U.S. WHEAT & BARLEY SCAB INITIATIVE

Fusarium Focus

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2019 FHB Forum: Science Shines

Nearly 200 scientists, graduate students, growers and industry representatives from the U.S. and foreign countries attended the 2019 National Fusarium Head Blight Forum in early December. The 22nd FHB Forum was held at the Hyatt Regency Milwaukee.

The event featured stakeholder and scientific invited speaker presentations, plus focused group discussions and social events for attendee interaction. Numerous research posters were on display as well, with primary authors present to discuss their research. For the sixth year, postdoctoral scientists and graduate students participated in "Flash & Dash" sessions in which they provided mini-oral presentations on posters they had at the Forum.

Organized/hosted by the U.S. Wheat & Barley Scab Initiative (USWBSI), the annual FHB Forum provides a central venue for reports on the latest research on Fusarium Head Blight (scab) and deoxynivalenol (DON), the mycotoxin produced by scab infection in grains.

The 2020 National Fusarium Head Blight Forum takes place on December 6-8 at the Hilton Cincinnati Netherland Plaza in Cincinnati, Ohio.

The following pages contain photos and talk summaries from several of the invited speaker presentations at the 2019 Forum. PDF copies of the following presentations are posted on the USWBSI website — scabusa.org — as are the full Forum Proceedings:

• *Impact of Fusarium Head Blight Resistance on Wheat Variety Registration in Canada* / Santosh Kumar, Agriculture and Agri-Food Canada, Brandon, Manitoba, Canada.

• *Updated Insights on Efficacy and Timing of Fungicides from Multi-State Efforts* / Pierce Paul, The Ohio State University, Wooster, Ohio.

• *Introduction and Overview of Each Lab and Their Work on Scab* / Guihua Bai, Gina Brown-Guedira, Jason Fiedler and Deven See, USDA-ARS Genotyping Labs, Manhattan, Kan., Raleigh, N.C., Fargo, N.D., and Pullman, Wash, respectfully.

• *Targeting Pathogenicity Mechanisms to Promote FHB-Resistance in Wheat* / Jyoti Shah, University of North Texas, Denton, Texas.

• *A Grower's Perspective on Scab from Northwest North Dakota* / Dustin Johnsrud, Epping, N.D.

• *Steps for Approving & Validating Commercial Mycotoxin Test Kits* / Ajit Ghosh, USDA-AMS, Kansas City, Mo.

• *Can Agronomic Practices Reduce DON?* / Carrie Knott, University of Kentucky, Princeton, Ky.

• *Effects of Head Morphology and Phenology on Fusarium Infection Processes and Implications for Disease Management in Barley* / Robert Brueggeman, Washington State University, Pullman, Wash.

• *Application of Model Ensembles to the Prediction of Fusarium Head Blight* / Erick DeWolf, Kansas State University, Manhattan, Kan.

• *Color and Spectral Imaging for High-throughput Field FHB Detection and Lab DON Assessment* / Ce Yang, University of Minnesota, St. Paul, Minn.

• *Challenges and Efforts to Maintain Winter Barley as a Viable Crop in the Eastern U.S.* / Carl Griffey, Virginia Tech, Blacksburg, Va. ❖

— 2019 FHB Forum —

Impact of FHB Resistance on Wheat Variety Registration in Western Canada

The 2019 National FHB Forum's first speaker was **Santosh Kumar**, Brandon, Manitoba-based spring wheat breeder with Agriculture and Agri-Food Canada (AAFC). Kumar's topic was the "Impact of Fusarium Head Blight Resistance on Wheat Variety Registration in Western Canada."

Santosh Kumar

Canada's 2019 production of spring wheat totaled about 32 million metric tons, Kumar said, with about half that amount ending up exported (as of October). Canada is the world's second leading exporter of wheat, behind Russia, at about 14% of the global total.

Canada Western Red Spring (CWRS) is by far the largest category of wheat grown in Canada. AAFC's main breeding programs for CWRS are in southwestern Manitoba (Brandon), Saskatchewan (Swift Current) and northern Alberta (Beaverlodge). All three AAFC programs focus on the development of CWRS quality wheat. Within the CWRS wheat class, the Brandon program focuses on disease resistance; Swift Current's program focuses on abiotic stresses, and the Beaverlodge program concentrates on early maturing wheat varieties.

Registration of new varietal releases in Canada is heavily influenced by the recommendations of the Prairie Grain Development Committee (PGDC), a consortium of federal and provincial agriculture officials, along with university and co-op/private company stakeholders. Breeders submit extensive agronomic performance, grain/flour quality and disease data to the committee for each planned release — including, of course, resistance to diseases such as Fusarium Head Blight. Quality traits such as milling, dough strength and baking attributes are integral to whether a line is recommended for release. Lines must be licensed to be registered.

The Agriculture and Agri-Food Canada FHB nursery at Brandon consists of 30 acres in a three-year rotation under irrigation, with about 40,000 rows grown out in the 2019 season. This nursery evaluates breeding germplasm for FHB resistance. The other two nurseries at Morden and Carman, Manitoba, generate FHB ratings for the registration trials as mandated by the PGDC.

The protocol for evaluating reaction to Fusarium Head Blight using macroconidia inoculum goes as follows:

• Identify rows at 50% anthesis. Inoculate plants with 50 ml spore suspension per meter of row when 50% of the heads are in anthesis. Inoculate the same rows two to three days later to infect later tillers.

• The cultivars 'AC Vista', 'CDC Teal' and 'AC Morse' are used as susceptible checks. 'AC Cora' and '5602 HR' are used as intermediate checks, 'FHB 37' as a moderately resistant, and 'AAC Tenacious' as a resistant check.

• Check varieties are planted at regular intervals throughout the nursery, and interpretation of disease ratings (VRI) have to take conditions and check reactions into account. The checks planted at regular intervals allow the pathologists to distinguish not only the actual disease ratings but also disease escapes, as a low score may mean escape rather than resistance, Kumar noted. "It is therefore very difficult to make an arbitrary statement about levels of disease being rated as MS or MR, etc."

• The FHB reaction (R, MR, I, MS, S) is determined relative to the check lines' reactions and will change from year to year.

"Fusarium is a major challenge for wheat breeders in Canada," Kumar affirmed. But, he added, progress is definitely being made, with more moderately resistant lines being supported by the Prairie Grain Development Committee's disease evaluation team in the past two to three years, compared to prior years. ❖

Left: Ruth Dill-Macky and Doyle Lentz, shown here at the 2019 National FHB Forum, serve as the co-chairs of the U.S. Wheat & Barley Scab Initiative. Dill-Macky is a research plant pathologist with the University of Minnesota, St. Paul. Lentz is a small grains producer from Rolla, N.D.

— 2019 FHB Forum —

Can Agronomic Practices Reduce DON?

"Can Agronomic Practices Reduce DON?"

That was the question/title leading off **Carrie Knott**'s presentation at the 2019 National FHB Forum. Knott is the grains crops extension agronomist with the University of Kentucky.

Carrie Knott

Essentially all of Kentucky's soft red winter wheat follows corn in the rotation, with the majority of wheat drilled into either no-till or minimally tilled corn residue. Along with full-season corn, there is also a lot of double-cropped wheat/soybeans in the state.

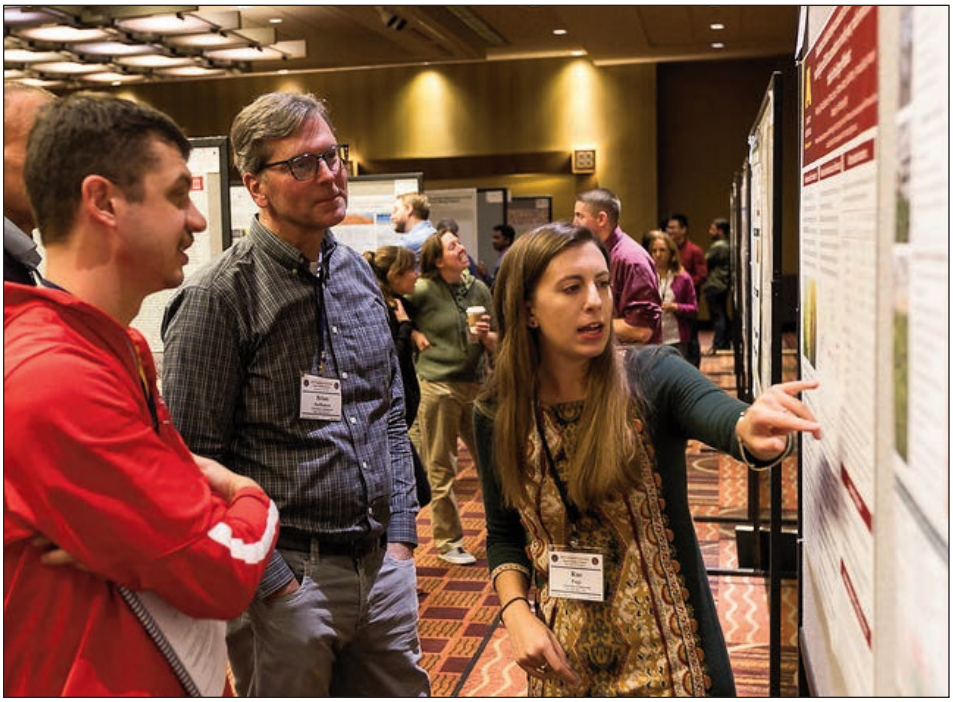
Current UK recommendations for managing FHB in wheat call for the planting of moderately resistant cultivars, along with the application of an appropriate fungicide at the Feekes 10.5.1 stage of growth. One limitation of the fungicide timing, however, is the potential for significant differences in growth stage development within the same wheat field due to areas within the field that have heavy corn residue that can impact wheat emergence and development.

The objectives of the research by Knott and her UK colleagues across three years (2016-18) were to determine whether certain management practices can reduce variability in wheat flowering (*i.e.*, increase uniformity across the field) and result in lower DON at season's end. Specifically, they looked at (1) in-furrow phosphorus application, (2) an increased seeding rate, and (3) harvest timing, *i.e.,* higher vs. lower moisture percentages.

One testing environment was a mist-irrigated Fusarium Head Blight nursery inoculated with *Fusarium*-infested corn; the second environment was a non-inoculated control. The treatments included two seeding rates (377 and 603 pure live seed per m^{-2}; two cultivars — one with moderate resistance to FHB and the other with moderate susceptibility; and two in-furrow phosphorus treatments (zero and 47 kg P_2O_5).

The UK researchers measured *Fusarium* incidence, severity and index for all three years, along with *Fusarium*-damaged kernels (FDK), DON contamination, grain yield and test weight. They found that the investigated management practices did not reduce time to heading, beginning flowering or full flowering. Also, in-furrow phosphorus and seeding did not reduce FHB Index, FDK or DON. However, the phosphorous and higher seeding rate did increase grain yield.

"More-detailed analyses of all three years will provide a better understanding of whether additional agronomic practices can reduce DON contamination of wheat," Knott reported. The analyses of the research is ongoing to allow a more-thorough investigation of the results prior to publication in scientific literature. ❖



Left: The poster sessions on Monday and Tuesday afternoons were, as always, a popular feature at the National FHB Forum, with most authors present for questions and discussion regarding their research. Several postdoctoral scientists and graduate students piqued interest in their posters by presenting mini-talks about their work during the 'Flash & Dash' sessions leading up to each afternoon's poster session.

— 2019 FHB Forum —

Targeting Pathogenicity Mechanisms to Aid FHB Resistance

"Targeting Pathogenicity Mechanisms to Promote FHB Resistance in Wheat" was the title of **Jyoti Shah**'s presentation at the 2019 National FHB Forum. Shah is a professor of biology and chair of the Department of Biological Sciences at the University of North Texas.

Pathogenicity — the ability of a pathogen to cause disease — is determined by fungal virulence mechanisms and host mechanisms that contribute to susceptibility. As such, "pathogenicity mechanisms provide excellent targets for controlling disease caused by *Fusarium graminearum*," Shah noted.

His FHB Forum discussion centered on two approaches underway in collaboration with other USWBSI-funded labs to enhance plant resistance to *F. graminearum* by targeting knock-down of genes associated with mechanisms contributing to pathogenicity.

Jyoti Shah

"The first involves enhancing resistance against *F. graminearum* by knock-down of a class of plant lipoxygenases, which are involved in oxylipin (oxidized lipid) metabolism that contribute to susceptibility," Shah explained. "The second approach involves the utilization of host-induced gene silencing (HIGS) to knock-down expression of fungal virulence genes."

HIGS comprises the expression of double-stranded RNA (dsRNA) corresponding to fungal genes in the host plant, Shah noted. When taken up by the fungus, small RNA, resulting from dsRNA processing, "are expected to destabilize accumulation of the corresponding fungal gene transcript to attenuate fungal pathogenicity."

Shah reported that his research group has, to date, successfully utilized HIGS in Arabidopsis and wheat to target two secretory protein-encoding *F. graminearum* virulence genes to enhance resistance against *Fusarium graminearum*. ❖

A North Dakota Producer's Perspective

Dustin Johnsrud provided the 2019 FHB Forum audience with a northwestern North Dakota grower's first-hand perspective on scab and its impact. Johnsrud, a board member of the North Dakota Wheat Commission, produces several small grain and broadleaf crops on his farm near Epping, including spring wheat and durum.

Dustin Johnsrud

Williams County, N.D., is typically semi-arid, with annual rainfall often totaling around 11-12 inches. That changed dramatically in 2019, however, as late-season rains hiked the year's rain total to more than 20 inches.

For those growers impacted by scab, the economic impact may be severe, Johnsrud affirmed. Elevator discounts can run $1.00/bu per point above 2.0 ppm, with no bid for grain above 5.0 ppm. On-farm cleaning of grain is an option to reduce the scab level — but it requires considerable time and expense. Johnsrud used the example of cleaning 150,000 bushels of wheat at 5,000 bushels per day. That's 30 days of cleaning at an estimated cost of $1.00/bu.

But, cleaning can bring down the scab levels from, say, 10 ppm to as low as 2.0 ppm. Johnsrud then compared that to the value of a timely fungicide application during flowering at a cost of about $20 per acre.

Johnsrud said he uses three primary means to assess the risk for scab in his spring wheat and durum. Forecast models available through North Dakota State University are very valuable, he said. Also essential are crop advisors and his own "on the ground" field scouting.

The northwestern North Dakota producer also gave his Forum listeners a glimpse of how small grain farming has changed in his area in recent decades. The "old way," he illustrated, was to use untreated seed, poor fertilizer management by todays standards, spray solely a herbicide — and to harvest in early to mid-August. The "new way" incorporates forecast maps, precision farming practices, variable-rate application of fertilizer and herbicides, multiple fungicide treatments if needed — and harvesting in late August to early September. ❖

2019 National FHB Forum Photo Credits:

Dave Hane
USWBSI, Newark, Calif.

— 2019 FHB Forum —

Efficacy & Timing of Fungicides: Multi-State Trials Update

Pierce Paul, Wooster-based plant pathologist and extension state specialist with The Ohio State University, provided 2019 FHB Forum attendees with "Updated Insights on Efficacy and Timing of Fungicides from Multi-State Efforts."

Paul began his presentation by reminding his audience of the basic components generally recommended by small grains specialists for optimum management of Fusarium Head Blight: genetic resistance; use of forecast models; application of either Prosaro or Caramba fungicides at anthesis; tillage; and crop rotation. When it comes to fungicide applications, however, their optimal timing may not be possible due to adverse weather delaying treatment. Also, lack of flowering uniformity across a field and the inability to adequately identify anthesis may further downgrade a fungicide's field-wide efficacy.

Among the questions commonly posed by researchers, growers and other stakeholders, Paul observed, are these:

- How effective are pre- and post-anthesis (early and late) fungicide applications on FHB Index, DON, grain yield and test weight?
- Is efficacy influenced by fungicide (*i.e.*, Prosaro vs. Caramba)?
- Is efficacy influenced by wheat type/region (*e.g.*, spring vs. winter wheat)?
- Is fungicide efficacy influenced by cultivar resistance (the other "primary half" of the current FHB integrated management equation)?

Paul then summarized data from the multi-state uniform fungicide trials, which encompass 27 different environments. Along with non-treated checks, the treatment regimen he addressed included Caramba and Prosaro early, at anthesis and late.

The best control of FHB with both fungicides was when applied at anthesis, followed by two to six days after early anthesis (Feekes 10.5.1). For DON, the highest control came with the two-to six-days after early anthesis treatment, followed closely by the "at early anthesis" timing. For both FHB and DON, the lowest level of control came with the pre-anthesis treatment timing, although that timing did provide significant control compared to non-treated checks.

Pierce Paul

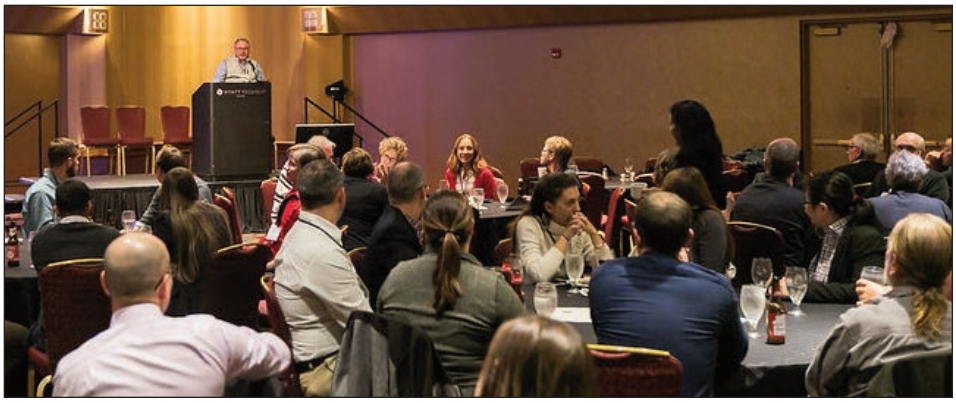
In terms of FHB control with cultivars of varying levels of resistance, the uniform fungicide trials have shown, not surprisingly, that control is highest with moderately resistant cultivars. Not far behind, however, is control with moderately susceptible + fungicide. The susceptible + fungicide category lags by a significant margin. In all three cultivar scenarios, however, the timing pattern is similar: best at "two days after early anthesis," with the "at early anthesis" and "four days after early anthesis" timings fairly equivalent. "Six days after early anthesis" lagged, but not by a big margin.

DON levels have shown a similar pattern, with the "at early anthesis" fungicide timing lagging slightly in its efficacy compared to the other timings.

Paul also reported on the FHB and DON management efficacy of Miravis® Ace, the new fungicide from Syngenta. The uniform trials, he noted, have shown Miravis to be just as effective against FHB and DON as Caramba or Prosaro when applied at early anthesis. Efficacy of Miravis Ace was comparable between early anthesis and later applications, but was less consistent in early heading applications.

Finally, a two-treatment program — early anthesis application of Miravis Ace followed by an application of Caramba, Prosaro or Folicur four to six days later — resulted in the greatest reduction in DON among the regimens tested across the multi-state uniform trials.

"As was the case with Prosaro and Caramba, combining an early anthesis application of Miravis Ace with genetic resistance resulted in lower FHB and DON than did resistance or fungicide application alone or the combination of an early heading application with resistance," Paul concluded. ❖



Forum participants gather for the traditional Sunday evening dinner and program.

— 2019 FHB Forum —

Maintaining Winter Barley in Eastern U.S.

Carl Griffey, longtime Virginia Tech wheat and barley breeder, updated the 2019 FHB Forum audience on "Challenges and Efforts to Maintain Winter Barley as a Viable Crop in the Eastern U.S."

Virginia's barley acreage has trended downward for decades, with only about 30,000 acres planted in 2018 and 35,000 in 2019. The decline has been especially dramatic during the period since Fusarium Head Blight first became problematic in the state (early 2000s).

Hybridization, breeding, genetics and development of winter barley varieties has been conducted for more than 75 years at Virginia Tech. From the early 1960s onward, emphasis was placed on the development of awnless and apically awned varieties, Griffey said, "due to the difficulty farmers had threshing long-awned varieties under the humid conditions in the mid-Atlantic region." However, while such varieties were — and continue to be — preferred for forage production, "they produce grain having lower test weights and less plump kernels, which are not ideal for either feed or malt uses."

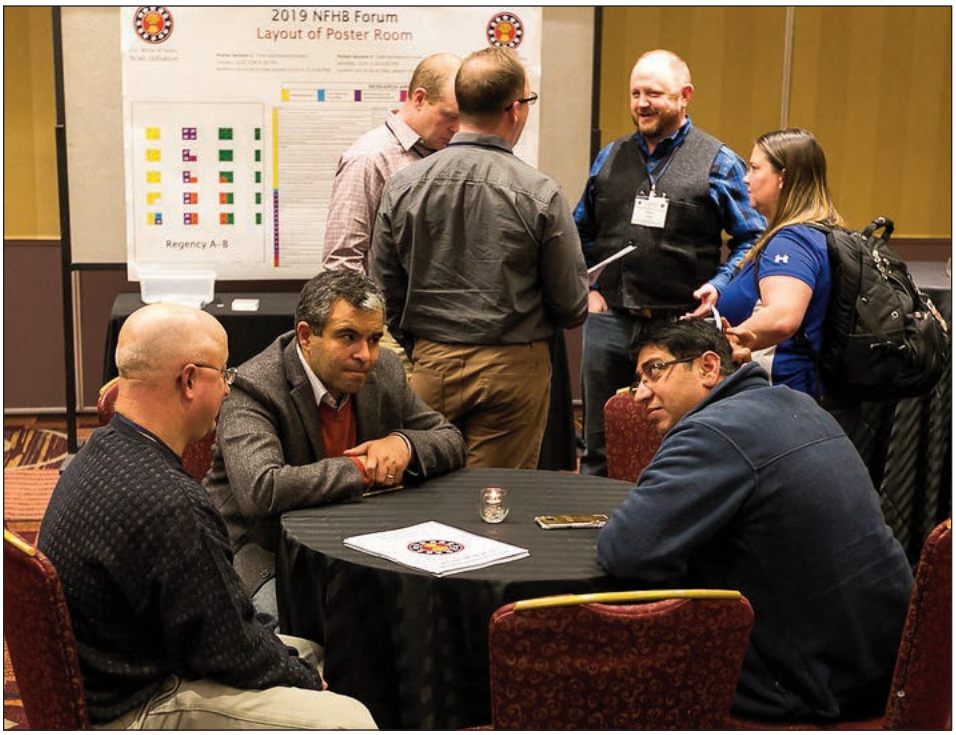
Carl Griffey

During the past three decades, under Griffey's direction, the Virginia Tech barley program has transitioned away from awnless six-rowed feed barley varieties and currently is focused primarily on two-rowed malt barley types. That emphasis has led to barley releases with superior quality grain for both domestic and export markets.

Also, interest in improving both the quality and nutritional value of barley for use in large local swine and poultry industries — and the onset of local interest in ethanol production — led to the development of hulless barley varieties with significantly higher starch and lower fiber compared to traditional varieties. "Doyce" was the first hulless variety released by Virginia Tech (in 2003). Several more have been released since then, including the newest one, "VA15H-73," a two-rowed hulless variety in 2020. VA15H-73 has lower FHB Index, FDK, ISK Index and DON values than the moderately resistant cultivar "Eve," released in 2007.

One Virginia Tech-developed barley variety, "Thoroughbred" (released in 2003), was found to have deciduous awns, a trait contributing to improvement in grain quality and plumpness. In response to interest from a Virginia distillery, Thoroughbred debuted as Virginia Tech's first malt barley variety. "Since then, Thoroughbred also has been used for malting and production of craft beers," Griffey reported.

With the ongoing declining demand for winter barley for principle use in the feed and fuel ethanol industries, Virginia Tech's barley program concentrates on developing two-rowed winter malt barley varieties. The first two are slated for release in 2020. Such varieties "must meet significantly higher quality standards than traditional feed barley varieties," Griffey pointed out, including resistance to FHB and low DON accumulation levels. ❖



Left: Engaging conversation among meeting participants before, in-between and after the general sessions is a welcome and essential facet of any research gathering — including at the annual National Fusarium Head Blight Forum.

— 2019 FHB Forum —

USDA-ARS Small Grains Genotyping Labs: Mission & Function

One highlight of the 2019 National FHB Forum's general sessions was a panel discussion focusing on the USDA-ARS small grains genotyping labs: their mission and their function.

Participating on the panel were the leaders of these four regional labs: Jason Fiedler, North Central in Fargo, N.D.; Gina Brown-Guedira, East at Raleigh, N.C.; Deven See, West at Pullman, Wash., and Guihua Bai, Central in Manhattan, Kan.

Each lab works with small grains breeders from multiple states within their respective regions. The labs rely strongly upon support from stakeholder entities such as the U.S. Wheat & Barley Scab Initiative.

The core mission of these genotyping labs boils down to four focus areas: (1) developing new molecular marker technologies; (2) implementing effective strategies for their application in the breeding of small grains; (3) providing breeders with access to state–of–the–art molecular technologies, and (4) helping to maximize the efficiency of small grains breeding programs by speeding up the process of new cultivar release.

Plant breeders, both public and private, annually submit thousands of samples from their research programs to these labs. The labs then employ their sophisticated gene marker technology to analyze the samples for traits of interest and to interpret the generated data. This information, back in the hands of the breeders, is of great value as they focus on incorporating the desired trait(s) into their breeding populations much more quickly than they could have otherwise.

Fiedler said that along with him, the Fargo lab employs two full-time technicians, one post-doc position and two part-time undergraduates. A Cat4 scientist hopefully will be added this year.

Research leaders from the four ARS regional small grains genotyping laboratories answered audience questions following their panel discusson at the 2019 Forum. Shown, left to right, are: Jason Fiedler, Fargo, N.D.; Gina Brown-Guedira, Raleigh, N .C.; Deven See, Pullman, Wash., and Guihua Bai, Manhattan, Kan. The U.S. Wheat & Barley Scab Initiative is a prominent supporter of the labs' work.

The lab's equipment includes LH Robotics for DNA extraction and normalization (ranging from nearly 400 up to about 770 lines per day), Proflex x 6 (capable of 4,600 data points daily), an iScan for wheat, barley and oat (192 lines per day), and a NextSeq500 for sequencing.

Brown-Guedira explained that the Raleigh lab's work with marker-assisted selection for FHB resistance includes two to three breeder projects annually (*Fhb1* and other FHB QTL); QTL pyramiding for doubled-haploid production; and introgression into soft red winter wheat of PI 277012 resistance. The haplotyping inbred material portion of the Raleigh lab's work includes markers on uniform scab screening nurseries, FHB marker genotyping of eastern winter wheat nurseries, and three to four breeder projects per year. Finally, the lab performs genome-wide marker analyses, including the prediction of lines in current-year nurseries as well as about 5,000 yet-untested lines.

Along with scientific lead Deven See, the Pullman genotyping lab has one post-doc and three technicians. FHB phenotyping activities cover a spring wheat breeding program, varietal testing program and a plant pathology research farm.

Wheat genotyping work at Pullman encompasses incorporating *Fhb1* into amplicon sequencing platform, *Fhb1* introgression into both the winter wheat and spring wheat programs, obtaining genotypes for the variety testing program — and, exome capture on selected breeding lines and the variety testing program.

With barley, the Pullman ARS lab collaborates with Oregon State University's doubled-haploid production program to genotype and validate introgression in a DH production system using amplicon sequencing.

— Continued on Next Page —

— 2019 FHB Forum —

ARS Genotyping Labs

(Continued)

The Manhattan lab has three ARS employees (including Bai) and several Kansas State University staff. The lab serves hard winter wheat breeding programs in the Great Plains, genotyping the Regional Performance Nursery and other elite breeding lines, with more than 100 markers annually. It generates more than 2,000 samples of GBS data for breeders/ geneticists to conduct QTL mapping and genomic selection. It also converts other types of markers to high-throughput SNP markers.

The Manhattan genotyping lab's research focuses on the identification of QTLs and linked markers for yield components and resistance to FHB, other key wheat diseases and insects, and preharvest sprouting. It also performs fine mapping for FHB and these factors.

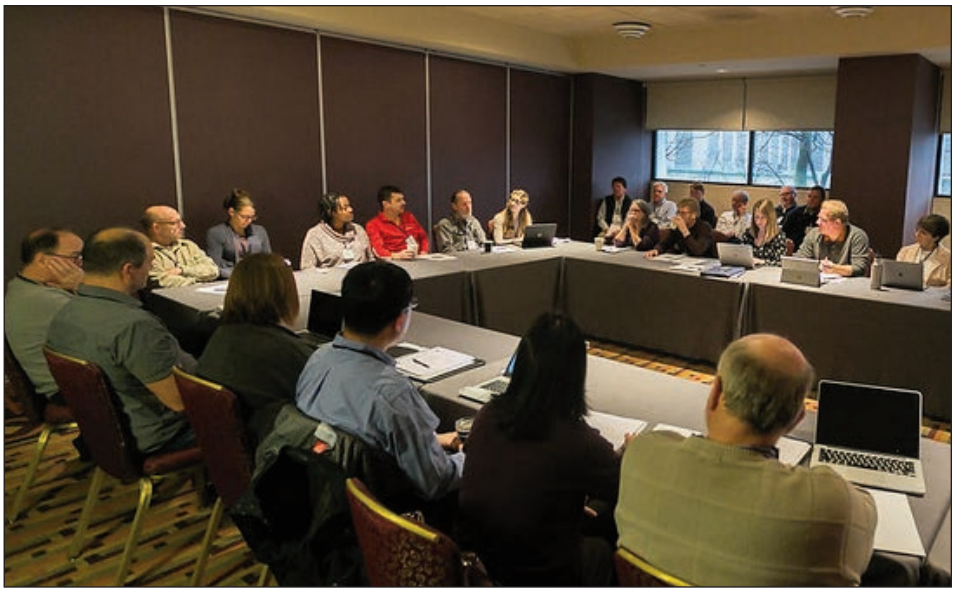
Additional research includes marker-assisted transfer of *Fhb1* and other exotic genes to adapted cultivars, characterization of gene functions, and the development of high-throughput genotyping technology. ❖

Recent Peer-Reviewed Scab-Related Publications

• *Fulcher, M.R., J.P. Garcia, K.C.M. Damann, and G.C. Bergstrom. 2019. Variable interactions between non-cereal grasses and Fusarium graminearum. Can. J. Phytopathol.41: 450-456. https://www.tandfonline.com/doi/full/10.1080/07060661.2019.1605540*

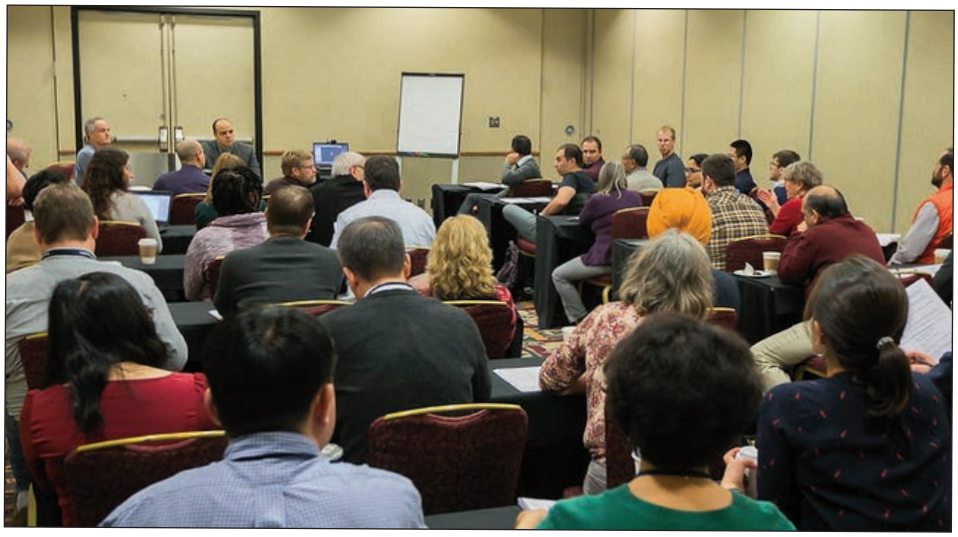
• *Fulcher, M.R., J.B. Winans, M. Quan, E.D. Oladipo, and G.C. Bergstrom. 2019. Population genetics of Fusarium graminearum at the interface of wheat and wild grass communities in New York. Phytopathology 109: 2124-2131.*

• *https://apsjournals.apsnet.org/doi/10.1094/ PHYTO-05-19-0169-R*



Above: Breakout meetings were held for several grain class categories: hard winter wheat, barley, soft winter wheat and spring wheat/durum. The meetings were preceded and followed by a VDHR-MGMT joint session of breeders and pathologists. Part of the barley breakout group, facilitated by Alyssa Collins (Penn State) and Kevin Smith (University of Minnesota) is pictured above.

Below: Four research area breakout meetings also took place at the 2019 Forum, including FHB Management (MGMT), Food Safety & Toxicology (FST), Gene Discovery & Engineering Resistance (GDER) and Pathogen Biology & Genetics (PBG). The individuals pictured here were part of the GDER session chaired by Steve Scofield (USDA-ARS).



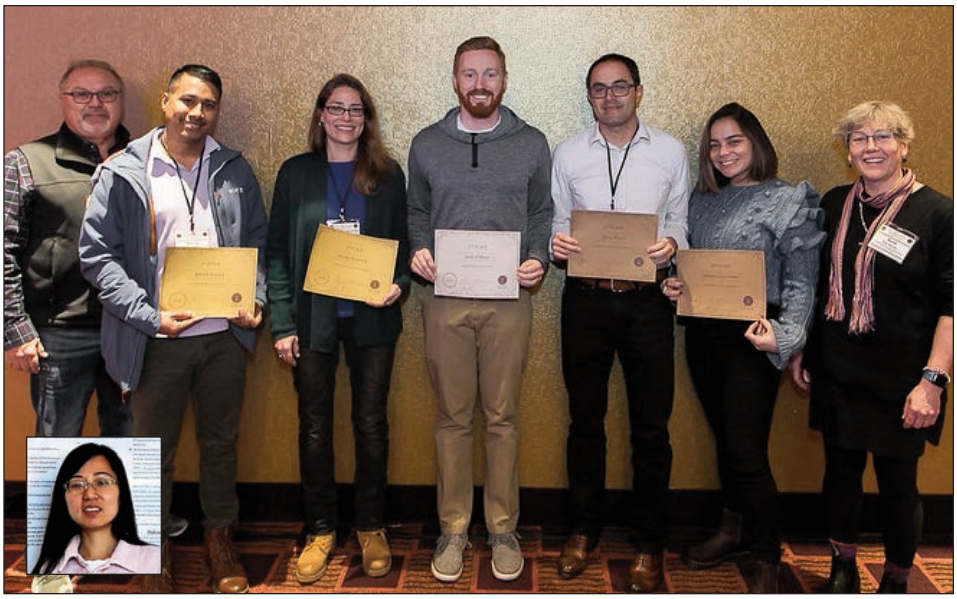
— 2019 FHB Forum —

Winners of Forum Poster Competition

The U.S. Wheat & Barley Scab Initiative held its first poster competition during the 2019 FHB Forum. Of the 67 posters that were presented during the two poster sessions, 31 participated in the poster competition for graduate students and post-docs.

The competition was divided into two groups: graduate students (22 participants) and post-docs (9 participants). Twenty representatives from industry and universities judged the competitors during a two-day poster session for this year's competition.

Posters in the competition represented the following five research categories: FHB Management (3), Food Safety and Toxicology (1), Gene Discovery and Engineering Resistance (4), Pathogen Biology and Genetics (7), and Variety Development and Host Plant Resistance (16). ❖

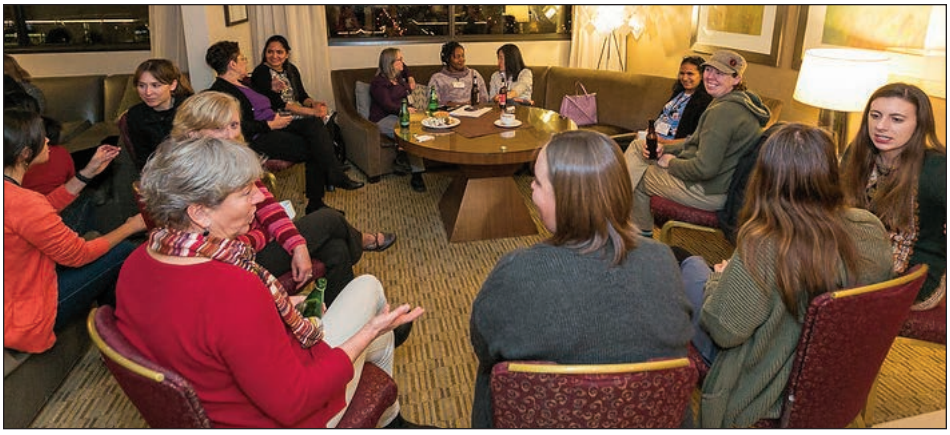


USWBSI co-chairs Doyle Lentz (left) and Ruth Dill-Macky (right) flank the winners of the poster competition at the 2019 National FHB Forum. They include, left to right: Bikash Poudel, North Dakota State University,1st Place Graduate Student; Marike Boenisch, University of Minnesota, 1st Place Post-Doctoral Researcher; Sean O'Mara, University of Minnesota, 2nd Place Graduate Student; Brian Ward, USDA-ARS North Carolina, 3rd Place Post-Doctoral Researcher; and Andrea Lugo-Torres, Cornell University, 3rd Place Graduate Student. Shown in the inset photo is Zhao Jin, North Dakota State University, 2nd Place Post-Doctoral Researcher.

Women in Ag Gather at Forum

The 2nd annual open house for women in the USWBSI community was took place at the 2019 National FHB Forum in Milwaukee, Wisc., on Monday evening, December 9. About 35 women attendees at the Forum gathered at the event, which was hosted by USWBSI Co-Chair Dr. Ruth Dill-Macky. The open house commenced following the Forum's final poster session and early evening reception.

The event was conceived to encourage networking among women working at different institutions and at different points along their career path. It provided women the opportunity to discuss science and topics related to Fusarium Head Blight of wheat and barley with other women and to socialize in an informal setting. Participants enjoyed light refreshments and much conversation during the open house.



The Initiative is looking to support similar informal networking events in association with future forums, particularly to support networking opportunities for graduate students and postdoctoral researchers. ❖

— 2019 FHB Forum —

Application of Model Ensembles to the Prediction of FHB

Kansas State University plant pathologist **Erick DeWolf**, a principal developer and coordinator of the Fusarium Head Blight Prediction Center (FHBPC), updated the 2019 Forum audience on the application of model ensembles for the prediction of FHB.

This predictive resource — in its 11th year of operation as of 2020 — is centered on weather-based models. It is used in 30 U.S. states where FHB and deoxynivalenol (DON) contamination consistently reduce the quality and yield of wheat and barley.

The first generation of predictive models was developed with just 50 observations (unique site-year variety combinations), DeWolf noted. The data set has been greatly expanded through cooperation with the Integrated Management Coordinated Project (IMCP), and nearly 1,000 cases are now available for modeling. "Some of the recent additions to the data set are noteworthy," DeWolf stated, "because they represent striking deviations from normal temperature and rainfall patterns." Bringing these observations into the available data set expands the range of conditions used in model development and will lead to more-robust predictions in an era of climate change, he noted.

Erick DeWolf

The FHB Prediction Center (http://www.wheatscab.psu.edu) currently has a rich set of logistic regression models representing four generational cycles of development, DeWolf told the Forum audience. "Summary metrics reveal that the models have gotten better over the generations, reflecting a better understanding of the relationships between weather and FHB epidemics," he observed.

Despite such improvements, though, there are limitations as to how well any one simple model captures the dynamics of an epidemic. Combining multiple simple models can yield a predictive performance that is superior to that of any one individual component models.

The technique of combining models is generally known as "ensembling" and is common in weather forecasting, as an example. "Hierarchical cluster analysis of the FHB models indicates there are at least four groups of models with respect to Brier score (a statistic comparing model performance)," DeWolf said. "Ensembles representing these groups of models captured more information and improved prediction accuracy relative to the individual models."

DeWolf also gave his audience a preview of FHB forecasting tool updates for 2020. The updates include clean design features, simplified navigation controls, improved browser compatibility and also scales well to mobile devices.

The KSU plant pathologist provided several take-away points in summarizing his Forum presentation:

- There is tremendous value in the cooperative efforts supported by the U.S. Wheat & Barley Scab Initiative. Users of the predictive tools indicate the models help them save millions of dollars by avoiding potential disease loss and spending money on unneeded farm inputs.
- Recent observations are helping account for variabilities in our climate and enabling expansion into new geographic areas.
- Progress in modeling FHB has yielded a suite of potentially useful predictive models.
- The modeling effort is undergoing a paradigm shift that may well improve performance of the forecasting system.
- Web-based tools also are undergoing renovations.

"In time, such ensemble approaches should improve the predictions of FHB epidemics in the U.S. delivered via the Fusarium Head Blight Prediction Center," DeWolf concluded. ❖

Fusarium Focus

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