U.S. WHEAT & BARLEY SCAB INITIATIVE

# Fusarium Focus

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# 2011 National FHB Forum Set for St. Louis Dec. 4-6

Photo Courtesy St. Louis Convention & Visitors Commission

The Hyatt Regency St. Louis at the Arch provides the venue for the 2011 National Fusarium Head Blight Forum, scheduled for December 4-6. This year's Forum — the 14th — is geared toward wheat and barley growers, grower group representatives, public and private scientists, millers, maltsters and brewers, additional food processors, consumers and others with interest in Fusarium Head Blight (scab) and its impact.

Hosted by the U.S. Wheat & Barley Scab Initiative (USWBSI), the 2011 Forum features stakeholder and scientific presentations, focused group discussions, event breakout gatherings and poster sessions, as well as social opportunities for participants.

The Forum convenes at 1:00 p.m. on the 4th with a welcome from Dave Van Sanford, USWBSI co-chair. The keynote presentation will be delivered by Ralph Judd III of Anheuser-Busch. That's followed by *Session 1: Variety Development and Host Plant Resistance*. A poster session focused on this program area rounds out the afternoon. and the day ends with dinner and evening breakout meetings.

*Session 2: Pathogen Biology and Genetics* starts off the day on Monday, December 5. It's followed by *Session 3: Gene Discovery and Engineering Resistance*. Focused group discussions are planned for that afternoon. There are two poster sessions on Monday.

*Session 4: Food Safety, Toxicology and Utilization of Mycotoxin-Contaminated Grain* takes center stage early Tuesday morning, with *Session 5: FHB Management* wrapping up the 2011 Forum.

The USWBSI Steering Committee meets on Tuesday afternoon following the Forum's noon adjournment.

Key dates for the 2011 National Fusarium Head Blight Forum include:

- *Oct. 31* — Deadline for registration of posters, papers and abstracts.
- *Nov. 4* — Deadline for submission of abstract and paper content for the Forum proceedings.
- *Nov. 7* — Deadline for early registration (fee: $135.00) and last day to receive a full refund.
- *Nov. 8* — Late registration begins (fee: $175.00).
- *Nov. 14* — Last day to reserve a Hyatt hotel room with guaranteed availability and rate.
- *Nov. 16* — Last day to receive a partial refund.
- *Nov. 23* — Registration closes.

Advance registration is required and can be accomplished on the USWBSI website: www.scabusa.org. Participants are responsible for making their own hotel reservations at the Hyatt Regency. To do so, use the link on the USWBSI website ❖

# Fusarium Head Blight in 2011

## — An Overview —

*Several states experienced low to virtually non-existent problems with Fusarium Head Blight (scab) during the 2011 U.S. small grains production season, while a few others incurred significant disease incidence and crop loss. As always, growing season weather played a large role in the disease's status; but so too, on an expanding basis, has the use of FHB management tools like varietal selection, fungicide applications and crop rotation.*

*A recent survey by the U.S. Wheat & Barley Scab Initiative (USWBSI) of university specialists in several states tells the story. Here's an overview, presented by region. — Don Lilleboe*

### Mid-Atlantic Soft Winter Wheat Region

If you're looking for good news on the scab front, it's hard to top the brief — and very positive — report from Erik Stromberg, extension plant pathologist with **Virginia** Polytechnic Institute and State University. "To my knowledge, Fusarium Head Blight was a non-issue in Virginia [in 2011]," Stromberg reports. "This was the best wheat crop (no disease) in my 30 years in Virginia."

The situation was just as benign in **North Carolina** this year. Christina Cowger, USDA-ARS plant pathologist at North Carolina State University, says scab was not a problem in her state's fields. "Most wheat and barley flowers in April or early May in this state," she notes, "and conditions were dry — with the exception of a short rainy spell in late April."

Cowger adds that of the 14 wheat varieties ranked as "above average" in yield statewide in NCSU 2010-11 replicated trials, three (DynaGro Dominion, Southern States 8700 and Coker Oakes) are moderately resistant to scab. Also, "of the several varieties popular in some counties but not in the statewide top tier for yield, three are moderately scab resistant: P26R15, USG 3555 and Progeny 185." It's difficult to accurately peg the extent to which scab-resistant varieties were planted in 2011, Cowger says. But informal estimates by extension agents and certified seed producers suggest that DynaGro Dominion and Coker Oakes were among the highest-acreage wheat varieties. However, it appears the other six varieties in the top eight are susceptible or moderately susceptible.

"Fungicides were not widely used in North Carolina to combat head scab in 2011," Cowger adds, "because producers correctly interpreted the scab forecast to indicate that a scab fungicide was not warranted." The state's small grain producers and their advisors were encouraged to sign up for scab alerts (i.e., the FHB Alert System, hosted by the U.S. Wheat & Barley Scab Initiative) early last spring, and many did so. "This system has been a success in establishing the capacity for rapid response, should scab pose a risk to North Carolina producers in 2012," Cowger states.

Scab was not a problem for **South Carolina** producers this year, either, reports Jay Chapin, Clemson University peanut and small grain production specialist. The lack of scab was likewise reflected in Chapin's annual variety evaluations, where the disease's absence prevented any scab ratings, though "we rate all diseases present," he notes.

Predictably, no applied fungicides were targeted at scab in South Carolina. "Leaf rust and leaf/glume blotch are primary targets," Chapin relates. "Tebuconazole is widely used, primarily before head emergence. But some applications [were] delayed until head emergence with the idea of still getting adequate rust/glume blotch protection and perhaps reducing scab risk."

The situation was not nearly as pleasant to the north, in **Pennsylvania**. Fusarium Head Blight "was real serious on wheat and barley — perhaps as bad as I have ever seen, especially in the southern counties of the state," reports Greg Roth, extension agronomist with Pennsylvania State University. "It was also a significant problem in the central counties on wheat, even though they were relatively 'low risk' through the heading period." Roth says about one-half of Pennsylvania's 2011 wheat crop came in with vomitoxin (DON) levels above the 2.0 ppm threshold.

Producers in southern counties who used Prosaro and Caramba fungicides had generally good success, Roth says, "with increases in yield and reductions in DON under high-pressure situations." He had more reports of mixed results in Pennsylvania's central counties, with even treated fields showing high DON levels. "Fungicides were a real benefit to many producers in the southern counties, and they will likely become part of mainstream wheat management," the PSU agronomist predicts.

*While most Mid-Atlantic SWW states had little or no scab, Pennsylvania was the exception — particularly in its southern counties.*

Alyssa Collins, director of Penn State's Southeast Agricultural Research & Extension Center at Manheim, believes university small grain specialists did a good job of alerting growers to this year's scab risk as flowering approached — and

most farmers who could spray did so. However, she adds, there's more work to be done in helping growers understand the timing issues involved in getting efficacy from their sprays. Also, while fungicide treatments are a key facet of managing this disease, variety selection and other management steps play an equally important role. "I feel like more farmers will be open to trying scab-resistant varieties [in 2012] if they are available," Collins affirms.

In **Maryland**, spring weather was conducive for FHB development — particularly in the central and northern parts of the state, reports University of Maryland field crops plant pathologist Arv Grybauskas. The southern wheat district generally escaped conditions favorable to disease and, in turn, produced a crop of excellent quality.

"Rejections of seed at mills and elevators was considerably less in 2011 than in 2009," Grybauskas says. "This was in part due to the availability of low-DON seed for blending and in part due to lower disease severity." Maryland wheat growers slightly increased their use of moderately resistant varieties, he adds, in concert with such varieties' increased availability. They also made better use of the scab forecasting website and hiked their use of fungicides for managing the disease. "Fungicides helped to keep DON to acceptable levels," Grybauskas affirms.

## Southern Soft Winter Wheat Region

As in the Carolinas, scab took a vacation in **Georgia** in 2011. That's not surprising, given that Fusarium Head Blight historically has been very low in the state, notes Alfredo Martinez, extension plant pathologist with the University of Georgia. "Additionally, crop rotation with non-host crops has greatly reduced the possibility of the fungus carryover," he explains.

Because scab is rare in Georgia, fungicide treatments are geared toward controlling diseases like rust, powdery mildew and stagonospora, among others. "While there are some FHB-tolerant varieties available, most producers based their variety selection on high-yielding varieties that are resistant to foliar diseases and insects," Martinez says. In concert with the USWBSI, the university's small grains team is actively pursuing the development of high-yielding soft red winter wheat cultivars with improved FHB resistance, he adds.

In **Alabama**, scab issues in 2011 were confined to the Quad Cities (Florence) area, comprised of three counties in the northwestern part of the state. Dry weather patterns in other wheat production areas greatly limited disease development there.

Growers in the Quad Cities area who applied a timely fungicide experienced yields in the range of 90 to 100 bushels per acre (compared to less than 60 bushels in untreated fields), notes Austin Hagen, Auburn University extension plant pathologist. Prosaro, Caramba and generic tebuconazole were the fungicides of choice.

Next door, in **Mississippi**, "light" is the best word to describe the 2011 scab footprint, says Tom Allen, extension plant pathologist with Mississippi State University's Delta Research & Extension Center. Fields that did incur some FHB were typically in the eastern part of the state. Fungicides are the preferred control measure, though Allen expects more grower interest in tolerant or resistant varieties next year. He says Mississippi growers who do apply a fungicide to their wheat tend to do so more as a "plant health" treatment (*i.e.*, yield enhancement) rather than for yield loss prevention due to a specific disease.

To the northwest, in **Arkansas**, "scab was generally absent south of I-40 where most of the wheat is grown and where conditions before, during and after flowering were dry," reports Gene Milus, University of Arkansas plant pathologist. Northeastern Arkansas did experience some heavy rains, with some scab developing late in the growing season. "However, I did not hear about any loads being rejected at the elevator," Milus relates.

Of the 20 commonly grown wheat varieties in the state as of 2011, three were rated as moderately resistant to scab, eight were moderately susceptible, six were susceptible and the final three were very susceptible to FHB. It's very difficult to determine how much of the Arkansas wheat crop was seeded to a resistant variety, Milus adds. "Seed was in short supply, so farmers planted whatever they could get," he indicates. Little fungicide was used this year because conditions conducive to scab did not appear until after flowering.

## Midwest / Northern Soft Winter Wheat Region

**Ohio** experienced a very tough year of Fusarium Head Blight in 2010, with disease incidence levels ranging from 3% all the way up to 60%, and with DON levels of from less than 1.0 ppm up to 18.0 ppm. Fortunately, while scab made its presence known again this year, the 2011 experience was much less damaging, reports Pierce Paul, Ohio State University plant pathologist.

"Vomitoxin levels are relatively low, being below 5.0 ppm in the majority of harvested fields, with the odd field having 7.0 to 9.0 ppm," Paul reports. "These numbers are much lower than last year's numbers, which [reflected] the most severe scab and vomitoxin problem Ohio has had in over 10 years."

*Scab made its presence known again this year in Ohio — but the 2011 experience was much less damaging than the 2010 version.*

The average scab incidence in 2011 Ohio fields not treated with a fungicide was 12.4%, with more than 41% of those fields having more than 10% incidence, according to Paul. "That makes 2011 the third highest year for wheat scab since

2002." Average incidence of all non-treated fields within each county surveyed ranged from 1.4% to 31.1%, while averages for individual fields ranged from 0 to 44.9% incidence. Higher incidence levels tended to occur in two main clusters of counties within the state: (1) the southwest and (2) the central to mid-northwest.

"Overall, fields planted to varieties with moderate levels of resistance to scab and/or treated with a fungicide had lower disease levels than those planted to a susceptible or moderately susceptible variety and/or not treated with a fungicide," Paul notes. In addition, moderately resistant varieties treated with a fungicide had the lowest overall average level of scab (4%). Similarly, fields of susceptible varieties treated with a fungicide had an overall average incidence of 7.4%, compared to those that were not treated (average incidence of 11.3%).

"Wheat scab and vomitoxin continue to be the biggest threats to profitable production of high-yielding, high-quality wheat in Ohio," Paul emphasizes. "However, today we have better and more-effective tools than we did 10 years ago — *i.e.*, the scab risk assessment system, better fungicides and more-resistant varieties. Results for 2010 and 2011 show that selecting varieties that are moderately resistant, planting wheat after soybean (which the majority of growers in Ohio are doing), along with a well-timed fungicide application, is the most effective integrated approach for minimizing yield and quality losses due to scab."

Photo: Stephen Wegulo / Univ. of Nebraska

**Kentucky** harvested an excellent wheat crop overall in 2011 — a surprise to many, since the crop was planted during a very dry period, followed by continuous spring rains that increased disease risk. At times during the spring, it appeared many fields had significant levels of Fusarium Head Blight and/or leaf and glume blotch, reports Don Hershman, University of Kentucky extension plant pathologist. But above-average temperatures during the first part of June helped the crop dry down rapidly. "In essence, the crop outraced the diseases to the finish line," Hershman says, thus softening the potential impact from disease infections. He says about 20% of the state's wheat had at least moderate levels of FHB (some severe), "but it did not translate into any serious damage, fortunately."

Hershman says about 40% of Kentucky wheat acres were treated with a fungicide (mainly Caramba and Prosaro), with FHB as the prime target. "Overall, farmers seemed pleased with the visual results of treatments when fungicides were applied in a timely fashion," he states. Some fields could not be treated promptly due to ongoing rains; but the ensuing dry weather helped rein in scab development.

To the north, in **Indiana**, less scab developed in 2011 than in preceding years. "The northeast corner of Indiana did experience some problems with FHB due to moderate temperatures, high rainfall and high humidity as wheat was beginning to flower," reports Kiersten Wise, Purdue University extension plant pathologist. Those conditions complicated timely fungicide treatments, and some producers incurred high levels of FHB as a result, she says. "Fields that had a combination of varietal genetic resistance and a well-timed fungicide application experienced less disease," Wise notes.

"There were a few reports of dockage due to DON levels over 2.0 ppm; but overall, reports were low."

Most **Illinois** wheat acreage is located in the state's southern portion. There, just prior to anthesis, the FHB risk ran moderate to high. "But we lucked out and caught some dry weather during the majority of anthesis — which dropped the FHB risk to low," notes University of Illinois extension plant pathologist Carl Bradley. "Scab could be detected in fields, but incidence and severity were low. I did not hear of any issues of high DON levels in southern Illinois wheat this year."

Bradley says a lot of southern Illinois wheat fields were treated with a fungicide this year to aid scab management. That doubtlessly was a contributing factor to the overall low impact from the disease in 2011, as was the use by some growers of moderately resistant varieties.

**Wisconsin** also enjoyed a benign scab year in 2011. University of Wisconsin extension plant pathologist Paul Esker says conditions for development of FHB were variable, depending upon a particular field's flowering period. "Fields that flowered in early June were under conditions that were less favorable for the development of Fusarium Head Blight," he reports.

Fields flowering later in the month were more prone to infection, and many were sprayed with a fungicide. "Postharvest, we have received few reports of damaging levels of FHB," Esker relates.

To the east, the incidence of scab in **Michigan** fields was very low this year, says Martin Nagelkirk, Michigan State University extension director for Sanilac County. DON levels were correspondingly low as well, though an

occasional load tested in the 2.0 to 4.0 ppm range.

While there are as yet no scab-resistant soft white winter wheat (which comprises one-third of the state's crop) varieties in Michigan, "growers are beginning to select high-yielding white varieties that might be considered moderately susceptible rather than highly susceptible," Nagelkirk advises. "Moderately resistant varieties of soft red winter wheat are not as accessible as others, but they can be obtained."

The use of fungicides on wheat in Michigan increased dramatically in 2011 due to the crop's elevated value along with encouragement from extension and agribusiness. "A reasonable guess is that 75% of the soft white and 50% of the soft red received at least one application of fungicide this year," according to Nagelkirk. "As last year, the use of fungicides likely increased grain yields by several bushels."

*Scab was a big problem this year in some areas of South Dakota. Winter wheat took the hardest hit in the central and south central districts.*

The MSU extension educator views the efforts of the U.S. Wheat & Barley Scab Initiative as proving of significant benefit to his state's wheat producers. "Of particular value is the forecasting model, trials that measure the efficacy of fungicides — and educational materials regarding FHB and other diseases," he affirms.

Up in **New York**, wheat planting in the fall of 2010 was delayed following a late soybean harvest. "This resulted in a delay in wheat flowering into early June 2011, after the prolonged rainy period had ended," notes Gary Bergstrom, Cornell University plant pathologist. "In general, only low levels of Fusarium Head Blight were observed in New York winter wheat fields in June and July."

Isolated winter wheat fields — particularly some early planted ones that flowered in late May — did experience moderate levels of FHB. However, says Bergstrom, feedback on wheat quality from wheat mills confirmed the year's pattern of low FHB observations. More than 90% of winter wheat loads received as of late August tested below 1.0 ppm of DON, he reports, with just a handful of samples statewide showing levels in the 2.0 ppm area.

"Strides have been made by New York growers to reduce the planting of soft winter wheat varieties with a reputation for extremely high DON levels," Bergstrom relates. "However, moderately susceptible (to FHB) varieties of red and white wheats still predominate in New York, and yield remains the major factor in variety choice."

The Cornell specialist says less than 20% of the state's wheat acreage received a fungicide treatment in 2011. A number of producers made flowering applications of Caramba or Prosaro, aimed at control of both FHB and flag leaf diseases. Those applications resulted in modest yield boosts, due primarily to control of leaf rust and leaf blotches. Research trials in New York show that Caramba and Prosaro applications "result in consistent reduction in DON levels, especially when applied to varieties with moderate resistance to FHB," Bergstrom observes.

## Great Plains Hard Winter Wheat

The 2011 Fusarium Head Blight situation in **Nebraska** ranged from very low to severe, depending upon the area and field. While scab occurred in the southeastern, south central and southwestern parts of the state, the most severely affected fields were in southwestern Nebraska, reports Stephen Wegulo, University of Nebraska extension plant pathologist. Such fields "were either planted with a susceptible variety or had corn stubble on the soil surface — or both," he notes.

Overland, a scab-tolerant variety, was the top-acreage cultivar in Nebraska this year at 10.8% of total wheat acreage. Millennium, which also has shown good tolerance to scab, went on 7.6% of the state's wheat acreage.

"Overall, losses due to scab statewide were minimal for the most part," Wegulo summarizes. "However, losses in several isolated fields were significant."

Scab losses in **Kansas** were very low this year, notes Kansas State University extension plant pathologist Erick DeWolf. Drought was a major reason why, as dry conditions dominated for much of the growing season. "I was concerned when we saw some wet weather move through near the end of flowering in parts of eastern Kansas," DeWolf says. "However, severe FHB did not develop."

The situation was similar in **Oklahoma**, where most of the state was under extreme drought conditions for the entire 2011 wheat growing season. Bob Hunger, Oklahoma State University extension wheat pathologist, says neither he nor the OSU wheat extension agronomist observed any scab this year. Fungicide use likewise was minimal, given that all foliar diseases were limited due to the season's drought and high temperatures.

## Northern Great Plains Hard Spring Wheat Hard Winter Wheat / Malting Barley

"Scab was a major problem this year in certain areas of **South Dakota**," reports Kay Ruden, extension/research associate with South Dakota State University. Winter wheat took the hardest hit in the state's central and south central districts.

As of late August, Ruden was aware of DON levels ranging from 2.0 all the way up to 20.0 ppm in winter wheat, and from 2.0 up to 9.0 ppm in spring wheat samples. Yields and test weights of both wheats are down from last year, though not all of the decline can be pinned on scab. Several other diseases, along with frost in some areas, also contributed to yield and quality problems.

"With the weather conditions being wet to very wet in the spring and wet during the growing season, it was a perfect set-up for all of these to get a foothold in the wheat

crop and cause havoc," Ruden observes.

South Dakota growers do have several options when it comes to selecting scab-resistant wheat varieties. In spring wheat, most of the available varieties have some level of resistance to scab, Ruden explains. "And in a year like this one, it has helped. But we also need to look at the whole picture when thinking about scab." That includes, she emphasizes, crop rotation considerations and fungicide applications.

This year's wet and humid conditions prompted heavy fungicide use by South Dakota wheat producers. Products included Prosaro, Caramba, Proline and generic versions of tebuconazole. While the fungicides helped protect the crop, the "almost-perfect" conditions for scab in 2011 resulted in a lower degree of protection than would be expected in a "more-normal" season, Ruden says. Still, where fungicides were not applied, "we saw a lot more scab, and the yields were a lot lower than in the treated wheat," she adds.

"The research we have done here in South Dakota and across the nation with the help of USWBSI has helped us get information out to producers, crop consultants, elevators, etc., about the importance of choosing resistant crop varieties, crop rotation and testing for DON," Ruden emphasizes. "With the national scab forecasting system in place, we do have producers in South Dakota checking it and seeing if and when they need to spray. They are more willing to spray their wheat crop now than they were when USWBSI first started."

**North Dakota** small grains extension plant pathologist Marcia McMullen says symptoms of Fusarium Head Blight were observed in about 50% of surveyed post-flowering wheat fields in 2011. However, average field severity in those symptomatic fields (primarily spring wheat and winter wheat) averaged between 3-5%. "Field severities ranged from less than 1% to over 37%, with the highest levels observed in some winter wheat fields," McMullen reports. Initial harvest and DON analyses indicated that DON levels were "generally below 1.0 ppm in spring wheat, but higher levels have been observed in winter wheat, depending on the variety grown," she notes.

Surveys of North Dakota barley fields showed very few with obvious FHB symptoms, according to McMullen. Preliminary reports indicated variable DON levels in barley, averaging between 0 to 2.0 ppm.

In September, as more North Dakota durum wheat was harvested, McMullen received reports of higher DON levels (3.0-5.0 ppm) in durum grain.

"The biggest story from North Dakota is that the growing season had a very unfavorable environment for small grains," McMullen observes. Excessive moisture (leading to many prevented plant acres), very high dew points, hot temperatures during July, frequent storms, drowned-out fields, and multiple root, leaf and head diseases all contributed to "very low and disappointing yields for most North Dakota producers."

Across the Red River of the North, in **Minnesota**, the 2011 growing season served as a reminder that Fusarium Head Blight is "a nemesis that you cannot ignore," says Jochum Wiersma, small grains specialist with the University of Minnesota's Northwest Research & Outreach Center, Crookston. Delayed spring planting, coupled with high temperatures during the second half of the growing season, set the stage for reduced spring wheat, winter wheat and barley yields. Then FHB contributed as well. "Field severities ranged from just a few percentage points to as high as 30% in some fields," Wiersma reports.

Early reports indicated DON levels, for the most part, hovering below 2.0 ppm — probably a reflection of growers' efforts to remove as many visually scabby kernels as possible during harvest. Nonetheless, says Wiersma, initial estimates suggest that scab "may have caused economic losses not seen since 2005, the last year of widespread problems" in Minnesota.

This level of disease occurred despite a higher portion (almost 40%) of the acreage being planted to varieties rated moderately resistant or better to FHB — and a higher percentage of acreage receiving a fungicide application at the beginning of anthesis. "Industry representatives estimate that more than 85% of Minnesota's spring wheat acreage was sprayed at Feekes 10.51," Wiersma relates, "with a larger percentage of those acres being treated with either Prosaro or Caramba when compared to previous years."

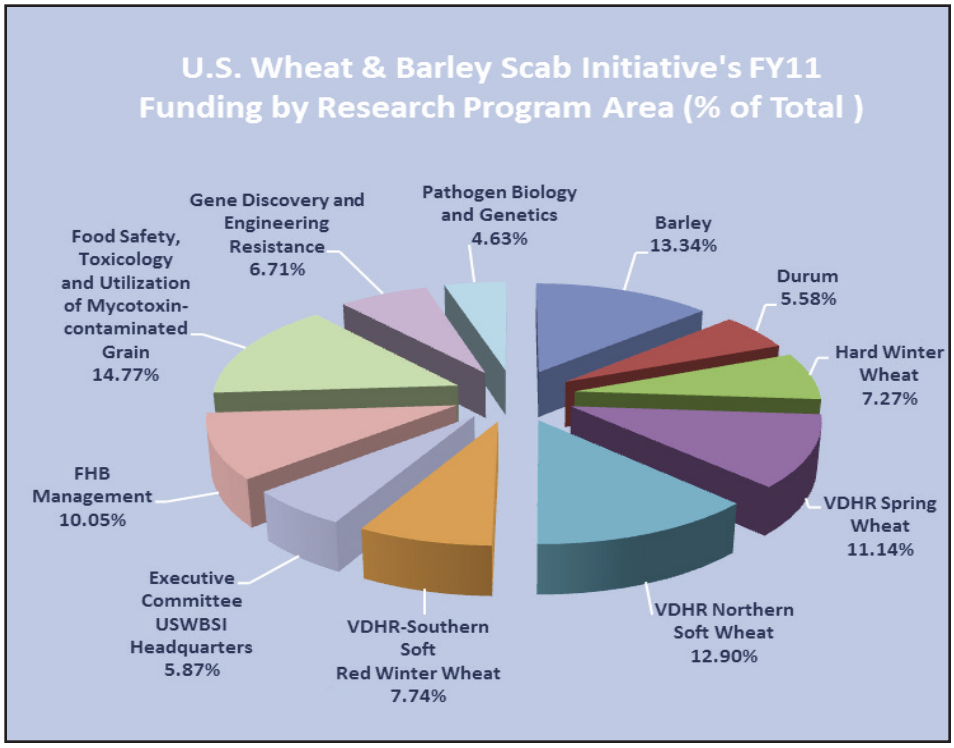
In terms of new wheat varieties, the University of Minnesota released Prosper, a HRSW cultivar and sister line to Faller, jointly with North Dakota State University. Minnesota also released Rollag, another HRSW variety whose FHB resistance is rated as good as anything on the market. "It will be cultivars like Rollag that are needed to further increase the fraction of the acreage being planted to cultivars rated moderately susceptible or better to FHB," Wiersma states, "as yield potential, quality and agronomic traits such as straw strength are more important to growers in the cultivar selection process than the cultivar's FHB resistance." ❖

# USWBSI Research Funding: FY '11

The U.S. Wheat & Barley Scab Initiative (USWBSI) Steering Committee recommended that USDA's Agricultural Research Service award $4,976,740 in scab-related research project funding for fiscal year 2011. That total encompassed 153 projects in 25 states and covered 24 land grant universities and USDA-ARS.

The pie chart at right depicts the percentage of recommended funding, broken down according to research area. USWBSI recommended levels, in dollars, were as follows:

- *Variety Development & Host Resistance (VDHR) / Northern Winter Wheat Region* — $641,928 / 29 projects
- *VDHR / Spring Wheat Region* — $554,570 / 16 projects
- *VDHR / Southern Winter Wheat Region* — $385,035 / 6 projects
- *Hard Winter Wheat Coordinated Project* — $361,706 / 12 projects
- *Durum Coordinated Project* — $277,593 / 6 projects
- *Barley Coordinated Project* — $664,088 / 18 projects
- *FHB Management* — $500,394 / 40 projects
- *Food Safety, Toxicology & Utilization of Mycotoxin-Contaminated Grain* — $734,841 / 7 projects
- *Gene Discovery & Engineering Resistance* — $334,060 / 9 projects
- *Pathogen Biology & Genomics* — $230,490 / 7 projects
- *Executive Committee & USWBSI Headquarters* — $292,035 / 3 projects




Each year, the USWBSI is charged with developing a comprehensive research plan and budget recommendation geared toward achieving its primary mission: to develop, as quickly as possible, effective control measures that minimize the threat of Fusarium Head Blight (scab) — including reduction of mycotoxins — to producers, processors and consumers of wheat and barley.

In 2006, USDA-ARS charged the USWBSI with the task of developing a three- to five-year Action Plan that would include a greater focus on the reduction of deoxynivalenol (DON). Development of the Action Plan began at the 2006 National FHB Forum, and it has continued to evolve since then with the incorporation of feedback from the overall scab community.

The process followed to develop this research plan and budget is the product of extensive deliberations overseen and approved by the USWBSI Steering Committee (SC). The SC is comprised of growers, farm organizations, food processors, public and private scientists and consumer groups.

This year's initial proposal review process was coordinated by USWBSI's Networking & Facilitation Office in close consultation with the Executive Committee (EC) and the chairs of each individual research area and coordinated project. The EC's recommended plan and budget were presented to the USWBSI Steering Committee in December 2010.

Following a briefing and study of the plan, the SC passed it unanimously, and it then became the official USWBSI comprehensive research plan and budget recommendation for fiscal 2011. It later was translated into individual ARS grant applications, which in turn were submitted, en mass, as the USWBSI's recommendation for how ARS could allocate the resources awarded it by the U.S. Congress.

Anyone wishing to learn more about the funding application and approval process should visit the U.S. Wheat & Barley Scab Initiative's website: www.scabusa.org. ❖

## Individual Project Details

To view complete listings of fiscal 2011 research project titles, names of principal investigators, institutions and level of USWBSI funding, visit www.scabusa.org. Click on the "Research Categories" tab and then go to the desired research area.

# Research Accomplishments & Goals

The administrative structure of the U.S. Wheat & Barley Scab Initiative encompasses 11 research committees — four based according to "Research Area" and seven by "Commodity" (Coordinated Projects). All these committees serve under the umbrella of the USWBSI Steering Committee and look to the Steering Committee for direction and research funding approval.

At the Spring 2011 meeting of the USWBSI Steering Committee, each committee chair presented a recap of progress made in recent years and of expectations during the next two-year funding cycle. Provided below and on the next four pages are summaries of the committee reports. For more details on any of them, visit the USWBSI website, www.scabusa.org, then click "Research Updates." ❖

| Research Area | Recent Years' Key Accomplishments | Goals / Next 2-Year Funding Cycle |
|---|---|---|
| **FHB Management**<br>*Chair: Christina Cowger*<br>*USDA-ARS, North Carolina* | • Scab risk forecasting model improved and made available to 25 states.<br>• Integrated management practices were evaluated and promoted.<br>• Fungicide management largely optimized.<br>• ScabSmart created and updated; mgmt. info for various regions and market classes<br>• Commentaries from FHB forecasting site available to users via smart phone, email.<br>• Documented influences of post-anthesis weather and late infections on FHB, DON. | • Enhance scab risk forecasts with addition of variety resistance in winter wheat; add DON forecasts.<br>• Increase scab alert subscriptions significantly in central and eastern U.S.<br>• Develop regionally appropriate specific recommendations for corn and small grain debris management.<br>• Survey producers and crop advisors in several states to identify levels of adoption of techniques (and barriers to adoption).<br>• Use survey findings to refine extension-outreach objectives and implementation.<br>• Produce USWBSI brochure, including state-customized information.<br>• Additional fungicide optimization work.<br>• Develop better understanding of how "less-than-optimum" conditions affect FHB and DON levels. |
| **Pathogen Biology & Genetics**<br>*Chair: Frances Trail*<br>*Michigan State University* | • New pathogen-based targets that may help control FHB in future (*e.g.*, improved enzymes to detoxify DON for use in transgenics).<br>• Increased understanding of the FHB pathogen populations.<br>• Ability to monitor shifts in populations and assess their threat, if necessary.<br>• Identification of accumulation pattern of DON during infections.<br>• Identification of genes involved in spore germination and infection, understanding how pheromones and pheromone receptors affect spore germination.<br>• Development of a pathogen gene-silencing procedure. | • Focus on discovering genes for pathogenesis and trichothecene reduction and generating material for development of resistant, transgenic plants.<br>• Develop an increased understanding of how asymptomatic grain with high DON develops and how infection and grain colonization occurs.<br>• Enhance USWBSI web-based resources for access to information on mutants created through this committee and their respective phenotypes. |

| Research Area | Recent Years' Key Accomplishments | Goals / Next 2-Year Funding Cycle |
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| **Gene Discovery and Engineering Resistance**<br>*Chair: Steve Scofield*<br>*USDA-ARS, Indiana* | • Range of genes identified that can degrade DON or increase the tolerance to DON *in planta*. They are being tested for efficacy in wheat and/or barley in funded USWBSI projects.<br>• Two major plant signal transduction pathways have been demonstrated to play essential roles in Type II resistance to FHB: (1) ethylene signaling and (2) signaling activated by Pathogen-Associated Molecular Pattern (PAMP) receptors. | • Data should be obtained from transgenic wheat and/or barley that can be used to critically judge the viability of FHB resistance strategies based on the two outputs noted at left.<br>• It is strongly believe that within the next two years, ongoing discovery work will generate important new leads for engineering FHB resistance. |
| **Food Safety, Toxicology and Utilization of Mycotoxin-Contaminated Grain**<br>*Chair: Paul Schwarz*<br>*North Dakota State University* | • Analytical support has continuously provided timely and accurate measurements of DON and other tricothecenes to barley and wheat breeders/researchers, as well as other researchers conducting work on FHB. This support is critical to the development of cultivars resistant or tolerant of FHB.<br>• A candidate physiological-based biomarker of growth retardation in mice has been identified. This is important for future risk/safety assessments. | • Continue to provide rapid, accurate analyses of DON and related compounds.<br>• Improve the understanding of mechanism of action of DON in mouse models, which is relevant to the development of appropriate risk assessment models.<br>• Gain insight into the bioavailability of DON from DON conjugates (relevant to accurate exposure estimations and risk/safety evaluations).<br>• Improve understanding of DON's fate during milling and baking — especially the extent to which conjugated or "hidden" DON forms in grain or flour contribute to DON content of products. |

| Coordinated Projects Commodity-Based | Recent Years' Key Accomplishments | Goals / Next 2-Year Funding Cycle |
|---|---|---|
| **Barley**<br>*Chair: Kevin Smith*<br>*University of Minnesota* | • New variety (Quest) with lower DON.<br>• Multi-location transgenic nursery that produces reliable data.<br>• Identified a barley UDP-glucosyltransferase gene that detoxifies DON.<br>• Marker information being implemented for MAS and genomic selection.<br>• Accurate DON forecasting model.<br>• Two transgenic lines showing approximately 40% less DON than Conlon have been crossed to Quest and ND20448. | • Two new variety candidates with enhanced FHB resistance entered into industry plant-scale brewing evaluations.<br>• Ten new variety candidates entered into industry pilot malt evaluations.<br>• Evaluation of the effectiveness of genomic selection to enhance FHB resistance and lower DON.<br>• Improved genomic selection model.<br>• Identification of 10 new genes as targets for barley transformation.<br>• Evaluation of up to 10 genes for disease resistance in transgenic barley.<br>• Initial evaluation of elite breeding lines carrying a transgene for lower DON.<br>• Identification of resistant lines from advanced backcross mapping population used as parents in breeding, with associated marker information. |

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|---|---|---|
| **Durum**<br>*Chair: Xiwen Cai*<br>*North Dakota State University* | • Released three cultivars since 2005 that are less susceptible to FHB than older ones.<br>• Identified Tun. 7 durum line as good source of FHB resistance; now being incorporated into adapted durum backgrounds.<br>• Developed several hundred durum experimental lines with improved FHB resistance.<br>• Identified FHB resistance from emmer and Persian wheat and developed eight germplasm lines with improved FHB resistance from these sources.<br>• Identified and mapped six novel FHB resistance QTL.<br>• Developed a number of introgression lines with FHB resistance from various sources. | *Partial list only; go to www.scabusa.org, then "Research Updates" for more.)*<br>• Screen durum populations/experimental lines for FHB resistance in greenhouses and irrigated field nurseries.<br>• Evaluate more than 1,000 experimental lines for DON each year.<br>• Collect and use 4,000 to 5,000 molecular marker genotyping data points for selection in collaboration with USDA-ARS Fargo genotyping center.<br>• Evaluate 800 identified FHB-resistant lines for quality.<br>• Continue developing durum germplasm lines with improved resistance from hexaploid wheat. |
| **Hard Winter Wheat**<br>*Chair: Bill Berzonsky*<br>*South Dakota State University* | • Four hard winter wheat varieties released with above-average resistance to FHB (one each from South Dakota, Nebraska and Kansas).<br>• Individual and/or regional HWW breeding lines have been phenotyped in the field for resistance to FHB each year since 2000/01. Field phenotyping nurseries for private company breeding programs in the HWW region have been established since the 2009/10 season. Similar nursery trials conducted in North Dakota; results shared with growers.<br>• Multiple fungicide field tests have been established since 2004/05, with many of them conducted to determine the effect of genetic FHB resistance when combined with fungicide treatment. Much of the data shared with growers.<br>• Breeders and regional genotyping lab at Manhattan, Kan., collaborated to transfer *Fhb1* into Wesley, Harding and Trego using MAS, and resistant lines with *Fhb1* have been selected within each background. Selected lines have been released to several HWW breeding programs for yield evaluations and use as parents in crosses.<br>• Various additional transfers of *Fhb1* also have been made. *(Visit www.scabusa.org and go to "Research Updates" for details.)* | • Determine if *Fhb1* is responsible for any yield drag in winter wheat. This QTL, along with the 5A QTL for resistance to FHB, will be introduced into advanced breeding lines.<br>• A Wesley Fhb1 backcross-derived breeding line with suitable agronomic characteristics will be released for Nebraska and South Dakota or made available as FHB-resistant germplasm.<br>• All programs in the HWW region will continue to improve the levels of resistance to FHB in their breeding lines, with field nurseries at multiple locations. Field fungicide testing experiments also will be continued.<br>• Germplasm having Fhb1 plus an additional QTL in Jagger, Overley and Overland backgrounds will be released to breeders for additional yield tests and for use as parents in crosses.<br>• Linkage mapping and association mapping will be used to identify QTL in U.S. HWW germplasm. |

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|---|---|---|
| **VDHR Spring Wheat**<br>*Chair: Karl Glover*<br>*South Dakota State University* | • Releases of new varieties Tom, Sabin and Rollag (all MN), Faller, Barlow and Prosper (all ND), and Brick and Select (SD).<br>• Many potential releases are at various stages of the breeding programs.<br>• Identification of several non-*FHB1* sources of resistance.<br>• Germplasm exchange through URSN. | • Continue to develop cultivars with better resistance.<br>• Reduce prevalence of susceptible cultivars in the region to a minimum.<br>• Identify new QTLs that contribute to resistance.<br>• Incorporate / pyramid new sources of resistance into germplasm.<br>• Continue to refine screening methods.<br>• More emphasis on MAS.<br>• Select germplasm with low DON accumulation.<br>• Discover / validate new molecular markers for existing genes.<br>• Continue with URSN participation.<br>• Continue to pursue an integrated management approach that includes cultivar resistance and agronomic management. |
| **VDHR Northern Soft Winter Wheat**<br>*Chair: Clay Sneller*<br>*Ohio State University* | • Toward the goal of increasing acreage planted to varieties exhibiting improved FHB resistance, several new cultivars have been released since the beginning of the CP, including eight reported in 2010. Seed of at least 30 promising breeding lines have been increased. It is estimated that more than 6,500 breeding lines are phenotyped in the field for FHB each year, for a total of about 19,500 in the CP's first three years. Along with screening breeding lines, each CP cooperator screens all entries in his/her state's official variety trial and makes the information available to growers.<br>• To help increase efficiency of individual breeding programs to develop and release FHB-resistant varieties, we are progressing on developing a database for soft wheat performance. We also have used MAS in many F2-F4 and F2 enrichment schemes, and many programs have been BCing FHB QTLs into multiple recurrent parents. We are attempting to map some native resistance to determine if there are large-effect QTL suitable for MAS. We also have conducted studies on the interaction of host genotypes with different levels of FHB resistance and fungicide on FHB and DON.<br>• The project has constructed germplasm to assess the value of the *Qfhs.pur-7EL* in the field and greenhouse. | • Release four or more FHB-resistant varieties.<br>• Increase seed of 40 breeding lines that are candidates for release due to their FHB resistance and yield.<br>• Assess the FHB resistance of more than 12,000 breeding lines.<br>• Complete data base interface and keep updating the data base with new performance information.<br>• Complete mapping of QTL from Truman and NY91017-8080.<br>• Map type I resistance from INW0412.<br>• Begin incorporating the *Qfhs.pur-7EL* into elite germplasm.<br>• Begin selection in populations fixed for *Fhb1* and other FHB QTLs.<br>• Further populations that pyramid FHB QTL, including new QTL from Truman.<br>• Complete association mapping of FHB QTL in adapted SWW populations.<br>• Develop and begin using genomic selection models to improve FHB resistance.<br>• Assess the extent of resistance to kernel infection and to toxin accumulation.<br>• Initiate recurrent selection with the male-sterile populations. |

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| **VDHR Southern Soft Red Winter Wheat**<br>*Chair: Jose Costa*<br>*University of Maryland* | • Several germplasm lines and commercial varieties have been released with enhanced FHB resistance, including Jamestown, SS 5205, SW049029104, Tribute, MD01W233-06-01 and VA04-90.<br>• Posting of results online of FHB evaluations of current commercial varieties and breeding lines. | • Most of the currently funded projects started in the previous cycle and are mostly just getting started. These will continue in the next two-year cycle to reach completion. For example, the evaluation of scab resistance in MD01W233-06-1 and the association mapping study of Roane and Jamestown populations in the Southern CP. These evaluations are being done cooperatively across several programs in the region (VA, MD, NC, GA, LA).<br>• Additionally, initiate the development of regional wheat breeding populations segregating for FHB resistance QTL.<br>• Generate doubled-haploid lines and distribute them to all participating breeding programs. |


## *Fusarium Focus*

***Fusarium Focus*** *is an online newsletter published periodically by the U.S. Wheat & Barley Scab Initiative. The USWBSI is a national, multi-disciplinary and multi-institutional research system whose goal is to develop as quickly as possible effective control measures that minimize the threat of Fusarium Head Blight (scab), including the production of mycotoxins, for the producers, processors and consumers of wheat and barley. Contact information is as follows:*

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## Recent FHB Publications *(Peer-Reviewed)*


• Khatibi, P.A., Montanti, J., Nghiem, N.P., Hicks, K.B., Berger, G., Brooks, W.S., Griffey, C.A., and Schmale, D.G. 2011. Conversion of deoxynivalenol in barley derived fuel ethanol co-products with yeast expressing 3-O-acetyltransferases. Biotechnology for Biofuels, DOI 10.1186/1754-6834-4-26. *http://www.biotechnologyforbiofuels.com/content/4/1/26/abstract*

• Agostinelli, A.M., Clark, A.J., Brown-Guedira, G., and Van Sanford, D.A. Optimizing phenotypic and genotypic selection for Fusarium head blight resistance in wheat. Online in EUPHYTICA. DOI: 10.1007/s10681-011-0499-6. *http://www.springerlink.com/content/0014-2336/*


*Listings of recent FHB-related publications by USWBSI-associated principal investigators are invited. If publications are currently accessible online, please include the URL address. Listings for the next edition should be sent to Don Lilleboe at dlilleboe@forumprinting.com.*