USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY12 Final Performance Report
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Cover Page

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Fiscal Year:	FY12
USDA-ARS Agreement ID:	59-0206-1-120
USDA-ARS Agreement Title:	Interactions of *Fusarium graminearum*, the Head Scab Pathogen, with Wheat and Barley.
FY12 USDA-ARS Award Amount:	$ 97,612[*]

USWBSI Individual Project(s)

USWBSI Research Category[**]	Project Title	ARS Award Amount
BAR-CP	Understanding Routes for Barley Infection.	$ 50,955
PBG	Elucidating Alsen Resistance to *Fusarium* Ingress.	$ 46,657
	Total ARS Award Amount	**$ 97,612**

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Principal Investigator Date

[*] Partial funding for this research is under ARS agreement # 59-0206-9-057

[**] MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Understanding Routes for Barley Infection.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

Previously we showed that *Fusarium graminearum* interacts in a specific way with trichomes to coloize the lemma and palea. Since these bracts become the seed coat, reduction of infection at this stage would lower the risk of mycotoxin contamination and yield reduction in the host. We are investigating the use of trichome-less varieties to enhance resistance to *F. graminearum.*

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment:

Trichome mutants have been collected and grown. We collected 13 varieties; between the US and Canada, that have differences in trichomes and are screening these for ability of *F. graminearum* to infect. Some trichome-less varieties do not produce trichomes, but silica cells remain in their stead. These silica cells are the natural base of the trichomes (when trichomes are present). Our progress on the rest of the project is as follows:
1: Are trichomes important in the interaction? Results so far indicate that trichomes are important to accessing the two main vascular bundles of the lemma and palea.
2: Compare the fungal:barley interaction through gene expression in resistant and susceptible cultivars. In observing infection of Stander vs. Quest, Stander allows the fungus to rapidly penetrate and cause disease, which is delayed in Quest. By day 3 after inoculation, the difference in infection can be seen. We are currently sequencing the mRNA in this tissue for both varieties at day 3, to identify gene expression changes that may define this type of resistance.

Impact:

If access to vascular bundles allows the fungus to colonize and spread to the developing seed, then elimination of the trichomes could provide an additional benefit of reducing colonization and inoculum establishment.

Project 2: *Elucidating Alsen Resistance to Fusarium Ingress.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   Previously, during a detailed study of the scab resistant variety Alsen, we identified the ability of Alsen to purge *F. graminearum* during the process of infection and colonization. The goal of this project is to elucidate this process in Alsen, so it can be more effectively exploited in varietal resistance development. We are taking a three-fold approach: (1) identify the precise timepoint of this occurrence; (2) determine the involvement of DON in the interaction; (3) Compare the details of colonization of grain in Alsen versus the susceptible Wheaten.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   Accomplishment:

   We have identified the resistance response as setting in on day 21 post inoculation. At this point, the infection stops its slow forward move and begins to be purged. Preliminary data suggest that the process is accompanied by a decrease in DON accumulation, but at this point we do not understand the underlying cause of this observation.

   Impact:

   Identification of the mechanism whereby Alsen purges *F. graminearum* has implications for reduction in high DON/asymptomatic grain, as a mechanism that does not allow small amounts of mycelia to remain in kernels could be highly effective in reducing this phenomenon.

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.

Harrison, N., Cavinder, B., Townsend, JP, and Trail, F. 2013. Optimized primers and other critical conditions for efficient fusion PCR to generate knockout vectors in filamentous fungi. Fungal Genetics Reports 60: 1-10.

Trail, F, DM Gardiner. Application of genomics to the study of pathogenicity and development in *Fusarium.* Invited review to The Mycota series. *In Press.*

Ma, L-J, DM Geiser, RH Proctor, AP Rooney, K O'Donnell, F Trail, DM Gardiner, JM Manners, K Kazan. Fusarium Pathogenomics, Invited review to Annual Review of Microbiology, *In Press*.

Trail, F., B. Cavinder. Hold fire: Spore release in the Ascomycota. Invited review to Fungal Biology Reviews. *In revision.*

Trail, F. 2013. Sex and Fruiting in Fusarium. *In, Fusarium*: genomics, molecular and cellular biology. Daren Brown and Robert Proctor, *eds.* Horizon Scientific Press and Caister Academic Press, Norwich, UK.

Public presentations:

Trail, F. New strategies to control head scab in wheat. Talk presented to the Wheat College, East Lansing Michigan, June 2013.

Trail, F. The life cycle of a head blight pathogen, *Fusarium graminearum,* and its importance to agriculture. Invited talk, European Fusarium Seminar, Bordeaux, France, May, 2013.

Trail, F. Genetics of forcible spore discharge in fungi. Invited talk to be given at Université Nice, Nice France, May. 2013.

Trail, F, U Sikhakolli, K Fellows, N Lehr, JP Townsend. Comparative transcriptomics identifies new genes for perithecium development. Fungal Genetics Conference, Asilomar, CA, March. 2013.

Trail, F. Unraveling the genetics of perithecium form and function in *Fusarium graminearum.* Fungal Genetics Conference, Fusarium meeting, Asilomar, CA, March. 2013.

Trail, F. The secret lives of fungi: the good, the bad and the ugly. Given to the local chapter of the Wild Ones native plant society. February 2013.

Trail, F. Dissecting the machinery of the fungal cannon. Department of Applied Mathematics. Harvard University, Cambridge MA. December 12, 2012.

Trail, F., and H. Hallen-Adams. 2012. Establishing strategies for control of mycotoxins in corn. Corn Utilization Conferences, Indianapolis, June.

Trail, F. The Impact of the Fusarium graminearum Genome Sequence on the Quest for Control of Head Blight. National Fusarium Head Blight Forum, Orlando, FL. December. 2012.

2012. Trail, F. and Drew Afton. Host colonization leading to sporulation in *Fusarium graminearum.* Special Session at the American Phytopathological Society Meetings. Providence RI. August.

2012. Lessons learned from genomic studies of toxigenic Fusarium species. Invited talk. EU Mycored Conference. Ottawa, Canada, June.