U. S. Wheat & Barley Scab Initiative

Scab News

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U.S. FHB Research Activities Detailed at Global Forum in China

A group of U.S. wheat and barley researchers from the United States traveled to China in May to participate in an international forum focused on scab research advancements in wheat and barley.

"The problems we've been seeing are being shared by scientists from around the world. We're not alone in this problem," says Bob Stack, plant pathology professor at North Dakota State University, and a speaker at the forum. "Despite a lot more experience in dealing with the scab issue, the Chinese are not really any further along than we are."

The fungal disease has been a significant problem in areas of the U.S. in the 1990s, resulting in yield and quality losses valued at well over $2 billion on wheat and barley farms in at least 18 states, according to university and industry estimates.

At the International Scab Forum held during May in China, Sanjaya Rajaram of India, (left) wheat director of CIMMYT (International Maize and Wheat Improvement Center) and University of Minnesota wheat breeder Jim Anderson (right) pose with Zhang Feng Ming, one of the Chinese wheat breeders that developed Sumai 3, a key source of germplasm that many wheat and barley breeders from around the world are using to help develop commercial varieties with greater scab tolerance.

Scab is an even bigger problem in China, the world's largest wheat producing nation that has been researching methods to control the fungal disease for decades. The Chinese have a large wheat research program, which they need to keep up with their food consumption demands.

About 100 scientists from around the world attended the forum, and most were plant breeders and geneticists. Some of the presentations focused on genetic engineering and the use of pieces of plant DNA called "molecular markers," which researchers use to identify genes that are associated with a specific trait such as disease resistance. Other presentations emphasized classical breeding methods.

"We had an excellent meeting in China that provided a very thorough update on what is happening worldwide on scab research. We began to formalize our collaboration with CIMMYT (International Maize

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2000 National FHB Forum Dec. 10-12, Cincinnati

The 2000 National FHB Forum will be held Dec. 10-12 in Cincinnati at the Holiday Inn Cincinnati Airport, which is just a few miles from the Cincinnati and Northern Kentucky International Airport. More information as it becomes available will be sent via the USWBSI email listserver (fhbtalk_mg@listserv.msue.msu.edu) and posted on the Initiative's website, www.scabusa.org, where proceedings of previous forums are posted. Copies of the 1997, 1998, and 1999 Forum proceedings will be able to be checked out of the National Agricultural Library in the near future, and are also available for purchase from the Initiative's Networking and Facilitation Office.

2000 National FHB Forum deadline dates

November 1: Deadline for early registration

November 1: Deadline for submissions to include in Forum Proceedings

November 25: Deadline for hotel reservations (Low rate still guaranteed, but not availability)

China Key Asset in Research Improvement Effort

By Rick Ward, Michigan State University Wheat Breeder, USWBSI Co-Chair

Highly skilled and hard working, the Chinese wheat research community represents an extraordinary asset in the overall global wheat and barley improvement effort.

I have been fortunate to make four trips to the Peoples Republic of China, visiting 10 research institutes in five provinces. My most recent visit was in May to attend the International Scab Forum and the National Wheat Breeding Conference.

In my experience, American scientists are very welcome and are looked upon as natural allies in our quest for improved genetic and management technologies. I've personally learned a great deal from my visits. China's limited resources restrict their breeding efforts to a very small scale. My F2 nursery is larger than the size of a complete Chinese breeding program. And yet they continue to make great progress.

How do they do it? By detailed attention to each and every plant and plot in their nurseries. Most of us here in the U.S. run such large scale programs that this level of focus is impossible. Personally, I think the Chinese can benefit from more of the high throughput, data-driven philosophy. On the other hand, I also think we are losing opportunities in our love affair with high volume technologies.

Grain quality is only just now becoming a selection criteria in China. Sheer mass has been the objective up to now. No one even knows what the distribution of hard and soft wheat is in the PRC! This will change rapidly. From the perspective of U.S. opportunities for marketing grain into the PRC, it will be wise for us to be active participants in the PRC's efforts to put in place a quality based marketing system.

I'd guess that there is more combined knowledge of wheat breeding and management in the PRC than in any other country on earth. They are also in possession of improved and land race germplasm that we have had little or no access to in the past. We can benefit from access to both of those resources. At the same time, the Chinese are very eager to learn from us.

Grassroots, mutually beneficial collaborations like those possible in small grains research can and will provide safe, stable linkages that are vital to our national interests. For that and other reasons we should be committed to ensuring that we make the most of the clear and present opportunities to work with the Chinese to advance research on scab in small grains, as well as research collaboration on other key research matters.

Global Forum • *from page 1*

and Wheat Improvement Center) on how they will facilitate germplasm exchange," says Anne McKendry, University of Missouri winter wheat breeder.

At the international forum, Michigan State University wheat breeder Rick Ward presented an overview of the U.S. Wheat and Barley Scab Initiative, organized in 1997 to solve scab through a concerted national research effort. Research supported by the USWBSI in FY2000 involves 104 projects carried out in 23 states by over 70 scientists from 22 land grant universities and the USDA-ARS.

"The Chinese are just as fascinated about the Scab Research Initiative as anyone else, and wondered how it got started. I explained how it came about and was funded through the U.S. Congress. It struck me later that here I am talking about raw democracy in action, in the heart of the world's largest communist nation," says Ward, who serves as co-chair of the Initiative.

Ward says the USWBSI could serve as a platform for greater international cooperation on disease research, with China and other countries, says Ward. His overview of the Initiative presented in China may be found on the Initiative's web site, www.scabusa.org.

Canty joins Initiative Networking Office

Sue Canty has joined the administrative staff of the U.S. Wheat and Barley Scab Initiative's Networking and Facilitation Office at Michigan State University. She replaces Jennifer Wagester, who transferred to a different department at MSU.

Canty received her B.A. from MSU, and has been working in the MSU Department of Crop & Soil Sciences (CSS) in the areas of plant breeding and variety testing for the past 5 ½ years. Prior to that, she administered the graduate program for the CSS department. Her contact information:

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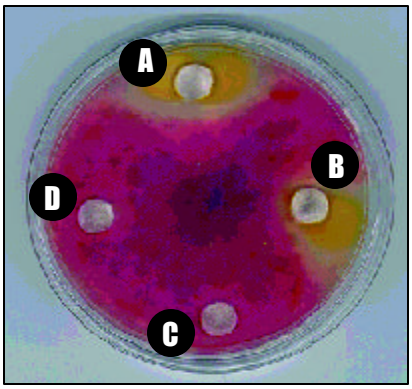
University of Nebraska Reports Progress in Developing Anti-Fungal Genes

The University of Nebraska is making progress in its goal of inserting anti-fungal genes into viable scab tolerant winter wheat varieties. The U of N has had success during the past year in using two different types of genes—lactoferrin and IAP, which has antiapoptic qualities—in its goal of developing resistance to the scab fungus. Lactoferrin is a type of protein found in mammals that has long been reported to be active against a wide range of microorganisms, including fungi, explains Stephen Baenziger, agronomist at the U of N. Antiapoptic, in this case, refers to a gene's ability to help prevent plant cells from being killed by the scab fungus.

The genes are among several chosen for scab research in small grains, since they have also demonstrated success in combating economically important fungal diseases in transgenic tobacco plants.

Effectiveness of the anti-fungal gene lactoferrin is demonstrated in the photo at right of a petri dish containing F. *graminearum* and extracts of tobacco plants containing the lactoferrin gene. The clear area (A and B) indicates no fungal growth, as opposed to the tobacco plant extracts that do not contain the lactoferrin gene (C and D) where fungal growth was not inhibited.



Transgenic wheat plants with adequate levels of expression of these genes are currently being grown in U of N growth chambers for inoculation with F. *graminearum*. This will help determine if the anti-fungal genes are being successfully expressed in the transgenic wheat plants.

Transgenic Spring Wheat and Barley Plants Developed

Transgenic spring wheat and barley plants carrying antifungal protein genes have been developed, and will be tested to determine if the plants convey scab resistance. If resistance is successfully confirmed, these plants will provide the germplasm needed to help breed wheat and barley varieties that have enhanced resistance to scab, says Gary Muehlbauer, molecular geneticist at the University of Minnesota, one of several crop scientists involved in biotechnological research approaches of the USWBSI.

Muehlbauer and others have developed a cDNA library from wheat spikes inoculated with F. *graminearum*, and have initiated sequencing genes from this library, with the goal of sequencing 2500-3000 genes. "This work will provide the genetic tools to further study the interaction between the fungus and wheat in addition to novel genes for resistance," says Muehlbauer.

Biotech researchers have characterized some of the early events in a F. *graminearum* infection, and the molecular response in wheat, says Muehlbauer. They have found that F. *graminearum* can infect through multiple pathways. Further, that wheat responds to infection by inducing the expression of defense response genes, and that the expression of these genes can be found in colonized as well as uncolonized portions of the spike. Completed characterization of a strain of F. *graminearum* that expresses the GUS (turns cells blue) gene will be useful for investigating the infection process in more detail, he says.

Mapping scab resistance genes in barley also continues, says Muehlbauer. Mapping involves using molecular markers to identify regions of the barley genome that confer with scab resistance. Molecular markers are used to indicate the location of the genomic regions that carry scab resistance genes. This work will provide the genetic tools to conduct marker-assisted selection and enhance scab resistance in the barley breeding project.

Proceedings of Canadian FHB Workshop Online

Proceedings of the Canadian Workshop on Fusarium Head Blight, held last November in Winnipeg, may be found online at www.cgc.ca/Views/fusarium99/workshop-e.htm. A limited number of hard copies of the proceedings are still available for a small fee, and may be obtained through Randy Clear, Canadian Grain Commission, rclear@cgc.ca.

Call for FY2000 Research Progress Reports

Progress reports forms for FY2000 research projects will be mailed out shortly to principal investigators. The deadline for submitting these federally-mandated progress reports to the USWBSI Networking & Facilitation Office is September 18, 2000

NDSU Fungicide Field Trial Results Available

North Dakota State University has compiled a 43-page booklet detailing results of various small grain fungicide studies completed in 1999. It includes results of ND testing locations for uniform fungicide trials.

Plant pathologists in 14 states participated in the 1999 uniform fungicide trials, conducted again this year with funding support by the USWBSI.

The NDSU booklet also includes results of field trials relating to fungicide effectiveness, timing, ground versus aerial treatments, ground application techniques, effect of planting date on DON in barley, and the effect of tank mixing a fungicide with an insecticide to suppress scab and the orange wheat blossom midge.

General conclusions from ground application trials and greenhouse tests indicate that across all crops and nozzle arrangements, an angled spray toward the grain heads outperformed a vertical orientation, for head coverage and disease control. However, optimum spray pressures and water volume varied among crops. General fungicide application recommendations from NDSU:

- For ground application, angle spray towards grain head, using forward and backward mounted XR8001 nozzles, or nozzles that have a two directional spray, such as Twinjet nozzles.
- When using XR flat fan tips, use 40 psi with 9 gpa, and 90 psi with 18 gpa.
- Increase spray volume for durum and barley to improve head coverage.
- Spray hard red spring wheat and durum at early flowering (Feekes 10.51)
- Spray barley at early heading (Feekes 10.3- 10.5)
- Use a good adjuvant.
- Whether using aerial or ground applications, spray in evening or early morning to capture dew as extra water volume, and use a small droplet size.

To help decide whether a fungicide treatment is necessary or economically viable, NDSU advises producers to follow general guidelines based on yield potential, price of crop, disease presence, past week's weather and two-week weather forecast.

If conditions warrant treatment for scab suppression, these recommendations have also resulted in good control of leaf spot diseases and leaf rust, notes NDSU extension plant pathologist Marcia McMullen.

Other key results from NDSU fungicide trials:

Experimental fungicides — In various wheat and barley trials, two experimental products, BASF 500 and Stratego, compared well with leading fungicide products that are currently available in controlling scab and leaf diseases.

Insecticide-fungicide applications — Limited studies conducted last year in ND indicated that Lorsban and Folicur can be applied together without antagonism for control of scab, leaf diseases, and orange wheat blossom midge. However, adequate economic thresholds for both the insect and diseases must be present for a dual application to be warranted. Timing is also key for the combination to be effective in controlling midge and disease.

Aerial vs. ground — Two studies conducted last year in ND compared the effects of aerial versus ground fungicide applications for controlling scab in wheat. Scab levels were very low in both fields, and thus no conclusions may be drawn yet from the limited data. More studies will be conducted this summer.

Barley planting dates and DON — A study of barley planting dates (April 27, May 18, May 27, June 8) at the Langdon Research Extension Center indicated that while DON levels (deoxynivalenol, or vomitoxin) decreased with later planting, there was a definite trade-off in yield. Yield was 113, 100.9, 99.3, and 55.6 for respective planting dates from earliest to latest, with corresponding DON levels (in parts per million) of 3.9, 2.9, 1.3, and 0.7 from earliest to latest planting dates.

For the more detailed report, "ND Small Grain Fungicide Studies, Field Results 1999," contact Sue Canty, USWBSI Office, ph., 517-355-2236, e-mail: scabusa@msu.edu.

Table 1. Effect of timing of application of Folicur (4 fl oz/acre) on field severity of scab in greenhouse, 1999, NDSU

Application Growth Stage	Scab Field Severity (Field Severity=Incidence x Head Severity)		
(Feekes)*	Grandin HRS	Munich Durum	Robust Barley
10.3	1.6	16.4	1.5
10.51**	0.5	3.5	1.3
10.54	7.0	22.5	1.9
Untreated	7.0	32.1	3.2

* Feekes growth stage 10.3 = 50% head emergence; 10.51 = early flowering; 10.54 = kernel water ripe
** Barley sprayed at Feekes 10.5 = head fully emerged

Research at NDSU indicates that fungicide application timing is a key factor for controlling scab in wheat and barley. Optimum timing in spring wheat and durum is early flowering (Feekes growth stage 10.51) and in barley, at early, full head emergence.

Barley Researchers Make Gains in China

North Dakota State University's barley breeding program established cooperative research with Zhejiang University in Hangzhou, China and the Shanghai Academy of Agricultural Sciences near Shanghai, China in 1995 to evaluate barley lines for resistance to scab.

The FHB nurseries in China are valuable for breeders and pathologists for several reasons: 1) a second field assessment can be obtained on materials within a single year; 2) other foliar pathogens that may confound the FHB reaction are absent, 3) winter and spring barleys head about the same time allowing for valid comparisons of resistance levels; and 4) lines with superior resistance can be harvested and brought back to the Midwest for late sowing at the northern experiment stations in ND and MN.

U.S. barley researchers including NDSU plant pathologist Brian Steffanson and six-row barley breeder Richard Horsley traveled to Hangzhou in May to evaluate the scab nursery. There, Horsley confirmed the transfer of resistance from CI 4196—a two-rowed land race from China that possesses the highest level of scab resistance known—into six-rowed ND breeding lines. He also gathered data on experiments designed to fully exploit a shuttle breeding strategy between the Midwest and China.

NDSU plant pathologist Brian Steffanson (left) and NDSU six-row barley breeder Rich Horsley evaluating the scab nursery in Hangzhou, China. The nursery was established cooperatively with Zhejiang University in Hangzhou, China and the Shanghai Academy of Agricultural Sciences near Shanghai, China in 1995 to evaluate barley lines for resistance to scab.

Also in China, NDSU two-row barley breeder Jerry Franckowiak made important selections of resistant lines in his two-rowed germplasm, and Steffenson identified several six-rowed winter barleys from Turkey with high levels of FHB resistance. He also found several resistant accessions of wild barley, Hordeum spontaneum, in the Hangzhou nursery.

University of Minnesota barley breeder Kevin Smith, in China as well, made critical evaluations on the performance of breeding lines derived from several FHB resistance sources. Further, Smith studied the variability of scab reactions in elite resistant germplasm across different environments in the Midwest and China. These efforts should help facilitate the development of scab-tolerant barley cultivars in the near future.

Barley breeding research at NDSU and the U of M for increased scab resistance is supported in part by the U.S. Wheat and Barley Scab Initiative.

Flooding Affects NDSU Breeding Trials

Well over seven inches of overnight rain overwhelmed eastern North Dakota in June, flooding thousands of homes and causing millions in damage—estimated at over $40 million on the campus of North Dakota State University alone.

NDSU's crop trials, including breeding material for increased scab resistance in spring wheat, durum, and barley, were affected to a varying degree. Some plants were drowned, some injured, while others were unaffected. Seed increases will be affected to some extent, but NDSU spring wheat breeder Richard Frohberg and NDSU barley breeder Rich Horsley both say that the real damage will be increased variability and the influence of flooding which will make varietal analysis more difficult. Especially breeding material in first-year yield trials, says Horsley: It will be more difficult to determine which lines to advance. Plant recovery and yield/quality variability can be better assessed after plots are harvested this summer, says Frohberg.

Research Demonstrates Feasibility of Biocontrol

In response to a lack of control options effective against scab in wheat, crop researchers are seeking to discover and develop microorganisms to provide biocontrol of Fusarium head blight, or scab.

The feasibility of biologically controlling scab of wheat has been demonstrated by several crop research programs including Embrapa (The national ag research agency in Brazil) and in the United States, at Cornell, South Dakota State University, the USDA's Agricultural Research Service, Ohio State University, and others.

David Schisler is one plant pathologist involved with fermentation biochemistry research, at the USDA-ARS National Center for Agricultural Utilization Research, Peoria, Ill. He says that biocontrol research was launched there in the fall of 1997, and is being conducted cooperatively with OSU plant pathologist Michael Boehm.

Their research is concentrated on selecting microorganisms that possess attributes which would indicate an enhanced aptitude in colonizing anthers and inhibiting infection by Gibberella zeae, the primary causal agent of FHB. Six microbial strains were discovered that consistently reduced the severity of FHB in greenhouse and field tests.

A second year of cooperative studies testing the possibility of these promising biocontrol agents to be mass produced and control disease in the field were carried out in 1999 at sites in Peoria and Wooster, OH. The most effective microbes reduced disease severity in field trials by as much as 75% percent, says Schisler, with disease reduction being demonstrated on 3 different types of wheat. Currently, fermentation studies to optimize inoculum production and efficacy are underway.

Research on Multiple Fronts

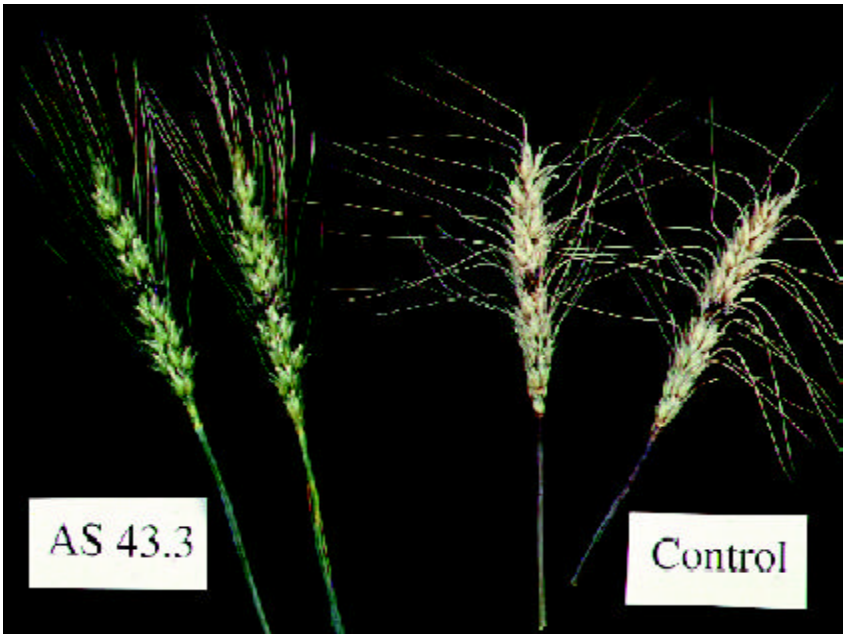
Large-scale cooperative field studies in Peoria, Wooster, and Langdon, ND (in cooperation with North Dakota State University) where disease pressure is consistently severe, are planned for the 2000 field season.

Research on this and other biocontrol projects during the past few years was made possible in part by funding obtained from the U.S. Wheat and Barley Scab Initiative. Biocontrol research marks a crucial step towards the development of biological control products for use against scab.

"The exciting prospect of biocontrol is being researched along multiple fronts that will hopefully converge in identification of all viable solutions for our wheat and barley growers who are in desperate need of solutions," says Gary Bergstrom of Cornell University, in Ithaca, New York. There, Christine Stockwell and Gary Bergstrom have been working in close cooperation with Wilmar Luz of Embrapa-Trigo (Brazilian National Wheat Research Center) in Passo Fundo, Brazil to select bacterial strains with potential for scab control in diverse cereal production environments. The research involves isolating naturally-occuring bacterial strains from the U.S. and Brazil, followed by laboratory, greenhouse, and field tests for biocontrol activity.

For the first time, two bacterial strains from the cooperative Embrapa/Cornell research program have been entered as treatments in the USWBSI Uniform Fungicide Trial in 10 states. Both of these bacteria showed significant control of scab in field tests in Brazil in 1999.

In spring/summer 2000, biocontrol bacteria are being testing alongside foliar fungicides in Indiana, Maryland, Michigan, Missouri, New York, North Carolina, North Dakota, Ohio, South Dakota, and Virginia for control of scab and foliar diseases as well as reduction of vomitoxin in the grain. The combined application of fungicides and biocontrol organisms on cereal varieties with partial resistance to scab may be a useful strategy for combating the scab problem until varieties with higher levels of resistance are available, says Bergstrom.



This photo illustrates the effectiveness of inhibiting scab through biocontrol. The wheat heads at left were treated with microbes to help ward off scab infection. Wheat heads to the right in the untreated check are infected with scab.

Programs Developed to Help Keep Tabs on Scab

Several universities in the U.S. and Canada have developed web-based systems to help producers forecast and monitor scab during the 2000 growing season.

North Dakota State University is offering a disease forecasting system on the web (www.ag.ndsu.nodak.edu/cropdisease/) and through updated, summarized recordings that producers can access toll-free by phone at 1-888-248-7357. The forecasting system tracks fungal spores, wheat growth development, and weather conditions to pinpoint in near real-time the potential for scab, tan spot, and Septoria blotch disease infections in wheat. The NDSU disease forecasting system was made available to producers in the Red River Valley for the first time in 1999. This year, the system will also be able to track leaf rust, says project manager, NDSU plant pathologist Len Francl.

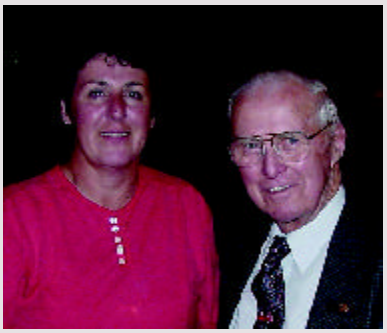
Also this year, Michigan State University and several cooperating sponsors launched a scab monitoring project to estimate the amount of wheat scab present throughout Michigan in 2000. Heads of wheat were randomly sampled from fields across 34 counties in Michigan in June, and analyzed for the presence of scab at MSU. Maps updated weekly and posted on the Michigan Scab Monitoring Project 2000 web site, www.agweather.geo.msu.edu/Wheat/, assessed the percentage of damaged spikelets in the field at various wheat growth stages. The project was headed by MSU small grains pathologist Pat Hart and MSU wheat breeder Rick Ward, with mapping assistance provided by MSU geography professor Jeff Andresen, and data collection, analysis, and web page creation by Janet Lewis and Kathleen Baker.

In Canada, Ridgetown College, University of Guelph, is offering a Fusarium Risk Model to producers through its Ontario Weather Network. The working model may be accessed on the web at: www.ridgetownc.uoguelph.ca/own/Fusarium/fusarium.htm. There's also a FHB Risk Forecast Program for Manitoba and Saskatchewan managed by the Agrometeorological Centre of Excellence, a link to which may be found online at www.gov.mb.ca/agriculture/news/ace/.

Winter Wheat Germplasm Evaluation Continues at University of Missouri

An aggressive worldwide search for resistance to F. *graminearum* (scab) continues at the University of Missouri. During the fall and winter of 1999 and 2000, accessions originating from China, South Korea, Japan, Brazil and Italy that exhibited Type II resistance (spread in the head) in a preliminary screen were verified by screening 16 progeny from resistant plants, according to UM winter wheat breeder Anne McKendry. Progeny from these accessions have been purified and increased in the greenhouse and will be available for distribution to interested breeders in July 2000.

Type II resistance in a second set of Asian, Italian and Brazilian accessions was verified during the spring of 2000, she says. Accessions with excellent Type II resistance and good kernel quality in the progeny test of resistance have been purified and are currently being increased, for seed that will be available to interested breeders in September.



University of Missouri wheat breeder Anne McKendry and Nobel Prize laureate Norman Borlaug, recognized worldwide as the "father" of the Green Revolution that enabled India and Pakistan to more than quadruple cereal production within 35 years. McKendry, Borlaug, and other wheat breeders from throughout the world attended the China National Wheat Breeding Conference held mid May in Ginan, Shandong Province, China.

"We had an excellent meeting in China that provided a very thorough update on what is happening worldwide on scab research," says McKendry.

Overview of U.S. Wheat Research Available www.wheatworld.org

A new report highlighting wheat research in the United States, prepared for the China National Wheat Breeding Conference held mid May in Ginan, Shandong Province, China, is now available on the National Association of Wheat Growers website, www.wheatworld.org. Click on the link to "Research Information."

I. Miley Gonzalez, Under Secretary of Research, Education, Economics for the U.S. Department of Agriculture, is senior author of the report.

Background information on U.S. wheat production and private sector wheat research is covered in the overview, along with details on the different facets of public wheat research. The report also explores U.S. wheat research challenges, and areas of international research collaboration.

MSU Researching Key Question:

Is DON a Threat to Food Safety?

Most food-borne illnesses in developed countries are attributable to microbiological contamination. Thus not surprisingly, there has been a sharp upsurge in national public interest about microbial and chemical food safety during the past few years. Included in these concerns are the possible effects of deoxynivalenol, or DON, a trichothecene mycotoxin that is a byproduct of scab. The contaminant can make barley unsuitable for malting, and wheat unsuitable for milling.

In a graphic example of this problem, cereal processors refused to buy Michigan wheat in 1996 because of widespread Fusarium head scab and DON contamination.

A level of 1-2 parts per million DON has been recommended by the Food and Drug Administration. Still, little is known about the toxicity of DON in humans. That's why food safety research underway at Michigan State University is a key component of the U.S. Wheat and Barley Scab Initiative.

While human feeding studies are not practical, it is possible to extrapolate human susceptibility to DON by evaluating and comparing its effects in animals and human cell culture systems. A study to that end is being led by Jim Pestka, a researcher at MSU's Department of Food Science and Human Nutrition, and the MSU National Food Safety and Toxicology Center.

Pestka's research focuses on how DON affects white blood cells. Related research has already been conducted on mice, which has shown that white blood cells and the immune system are primary targets of DON and similar mycotoxins. The new data will help in the assessment of human risk from DON exposure, says Pestka. This is critical, he says, since there is concern that advisory levels for DON could be changed in the absence of sound scientific data. Such modifications would have significant economic, trade, and legal implications for grain and food industries. The study is targeted for full completion by 2002, although some study objectives will be reached before then.

U.S. Wheat & Barley Scab Initiative

Scab Research News

This newsletter is made possible by the U.S. Wheat and Barley Scab Initiative. For more information about the Initiative, or to submit news items for consideration in this quarterly publication, contact Sue Canty, U.S. Wheat & Barley Scab Initiative, Networking & Facilitation Office, 380 Plant & Soil Sciences Building, East Lansing, MI 48824-1325 Phone: (517) 355-2236 FAX: (517) 353-3955 E-mail: scabusa@msu.edu.

This newsletter contains an update on only a sampling of projects 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.

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