

USDA-ARS / USWBSI
FY03 Final Performance Report (approx. May 03 – April 04)
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Cover Page

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Year:	FY2003 (approx. May 03 – April 04)
FY03 ARS Agreement ID:	NA
FY03 ARS Agreement Title:	Fusarium head blight biocontrol product development.
FY03 ARS Award Amount:	\$ 19,512

USWBSI Individual Project(s)

USWBSI Research Area *	Project Title	ARS Adjusted Award Amount
CBC	Fusarium head blight biocontrol product development.	\$ 19,512
	Total Amount Recommended	\$ 19,512

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: *Fusarium head blight biocontrol product development.*

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

Using naturally occurring microorganisms to biologically control plant diseases is a sustainable agricultural practice yet a serious impediment to the commercialization of biocontrol agents is the lack of adequate knowledge of the cultivation and formulation technologies needed to maximize strain tolerance to the biological stresses encountered during product development. Additionally, information is lacking in how to preserve the investment in producing stabilized, viable biocontrol cells once cells are deployed on the plant infection court. A primary objective for the research conducted under the current grant was to develop a formulation for our biocontrol agents that specifically enhanced agent survival and activity on wheat heads through the use of UV-protectants. The best UV-protectant formulations were then tested in field environments in Peoria, Illinois and Wooster, Ohio. A second objective was to discover new strains of biocontrol agents that would possibly be more effective than our most effective current strains or could be combined in later research with our most effective strain to produce a superior biocontrol product. To accomplish this, more than 700 microbial strains isolated from the anthers of field-grown wheat were screened for strains that were able to utilize choline, a compound found in wheat anthers that is reported to stimulate early germ tube growth of *Gibberella zeae*. Choline-utilizing strains (CUS) may be able to reduce pathogen activity by metabolizing a growth stimulating signal normally used by the pathogen. CUS discovered were greenhouse tested against FHB and the best strains field tested for efficacy against *G. zeae*.

2. What were the most significant accomplishments?

We demonstrated that UV protectant compounds enhanced the survival of bacterial FHB antagonist OH 131.1 *in vitro* and occasionally benefited the efficacy of OH 131.1 and OH 182.9 in the field. UV light can be devastating to the survival of microbial cells. We used a novel microtiter plate assay and an Atlas CPS solar simulator to discover that a water soluble sodium salt of lignin (Westvaco PC1307 experimental product, Charleston, SC) and the optical brightener Blankophor BBH (Sigma, Detroit, MI) enhanced the survival of cells exposed to 6 h of artificial sunlight from a xenon light source compared to controls (11% and 26 % reduction in UV-protected cell absorbances, respectively, compared to a 51% reduction in unprotected controls). Both UV-protectant compounds were effective at every concentration tested. When the lignin UV-protectant was tested in field trials on two wheat varieties in Peoria, IL and Wooster, OH, results were variable with the protectant further reducing FHB severity by 15% in a plot treated with our effective OH 182.9 antagonist yet showing no benefit in other cases. Formulations to resist wash-off of UV protectants would likely improve their field performance.

We discovered CUS to potentially combine with efficacious strain *Cryptococcus nodaensis* OH 182.9 from a microbial collection obtained from wheat anthers. 122 CUS were identified out of 738 (16.5%) assayed using a colorimetric, choline oxidase-based bioassay. Of 6 CUS tested at two field sites on two wheat varieties, 4 reduced FHB symptoms at both sites on both wheat varieties with Gram + bacterial strain AS 54.6 reducing disease severity by 17-60% on Pioneer 2545. Microbial strains OH 221.3 and AS 64.4 were also effective. OH 221.3 reduced FHB severity from 39-68% on Freedom and 5-32% on Pioneer 2545 while AS 64.4 reduced FHB severity from 50-62% on Freedom and 3-35% on Pioneer 2545.

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 your grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Publications

Khan, N.I., Schisler, D.A., Boehm, M.J., Lipps, P.E., and Slininger, P.J. 2004. Field testing of antagonists of *Fusarium* head blight incited by *Gibberella zeae*. *Biological Control* 29:245-255.

Schisler, D.A., Slininger, P.J., Behle, R.W., Zhang, S., Boehm, J.J., Lipps, P.E., and Palmquist, D.E. USDA-ARS, Ohio State University cooperative research on biologically controlling *Fusarium* head blight 1: *in vitro* and field testing of the effect of UV protectants on FHB antagonists. Proceedings of the 2003 National *Fusarium* Head Blight Forum, Kinko's, Okemos, MI. pp. 105-108.

Yuen, G.Y., Jochum, C.C., Bleakley, B.H., Ruden, K.R., Draper, M.A., Schisler, D.A., Zhang, S., Boehm, M.J., Lipps, P.E., and Bergstrom, G.C. 2003. Proceedings of the 2003 National *Fusarium* Head Blight Forum, Kinko's, Okemos, MI. pp. 113-115.

Zhang, S., Schisler, D.A., Boehm, M.J., and Slininger, P.J. 2003. USDA-ARS, Ohio State University cooperative research on biologically controlling *Fusarium* head blight 2: effects of carbon-to-nitrogen ratio of production media on the biocontrol efficacy and the survival of *Cryptococcus nodaensis* OH 182.9 after freeze-drying. Proceedings of the 2003 National *Fusarium* Head Blight Forum, Kinko's, Okemos, MI. pp. 116-119.

*Abstracts**

Core, A.B., Schisler, D.A., Hicks, T.E., Zhang, S., Lipps, P.E., and Boehm, M.J. 2003. Population dynamics of the *Fusarium* head blight biocontrol agent *Cryptococcus nodaensis* OH 182.9 on wheat. Proceedings of the 2003 National *Fusarium* Head Blight Forum, Kinko's, Okemos, MI. p. 65.

Core, A.B., Schisler, D.A., Hicks, T.E., Lipps, P.E., and Boehm, M.J. 2003. Survival of the *Fusarium* head blight biocontrol agent *Cryptococcus nodaensis* OH 182.9 on wheat. *Phytopathology* 93(6):S17-18.

Schisler, D.A. Formulation of *Bacillus* spp. for biological control of plant diseases. *Phytopathology* 93(6):S117.

Schisler, D.A., Behle, R.W., Slininger, P.J., and Jackson, M.A. 2003. Production and formulation of microbial products active against plant pests. Proceedings of the II Moscow International Congress of Biotechnology: State of the art and prospects of development, P&I JSC "Maxima", Moscow, Russia. p. 263.

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Zhang, S., Schisler, D.A., and Boehm, M.J. 2003. Effect of C/N ratios of production media on the survival of *Cryptococcus nodaensis* OH 182.9 after freeze-drying. *Phytopathology* 93(6):S94.

* Poster or oral presentations of research results were associated with each of these abstracts.