U. S. Wheat & Barley Scab Initiative

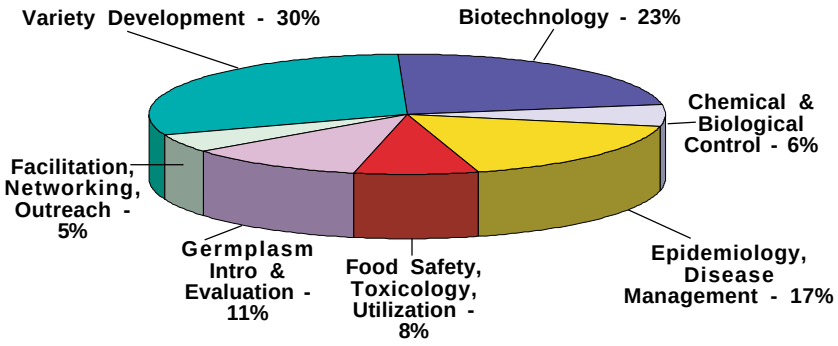
Fusarium Focus

Volume 4 • Issue 2 Summer 2002

Over 100 FHB Research Projects Funded Through FY02 Initiative

The $5 million U.S. Wheat and Barley Scab Initiative in the 2002 federal fiscal year involves 83 principal investigators working on 109 projects, carried out in 26 states at 25 land grant universities, the International Maize and Wheat Improvement Center (CIMMYT) and the U.S. Department of Agriculture's Agricultural Research Service, which funds the Initiative. The breakdown in FY02 funding by research area is outlined in the graph. An explanation of each program area and its research priority, along with a detailed listing of research projects, principal investigators, and funding amounts for FY02 is summarized on the following pages. The Request for Pre-proposals (RFP) for FY03 will be announced in early July, according to Sue Canty, manager of the USWBSI Networking and Facilitation Office at Michigan State University.■

U.S. Wheat and Barley Scab Initiative, FY02 Funding by Research Program Area



2002 FHB Research Forum Dec. 7-9, Cincinnati

The 2002 Fusarium Head Blight Research Forum will be held at the Holiday Inn-Cincinnati Airport, tentatively beginning at 1 p.m. on Saturday, Dec. 7 and concluding at noon on Monday, Dec. 9, 2002. More program details will be disseminated and announced on the Initiative web site, www.scabusa.org, and through the Scab Listserver.

Upcoming Events

European Symposium "*Fusarium* - Mycotoxins, Taxonomy And Pathogenicity," Sept 4-8, 2002, Poznan, Poland, Department of Chemistry, August Cieszkowski Agricultural University. See link to more information at www.scabusa.org

Tri-Annual North American Barley Researchers Workshop, Sept. 22-25, 2002, Fargo, N.D.: www.ndsu.nodak.edu/ndsu/plant_sciences/NABRW/

2002 National Fusarium Head Blight Forum, December 7-9, 2002, Erlanger, KY: www.scabusa.org

Barley Improvement Conference, San Francisco, Jan 7-9, 2003: www.ambainc.org/ni/index.htm

USWBSI FY02: Biotechnology Research

The Biotechnology research area encompasses both basic and applied research aimed at characterizing and creating germplasm resistant to Fusarium head blight. This research area involves transformation, gene discovery and mapping to help develop FHB and DON resistant cultivars of wheat, barley and durum.

This transformation effort is focused on developing novel germplasm for FHB resistance. In particular, the transformation effort involves the insertion and testing the effects of anti-fungal and anti-toxin genes, and the development of transient expression systems to test the effects of gene constructs on Fusarium growth.

The gene discovery aspect involves identifying additional genes that may reduce FHB and DON, and the isolation of promoter/controlling sequences to target transgene expression. Studies of molecular mechanisms governing host resistance and susceptibility will be used to discover new genes for the transformation efforts.

Mapping research includes locating FHB and DON resistant quantitative trait loci (QTLs) in new resistance sources, confirmation of existing QTL-marker linkage information, and efforts to saturation map QTL regions for eventual map-based cloning.

The Biotechnology research area of the U.S. Wheat & Barley Scab Initiative supports research efforts addressing one or more of the following priorities:

Transformation

- Transform wheat, barley and durum to demonstrate the effectiveness of anti-*Fusarium* transgenes to limit *Fusarium* infection, growth and spread in vitro, in growth chamber and greenhouse tests and, ultimately, in the field.
- As wheat and barley transformation often uses lines that perform poorly in the field or have poor end-use quality, transformation efforts should either use modern cultivars or consider moving potentially useful transgenes into modern wheat and barley commercial cultivars for more realistic field evaluations and better germplasm for use by plant breeders.

Gene/Promoter Discovery

- Identify more genes encoding effective anti-*Fusarium* proteins.

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FY02 Funds	Principal Investigator	Institution	Title
$60,000	Anderson, James	University of Minnesota	Mapping of FHB Resistance Genes in the Wheat Lines Wuhan 3 and Fujian 5114.
$54,500	Baenziger, Stephen	University of Nebraska - Lincoln	Enhanced Scab Resistance in winter Wheat Germplasm by Plant Transformation.
$40,000	Bai, Guihua	Oklahoma State University	Molecular Characterization of QTL for Scab Resistance in Wheat Cultivar Wangshuibai.
$71,000	Blechl, Ann	USDA-ARS	Engineering Improved Fusarium Resistance in Hexaploid and Durum Wheat.
$51,000	Bregitzer, P. Phil	USDA-ARS	Marker- and Plasmid-free Transgenic Barley Encoding Antifungal Proteins.
$110,000	Cregan, Perry	USDA-ARS	Microsatellite Marker Development and Mapping.
$34,624	Dahleen, Lynn	USDA-ARS	Spike-Specific Promoter Isolation from Bowman and Near-Isogenic Marker Lines.
$18,316	Faris, Justin D.	USDA-ARS	Molecular mapping of Fusarium head blight resistance genes in tetraploid wheat.
$28,000	Griffey, Carl A.	Virginia Tech	Identification, Characterization, and Confirmation of Major QTLs for Scab Resistance in Common Wheat.
$30,000	Kalavacharla, Venugopal S.	North Dakota State University	Saturation Mapping and Contig Development for Qfhs.ndsu-3AS, a Major FHB Locus in Durum Wheat.
$31,500	Kianian, Shahryar	North Dakota State University	Development of markers lined to FHB resistance in durum wheat.
$58,000	Kianian, Shahryar	North Dakota State University	Development of markers linked to FHB resistance in hexaploid wheat.
$50,000	Kleinhofs, Andris	Washington State University	Saturation mapping of a chromosome 3(3H) Fusarium head blight resistance QTL.
$67,000	Manoharan, Muthusamy	North Dakota State Univeristy	Development of Environment-Friendly Fusarium Head Blight Resistant Transgenic Plants in Barley and Durum Wheat.
$60,000	Muehlbauer, Gary	University of Minnesota	Enhancement of scab resistance in wheat and barley by plant transformation.
$58,000	Muehlbauer, Gary	University of Minnesota	Mechanisms and essential genes for wheat and barley scab resistance.
$50,000	Muthukrishnan, Subbaratnam	Kansas State University	Enhanced resistance to scab by genetic engineering with PR-protein genes.
$55,000	Sherwood, John	Montana State University	Control of Scab with Puroindoline-Containing Transgenic Wheat and Barley.
$48,673	Skadsen, Ronald W.	USDA-ARS	Genetic transformation of barley with an altered hordothionin gene.
$52,000	Smith, Kevin P.	University of Minnesota	Developing marker information for genetic diversity and FHB resistance in barley.
$54,000	Tumer, Nilgun	Rutgers, The State University of New Jersey	Modification of the Ribosomal Target to Enhance Resistance to Trichothecene Mycotoxins.
$21,467	Ward, Rick	Michigan State University	SSR Mapping of Novel FHB Resistance Genes from a Synthetic Hexaploid Wheat.
$40,000	Yen, Yang	South Dakota State University	Cloning and analysis of Fusarium and wheat genes essential to FHB development and resistance in wheat.
TOTAL: $1,143,080			

USWBSI FY02: Germplasm Introduction and Evaluation

Host plant resistance should offer breeders an economical tool for managing scab in small grain cereals, but breeding has been hindered by a lack of effective resistance genes. The discovery of new, genetically different sources of resistance is critical to the development of cultivars with effective levels of stable FHB resistance.

There is an urgent need to screen germplasm lines from different geographical regions in an effort to identify genetically different sources of resistance to this disease. In addition, there is a need to develop effective mechanisms for germplasm exchange through which new sources of scab resistance can be introduced into the United States. Where new sources of resistance are identified or acquired, and where the genetics of the sources are unknown, genetic analyses need to be conducted so that breeders can effectively use these new genes in their programs.

The Germplasm Introduction and Evaluation research area of the U.S. Wheat & Barley Scab Initiative supports research efforts addressing one or more of the following priorities:

- The discovery of new genes for resistance in wheat and barley through a systematic search of wheat and barley cultivars, breeding lines and land-races currently maintained in the National Small Grains Collection. Discovery within the primary gene pool of all commodities is of the highest priority followed by discovery within the secondary and tertiary gene pools respectively.
- Genetic analyses of newly identified or acquired sources of scab resistance in spring and winter wheat, durum and barley. In wheat, genetic studies of highest priority would be for highly resistant germplasm (comparable to e.g. Sumai 3) in which the source of resistance is not derived from well studied sources such as Sumai 3, Ning 7840 and, Frontana. Of low priority, are studies involving germplasm for which the pedigrees of accessions carrying the resistance suggest genes common with those in Chinese sources of resistance are already well studied. In barley, genetic studies of highest priority are those in highly resistant germplasm (comparable to CI4196), which carry genes thought to differ from those in Chevron or CI4196.
- Collaborative efforts that facilitate the introduction of highly resistant elite germplasm from international programs are of direct relevance to the germplasm research area.
- Recurrent selection research that will result in the rapid development of unique germplasm not currently found in breeding programs within the commodity. ■

Biotechnology • *from page 2*

- Identify more efficient screening methods to discover anti-*Fusarium* genes.
- Identify promoter sequences to target transgene expression to spike tissue.
- Characterize molecular mechanisms of host resistance to identify new resistance genes.

Mapping

- Map resistance genes from unmapped barley sources and wheat sources other than Sumai 3.
- Type II resistance from Sumai 3 is well mapped, but confirmation in other populations will be useful.
- Confirm existing linkage information in new populations.
- Saturation map QTL regions for map-based cloning.
- Less emphasis on marker development is needed as additional SSR markers have become publicly available. ■

FY02 Funds	Principal Investigator	Institution	Title
$30,975	Elias, Elias	North Dakota State University	Identify sources of resistance to Fusarium head blight in durum wheat.
$5,000	Franckowiak, Jerome D.	North Dakota State University	Resistance to FHB in wild barley associated with leaf rust locus Rph15.
$19,740	Horsley, Richard	North Dakota State University	Evaluation of barley germplasm for resistance to Fusarium head blight in an off-season nursery in China.
$29,300	Jauhar, Prem	USDA-ARS	Transfer of Fusarium head blight resistance from wild relatives into durum wheat.
$86,288	Jin, Yue	South Dakota State University	Maintain a germplasm center of scab resistant spring wheat.
$99,800	McKendry, Anne	University of Missouri	Winter Wheat Germplasm Introduction and Evaluation.
$140,000	Rajaram, Sanjaya	CIMMYT	Facilitate international germplasm and information exchange through CIMMYT.
$44,000	Shaner, Gregory	Purdue University	New Sources of Resistance to Fusarium Head Blight of Wheat.
$73,124	Steffenson, Brian	University of Minnesota	Evaluation of Barley Germplasm for Resistance to Fusarium Head Blight.
TOTAL: $528,227			

USWBSI FY02: Epidemiology and Disease Management

The purpose of the Epidemiology and Disease Management research area is to develop a comprehensive knowledge of the factors contributing to the development of FHB epidemics that will lead to effective disease management. Although traditional disease control options (crop rotations, crop residue destruction, fungicides and resistant cultivars) have made an impact on disease levels in the field, they have not been broadly adopted because of their frequent negative impact on farm economics, limitations by government programs and/or the lack of availability.

Until resistant, high-yielding cultivars become available, multiple disease control strategies will be required to manage *Fusarium* head blight. Even when resistant cultivars become widely available, some producers inevitably will continue to grow susceptible cultivars. Thus, the goal of the Epidemiology and Disease Management research area is to foster research on effective disease management practices based on a more complete understanding of the biology, genetics and pathogenicity of the causal agents; environmental conditions favoring pathogen development, inoculum dissemination and host infection; and the interactions between the causal agents and their host.

The Epidemiology and Disease Management research area of the U.S. Wheat & Barley Scab Initiative supports research efforts addressing one or more of the following priorities:

- **Pathogen biology and ecology:** determination of the nature, development, survival and spread of the causal *Fusarium spp.*, including spatial and temporal distribution, environmental influences and management.
- **Epidemiology:** determination of the environmental conditions favoring development of inoculum and promotion of infection leading to epidemics and the development and implementation of disease forecasting/risk assessment systems.
- **Fungal genetics:** examination of the diversity of *Fusarium spp.* to determine the genetic variability and extent of aggressiveness among species and isolates within and between crop production regions.
- **Host/parasite interactions:** document the infection and colonization processes and characterization of host resistance/susceptibility reactions (excluding analysis of host-parasite genetics).
- **Integrated disease management:** determine the influence of modern crop management practices on disease development and examine management systems for disease control.■

FY02 Funds	Principal Investigator	Institution	Title
$37,714	Andresen, Jeff	Michigan State University	Determination of Wetness Duration Using Radar-Derived precipitation Estimates: FY2002.
$35,000	Bergstrom, Gary	Cornell University	Airborne Propagules of Gibberella zeae: Their Function in Fusarium Head Blight.
$50,016	Bowden, Robert	USDA-ARS	Genetic mapping of aggressiveness and fertility barriers in Gibberella zeae.
$60,750	Bushnell, William	USDA-ARS	Pathways of Infection and Pathogenesis in Fusarium Head Blight.
$52,071	De Wolf, Erick	The Pennsylvania State University	Fusarium head blight prediction models and Gibberella zeae perithecia development.
$70,140	Dill-Macky, Ruth	University of Minnesota	Crop residues and the survival, production, and control of Fusarium inoculum.
$91,000	Francl, Leonard	North Dakota State University	Pathogen Population Dynamics, Inoculation, and Temporal Progress of FHB.
$18,440	Jarosz, Andrew	Michigan State University	Host specialization and genetic diversity in Gibberella zeae from corn, wheat & rice in Nepal.
$71,000	Jin, Yue	South Dakota State University	Scab forecasting and environmental effects on inoculum in eastern South Dakota.
$53,000	Kistler, H. Corby	USDA-ARS	Diversity of Gibberella zeae populations from the U.S., China and Italy.
$32,000	Kistler, H. Corby	USDA-ARS	Use of gene expression analysis to study pathogenicity in Gibberella zeae.
$26,336	Leslie, John F.	Kansas State University	Diversity of North and South American and Korean populations of Gibberella zeae.
$49,000	Lipps, Patrick E.	Ohio State University	Disease Forecasting System for Fusarium Head Blight and the Splash Dispersal of Gibberella zeae.
$37,000	Shaner, Gregory	Purdue University	Forecasting Fusarium Head Blight Based on weather and Pathogen Monitoring.
$15,000	TeKrony, Dennis	University of Kentucky	Fusarium graminearum and DON levels in single seeds following greenhouse point inoculation.
$44,000	Trail, Frances	Michigan State University	Genetics and morphology of perithecium development in Gibberella zeae on wheat and in vitro.
$40,750	Trail, Frances	Michigan State University	Use of gene expression analysis to study pathogenicity in Gibberella zeae.
$6,413	Vaillancourt, Lisa J.	University of Kentucky	Role of a Colletotrichum graminicola pathogenicity gene homologue in F. graminearum.
$40,750	Xu, Jin-Rong	Purdue University	Use of gene expression analysis to study pathogenicity in Gibberella zeae.
TOTAL: $ 830,380			

USWBSI FY02: Chemical and Biological Control

The Chemical and Biological Control research area supports research to develop effective and economical chemical and biological control options that meet the immediate and long-term needs of growers for managing FHB.

Uniform trials of fungicides and biological control agents (BCAs) have been conducted on wheat, barley, and durum across diverse environments to identify effective treatments. Application methods, adjuvants, and timings of applications have been evaluated to increase the deposition of fungicides and BCAs to heads of small grains and to enhance the efficacy of treatments.

PHOTO: University of Minnesota Agricultural Experiment Station

The Chemical and Biological Control research area of the U.S. Wheat & Barley Scab Initiative supports research efforts addressing one or more of the following priorities:

- Collaborative efforts that identify fungicides and biological control agents (BCAs), which are effective and consistent in performance against FHB across multiple environments, wheat classes and cultivars, and barley cultivars.
- Development and evaluation of techniques that enhance the efficacy of fungicides and BCAs against FHB in wheat and barley (techniques such as timing of application, nozzle configurations, sprayer types, additives, formulations of BCAs, etc.)
- Field-testing and development of BCAs that have been shown to have efficacy against FHB in preliminary tests.
- Determination of mechanisms for FHB control, and determination of optimum procedures for mass production/delivery of BCAs found to be effective in uniform tests.

Of low priority: *In vitro* screening or evaluations of early-generation fungicides, BCAs, or other products that have not been shown to have activity against FHB in preliminary tests.■

FY02 Funds	Principal Investigator	Institution	Title
$15,000	Bacon, Charles	USDA-ARS	Biological Control of Wheat Scab with the Endophytic Bacterium Bacillus mojavensis.
$11,313	Bergstrom, Gary	Cornell University	Fungicide/Bioprotectant Trials for Control of Fusarium Head Blight (New York).
$7,000	Bleakley, Bruce	South Dakota State University	Management of Fusarium Head Blight With Biological Control Agents.
$11,000	Draper, Martin A.	South Dakota State University	Chemical and biological trials for Fusarium head blight (FHB) management.
$7,000	Grybauskas, Arvydas	University of Maryland	Fusarium head blight uniform fungicide trial in Maryland.
$5,750	Hart, L. Patrick	Michigan State University	Chemical Management of FHB in Wheat.
$15,000	Heaton, Louis A.	Kansas State University	Can We Debilitate the Wheat Scab Fungus With a Virus?
$6,000	Hershman, Donald	University of Kentucky	Identification of Safe and Effective Foliar Fungicides for Managing Fusarium Head Blight in Wheat.
$20,384	Horsley, Richard	North Dakota State University	Efficacy of foliar fungicides in controlling barley scab in lines with partial resistance.
$6,000	Lipps, Patrick E.	Ohio State University	Uniform fungicide trial in Ohio to identify products effective against Fusarium head blight.
$34,536	McMullen, Marcia	North Dakota State University	Identification of Application Technologies that will Optimize Fungicide Efficacy against Fusarium Head Blight.
$15,378	McMullen, Marcia	North Dakota State University	Uniform trials to identify safe fungicides and biological agents effective against Fusarium Head Blight, ND.
$7,000	Milus, Eugene	University of Arkansas	Chemical and Biological Control of FHB on Wheat in Arkansas.
$7,700	Scherer, Thomas	North Dakota State University	Controlling a Watering System to Maintain Optimum Moisture Conditions for FHB Field Research.
$90,000	Schisler, David	USDA-ARS	Drying, formulation and field testing of a yeast product for biocontrol of FHB.
$7,000	Shaner, Gregory	Purdue University	Uniform Fungicide Trials for Control of Fusarium Head Blight.
$6,000	Stromberg, Erik	Virgina Tech.	Evaluation of fungicides and biological agents for control for FHB in Virginia.
$6,000	Sweets, Laura	University of Missouri	Uniform Fungicide Trial to Identify Fusarium Head Blight Effective Products.
$10,000	Van Ee, Gary	Michigan State University	Control Wheat Scab with Improved Fungicide Application Technology.
$20,000	Wiersma, Jochum	University of Minnesota	Evaluation of varietal responses to different fungicide management strategies in spring wheat.
$15,700	Yuen, Gary Y.	University of Nebraska - Lincoln	Biocontrol of Fusarium head blight.
TOTAL: $323,761			

USWBSI FY02: Variety Development and Uniform Nurseries

Wheat and barley germplasm sources that have resistance to FHB have been identified. Thus, development of enhanced germplasm and cultivars that have FHB resistance is an effective approach to minimizing production and product utilization losses due to FHB. Classical and biotechnological methods of plant breeding are being used to efficiently transfer and pyramid FHB resistance genes into adapted lines. Collaborations among breeding programs include regional testing nurseries for FHB resistance.

FY 02 Funds	Principal Investigator	Institution	Title
$87,585	Anderson, James	University of Minnesota	Breeding Fusarium Head Blight Resistant Wheat.
$35,288	Anderson, James	University of Minnesota	Marker-assisted Selection for an FHB Resistance Gene Derived from Sumai 3.
$48,839	Baenziger, Stephen	University of Nebraska - Lincoln	To Ehance Variety Development of Scab Resistant Varieties.
$63,491	Berzonsky, William	North Dakota State University	Improving Specialty Spring Wheat Germplasm for Resistance to Fusarium Head Blight.
$30,483	Bockus, William W.	Kansas State University	Development of scab resistant wheat cultivars for Kansas.
$60,533	Brown-Guedira, Gina	USDA-ARS	Scab resistant gene deployment into wheat lines via marker assisted selection.
$12,698	Costa, Jose M.	University of Maryland	Developing new SRWW germplasm with resistance to scab.
$82,821	Elias, Elias	North Dakota State University	Development of Durum Wheat resistant to Fusarium Head Blight.
$73,259	Franckowiak, Jerome D.	North Dakota State University	Enhanced resitance to Fusarium in two-rowed barley.
$72,038	Gallenberg, Dale	South Dakota State University	Spring wheat breeding for scab resistance in South Dakota.
$9,000	Garvin, David F.	USDA-ARS	Coordination of a Uniform Regional Scab Nursery for Spring Wheat Parents.
$68,375	Griffey, Carl A.	Virginia Tech.	Selective breeding for Scab Resistance in soft Winter Wheat.
$20,512	Harrison, Stephen	Louisiana State University	Development of FHB Resistant Wheat Genotypes Adapted to the Gulf Coast.
$90,000	Horsley, Richard	North Dakota State University	Accelerated development of scab resistant barley varieties.
$11,440	Horsley, Richard	North Dakota State University	Screening barley lines for scab resistance in uniform nurseries.
$66,079	Ibrahim, Amir	South Dakota State University	Winter wheat breeding for scab resistance in South Dakota.
$15,902	Johnson, Jerry	University of Georgia	Development of Scab Resistant Wheat Cultivars Adapted to the Southeast.
$79,464	Kolb, Frederic	University of Illinois	Development of Scab Resistance Soft Red Winter Wheat Varieties.
$75,212	Merguom, Mohamed	North Dakota State	Development of hard red spring wheat cultivars resistant to scab.
$81,765	McKendry, Anne	University of Missouri	Accelerating the Development of Scab Resistant Soft Red Winter Wheat.
$53,186	Milus, Eugene	University of Arkansas	Developing FHB-Resistant Wheat Cultivars for the Midsouth.
$17,484	Murphy, J. Paul	North Carolina State	Breeding Fusarium Head Blight Resistant Wheat for the Southeastern United States.
$76,165	Ohm, Herbert	Purdue University	Improvement of Soft Winter Wheat for Resistance to Fusarium Head Blight.
$79,712	Smith, Kevin P.	University of Minnesota	Accelerated Development of Fusarium Resistant Barley Varieties.
$76,000	Sneller, Clay	Ohio State University	FHB resistant germplasm adapted to Ohio and coordination of a Uniform nursery
$14,666	Sorrells, Mark	Cornell University	Fusarium Head Blight Resistant Wheat Variety Development - Cornell.
$39,071	Van Sanford, David	University of Kentucky	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.
$86,794	Ward, Richard W.	Michigan State University	Development of FHB Resistant Soft White Wheat Varieties for Michigan and Similar Environments.
$19,536	Yen, Yang	South Dakota State University	Implementation of Marker-assisted Selection in the Scab Breeding and Germplasm Enhancement Programs in South Dakota.
TOTAL: $1,547,398			

The Variety Development and Uniform Nurseries research area of the U.S. Wheat & Barley Scab Initiative supports research efforts addressing one or more of the following priorities:

- Proposals must relate to enhancement of wheat, barley, and durum wheat germplasm for FHB resistance with the overall objectives of evaluation and development of germplasm with improved resistance and release of cultivars for commercialization.
- The improved cultivars would not only have economic value for FHB resistance, but also have combinations of other important traits that result in commercial value in wheat and barley growing areas of the U.S.
- Proposals could include research on the inheritance of FHB resistance of resistance donor lines and protocols to improve selection efficiency and reduce the plant breeding cycle such as marker-assisted selection and production of doubled haploids.

Collaborations with other research programs relating to reducing production and grain quality losses due to FHB are encouraged. ■

For more information about the U.S. Wheat & Barley Scab Initiative, visit www.scabusa.org

USWBSI FY02: Food Safety, Toxicology and Utilization

FHB caused by toxigenic species of *Fusarium graminearum* (teleomorph *Gibberella zeae* [Schwein.]) produce a number of 12,13 epoxy trichothecene mycotoxins, as well as zearaleonone. The trichothecenes, a group of over 100 structurally related compounds, include the mycotoxins, deoxynivalenol, nivalenol, T-2 toxin, HT-2 toxin, and fusarenon-X. Many of these compounds are toxic to both plants and animals.

Deoxynivalenol (DON), also called vomitoxin, is the most common mycotoxin associated with Fusarium Head Blight in the USA and Canada, and as a consequence, the majority of research and governmental regulation has focused on DON. The Food and Drug Administration (FDA) has established guidelines for tolerances of DON in small grains intended for animal and human consumption. Generally, processors of small grains are demanding that the grain they purchase have levels of DON at or below the FDA guidelines. The FDA guidelines are based on animal studies done in the 1980s and early 1990s in the United States and Canada. Improved toxicological assays are available and need to be used to determine if the current guidelines are providing the appropriate safety factors for the consumer.

FY02 Funds	Principal Investigator	Institution	Title
$77,540	Dong, Yanhong	University of Minnesota	Diagnostic Services for DON.
$79,540	Hart, L. Patrick	Michigan State University	Regional Diagnostic Clinic Providing DON Analytical services for regional FHB research projects.
$77,540	Mostrom, Michelle	North Dakota State University	Diagnostic Services for Vomitoxin (DON) in Wheat.
$58,823	Pestka, James	Michigan State University	Human Susceptibility to Trichothecene Mycotoxins.
$108,014	Schwarz, Paul	North Dakota State University	Malting Barley Deoxynivalenol Diagnostic Services.
TOTAL: $401,457			

In the absence of current data, some European countries are promoting a reduction by 10-20 fold in EU guidelines. The Food Safety and Toxicology Program goals are: to provide tools for small grain producers, elevators, millers, and processors, to rapidly and reliably identify mycotoxin-contaminated grain, and to develop appropriate strategies to deal with contaminated grain. The program also provides centralized DON (and other *Fusarium spp.* toxins as needed) diagnostic services for all USWBSI research projects at several USWBSI-funded facilities.

The rationales for this centralized approach for DON assays are 1) results between research projects can be correlated with confidence; 2) analytical consistency between testing locations and years; 3) efficiency of cost; 4) limit of capital outlays for equipment; and 5) insuring that the USWBSI goal of reducing or eliminating contamination of grain by DON is being achieved.

PHOTO: University of Minnesota Agricultural Experiment Station

The Food Safety, Toxicology and Utilization research area of the U.S. Wheat & Barley Scab Initiative supports research efforts addressing one or more of the following priorities:

- Focus on understanding the effect of *Fusarium spp*. contamination in relation to human health, human nutrition and food quality.
- Develop risk assessment models to aid regulatory agencies in establishing realistic guidelines.
- Develop methodologies reducing or eliminating *Fusarium spp*. mycotoxins by post-harvest treatments or processing.
- Develop strategies for identifying grain contaminated with *Fusarium spp*. mycotoxins prior to harvest, allowing it to be diverted from inappropriate uses.
- Develop and promote appropriate methodologies to accurately identify grain contaminated with *Fusarium spp*. mycotoxins at transfer points in the movement of small grains from growers to processors.
- Maintain regional mycotoxin diagnostic laboratories, improve analytical capabilities, provide rapid and accurate diagnosis for research projects, and develop a check program to insure that inter-laboratory results are consistent and reliable. ■

USWBSI FY02: Facilitation, Networking, and Outreach

Communication and coordination of Initiative research is conducted by the USWBSI Network and Facilitation Office, headquartered at Michigan State University. This office serves as an administrative liaison between the USDA Agricultural Research Service and crop scientists nationally who conduct research under the Initiative. It serves as a central location for collecting and disseminating information to the public regarding FHB and FHB research. Among its objectives are to facilitate information to improve crop scientists' and the public's knowledge about FHB, and research conducted on FHB. Key Network and Facilitation Office responsibilities:

FY02 Funds	Principal Investigator	Institution	Title
$33,600	Anderson, Olin	USDA-ARS	Improving research results by increasing information hosted on the Initiative's website.
$30,315	Nganje, William	North Dakota State University	Economic Impact of Scab on Wheat and Barley: Update 2000-2001.
$190,660	Ward, Richard W.	Michigan State University	U.S. Wheat & Barley Scab Initiative Networking & Facilitation Office (NFO).
TOTAL: $254,575			

• Administration and coordination of Initiative research contract obligations.

• Organization of the annual FHB Research Forum.

• Maintenance and improvement of the Intiative web site.

• Dissemination of information related to FHB and research conducted under the USWBSI.■

Canadian Scientists Using Genomics in FHB Research

As part of its genomics research program on crop plants, Agriculture and Agri-Food Canada (AAFC) has increased its efforts to understand Fusarium diseases of cereals.

At the Eastern Cereal and Oilseed Research Centre (ECORC) in Ottawa (http://res2.agr.ca/ecorc/), the research groups of Linda Harris and Thérèse Ouellet are collaborating together to characterize the molecular interaction between *Fusarium graminearum* and two of its hosts, maize and wheat.

The Ouellet lab has developed four wheat head cDNA libraries enriched in genes induced by *Fusarium*. These include libraries from Frontana, FHB37 (a resistant spring line from Sumai3), FHB148 (a resistant winter line from Frontana) and Harus (a susceptible winter variety). To date, about 8000 wheat expressed sequence tags (ESTs) have been generated from those libraries and used to produce a wheat microarray containing approximately 3500 unique genes.

In parallel, the Harris lab has developed 9 cDNA libraries from susceptible and resistant maize ear and silk tissues infected with *Fusarium graminearum*. About 6000 ESTs have been generated so far and have contributed to the production of a 7000 unigene maize microarray enriched in genes expressed during biotic and abiotic stresses.

The wheat and maize microarrays are being used to characterize the patterns of gene expression in susceptible and resistant material, with the aim of defining the response of the plant to *Fusarium* attack and identifying mechanisms and essential genes for resistance to *Fusarium* in both crops. Comparison between the two crops will allow the identification of common as well as unique mechanisms.

A genomics approach is also being applied by Ouellet and Harris, in collaboration with Bob Watson (all three are research scientists in molecular pathology at the ECORC), to further study the pathogen itself, *Fusarium graminearum*. Nine cDNA libraries have been produced from fungal cultures under a range of stresses and at different stages of development. About 4500 ESTs have been generated and used to design a 2K unigene microarray that will be used to identify genes potentially important for pathogenicity.■

– By Thérèse Ouellet, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ontario.

FHB Forecasting Models to be evaluated in Ohio, Dakotas and Pennsylvania

Researchers at Ohio, North Dakota, Pennsylvania and South Dakota are evaluating several FHB forecasting models during the 2002 growing season. These weather-driven models can identify weather patterns that may result in epidemic levels of scab in a susceptible cultivar. The models are based on weather and FHB data from 50 study locations where scab severity data was obtained. The weather and disease data from these locations have been analyzed to develop a risk assessment model for scab.

Two models are being evaluated this year, one based on the weather conditions seven days before flowering, and the other based on pre-flowering data plus weather conditions 10 days post-flowering. The first model should help growers decide if they want to invest in a fungicide application at flowering, and the second model should help both growers and the wheat industry prepare for harvest and processing of scab-damaged grain.

The models are entirely weather based using hourly temperature, precipitation and relative humidity information. The models predict the risk of scab occurring in an area, and do not predict the amount of disease—much like a precipitation forecast, in that there is a prediction of the probability of rain, but not in the amount of rain.

The models have performed well in field tests thus far, and 2002 will mark the first wide-scale validation of the models. "This will be a definite improvement over the airborne spore samples we've been counting in our present scab forecasting system," says Len Francl, plant pathologist at North Dakota State University. "If this model holds up, we will be able to provide growers with a forecast at an extremely low cost."

"We are especially interested in how well the models provide a realistic scab risk prediction in the diverse agricultural areas of the U.S.," says Pat Lipps, plant pathologist at Ohio State University. The models have also been made available to researchers in other states, adds Erick De Wolf, plant pathologist at Penn State University. "We hope they will also evaluate the models at their locations," says De Wolf. "The feedback of cooperators from around the country is important for the further refinement and development of forecasting models for scab."

Regardless of the success of the risk prediction models, their development and testing has already provided extremely valuable insights into the conditions required for FHB development. "That takes us one step closer to its management," says Francl.■

FHB Forecasting Models

North Dakota State University
www.ag.ndsu.nodak.edu/cropdisease/cropdisease.htm

Ohio State University*
www.oardc.ohio-state.edu/ohiofieldcropdisease/

Penn State*
www.wheatscab.psu.edu

South Dakota State University
http://plantsci.sdstate.edu/wheatpath or
http://plantsci.sdstate.edu/planthealth

Ontario Weather Network and Ridgetown College
www.ridgetownc.on.ca/OWN/Fusarium/Fusarium_Frame.htm

* Preliminary models on the web for informational purposes, and not to be used for farm management decisions at this time.

Purdue Misting System Aids in FHB Development

We have established a system to apply a fine mist to a portion of our head row nurseries in the field at the Agronomy Research Center at West Lafayette, Ind., to enhance FHB disease development.

In 2002, the third season of operation, the system was expanded to cover 1.6 acres (0.67 ha). We seed the nursery into disked cornstalks in the fall and begin misting by mid-April, 4-5 weeks prior to beginning of flowering, and continue misting twice daily (5-8 pm and 6-9 am) as needed, depending on rainfall, until 2 weeks after flowering is completed.

Nozzles which deliver 11.4 L (3 gal) water per hour are at intervals of 2.4 m in rows 2.4 m apart and rows are offset 1.2 m. In our experience, application of this limited amount of water serves to keep the soil surface and corn stalks moist, but dry enough to allow note-taking and selection during the day. We also point inoculate selected plots.

In 2000, a season in which rainfall was typical for Indiana throughout the fall, winter and spring, with temperatures that were warm in early spring, FHB development in the head row nurseries was moderately severe (disease index on susceptible wheat lines was 0.5-0.7). In 2001, which was unusually dry from August the previous summer and throughout the fall, winter and spring, FHB was negligible on susceptible lines in non-misted areas of our head row nurseries, and the disease index was typically 0.2-0.4 in the misted area. In both seasons, disease severity was much higher for powdery mildew, Septoria leaf blotch and Stagonospora glume blotch in the misted area than in non-misted areas. In 2002, temperatures have been cooler than normal during heading and flowering; and it will be interesting to see how FHB develops as the season progresses.■

– By Herb Ohm, wheat breeder, Purdue University

Success Factors in Controlling FHB

Several factors can affect the success of a fungicide application for FHB control, including treatment timing, application rate, nozzle orientation (if spraying by ground), spray volume and pressure. Application recommendations by NDSU crop scientists can be found in the article "Success Factors in Controlling FHB" on the USWBSI web site, www.scabusa.org/fusarium.htm. The online article includes recommendations on split rate versus one full rate treatment; adjuvants; insecticide-fungicide applications; aerial versus ground applications; and barley planting dates and DON.■

PHOTO: University of Minnesota Agricultural Experiment Station

The best timing for maximum reduction of scab severity is at early heading for barley (Feekes 10.3- 10.5) and early flowering for spring wheat and durum (Feekes 10.51) Under weather conditions favoring infection, single fungicide applications that are too early (head half emerged) or too late (kernel watery ripe) are not effective.

FHB management web sites

Michigan State University Wheat Management Manual
www.cips.msu.edu/wheat/index.htm

North Dakota State University FHB of Small Grain
www.ext.nodak.edu/extpubs/plantsci/smgrains/pp804w.htm

NDSU Visual Scale to Estimate FHB Severity in Wheat
www.ext.nodak.edu/extpubs/plantsci/smgrains/pp1095w.htm

Ohio State University Extension FHB Factsheet
http://ohioline.osu.edu/ac-fact/0004.html

USDA-GIPSA DON Handbook
www.usda.gov/gipsa/reference-library/handbooks/don/don.htm

Purdue University Crop Diseases in Corn, Soybeans and Wheat
www.btny.purdue.edu/Extension/Pathology/CropDiseases/Wheat/wheat1.html

South Dakota State University FHB in South Dakota
http://plantsci.sdstate.edu/planthealth/Scab/scabnet.htm

Kansas State University Extension fact sheet on Wheat Scab
www.oznet.ksu.edu/path-ext/ (Click on factsheets, crops. Wheat diseases are listed)

University of Nebraska Scab of Wheat
www.ianr.unl.edu/pubs/PlantDisease/g1207.htm

Virginia Polytechnic Institute Wheat Scab Integrated Disease Management in Small Grains
http://ipm.ppws.vt.edu/stromberg/smallgrain/biology/wscab.html

Saskatchewan Agriculture and Food publication "Dealing with Fusarium Head Blight"
www.agr.gov.sk.ca/DOCS/crops/Integrated_pest_ management/disease/fusarium.asp?printerversion=1

Alberta Ag. Food and Rural Dev. Fusarium Head Blight of Barley and Wheat (revised May 2000)
http://plantsci.sdstate.edu/planthealth/Scab/scabbull.htm

Canadian Grain Commission: FHB in Canada
www.cgc.ca/Pubs/fusarium/fusarium-e2.htm

Manitoba Agriculture "Plant Diseases, FHB, Wheat and Barley"
www.gov.mb.ca/agriculture/crops/diseases/fac12s00.html

USDA-ARS Cereal Disease Lab
www.crl.umn.edu/scab/scab.html

U.S. Wheat and Barley Scab Initiative Fusarium Focus

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This newsletter contains an update on only a sampling of research funded by the USWBSI. For more information on scab research in the U.S., and projects funded by the USWBSI, see the Initiative's website, www.scabusa.org.

Fusarium Focus is compiled by Prairie Ag Communications, 2607 Wheat Drive, Red Lake Falls, MN 56750.

Growers Take Preventive Approach to FHB Control

Wheat and barley growers can get a leg up on FHB by taking a more tactical approach. For instance, Roseau, Minn., grower Richard Magnusson begins controlling scab before symptoms of the fungal disease become visible in his wheat and barley.

"That's one of the problems with *Fusarium*; by the time you see the symptoms it's too late to do much about it. It's one of those diseases you need to be proactive in treating," said Magusson, in one of five "virtual grower roundtables" held via teleconference early this spring. Sponsored by Bayer Corporation, 542 growers from ND, MN and SD representing over 517,000 acres of wheat and barley listened in on the Sessions.

Magnusson and Greg Daws, a Lakota, N.D. grower, described their experiences in managing scab. North Dakota State University extension plant pathologist Marcia McMullen and University of Minnesota small grains specialist Jochum Wiersma also offered tips on managing scab, and understanding the disease better.

Transcripts from the teleconferences can be found online at www.haltscab.com.

Management tips and recommendations given during one of the teleconferences can be found in the article "Growers Take Preventive Approach to FHB Control" on the USWBSI web site, www.scabusa.org/Fusarium.htm ■

"We need to be treating the disease before we ever see the symptoms"

—Richard Magnusson, Roseau, Minn. grain grower

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