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

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USDA-ARS Agreement Title:	A Rapid Assay System for Trangenes that Confer Resistance to DON and FHB.
FY06 ARS Award Amount:	$ 48,413

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
GET	A Rapid Assay System for Trangenes that Confer Resistance to DON and FHB.	$ 48,413
	Total Award Amount	**$ 48,413**

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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: *A Rapid Assay System for Trangenes that Confer Resistance to DON and FHB.*

1. **What major problem or issue is being resolved and how are you resolving it?**
There is a pressing need for germplasm and genes that can enhance resistance of wheat and barley to FHB and prevent the accumulation of DON. The functional screening of candidate genes requires assay systems that have efficient transformation and regeneration. It is difficult to perform such studies in wheat and barley, owing to their low efficiency of transformation. To overcome this hurdle, we developed a rapid and efficient gene assay system based on the recombinogenic plant *Physcomitrella patens*, which serves as a 'green yeast' and which allows gene function to be rapidly assessed through gene knockout or overexpression. Importantly, Physcomitrella is sensitive to the mycotoxins DON and DAS and is also susceptible to infection with FHB. The utility of this system was demonstrated by expressing genes that confer resistance to DON and to FHB. These results indicate that Physcomitrella can be a useful system for assessing the anti-fungal properties of genes prior to their deployment in wheat and barley.

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 shown that Physcomitrella is sensitive to the fungal toxins DON and DAS and is susceptible to FHB. The susceptibility of Physcomitrella to mycotoxins and FHB can be markedly reduced through the expression of transgenes that express a mutated ribosomal L3 protein or by genes that suppress plant programmed cell death. Resistance to FHB and mycotoxins is conferred independent of whether the cognate genes are derived from yeast, Arabidopsis, wheat or barley, indicating that the mechanisms of resistance uncovered in these studies are highly conserved. These results suggest that the similar expression of these genes in barley or wheat may confer a similar level of resistance to DON and FHB. They also indicate that the overall approach of screening for novel antifungal genes in Physcomitrella is valid, and can be extended to larger-scale screens for novel antifungal genes.

Impact: These results provide a rationale for the construction of transgenic wheat and barley plants expressing the cognate antifungal genes already expressed in Physcomitrella. Such transgenic crop plants may display enhanced resistance to FHB and a lowered incidence of contamination with DON and DAS. This example displays the potential impact of a rapid assay system for antifungal genes. There are potentially many additional antifungal effective against FHB and DON and these can be rapidly and inexpensively screened for activity against FHB in Physcomitrella.

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?

Development of the Physcomitrella rapid assay system provides the research community with a valuable new tool for gene discovery and for prioritizing the deployment of genes in transgenic wheat and barley plants. For agriculture, this provides a rapid route to identify new sources of FHB resistance. This is a significant development, given the paucity of natural FHB resistance within extant accession of wheat and barley. Collaboration with researchers in the USWBSI who have expertise in transformation of wheat and barley provides a direct route to deployment of these novel sources of FHB resistance in wheat and barley.

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.

Presentations

Genetic manipulation of cell death induced by mycotoxins in Physcomitrella. H. Saidasan and M.A. Lawton. Moss 2006, June 28-July 1, 2006, Berkeley, CA.

Physcomitrella patens: a genetically tractable system for studying Fusarium Head Blight. H. Saidasan and M.A. Lawton. Stadler Genetics Symposium: 'Genomics of Disease', Oct 2-4, 2006, Columbia, MO.

Physcopathology. *in* 'Sulfur-containing defense compounds: Pivotal players in plant stress tolerance'. M.A. Lawton and H. Saidasan, Oct 7th, 2006, Heidelberg, Germany.

Physcopathology: the genetic control of death and disease in *Physcomitrella patens.* M.A. Lawton. Oct 9th, 2006, University of Freiburg, Germany.

Physcomitrella patens: a genetically tractable system for studying Fusarium Head Blight. H. Saidasan and M.A. Lawton. 2006 National Fusarium Head Blight Forum, Dec 10-12, 2006 Research Triangle Park, NC.

Physcomitrella patens: a genetically tractable system for studying Fusarium Head Blight. H. Saidasan and M.A. Lawton. Jan 25, 2007. Rutgers University Microbiology Symposium, New Brunswick, NJ.

Physcomitrella patens: a model genetic system for understanding susceptibility to Fusarium Head Blight. H. Saidasan and M.A. Lawton. 5th Tripartite Symposium in Biotechnology and BioEnergy, April 9-12, 2007, New Brunswick, NJ.