USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY06 Final Performance Report (approx. May 06 – April 07)
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Cover Page

PI:	David Schisler
Institution:	USDA-ARS
Address:	NCAUR 1815 North University Street Peoria, IL 61604-3999
E-mail:	schislda@ncaur.usda.gov
Phone:	309-681-6284
Fax:	309-681-6693
Fiscal Year:	2006
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Fusarium Head Blight Research.
FY06 ARS Award Amount:	$ 30,383

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
CBCC	Optimization of Multiple Field Treatment Factors to Enhance Biocontrol of FHB.	$ 30,383
	Total Award Amount	**$ 30,383**

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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
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Optimization of Multiple Field Treatment Factors to Enhance Biocontrol of FHB.*

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

In accordance with a national research priority of the Agricultural Research Service to develop new pest management technologies that reduce our dependence on chemical pesticides, we are studying the possibility of utilizing microorganisms naturally present in agricultural ecosystems as environmentally compatible alternatives for controlling Fusarium head blight or as integral components of treatments that also include reduced levels of traditional chemicals. It has become apparent over the course of USWBSI sponsored research that no one control measure from among pesticides, biological control, cultural control, disease forecasting and the use of resistant varieties is likely to single-handedly reduce FHB to economically acceptable levels. Our research during this granting period evaluated the integration of several FHB control measures since this approach has great potential to achieve enhanced and more consistent control of FHB.

In previous work, we discovered microbial strains that reduce FHB in the greenhouse and field and demonstrated enhanced reduction of FHB via formulating biocontrol agents with UV protectants (Schisler et al., 2003), and mixing fungicide-tolerant variants of our biocontrol agents with fungicides (Schisler et al., 2002). In more recent work, we have discovered chemical inducers of systemic acquired disease resistance (SAR) that reduce FHB development in greenhouse tests (Zhang et al., 2005) and choline metabolizing strains (CMS) (Schisler et al., 2006) of antagonists that reduce FHB in greenhouse and field tests. Determining the relative importance of these factors when they are simultaneously tested on wheat cultivars that differ in resistance to FHB and identifying synergies, if any, when multiplexing these factors is crucial to elucidating which of these factors should be included in any recommended IPM program against FHB. Investigations were conducted under this grant to identify inexpensive, non-toxic UV protectants capable of enhancing the survival of biocontrol agents of FHB in field environments. The best protectant identified was then evaluated in a fractional factorial field test that also included 2 antagonists, a SAR chemical, and Folicur 3.6F on one FHB susceptible and one moderately resistant wheat cultivar.

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

<u>Accomplishment:</u>

The capability of the food grade dye napthol yellow to protect microbial inoculants from the deleterious effects of UV exposure was identified for the first time *in vitro*. We demonstrated that the integration of biocontrol agents *Cryptococcus flavescens* OH 182.9 and *Arthrobacter* sp. OH 221.3, folicur 3.6F, SAR chemical salicylic acid and UV protectant napthol yellow using a fractional factorial field design had mixed results that varied with the wheat cultivar tested. On cultivar Elkhart in Wooster, Ohio, the presence of fungicide Folicur 3.6F (P=0.001) and antagonist OH 221.3 (P=0.10) significantly reduced disease severity and incidence. Antagonist OH 182.9 reduced the DON content (P=0.04) while naphthol yellow decreased the test weight (P=0.05) of Elkhart grain. Treatments rarely had an effect on FHB symptom expression on moderately resistant cultivar Freedom. Analysis

of data did not indicate the presence of first order synergistic effects of combining the biocontrol agents, UV protectant, Folicur 3.6F and SAR chemical.

Impact:

Our discovery and demonstration that a food grade dye can protect biocontrol cells from the deleterious effects of UV light while showing no toxic effect to cell growth in the absence of UV will promote further consideration of a new group of compounds for use as UV protectants of biological materials that are employed in environments where degradation via UV light occurs. The difficulty in clearly interpreting results of using a fractional factorial design to evaluate multiple field treatments for the integrated control of FHB gives researchers additional information to evaluate in considering whether to use this powerful experimental design tool for evaluating multiple treatment effects in a decidedly variable field environment.

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?

Food grade dyes can now be considered as potentially useful, non toxic UV protectants that can be included in formulations of biological control agents with little possibility having a deleterious impact on product viability or, ultimately, the registration of the product. Additional experiments using fractional factorial designs in FHB field studies would be necessary to determine if this design can serve as a useful tool for researchers looking to maximize the number of treatments evaluated while minimizing the amount of field area required for the test.

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.

Peer-reviewed journal publications

Dunlap, C.A., Evans, K.O., Theelen, B., Boekhout, T., and Schisler, D.A. 2007. Osmotic shock tolerance and membrane fluidity of cold-adapted *Cryptococcus flavescens* OH182.9, previously reported as *C. nodaensis*, a biocontrol agent of Fusarium head blight. FEMS Yeast Res 7:449–458.

Schisler, D.A., Khan, N.I., Boehm, M.J., Lipps, P.E. and Slininger, P.J. 2006. Selection and evaluation of the potential of choline-utilizing microbial strains to reduce Fusarium head blight. Biological Control 39:497–506.

Zhang, S., Schisler, D.A., Boehm, M.J., and Slininger, P.J. 2007. Utilization of chemical inducers of resistance and *Cryptococcus flavescens* OH 182.9 to reduce Fusarium head blight under greenhouse conditions. Biological Control (in press).

Symposium Publications:

Schisler, D.A., Boehm, Dunlap, C., Paul, P. and Palmquist, D.E. 2006. USDA-ARS and The Ohio State University cooperative research: use of fractional factorial field designs to assess the integration of diverse treatments against FHB. Proceedings of the 2006 National Fusarium Head Blight Forum, Office Max Print and Document Services, Okemos, MI. pp. 21-26.