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:	Frances Trail
Institution:	Michigan State University
Address:	Department of Botany & Plant Pathology 342 Plant Biology Lab East Lansing, MI 48824
E-mail:	trail@msu.edu
Phone:	517-432-2939
Fax:	517-353-1926
Fiscal Year:	2006
USDA-ARS Agreement ID:	59-0790-6-068
USDA-ARS Agreement Title:	Starch Degradation by *Gibberella zeae* and its Role in Fueling Development.
FY06 ARS Award Amount:	$ 54,215

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
PGG	Starch Degradation by Gibberella zeae and its Role in Fueling Development.	$ 54,512
	Total Award Amount	**$ 54,215**

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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: *Starch Degradation by Gibberella zeae and its Role in Fueling Development.*

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

Fusarium graminearum stores up large quantities of lipids prior to plant senescence (Guenther and Trail, 2005). These reserves are probably used during overwintering and to fuel conidia and ascospores for the next disease cycle. The storage of this material appears to be unique among the Fusaria and we believe that without it, little inoculum would be produced in the spring. The present work is to further characterize the nutritional relationship between fungus and plant. We are looking at the amylases and maltases that are critical to degrading seed starch and resulting in the shrunken, tombstone kernels. Those nutrients are then used, under field conditions, to produce inoculum. In storage, they are used to produce mycotoxins.

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: We have generated a mutant to the gene form alpha-amylase. We have shown that this strain no longer grows on starch. Initial experiments appear to show it is reduced in its ability to produce zearalenone. In addition, it is weakened in its ability to colonize wheat kernels and has reduced pathogenicity in the floret-inoculation test. We have also mutated 2 maltases, but full characterization is not yet accomplished. The post-doc doing this work joined my lab in Jan 2007, so the work will run for another 5 months, which should be ample time to complete it.

Impact: Amylase inhibitors have been used for insect control. Some exist naturally in wheat. If we find that amylases severely inhibit mycotoxin production and the ability of the fungus to infect kernels, it may be worthwhile investigating the engineering of wheat (or perhaps breeding of wheat) to enhance production of these natural inhibitors.

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?
It is important to identify potential sources of additional resistance that may be introduced into wheat/barley to control the scab disease. This work may result in an additional source of resistance. In addition, understanding where and how the fungus uses energy sources to complete its life cycle will allow us to identify life-cycle dependent stages that we can target to reduce fungal proliferation.

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.

Papers funded by USWBSI (* indicates peer-reviewed):

Identification of two genes in *Gibberella zeae* necessary for spore discharge. 2007. Heather Hallen, Brad Cavinder and Frances Trail. Asilomar, CA, March.

2007. Weaving a life story: Studies on the disease cycle of *Fusarium graminearum* on wheat Invited seminar, Robert Gilmer Memorial. Plant Pathology Department, Cornell University.

2007. Perithecium development and ascus function in *Gibberella zeae* Invited talk. Fungal Genetics Conference, Asilomar, CA

2006. Analysis of polyketide synthesis in the life cycle of *Fusarium graminearum.* Invited talk. World Mycotoxin Conference. Cincinnati, OH, November.

2006. Integration of mycotoxin expression into the life cycle of *Fusarium graminearum.* USWBSI satellite meeting on DON synthesis. Detroit Michigan. October.

2006. Sexual development in *Fusarium greaminearum*: From corpulent hyphae to shooting spores. Invited seminar. Department of Botany and Plant Pathology, Purdue University, West Lafayette IN. August.

*Qi, W., Kwon, C. and F. Trail. 2006. Microarray analysis of transcript accumulation during perithecium development in *Gibberella zeae* (anamorph *Fusarium graminearum*). Molecular Genetics and Genomics 276:87-100.

*Trail, F., Gaffoor, I., and Vogel, S. 2005. Ejection mechanics and trajectory of the ascospores of *Gibberella zeae* (anamorph *Fusarium graminearum*). Fungal Genetics and Biology: *42:528-533*

*Guenther, J. and Trail, F. 2005. The development and differentiation of *Gibberella zeae* (anamorph: *Fusarium graminearum*) during colonization of wheat. Mycologia 97 (1): 232-240. COVER.

*Trail, F., Xu, J.-R., San Miguel, P., Halgren, R. G. and Kistler, H. C. 2003. Analysis of Expressed Sequence Tags from *Gibberella zeae* (anamorph *Fusarium graminearum*). Fungal Genetics and Biology 38:187-197.

Related peer reviewed journal articles with complementary funding sources:

Hallen, H., Huebner, M., Shiu, S.-H., Guldener, U., and F. Trail. 2007. Gene expression shifts during perithecium development in *Gibberella zeae* (anamorph *Fusarium graminearum*), with particular emphasis on ion transport proteins. Fungal Genetics and Biology. *In press.*

Trail, F. 200-. Fungal cannons: Explosive spore discharge in the Ascomycota. *In press.*

Goswami, R., Xu, J.R., Trail, F. Hilburn, K. and H. C. Kistler. 2006. Genomic analysis of host-pathogen interaction between *Fusarium graminearum* and wheat during early stages of disease development. Microbiology 152:1877-1890.

Gueldener, U., K.-Y. Seong, J. Boddu, S. Cho, F. Trail, J.-R. Xu, G. Adam, H.-W. Mewes, G.J. Muehlbauer, and H. C. Kistler. 2006. Development of a *Fusarium graminearum* Affymetrix GeneChip For profiling fungal gene expression *in vitro* and *in planta.* Fungal Genetics and Biology, 43 (5): 316-325.

Gaffoor, I., and F. Trail. 2006. Characterization of two polyketide synthase genes involved in zearalenone biosynthesis in *Gibberella zeae.* Appl. and Environ. Microbiol. 72:1793-1799.

Trail, F., I. Gaffoor, J. Guenther, and H. Hallen. 2005. Using genomics to understand the disease cycle of the Fusarium head blight fungus, *Gibberella zeae* (anamorph *Fusarium graminearum*). Can. J. Plant Path. 27:486-498.

Gaffoor, I., Brown, D. W., Plattner, R., Proctor, R. H., Qi, W., and Trail, F. 2005. Functional analysis of the polyketide synthase genes in the filamentous fungus *Gibberella zeae* (anamorph *Fusarium graminearum*). Euk Cell. 4:1926-1933.

Trail, F., Xu, H., Loranger, R. and Gadoury, D. 2002. Physiological and environmental aspects of ascospore discharge in *Gibberella zeae*. Mycologia 94:181-189.

Trail, F. and R. Common. 2000. Perithecial development by *Gibberella zeae*: A light microscopy study. Mycologia 92:130-138.