

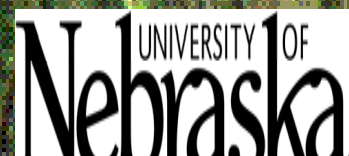


# Biological Control of Scab: How Close Are We to Reality?

Gary Y. Yuen

Department of Plant Pathology

University of Nebraska



# Biocontrol Researchers & Agents

Researcher	Organism	Mechanism
J. Bergstrom Cornell Univ.	<i>Bacillus</i> TrigoCor1448	iturin, surfactins
J. Bleakley, S. Dakota St.U.	<i>Bacillus</i> 1BA	iturin, surfactins
J. Schisler, NCAUR	<i>Cryptococcus</i> OH182.9	niche competition
J. Yuen, U. Nebraska	<i>Lysobacter</i> C3	induced resistance dihydromaltophilin

# Lab to Field Research

Isolation  
Propagation  
Formulation



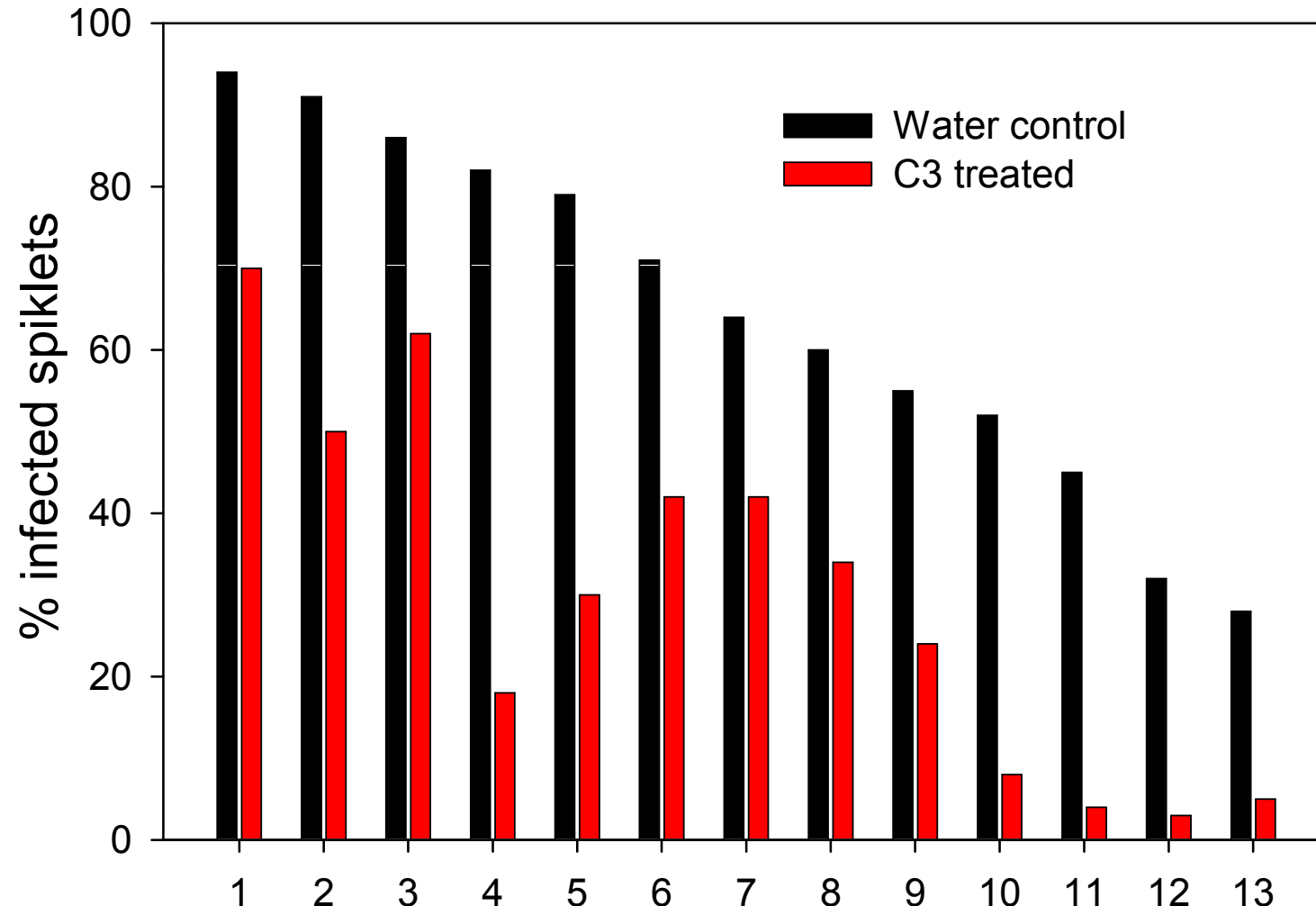
Efficacy  
Dosage  
Timing



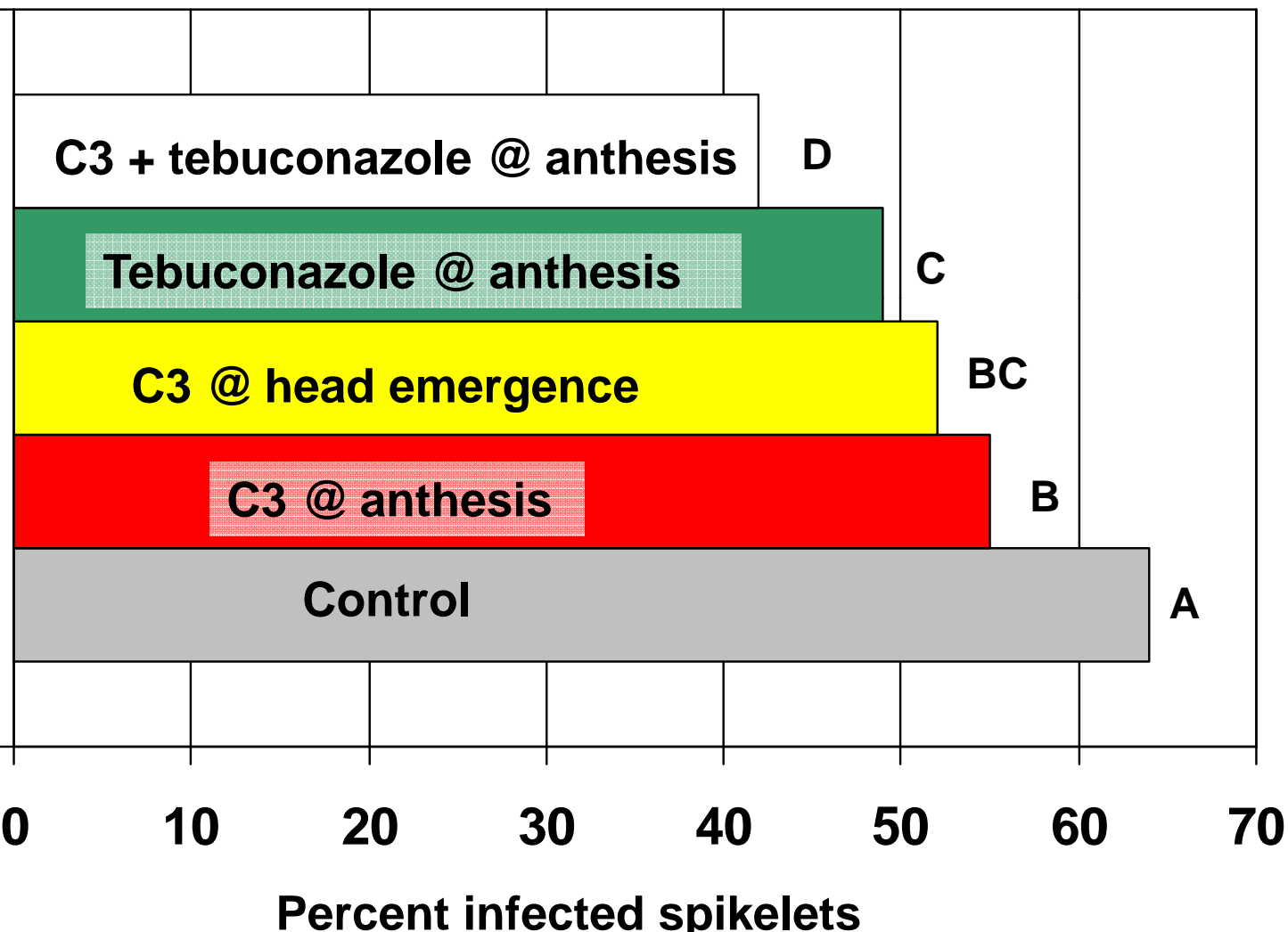
FHB Severity  
DON  
Yield



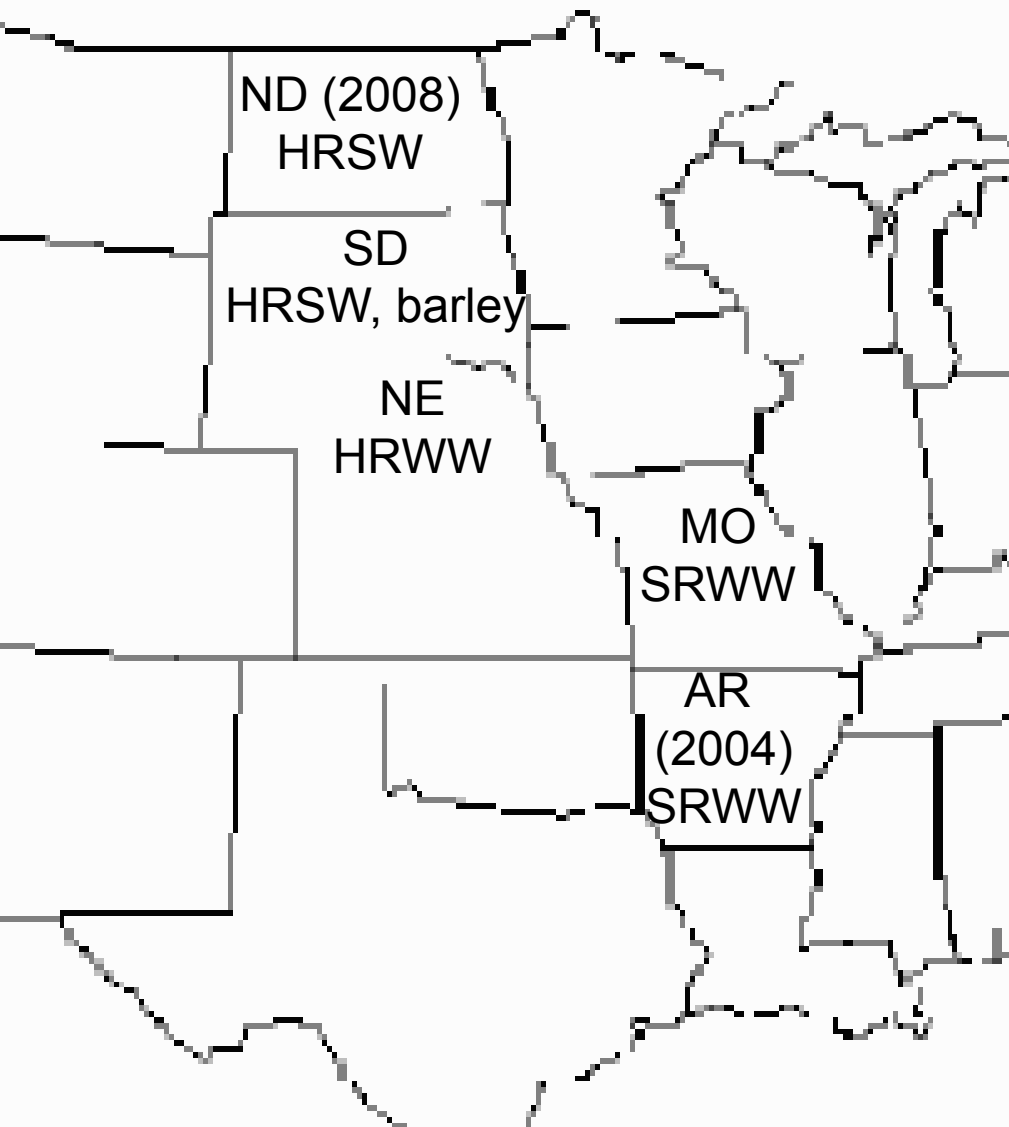
# Performance of *Lysobacter* C3 in 13 Greenhouse Experiments



# Control of Fusarium head blight in spring wheat with *Lysobacter enzymogenes* C3



# Uniform Biological Control Trials 2004-2008



AR - E. Milus

MO - L. Sweets

NE - G. Yuen,  
C. Jochum

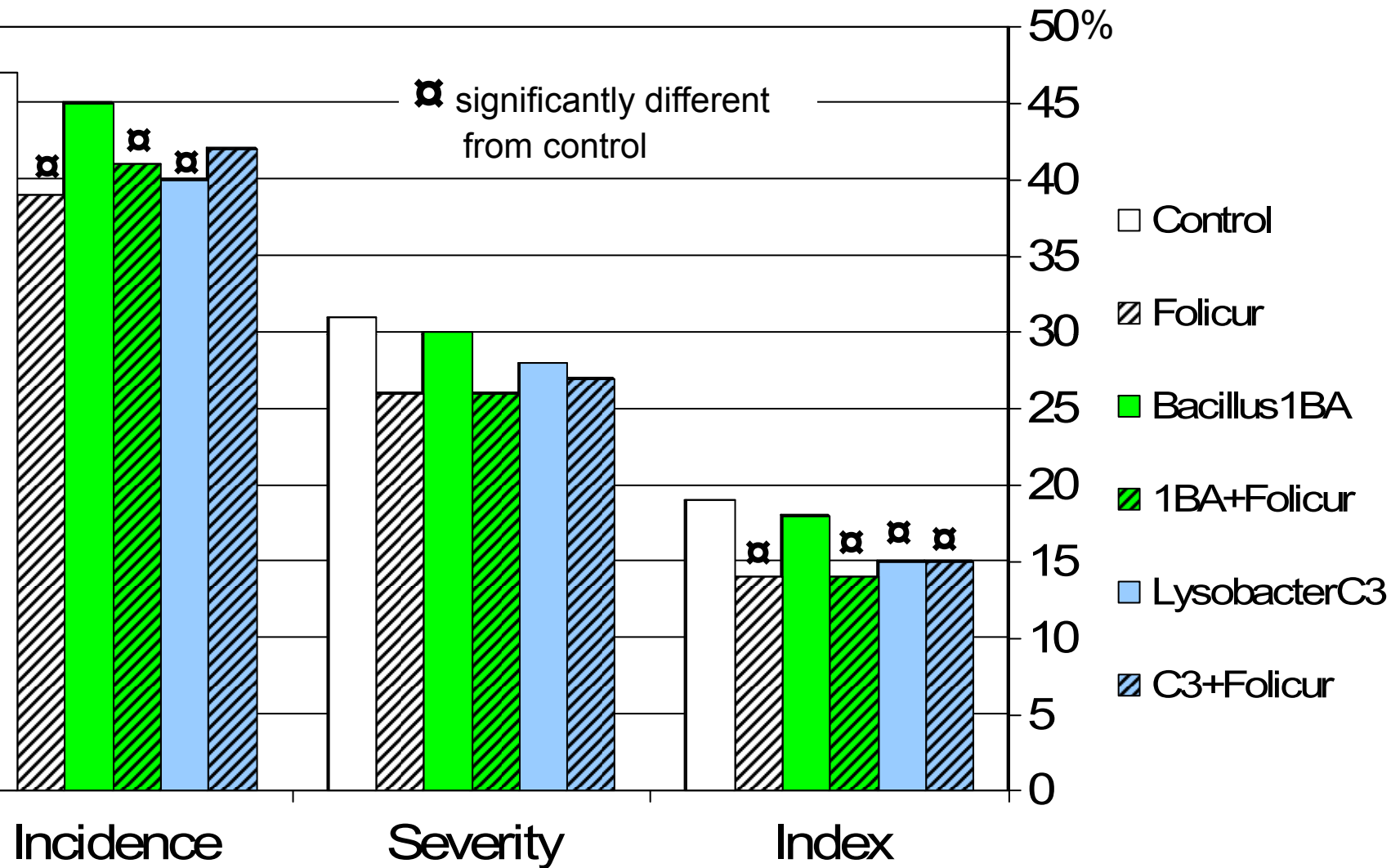
ND - S. Halley

SD - B. Bleakley  
M. Draper  
K. Ruden

# Uniform Biological Control Trials

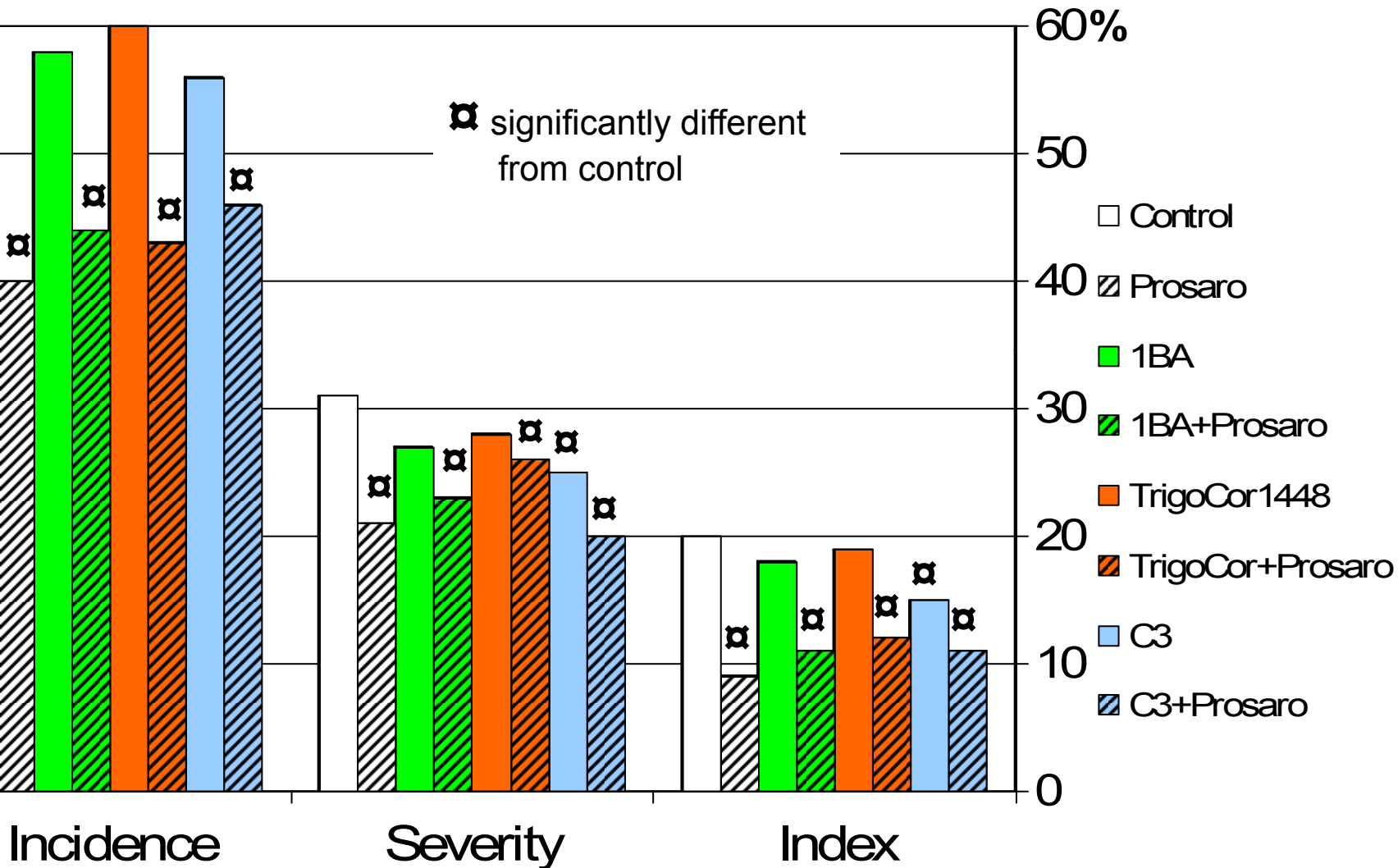
- Objectives:
  - Identify most effective biocontrol agent/product
  - Integrate biological and chemical strategies
- Standardized treatments
- Standardized methodology
  - Dosage, application method
  - Plot size, inoculation and misting
  - Disease, yield, DON data
  - Microbe propagation, handling, population measurement
- Results reported in Natl' EHB Forum Proc

# FHB Averaged Across 5 Trials 2005

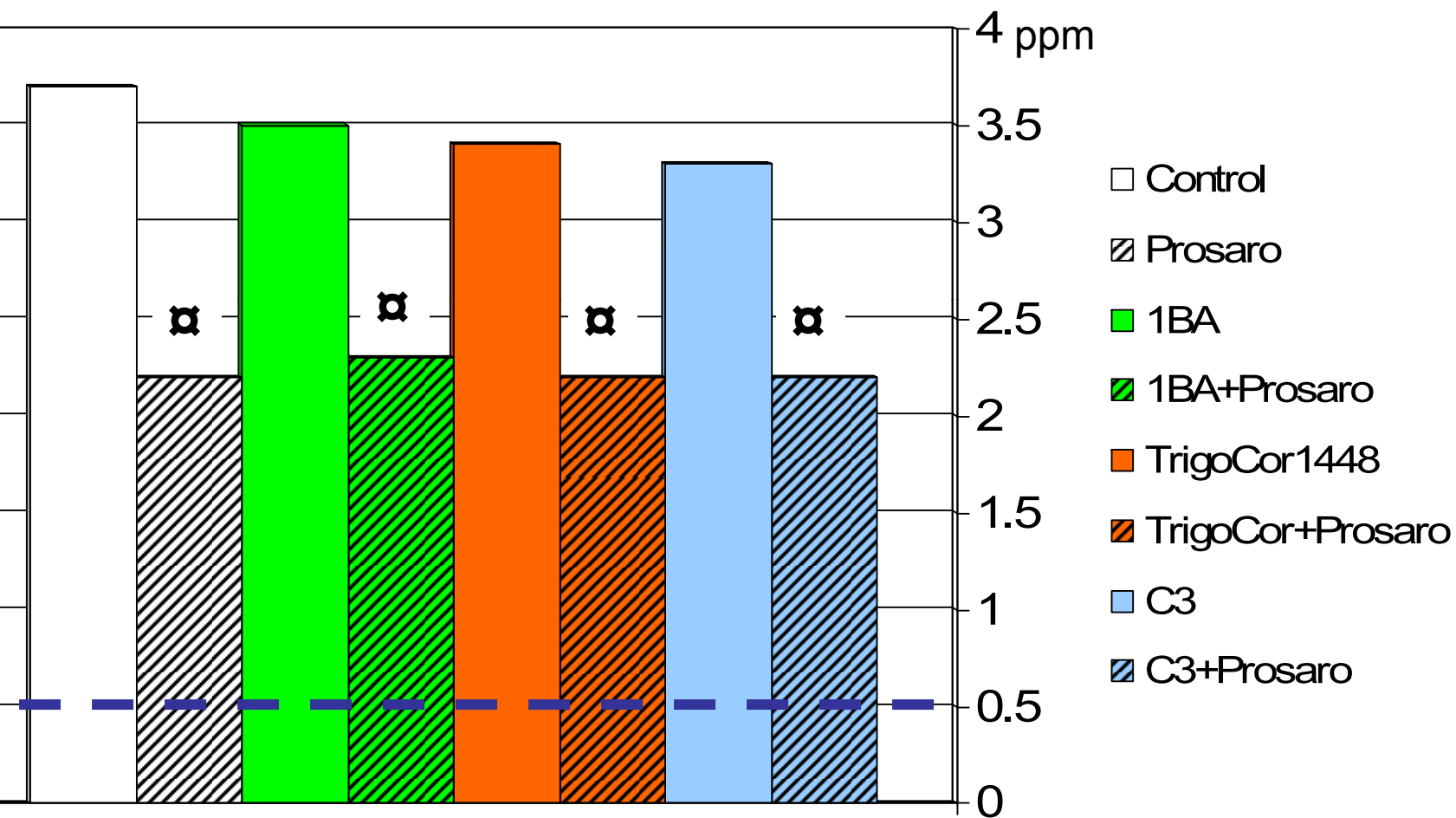




# FHB Averaged Across 6 Trials 2007

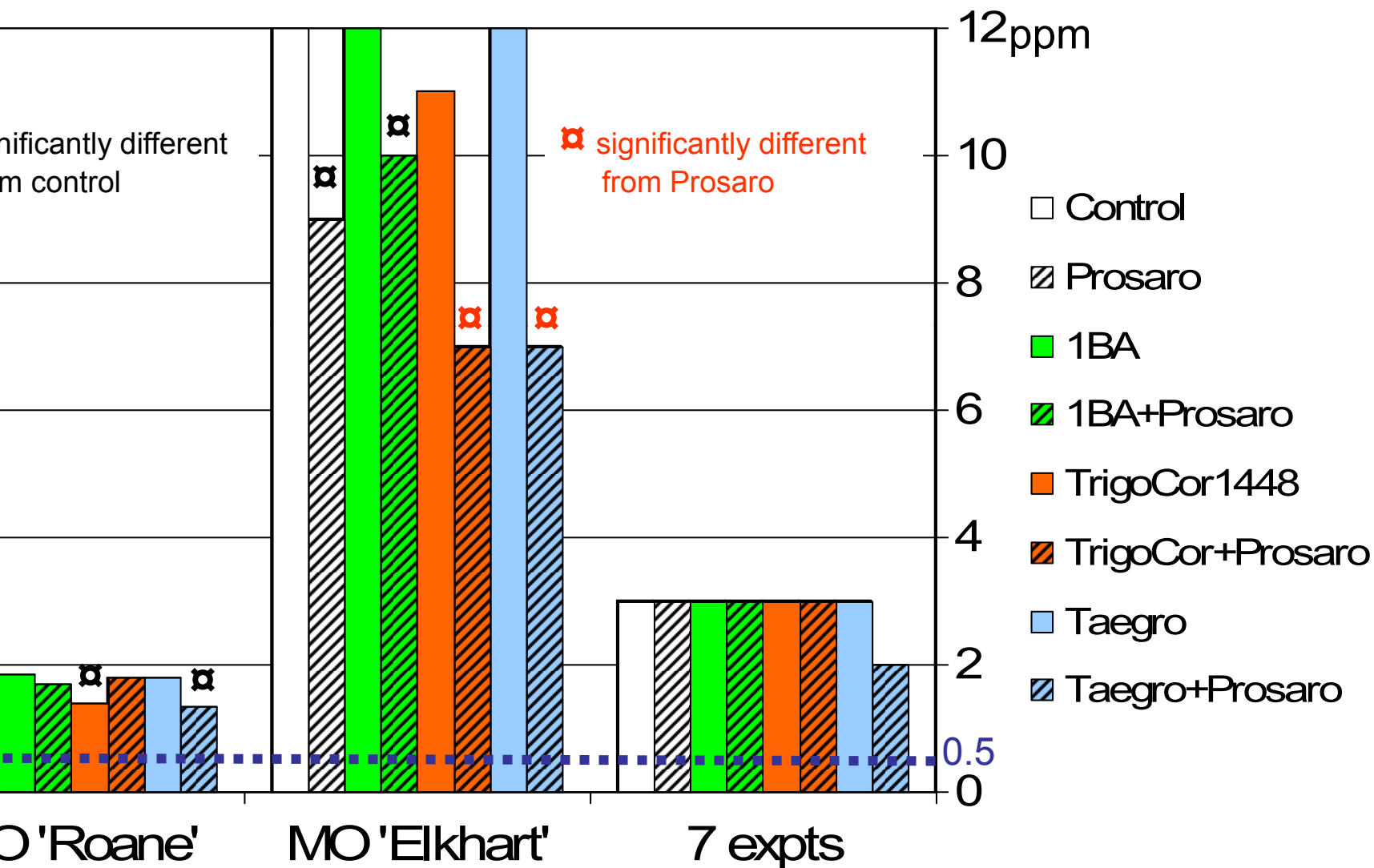


# DON Averaged Across 3 Trials 2007



\* significantly different from control

# DON in MO & Averaged Across 7 Trials 2008



Treatment effects were

# Summary of Findings From Uniform Biological Control Trials 2004-2008

Biocontrol agents can be as effective in controlling FHB as a fungicide in individual trials

- No agent is consistently effective across trials.

Biocontrol agent-fungicide combinations can provide better reduction of DON than a fungicide in individual trials

- Benefits of combinations do not appear across trials

Integration of biological agents or biocontrol agent-fungicide combinations with host resistance deserves more thorough investigation

Need for further development of biological strategies still exists

# Ongoing Research to Improve Biocontrol

Use of biocontrol agents to control late infections

- Scott Halley, NDSU

# Ongoing Research to Improve Biocontrol

Propagation and formulation technology

Poster #18

“Physiological Profiling and Carbon Source Utilization of  
Four Bacillus Strains Used as Biological Control  
Agents of FHB”

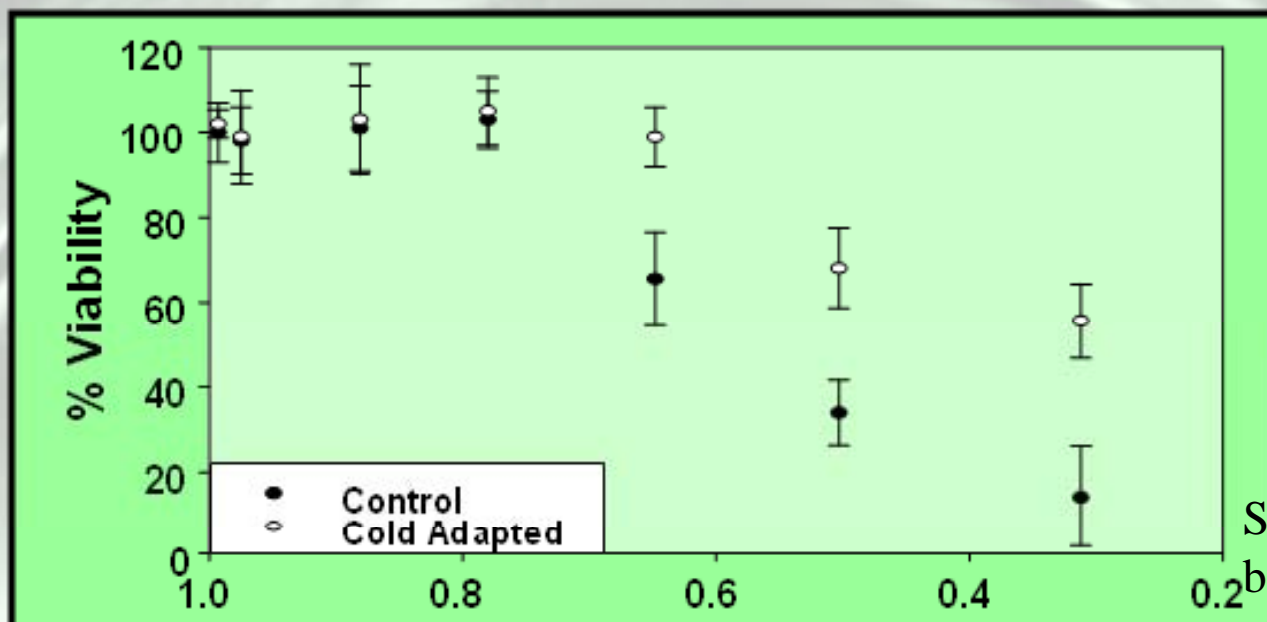
Morgan and Bleakley

# Ongoing Research to Improve Biocontrol

Propagation and formulation technology

- Enhance survival of yeast biocontrol agents using cold adaptation (D. Schisler, USDA ARS NCUAR)

**Cells of *Cryptococcus flavecens* adapted to cold during liquid culture fermentation possess enhanced isothermal osmotic shock tolerance at 25 C**



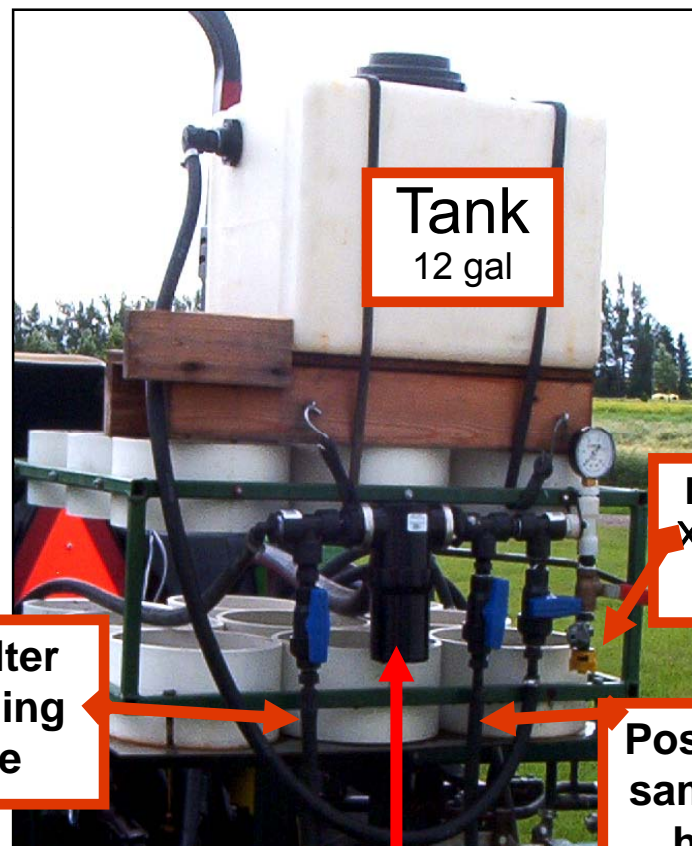
Slide provided  
by D. Schisler

# Ongoing Research to Improve Biocontrol

Compatibility with commercial application technology  
(Yuen et al. 2007)



**Cast iron gear  
drive centrifugal  
pump (HYPRO  
Model 9006C-O)**



**Tank  
12 gal**

**Nozzle  
XR8002**

**Pre-filter  
sampling  
hose**

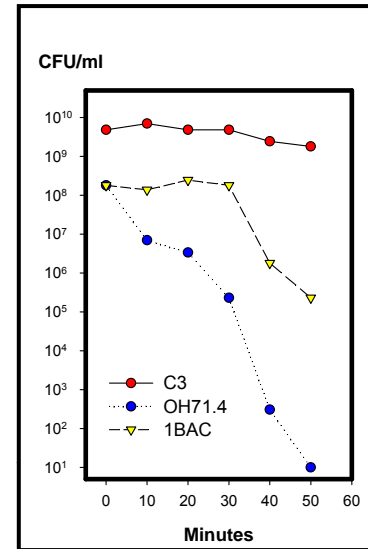
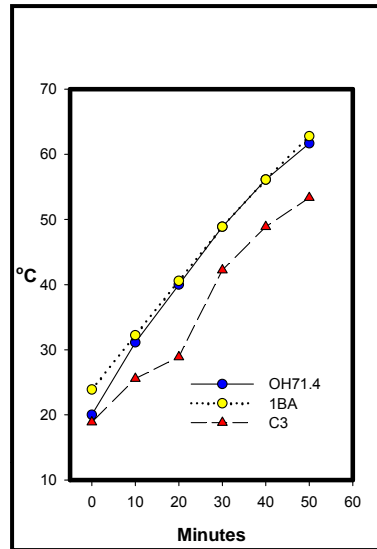
**Post filter  
sampling  
hose**

**Filter**

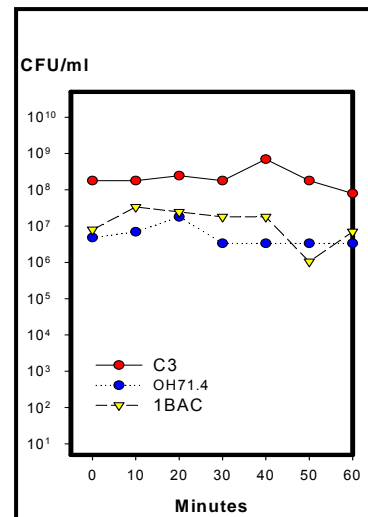
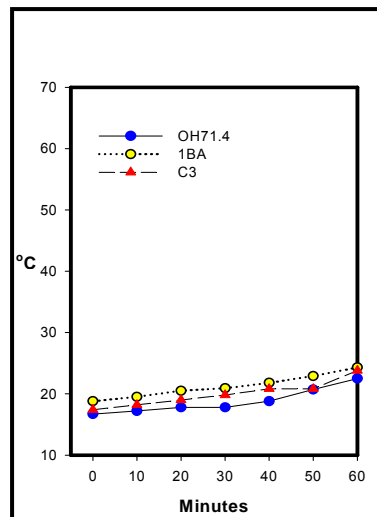


# Compatibility with commercial application technology

liquid volume  
mixing tank: 10 gallons



100 gallons



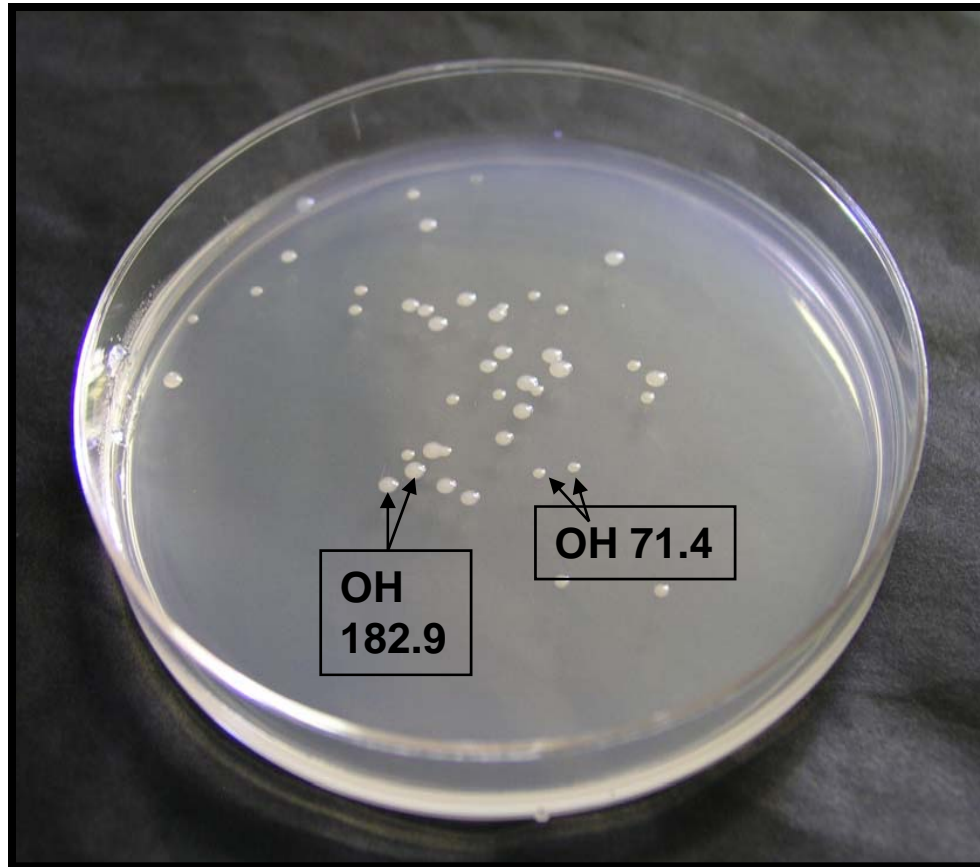
## Compatibility with commercial application technology



Foaming in suspension of *Bacillus* 1BA

# Ongoing Research to Improve Biocontrol

- Combinations of biocontrol agents

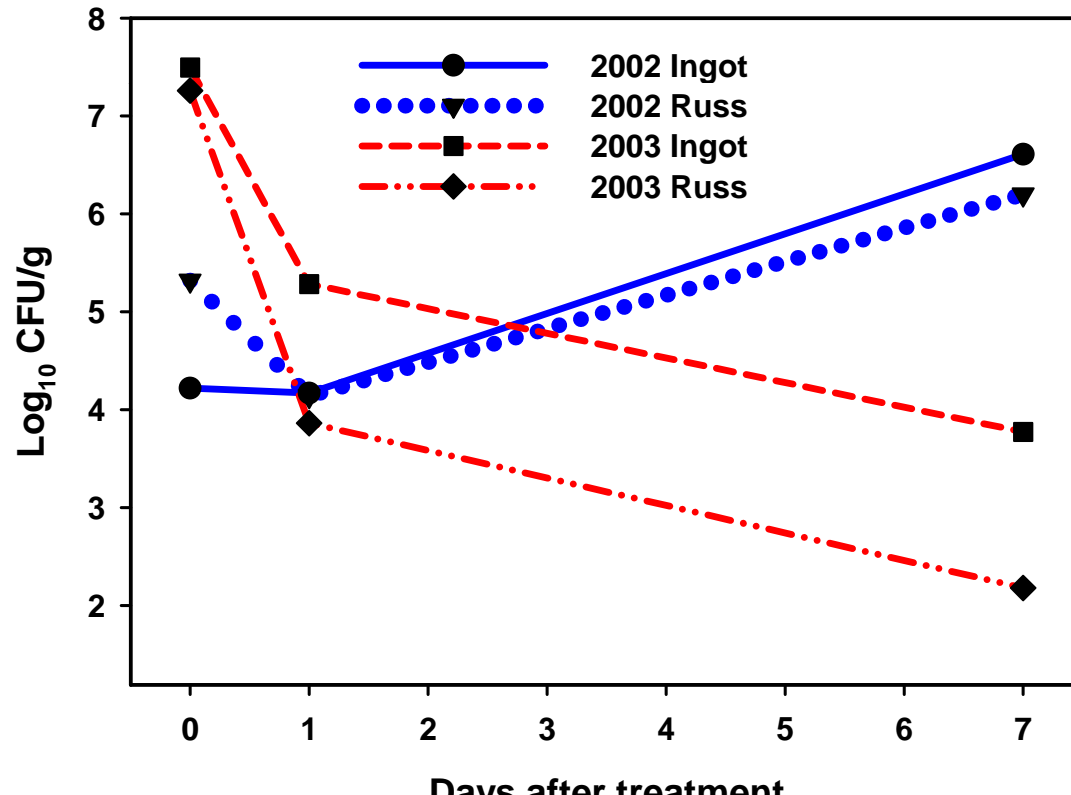


**Two co-fermented yeast antagonists cultured a melezitose medium that differentiates strains based on growth rates**

# Research to Improve Biocontrol

Host and environmental constraints on biocontrol agent populations and expression of biocontrol mechanisms

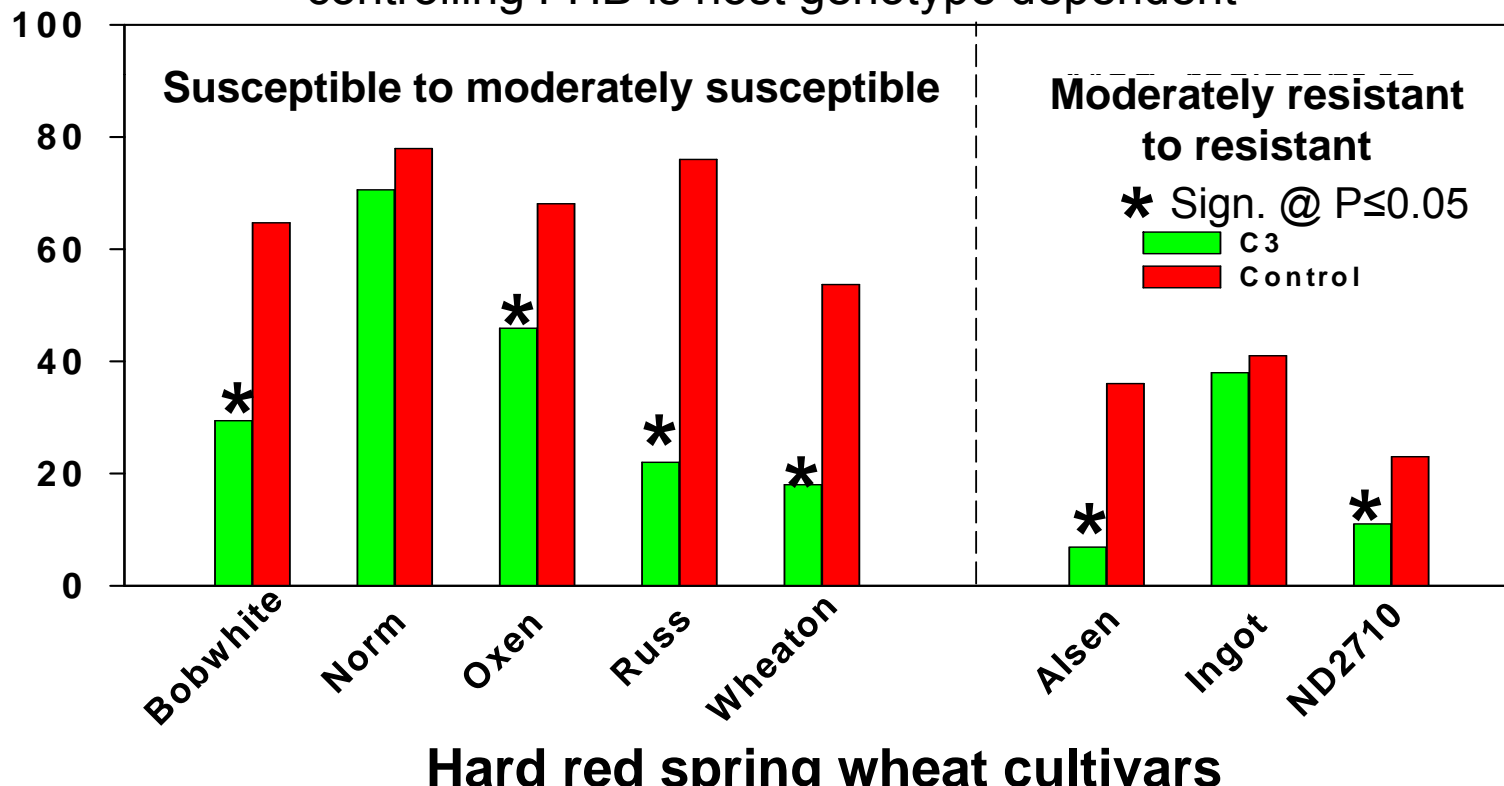
*Lysobacter enzymogenes* C3 populations on wheat heads



# Research to Improve Biocontrol

Host and environmental constraints on biocontrol agent populations and expression of biocontrol mechanisms

Efficacy of *Lysobacter enzymogenes* C3 in controlling FHB is host genotype dependent



# Research to Improve Biocontrol

Host and environmental constraints on biocontrol agent populations and expression of biocontrol mechanisms

Poster #11

“Ecology of *Bacillus subtilis* on Wheat Florets in Relation to Biological Control of FHB/DON”

Kawamoto et al.

Poster #19

“Use of Most Probable Number and PCR Methods to Estimate Populations of *Bacillus* Strain 1BA Applied to Wheat and Barley for Biological Control of FHB”

Morgan and Bleakley

# Thinking outside the box

Microbes that can degrade DON or inhibit DON formation

Engineer endophytic microbes to express antifungal compounds, DON inhibitors, DON degrading enzymes in plant tissues

Apply antagonists to crop debris or stimulate resident microbes to inhibit *Fusarium* sporulation



# Thanks

USWBSI

Gary Bergstrom

Bruce Bleakley

David Schisler

Scott Halley

Laura Sweets

All support staff

Colleagues in scab/DON  
research