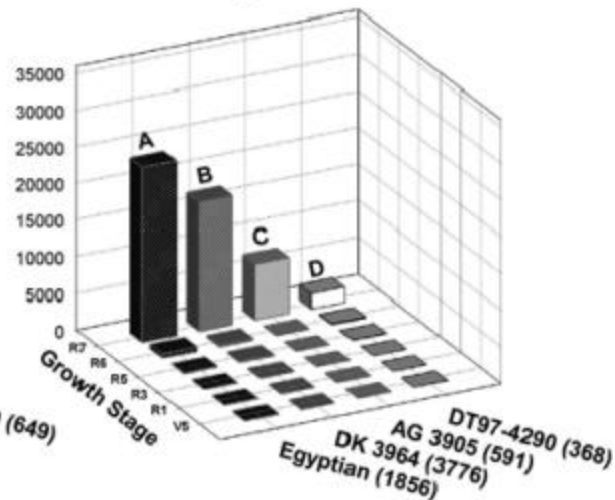
**B- Irrigated & non-infested**



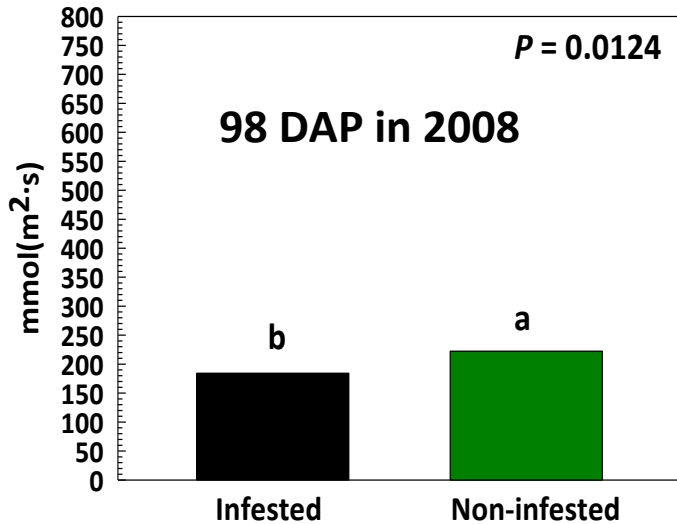
**C- Non-irrigated & artificially infested**



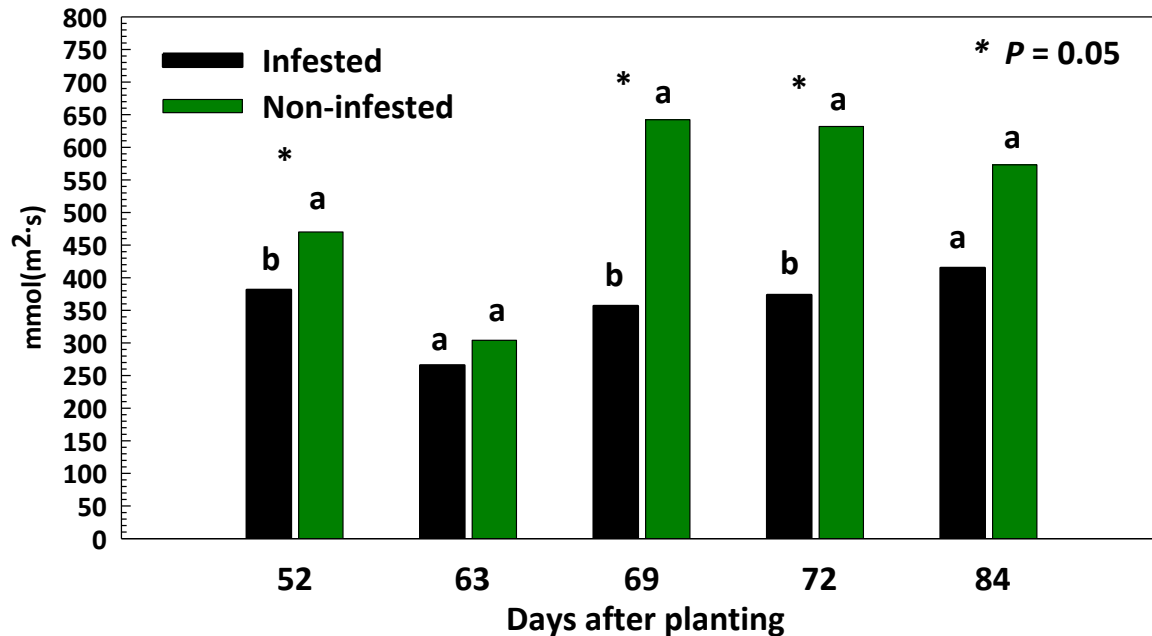
**D- Non-irrigated & non-infested**



# Stomatal Conductance for Infested vs. Non-infested plants in 2008 and 2009

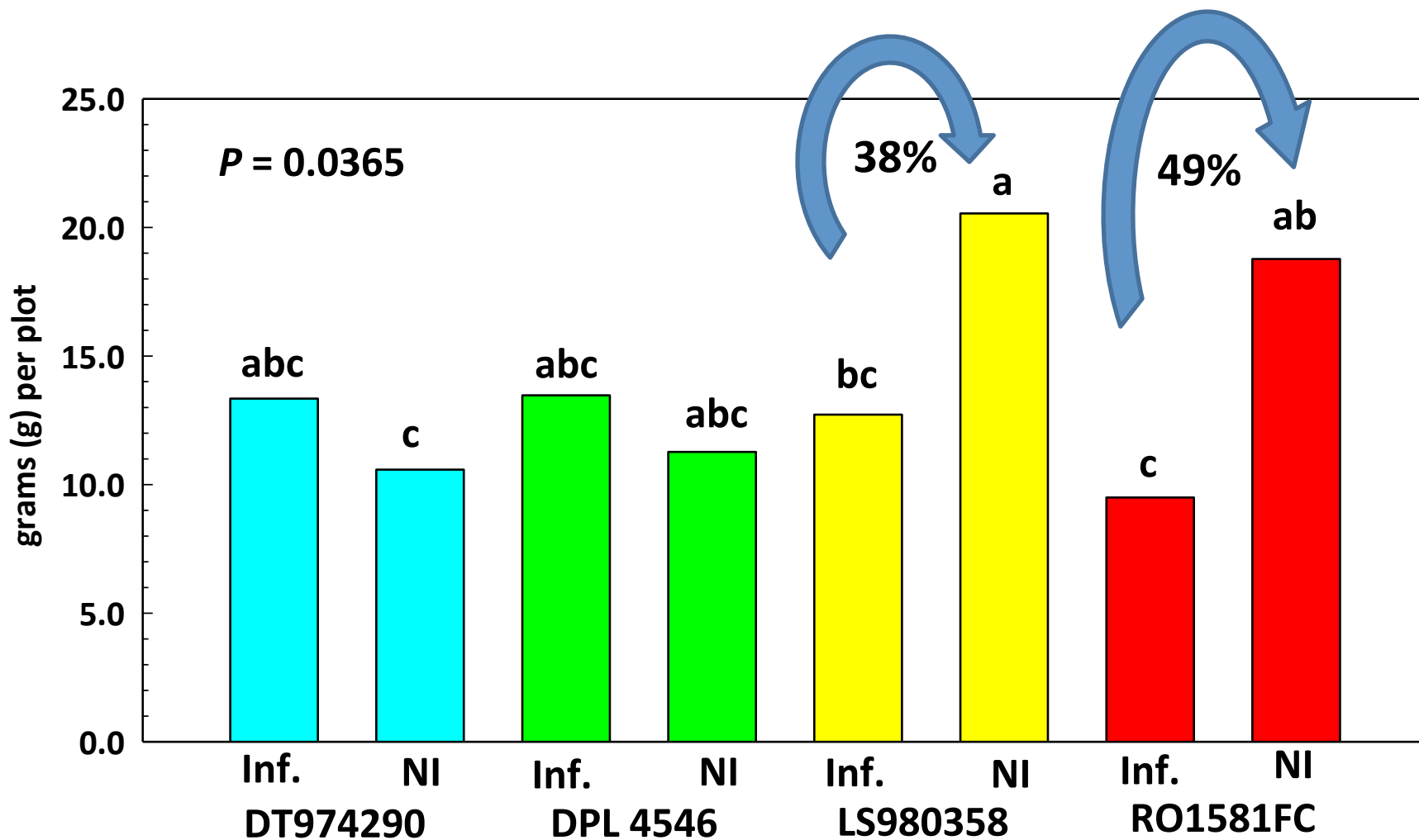


2009

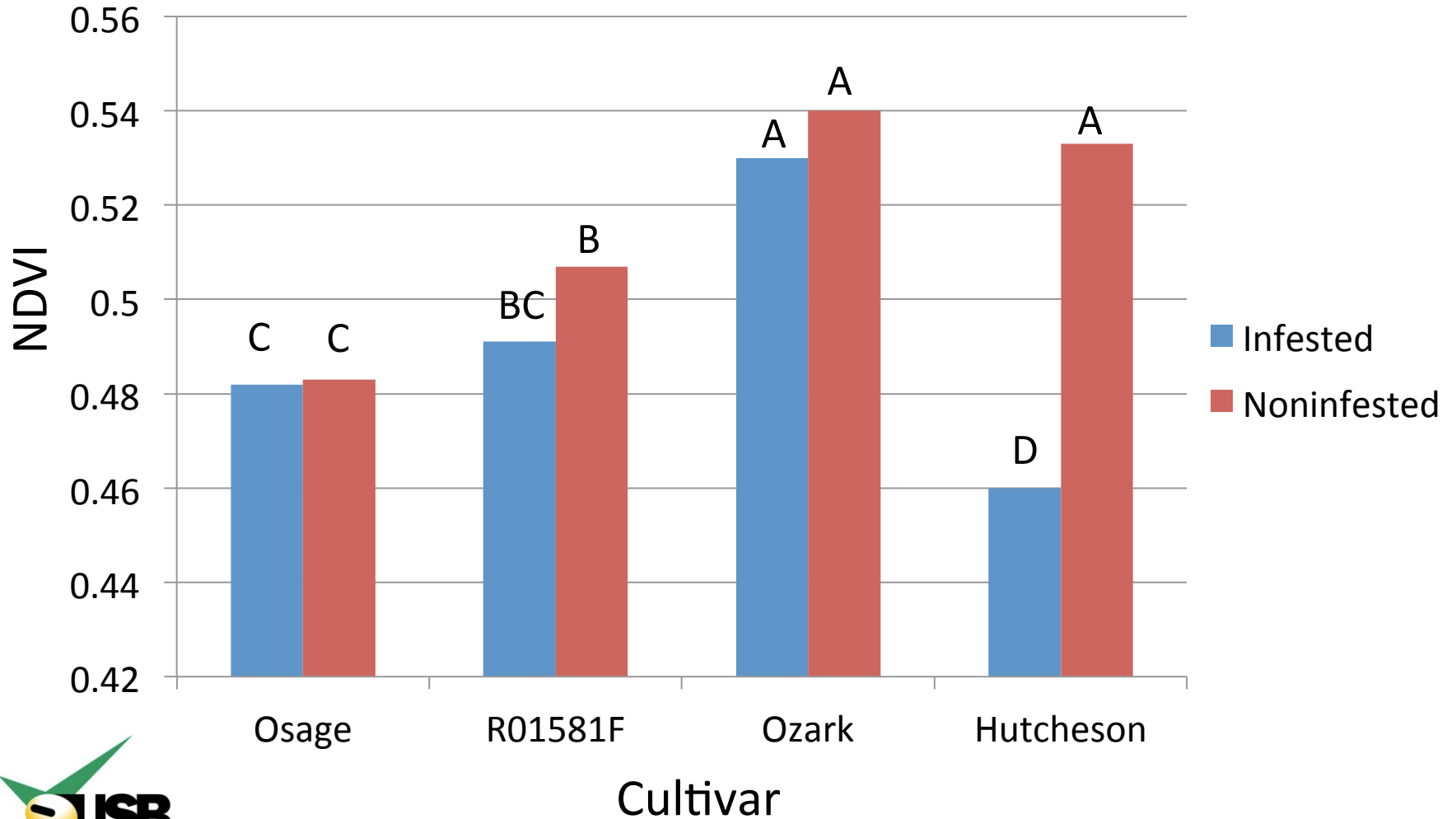




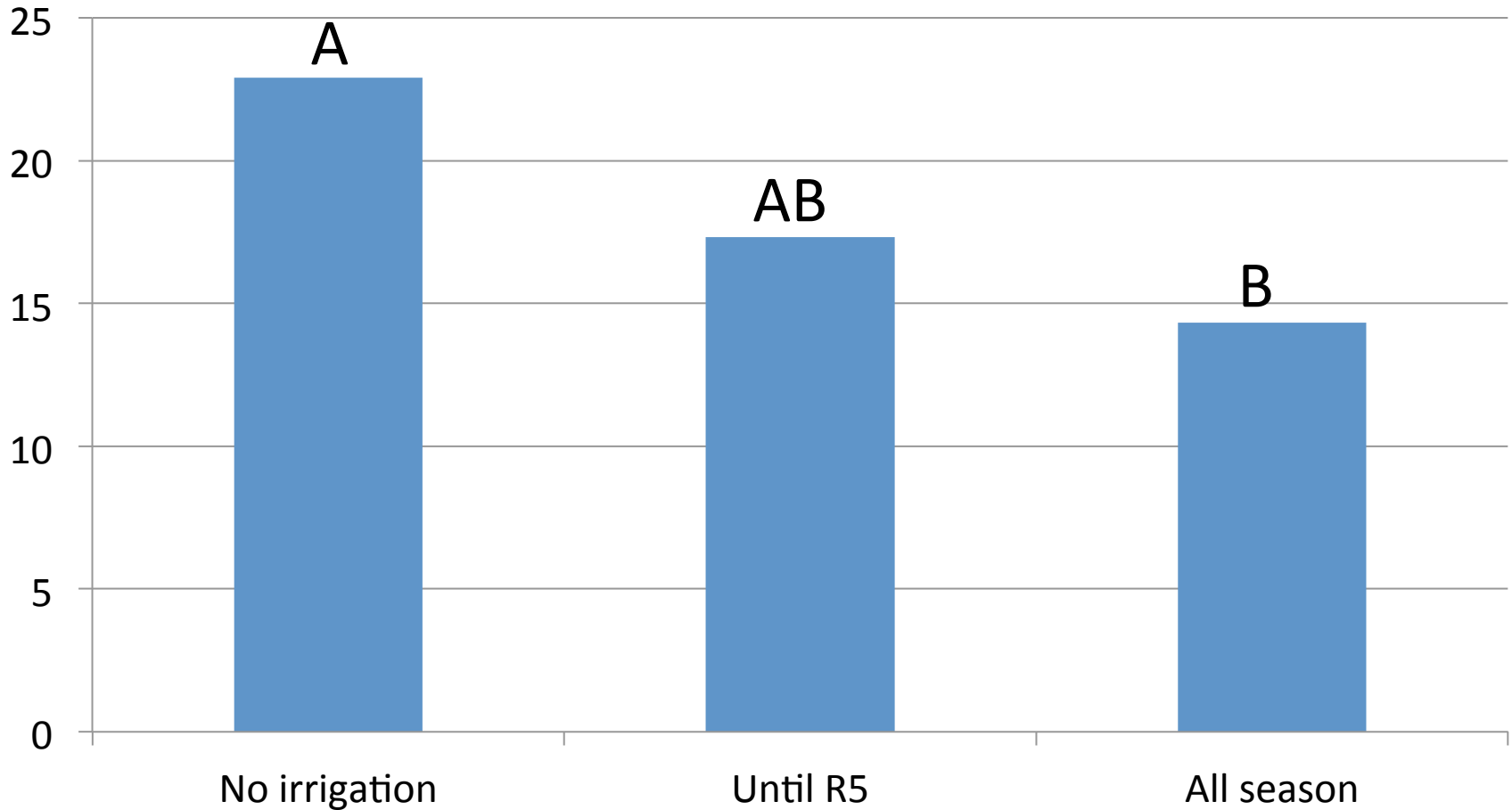
# Yield 2009 cont.



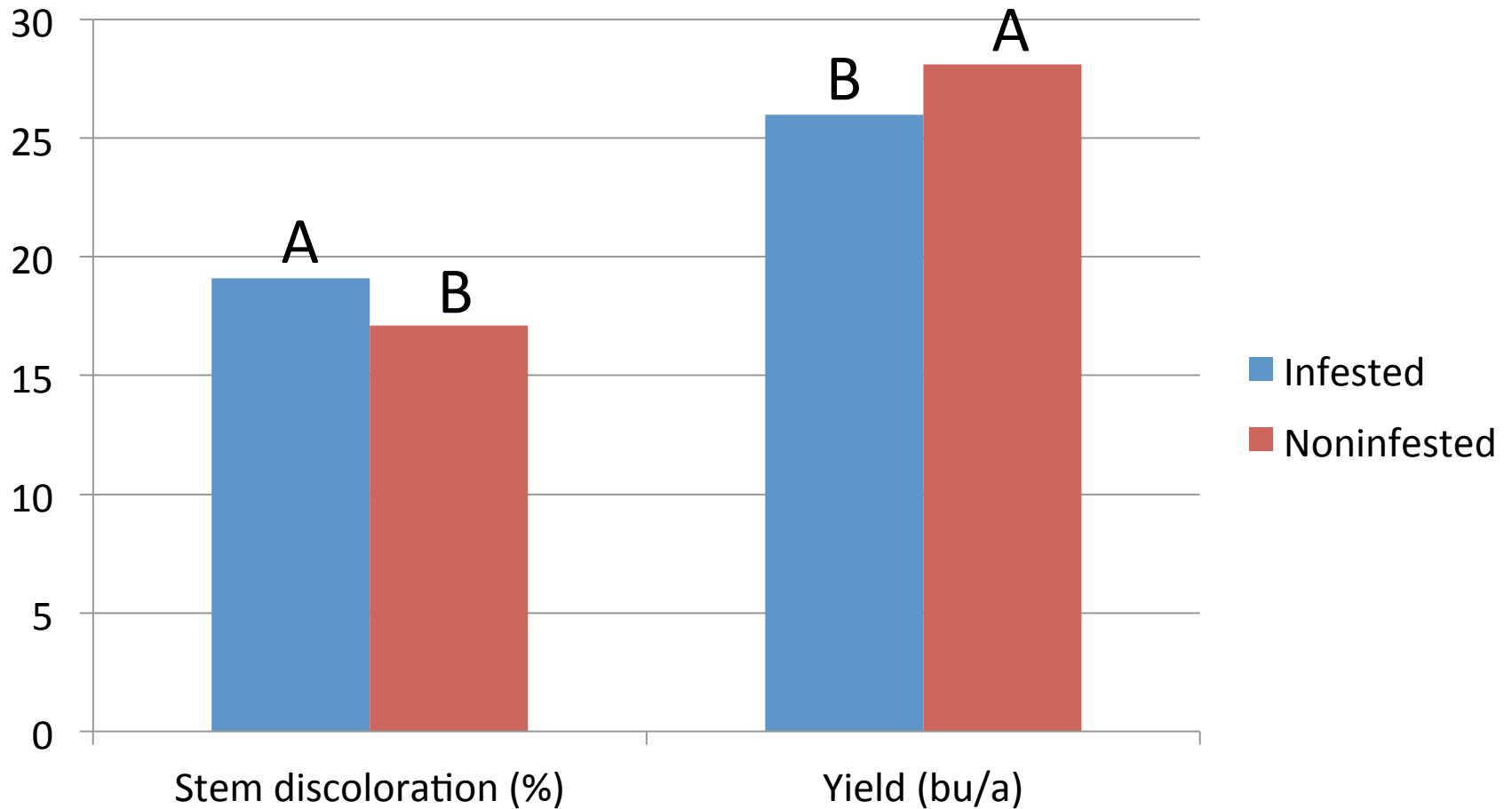
# NDVI R3: 2011



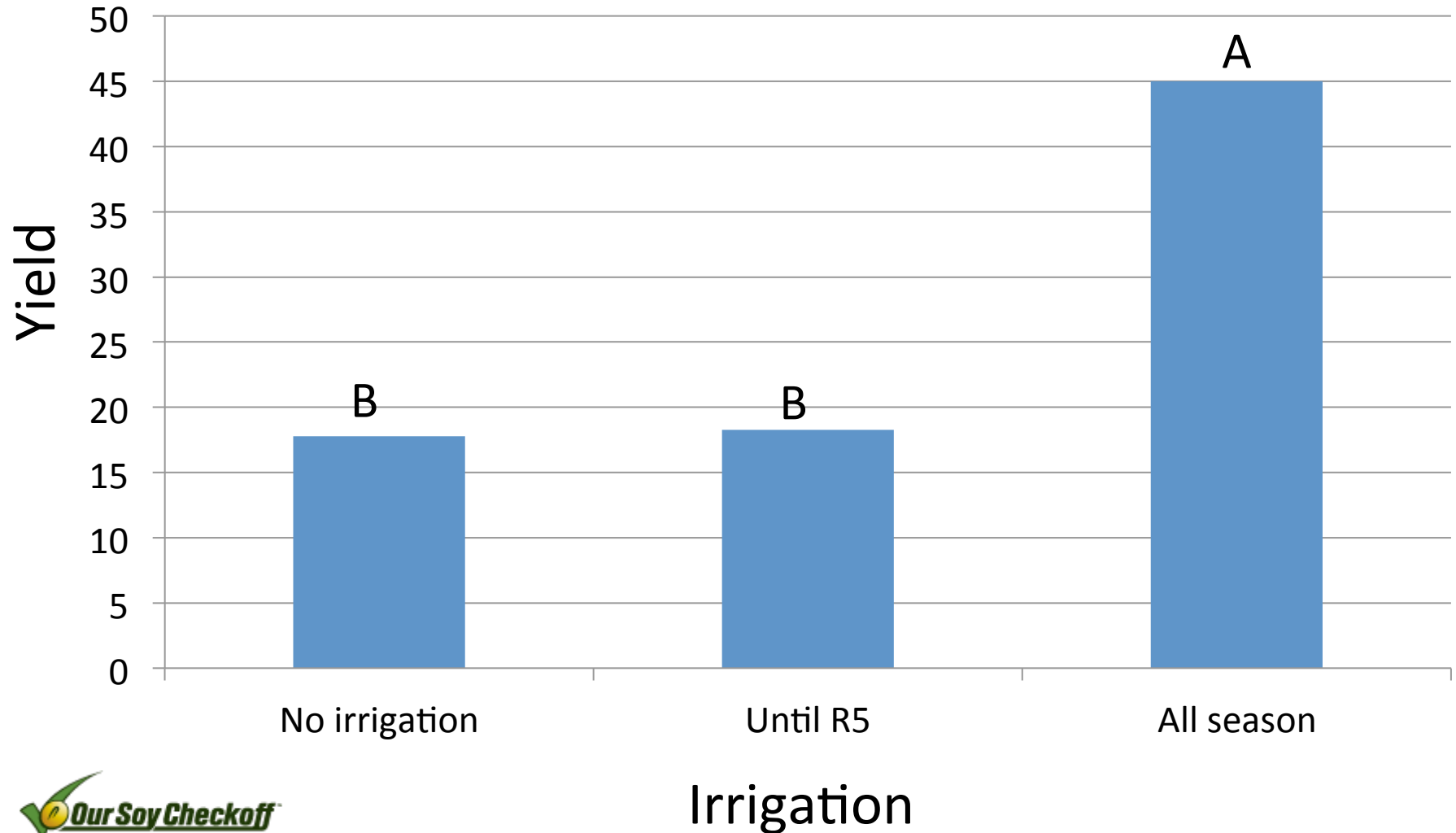
# Stem Discoloration (%): 2011



# Stem Discoloration and Yield: 2011



# Yield (bu/a): 2011





# Conclusions

- Plants affected all season
- Stress may not be necessary
- Yield losses may be affected by cultivar
- Added inoculum increases disease