

**U.S. Wheat and Barley Scab Initiative
 FY00 Final Performance Report (approx. May 00 – April 01)
 July 30, 2001**

Cover Page

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Grant Number:	59-0790-9-029
Grant Title:	Fusarium Head Blight Research
2000 ARS Award Amount:	\$44,581

Project

Program Area	Project Title	Requested Amount
Epidemiology & Disease Management	Genetics and Diversity of Gibberella zeae.	\$45,696.00
	Requested Total	\$45,696.00¹

Principal Investigator

Date

¹ Note: The Requested Total and the Award Amount are not equal.

Project 1: Genetics and Diversity of *Gibberella zeae*.

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

This research examines the genetic diversity and potential for genetic recombination in the FHB pathogen, *Fusarium graminearum* (*Gibberella zeae*). The information will help us understand the variability in the pathogen and help estimate the possibility of new highly aggressive types developing from crosses between pathogen lineages from different geographic locations. It may also identify genetic targets in the pathogen for resistance breeding or biotechnology solutions.

The research objectives of this project are: 1) to determine genetic diversity at field, regional, and continental levels; 2) to search for evidence of population subdivision, migration, sexual recombination, or adaptation in the pathogen; 3) to create genetic maps of *G. zeae* and map important traits such as toxin production; 4) to determine possible infertility across distantly related lineages of the pathogen, and 5) to study segregation of aggressiveness in crosses of pathogen strains in order to identify virulence factors.

What were the most significant accomplishments?

In 1999, we surveyed wheat scab populations from five states within the U.S. Corn Belt. We isolated *Fusarium* samples either directly from scabby wheat heads, or from individual seeds within contaminated seedlots. We have examined 42 polymorphic Amplified Fragment Length Polymorphisms (AFLP) loci for 71-75 randomly selected *Fusarium* isolates from each tested population. The percentage of these isolates that we identified as *Fusarium graminearum* (*Gibberella zeae*) ranged from a low of 79% (56/71) from an Illinois seedlot, to 100% (71/71) from a Kansas wheat head sampling. Divergence among *F. graminearum* populations from these five states was low. Pairwise G_{ST} values ranged from only 0.013 to 0.040, and indicate high rates of effective migration (Nm) between populations. We observed a positive, but statistically insignificant, correlation ($r = 0.46$, $p = 0.18$) between inter-population geographic distance and G_{ST} values. These data provide support for the hypothesis that regional populations of *F. graminearum* within the U.S. Corn Belt are part of a single, largely panmictic, metapopulation.

We constructed a genetic linkage map of *Gibberella zeae* (*Fusarium graminearum*) by crossing nitrate non-utilizing (*nit*) mutants of *G. zeae* strains R-5470 (from Japan) and Z-3639 (from Kansas). Ninety-nine Nit^+ progeny were selected and analyzed for Amplified Fragment Length Polymorphisms. We used 34 pairs of two-base selective primers to identify 1051 polymorphic markers that mapped to 502 unique loci on nine linkage groups. The total map length is approximately 1300 centiMorgans with an average interval of 2.5 map units between loci. Three of these linkage groups have high levels of segregation distortion, with selection of Nit^+ recombinant progeny accounting for two of the three skewed regions. Two linkage groups appear to have intercalary inversions. Loci governing trichothecene toxin amount and type (deoxynivalenol versus nivalenol) map on linkage groups IV and I, respectively. This linkage map will be useful in population genetic studies, map-based cloning, QTL analysis, ordering genomic libraries, and comparisons with related species.

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.

1. Alexander, N. J., Plattner, R. D., Bowden, R. L. and Leslie, J. F. 2001. Linkage of molecular markers with trichothecene chemotypes in *Gibberella zeae*. XXI Fungal Genetics Conference. Fungal Genetics Newsletter, Vol. 48- Supplement. Page 158.
2. Bowden, R. L. 2000. Pathogen population diversity and genetics. Oral presentation. 2000 National Fusarium Head Blight Forum, Cincinnati, OH. Dec. 11, 2000.
3. Bowden, R. L. 2001. Wheat scab fungus study includes Illinois samples. Newsletter of the Illinois Wheat Association. Spring, 2001.
4. Bowden, R. L., Zeller, K. A., Jurgenson, J. E., and Leslie, J. F. 2000. Population structure and genetics of *Gibberella zeae*. Pp 84-86 In: Canadian Workshop on Fusarium Head Blight. Winnipeg, Manitoba, Nov. 28-30, 1999. 140 pp.
5. Bowden, R.L., Zeller, K.A., and Leslie, J.F. 2000. Population structure of *Gibberella zeae* in the Great Plains of North America. Page 211-213 IN: Proceedings of the International Symposium on Wheat Improvement For Scab Resistance. 5-11 May, 2000, Suzhou and Nanjing, China.
6. Jurgenson, J.E. R. L. Bowden, K. A. Zeller, J. F. Leslie, N. A. Alexander, and R. D. Plattner 2000. AFLP Linkage map of *Gibberella zeae*. (poster). 2000 National Fusarium Head Blight Forum, Cincinnati, OH. Dec. 11, 2000.
7. Jurgenson, J.E., R. L. Bowden, K. A. Zeller, J. F. Leslie, N. A. Alexander, and R. D. Plattner. A genetic map of *Gibberella zeae* (*Fusarium graminearum*). (manuscript to be submitted to Eukaryotic Cell, Aug. 2001).
8. Jurgenson, J.E., R. L. Bowden, K. A. Zeller, J. F. Leslie, N. A. Alexander, and R. D. Plattner. AFLP linkage map of *Gibberella zeae*. XXI Fungal Genetics Conference. Fungal Genetics Newsletter, Vol. 48- Supplement. Page 77.
9. Jurgenson, J. E, R. L. Bowden, K. A. Zeller & J. F. Leslie. 2000. AFLP Linkage map of *Gibberella zeae*. (poster) *Phytopathology* 90: s40.
10. Zeller, K. A., R. L. Bowden & J. F. Leslie. 2000. AFLP diversity of *Fusarium graminearum* (*Gibberella zeae*) in two wheat-scab epidemic populations. *Inoculum* 51(3): 69.