USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY05 Final Performance Report (approx. May 05 – April 06)
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Cover Page

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Fiscal Year:	**2005**
FY05 ARS Agreement ID:	**59-0790-1-079**
Agreement Title:	**Evaluation of Biological Agents for Fusarium Head Blight.**
FY05 ARS Award Amount:	**$ 22,780**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
CBC	Combining Biological and Chemical Strategies to Control Fusarium Head Blight.	$ 14,000
CBC	Uniform Tests of Biological Control Agents Against Fusarium Head Blight.	$ 8,780
	Total Award Amount	**$ 22,780**

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Principal Investigator Date

* BIO – Biotechnology
CBC – Chemical & Biological Control
EDM – Epidemiology & Disease Management
FSTU – Food Safety, Toxicology, & Utilization
GIE – Germplasm Introduction & Enhancement
VDUN – Variety Development & Uniform Nurseries

Project 1: *Combining Biological and Chemical Strategies to Control Fusarium Head Blight.*

1. What major problem or issue is being resolved and how are you resolving it?

This project examined two strategies for controlling Fusarium head blight of wheat that incorporate both biological and chemical approaches. One strategy was the combination of a bacterial biocontrol agent *Lysobacter enzymogenes* C3 with a commercial fungicide tebuconazole (Folicur). The biocontrol agent, Folicur, and the combination of the two was tested in two field locations to determine if combination is more effective than the biocontrol agent or fungicide alone in different environments. In addition, treatments were applied at a high volume rate (70 gal/A), which conferred efficacy in previous tests, and at a low volume rate (20 gal/A) that is more typical of commercial spray application practices. The second strategy investigated involves the use of new biotic agents that can activate systemic host resistance, a mode of action unique from any existing scab fungicide or biological control agent. These agents included killed mycelia ('autoclaved fungal biomass' or AFB) prepared from Aspergillus niger and Pencillium strain 2 which had already been found to reduce scab severity in greenhouse tests conducted at USDA-ARS NCAUR, Peoria. Also investigated were strains of *Pseudomonas fluorescens* WCS417 that confirmed in greenhouse testing last year to suppress FHB. In two field experiments, these agents were compared with the biocontrol agent *L. enzymogenes* C3 and Folicur for control of FHB.

2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):

Accomplishment:

In the two field experiments in which biocontrol agent C3, Folicur and a C3-plus-Folicur combination applied at 20 and 70 gal/A, there was no significant difference between the combination treatment and the biocontrol agent or fungicide alone. There was a trend towards reduced scab by these three treatments compared to the control, but none were effective in reducing both disease severity and disease incidence in any one experiment to a statistically significant level. The combination treatment was effective in reducing one of the disease parameters in both experiment sites while C3 alone and Folicur alone were effective in only one site. There was no consistent difference found between the low and high application rate for any treatment. In experiments testing resistance-inducing agents, none of the treatments, including Folicur, controlled scab compared the control and there were no statistical differences between any of the treatments. There was a trend towards reduction of scab severity by the AFB and bacterial treatments. Results from these experiments were reported (see publication list).

Impact:

Combined with results from an experiment conducted last year, we found evidence that combining a biological control agent with a fungicide provides more consistent control of FHB over different environments than using the biological agent or the fungicide alone.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:
Both biocontrol agents and fungicide have shown to be inconsistent in controlling FHB across sites and years. Our results suggest that a combination of a biological control agent with a fungicide, while not necessarily being more effective in reducing scab than the biological agent or the fungicide alone, is likely to be more consistent in action over a wide range of environments. Thus, commercial use biological agents in the future should be integrated with the use of the best chemical fungicides.

Project 2: *Uniform Tests of Biological Control Agents Against Fusarium Head Blight.*

1. What major problem or issue is being resolved and how are you resolving it?
The objectives of this project were to coordinate efforts involving multiple states in standardized comparisons of biological treatments for control of Fusarium head blight and to conduct a field test on winter wheat in Nebraska as part of the 2005 Uniform Biological Control Tests. Five trials were conducted across three states (Missouri, Nebraska, and South Dakota) on a range of wheat market classes. Trials were conducted on hard red winter wheat in two locations in Nebraska. In each trial, *Bacillus* strain 1BA, provided by South Dakota State University and *Lysobacter enzymogenes* strain C3, provided by University of Nebraska-Lincoln, were tested alone and in a tank mixture with tebuconazole (Folicur). In addition, there was a non-treated control and a treatment with tebuconazole alone.

2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):
Accomplishment:
Results from the Nebraska experiment was published in the report of the 2005 Uniform Biological Control Tests (see publications list). In one NE experiment, none of the treatments affected scab compared to the control. In another NE experiment, combinations of either biocontrol agent with Folicur reduced disease incidence and index, while biocontrol agents and Folicur alone were ineffective. No significant treatment effects were found in the other states.

Impact:
Nebraska continued to contribute useful data to the Uniform Biological Control Test program. While results from Nebraska experiments were not consistent with other states, they were consistent with finding from Project 1.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:
Control of FHB either using fungicides or biocontrol agents alone continues to exhibit inconsistency across different sites. While data from Nebraska experiments suggest that combining biological agents with chemical fungicides might improve the consistency of control, biologicals and chemicals individually need to be improved before the efficacy of the combination can be ensured.

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Publications:

C.C. Jochum (1), L.E. Osborne (2), and G.Y. Yuen. 2006. Fusarium head blight biological control with *Lysobacter enzymogenes* strain C3. Biological Control (in press; doi:10.1016/j.biocontrol.2006.05.004)

G.Y. Yuen, C.C. Jochum, B.H. Bleakley, M.A. Draper, K.R. Ruden, and L.E. Sweets. 2005. Standardized Evaluation of Biological Agents for the Control of Fusarium Head Blight: 2005 Results. In: Canty, S.M., Boring, T., Wardwell, J., Siler, L. , and Ward, R.W. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2005 Dec. 11-13; Milwaukee, WI. East Lansing: Michigan State University. pp. 237-239.

C.C. Jochum, G.Y. Yuen, and B. Tisserat. 2005. Effects of Induced Systemic Resistance-Activating Agents on Fusarium Head Blight. In: Canty, S.M., Boring, T., Wardwell, J., Siler, L. , and Ward, R.W. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2005 Dec. 11-13; Milwaukee, WI. East Lansing: Michigan State University. pp. 211-214.

Poster presented at 2005 National Fusarium Head Blight Forum:
Effects of Induced Systemic Resistance-Activating Agents on Fusarium Head Blight. C.C. Jochum, G.Y. Yuen, and B. Tisserat.