USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY07 Final Performance Report (approx. May 07 – April 08)
July 15, 2008

Cover Page

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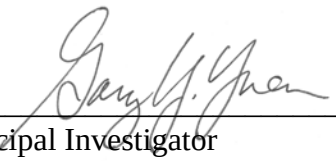
Fiscal Year:	2007
USDA-ARS Agreement ID:	59-0790-6-072
USDA-ARS Agreement Title:	Enhancing Biological Strategies to Control Fusarium Head Blight and Evaluation Biological Control Agents in Uniform Tests Against FHB.
FY07 ARS Award Amount:	$ 36,976

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
CBCC	Control of Fusarium Inoculum Production in Crop Residue.	$14,634
CBCC	Effects of Spray Application Methods on Biocontrol Agents.	$ 9,756
CBCC	Uniform Tests of Biological Control Agents against Fusarium Head Blight.	$ 12,586
	Total Award Amount	**$ 36,976**



_____July 14, 2008_____
Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
IIR – Integrated/Interdisciplinary Research
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Control of Fusarium Inoculum Production in Crop Residue.*

1. What major problem or issue is being resolved and how are you resolving it?
Host resistance and fungicides individually provide partial control of Fusarium head blight and DON formation. The goal of this project was to test new strategies to reduce pathogen inoculum production in infested crop residue. Specific project objectives were to determine the effects of physical processing (chopping) of corn residues and application of commercially-available fungicides and biological control agents to corn residues on sporulation of *Fusarium graminearum* in the residue and on development of Fusarium head blight in the following wheat crop. Field experiments were conducted in two Nebraska sites in which corn residue chopped in the fall was transferred in the spring to plantings of winter-planted wheat. This treatment was compared with no addition of corn residue and to the addition of whole (unchopped residue). The residue in the plots were given one of six spray treatments when the wheat reached early stem extension stage (Feekes 6-8), corresponding the time when herbicidal applications were made.The treatments included Headline a strobilurin fungicide, Dithane DF, Prosaro, Serenade (*Bacillus subtilis*) from AgraQuest, T22 (*Trichoderma harzianum*) produced by Bioworks, and the control (distilled water). Corn residue was sampled from the plots at wheat anthesis and ascospores were washed from the residue samples and counted. Field data collected were FHB incidence and severity. DON content, yield of kernels, and percentage of Fusarium disease kernels (FDK) were measured after harvest.

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:
Disease measurements and DON levels were lower in no-residue than in plots in which chopped or whole residue was added. While disease parameters in chopped residue tended to be lower in magnitude than in the whole residue, the differences largely were not significant. This may have been related to chopping of corn residues being in effective in reducing pathogen sporulation in the residue. Application of Prosaro to corn residue at one site decreased scab incidence and index.

Impact:
Our research demonstrated that reducing residue size does not affect inoculum production in the residue such that infection of wheat heads is affected. However, our research showed there is some promise to using spring applications of commercial fungicide to reduce inoculum levels.

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?:
Previously, the concept of residue management, through chopping and by applying chemicals to the residue, to reduce scab inoculum production was hypothesized and tested under laboratory conditions. This is the first testing of the concepts in the field. Demonstration that fungicides applied in residue the spring has some promise opens a new area of research that may lead to another strategy to integrate with disease resistance and fungicide applications to protect wheat head.

Project 2: *Effects of Spray Application Methods on Biocontrol Agents.*

1. What major problem or issue is being resolved and how are you resolving it?
Biological agents have been demonstrated in greenhouse tests to have promise for controlling Fusarium head blight, but it has been difficult to achieve consistent high-level control in the field using any agent. While environmental variation likely contributes to variable performance, the manner in which biocontrol agents are applied might also be an important factor. Spray application conditions may be of even greater importance when biological control agents are applied using commercial field spray equipment. This project assessed the compatibility of biological control agents with current commercial fungicide application technology. The objective in this project was to determine the effects of commercial ground spray application systems on viability of representative biological control agents. The primary hypothesis was that each stage of a spray application (i.e., transport of cell suspension in tank; pumping of cell suspensions through the spray line; and discharge of cell suspension as droplets through nozzles) will affect the population of the biocontrol agent. A selection of biological control agents, representing a wide range of microorganism types were applied through two spray systems: #1) a modifed spray system having shortened lines, a small (10 gal) tank and a centrifugal pump; and #2) commercial spray system with a standard (115 gal) tank and a piston pump. Samples were collected every 10 minutes for 50 minutes to monitor population changes from the tank, before the filter, immediately after the filter, and out of the nozzle. Temperature of cell suspensions in the tank were also monitored every 5 to 10 minutes.

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:
Populations of the test biological control agents maintained stable when applied through the commercial sprayer but all of the organisms rapidly lost viability when sprayed through the modified system. The loss in viability was no related to physical forces occurring in the pump, filters or nozzels. Instead, lost in viability was due to heat accumulation of engine in the small mixing tank volume. This problem did not occur when large liquid volumes were used in the commercial spray system.

Impact:
The result indicated that as long as biocontrol agents are prepared in large liquid volumes, typical of commercial fungicide spray applications, no modification of current commercial spray equipment is needed in order to optimally apply biological control organisms to wheat heads.

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?:
This is the first investigation to address the question as to the compatibility of biocontrol agents with standard commercial equipment. The question was resolved with the finding that heat accumulation under artificial (small liquid volume) conditions was the only deleterious factor.

Project 3: *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?

Biological control methods are needed to augment cultivar resistance and fungicide strategies for management of Fusarium head blight (FHB). This project was part of the 2007 Uniform Biological Control Tests, a multistate effort to evaluate a standard set of biocontrol organisms for efficacy across a range of classes and cultivars of wheat and barley and under different environmental conditions in order to identify the best candidate(s) for further reseqrch and commercial development. One specific objective for efforts in Nebraska was to coordinate experiments among three states involving six experiment sites, compile the data and report the results. Another objective was to conduct two field tests in Nebraska of bacterial biological control agents (*Bacillus* sp. 1BA., *B. subtilis* Trigocor 1448, and *Lysobacter enzymogenes* C3) applied alone and in combination with the fungicide Prosaro for control of FHB on winter wheat.

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:
Experiments in Nebraska did not point to any bacterial agent being effective by itself in controling scab or any combination of a biocontrol and Prosaro being more effective than Prosaro alone. The collective results all of the trials indicated *L. enzymogenes* C3 to the be the most effective biocontrol agent across a range of environments, but treatments with the bacterium are not as effective or as consistent as treatment with Prosaro 421 SC. Furthermore, no benefit was revealed in this study from combining biocontrol agents with Prosaro 421 SC, contrary to past studies with biocontrol agent-tebuconazole combinations.

Impact:
The results from the 2007 Uniform Biological Control Tests revealed one organism that might have some potential as a biocontrol agent applied in multiple environments but also pointed out that much further improvement is needed before the biocontrol agent can provide economically practical levels of control.

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?:
This was the first field evaluation of the combination of biocontrol agents with the new fungicide Prosaro 421 SC. No benefit was revealed in this study from combining biocontrol agents with Prosaro 421 SC, contrary to past studies with biocontrol agent-tebuconazole combinations. The difference in results is most likely related to the greater effectiveness of Prosaro 421 SC over tebuconazole. Therefore, it may be desirable to explore combinations of biocontrol agents with less efficacious fungicides as a means to broaden the selection of treatments that can be used to protect florets from Fusarium infection.

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.

Posters presented at the 2007 National Fusarium Head Blight Forum

"Control of Fusarium Inoculum Production in Corn Residue by Mechanical, Biological, and Chemical Treatments". G.Y. Yuen, C.C. Jochum, J.E. Scott, and S.Z. Knezevic.

"Effects of Spray Application Methods on Biocontrol Agent Viability." G.Y.Yuen, C.C.Jochum, S. Halley, G. Van Ee, V. Hoffman, and B.H. Bleakley.

"Results From the 2007 Standardized Evaluation of Biological Agents for the Control of Fusarium Head Blight on Wheat and Barley." G.Y. Yuen, C.C. Jochum, K.R. Ruden, J. Morgan, B.H. Bleakley, and L.E. Sweets.

Non-peer reviewed articles

Yuen, G.Y., Jochum, C.C., Halley, S., Van Ee, G., Hoffman, V., and Bleakley, B.H. 2007. Effects of spray application methods on biocontrol agent viability. In: Canty, S., Clark, A., Ellis, D., and Van Sanford, D. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2007 Dec. 2-4; Kansas City, MO. University of Kentucky. pp. 149-152.

Yuen, G.Y., Jochum, C.C., Ruden, K.R., Morgan, J., Bleakley, B.H., and Sweets, L.E. 2007. Results from the 2007 standardized evaluation of biological agents for the control of Fusarium head blight on wheat and barley. In: Canty, S., Clark, A., Ellis, D., and Van Sanford, D. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2007 Dec. 2-4; Kansas City, MO. University of Kentucky. pp. 153-157.

Yuen, G.Y., Jochum, C.C., Scott, J.E., and Knezevic, S.Z. 2007. Control of Fusarium inoculum production in corn residue by mechanical, biological, and chemical treatments. In: Canty, S., Clark, A., Ellis, D., and Van Sanford, D. (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2007 Dec. 2-4; Kansas City, MO. University of Kentucky. pp. 144-148