USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY05 Final Performance Report (approx. May 05 – April 06)
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Cover Page

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Fiscal Year:	**2005**
FY05 ARS Agreement ID:	**58-5430-2-327**
Agreement Title:	**Diversity of American, Asian and Australian Populations of Gibberella zeae.**
FY05 ARS Award Amount:	**$ 52,500**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
EDM	Diversity of American, Asian and Australian Populations of Gibberella zeae.	$ 52,500
	Total Award Amount	**$ 52,500**

17 July 2006
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: *Diversity of American, Asian and Australian Populations of Gibberella zeae.*

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

Recently it has been proposed that the nine lineages described within the species *G. zeae* should actually be elevated to distinct species. While considerable genetic diversity in gene sequence does exist between the lineages, the lineages are not reproductively isolated under laboratory conditions suggesting that the lineages are not distinct species under the biological species concept.

We have been characterizing the genetic diversity in 472 isolates of *G. zeae* that had been collected from around South America from (wheat and sorghum). How does genetic variability compare among and within lineages of *G. zeae*? Is there any evidence in this population for naturally occurring "hybrids" between the lineages? We also have been working with smaller populations from Australia/Oceania and Korea. The populations in all three locations differ from those found in the United States in that strains from multiple lineages occur in these locations, and only one lineage, lineage 7, is known from the United States.

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:

Amplified Fragment Length Polymorphisms (AFLPs) were used to initially assign each of the 472 isolates from South America to one of the nine lineages. Currently the AFLP haplotype of each isolate is being compared to DNA sequence data from four genes [Mating Type (*MAT*), *TRI-101*, Reductase (*RED*), and β-tubulin (*TUB2*)]. Sequencing of portions of all four genes for each of these isolates is nearly complete. Preliminary results show considerable variability not only among, but also within lineages.

Haplotype networks assembled from the sequence data of the genes *MAT*, *TRI-101* and *RED* are not homologous with regards to the association of the lineages. This lack of concordance between gene genealogies is consistent with a hypothesis that these lineages are distinct but that all form a part of a single species and should not yet be accorded species status. The polytomies that characterize these genealogies also are consistent with all nine lineages being members of the same species rather than members of a number of different species. One isolate has a *TRI-101* sequence that is a hybrid between lineages 2 and 7, demonstrating that gene flow and recombination can occur between the lineages under field conditions.

Australian/Oceania and Korean data are similar in nature to the South American data, but not as detailed. In Australia/Oceania, many of the AFLP haplotypes do not resolve into identifiable lineages, but instead to be possible intermediates. In Korea, the hybrids being observed appear to occur between lineages 3 and 7; a combination not found in South America where lineage 3 is not present in our samples.

Impact:

Taxonomic status of *G. zeae*/*F. graminearum* is of critical importance for plant quarantine and trade measures. If there are a number of species then each must be treated separately and the

presence/absence of a particular species can be used as a non-tariff trade barrier. Our results strongly suggest that while isolated populations of *F. graminearum* exist, these populations are not reproductively isolated and should be recognized as portions of a single, large, diverse species rather than as nine discrete entities. Such recognition would not materially impact the plant quarantine regulations currently in place, nor alter the application/implementation of current trade practices.

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?:

The question of how different strains of F. graminearum need to be named is controversial. Using morphology and cross-fertility as measures, the nine lineages are not resolvable, although with DNA sequence markers there is evidence that most isolates can be resolved into particular lineages. Some unresolvable isolates appear to be natural hybrids between lineages and these demonstrate that different lineages can exchange genetic information

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.

Books:

1. Leslie, J. F. & B. A. Summerell. 2006. *Fusarium* Laboratory Manual. Blackwell Professional Publishing, Ames, Iowa. 385 pp.

Refereed journal articles:

2. Bentley, A. R., M. G. Cromey, M. G., R. Farrokhi-Nejad, J. F. Leslie, B. A. Summerell & L. W. Burgess. 200x. *Fusarium* crown and root rot pathogens associated with wheat and grass stem bases on the South Island of New Zealand. (in press).

3. Leslie, J. F. & B. A. Summerell. 2006. *Fusarium* Laboratory Workshops – A recent history. *Mycotoxin Research* (in press).

4. Schmale, D. G., J. F. Leslie, K. A. Zeller, A. A. Saleh, E. J. Shields & G. C. Bergstrom. 2006. Genetic structure of atmospheric populations of *Gibberella zeae*. *Phytopathology* (in press).

Abstracts and meeting presentations:

1. Bowden, R. L., J. F. Leslie, J. Lee, & Y.-W. Lee. 2005. Cross fertility of lineages of *Gibberella zeae*. *Fungal Genetics Newsletter* **52 (Supplement):** 60.
2. Bowden, R. L., J. F. Leslie, J. Lee, & Y.-W. Lee. 2006. Cross fertility of *Gibberella zeae*. CIMMYT Fusarium Head Blight Workshop on the Global Fusarium Initiative for International Collaboration. March 14-17, 2006. El Batan, Mexico.
3. Leslie, J. F. & R. L. Bowden. 2005. Field populations of *Gibberella zeae*. *Proceedings of the 2005 National Fusarium Head Blight Forum* (Milwaukee, Wisconsin): 166.
4. Leslie, J. F., A. A. Saleh & R. L. Bowden. 2005. Naturally occurring hybrids of *Fusarium graminearum*. *Phytopathology* **95:** s58.
5. Schmale, D. G., III, J. F. Leslie, R. L. Bowden, K. A. Zeller, A. A. Saleh, E. J. Shields & G. C. Bergstrom. 2005. Genetic structure of atmospheric populations of *Gibberella zeae*. *Proceedings of the 2005 National Fusarium Head Blight Forum* (Milwaukee, Wisconsin): 149.
6. Schmale, D. G., III, J. F. Leslie, A. A. Saleh, E. J. Shields, and G. C. Bergstrom. 2005. Temporal scales of genetic diversity within New York atmospheric populations of *Gibberella zeae*. *Proceedings of the 2005 National Fusarium Head Blight Forum* (Milwaukee, Wisconsin): 150.

Dates and locations of invited presentations by Dr. Leslie that contained information from this project but for which there is no published abstract:

1. US/EU Joint Workshop on Mycotoxins, New Orleans, Louisiana; July 2005.
2. Korean Society of Plant Pathology, Daejeon, South Korea; August 2005.
3. School of Biological Sciences, Science University of Malaysia, Penang, Malaysia; August 2005.
4. Faculty of Medicine, Science University of Malaysia, Kota Baru, Malaysia; August 2005.
5. School of Integrative Science, College University of Technology & Management Malaysia, Kuala Lumpur, Malaysia; August 2005.
6. Padang University, Padang, Indonesia; August 2005.
7. Conference on Reducing Impact of Mycotoxins in Tropical Agriculture with Emphasis on Health and Trade in Africa, Accra, Ghana; September 2005.
8. International Institute for Tropical Agriculture, Ibadan, Nigeria; September 2005.
9. Hohenheim University, Stuttgart, Germany; October 2005.
10. Leibnitz Institute for Applied Biotechnology, Jena, Germany; October 2005.
11. Mycoglobe South American Conference, Villa Carlos Paz, Argentina; March 2006.
12. Greenwood Genetics Center, Greenwood, South Carolina June, 2006.