U.S. WHEAT & BARLEY SCAB INITIATIVE

Fusarium Focus

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2018 FHB Forum Draws 200+

More than 200 scientists, graduate students, growers and industry representatives from the U.S. and foreign countries attended the 2018 National Fusarium Head Blight Forum in early December. The 21st FHB Forum took place at the Hyatt Regency St. Louis at the Arch, St. Louis, Mo.

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 the research. For the fifth 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 findings on Fusarium Head Blight (scab) and deoxynivalenol (DON), the mycotoxin produced by scab infection in grains.

The 2019 National Fusarium Head Blight Forum will be held at the Hyatt Regency, Milwaukee, Wisc. Dates are December 8-10.

The following pages contain photos and talk summaries from several of the invited speaker presentations at the 2018 Forum. PDF copies of the following presentations are posted on the USWBSI's website — scabusa.org — as are the full Forum Proceedings:

• *Mycotoxin Control and Monitoring Program: All Hands on Deck* / Anthony Adeuya, Food & Drug Administration, College Park, Md.

• *A Quantitative Proteomics View on the Function of Qfhb1* / Yang Yen, South Dakota State University, Brookings, S.D.

• *FHB Now Westward Bound, and New Struggles to Keep DON Down* / Juliet Marshall, University of Idaho, Idaho Falls, Idaho

• *Regional Perspective on the Management of FHB in the Mid. Atlantic* / Alyssa Collins and Paul Esker, Pennsylvania State University, Manheim and University Park (respectively), Penn.

• *Breeding for FHB Resistance in North Dakota: More Questions than Answers* / Andrew Green, North Dakota State University, Fargo, N.D.

• *Cropping Factors: The Key for Sustainable Mycotoxin Management in Small Grain Cereals* / Susanne Vogelgsang, Agroscope, Zurich, Switzerland

• *Integrating the Management of Fusarium Head Blight and Foliar Diseases Through Fungicide Use and Variety Selection to Develop Practical Strategies for Winter Wheat Growers* / Martin Nagelkirk, Michigan State University-Extension, Sandusky, Mich.

• *Wheat Breeding for Southern Brazil, with Focus on Fusarium Head Blight Resistance* / André C. Rosa, Biotrigo Genética Ltda., Passo Fundo, Brazil

• *Fusarium graminearum Population-Specific Differences During Wheat Infection* / Martha Vaughan, USDA-ARS-NCAUR, Peoria, Ill. ❖

— 2018 FHB Forum —

'All Hands on Deck'

"Mycotoxin Control and Monitoring Program: All Hands on Deck" was the title of **Anthony Adeuya**'s 2018 FHB Forum keynote presentation. Adeuya, a chemist with the U.S. Food and Drug Administration's Office of Food Safety, emphasized that the threat posed by mycotoxins to global food safety and security "requires involvement from *all* stakeholders."

Anthony Adeuya

Along with outlining the main components of FDA's strategic plan to control mycotoxins, Adeuya reviewed the workings of Codex, the internationally adopted collection of standards, guidelines and codes of practice for food safety and trade.

The U.S. Wheat & Barley Scab Initiative's mission and activities dovetail with Codex priorities in several ways, Ayeuda added. For example, as expressed in Codex's codes of practice for controlling mycotoxins in food:

(1) Codex favors the use of toxigenic fungi-free seed; USWBSI supports the development of resistant cultivars and reduction in the use of highly susceptible cultivars.

(2) Codex recognizes the impact of regional variation of weather conditions when it comes to mycotoxin control; USWBSI operates a multi-state disease forecasting system.

(3) Codex is committed to deoxynivalenol (DON) testing; USWBSI provides financial support for four U.S. DON testing laboratories.

(4) Codex recognizes the role of fungicides in managing mycotoxins; USWBSI has helped develop a multi-state fungicide evaluation network. ❖

CRISPR/Cas9 Editing for FHB Resistance

Hui Chen, a research assistant professor with the Department of Agronomy at Kansas State University, updated the 2018 FHB Forum audience on his group's work in utilizing CRISPR/Cas9 genome editing technology for FHB resistance improvement in wheat.

"Recently, we cloned *TaHRC* (a histidine-rich calcium binding protein) as the key determinant of *Fhb1* and showed that the wild type *TaHRC* is a susceptible allele, and a large mutation in the start codon region is the causal mutation for *Fhb1* resistance," Chen reported. "This finding suggests that knocking out the susceptible allele of *TaHRC* can improve FHB resistance in wheat."

Hui Chen

CRISPR/Cas9 genome editing technology can be used to modify plant traits by changing DNA sequence at a specified genome location. Although Chen's group did knock out the susceptible gene *TaHRC* by utilizing CRISPR/Cas9 and ended up with significantly improved FHB resistance of transgenic wheat, he noted they are currently "only able to transform the varieties Bobwhite and Fielder for gene editing due to low gene-editing efficiencies and poor regeneration rates of many wheat genotypes." Those factors, he pointed out, presently limit the application of gene editing as a routine tool in many breeding programs.

Chen also discussed his research group's more-recent development of a novel Barley stripe mosaic virus-mediated CRISPR/Cas9 genome editing system that can bypass the routine transformation and regeneration steps that are used in conventional wheat gene transformation. The new system "shows significant improvement from the existing wheat transformation technique," he noted, "and can edit genes in many wheat backgrounds for gene function validation and wheat breeding."

The KSU researcher ended by reminding his FHB Forum audience that the European Union has declared CRISPR to be a "transgenic" process, meaning gene editing is not, as yet, accepted for commercial breeding due to regulatory issues. ❖

Left: Ruth Dill-Macky, co-chair of the U.S. Wheat & Barley Scab Initiative, welcomed participants to the 2018 National Fusarium Head Blight Forum in St. Louis. She noted that the USWBSI presently works with 85 PIs in 31 states, operating with an annual budget of $6.2 million to fund research in quest of solutions to FHB and DON. Dill-Macky is a research pathologist with the University of Minnesota, St. Paul. The USWBSI's other co-chair is Doyle Lentz, a small grains producer from Rolla, N.D.

— 2018 FHB Forum —

Whole Genome Sequences of Wheat: A New Era

Last summer, the International Wheat Genome Sequencing Consortium announced that scientists had successfully completed the sequencing of the wheat genome — a genome more than five times the size of the human genome and one comprised of 21 chromosomes originating from three similar sub-genomes. Among the wheat assemblies was that of Chinese Spring, the bread wheat landrace.

Sean Walkowiak addressed that hugely significant milestone in his presentation to the 2018 National FHB Forum, titled *"Whole Genome Sequences of Wheat Bring a New Era for Gene Discovery and Breeding."* Walkowiak is a research officer with the Crop Development Centre at the University of Saskatchewan, Canada.

"Genomics is particularly useful for marker development, QTL discovery and understanding the root cause of important traits — including complex traits such as resistance to Fusarium Head Blight," Walkowiak pointed out. "To date, over 20 chromosomal regions have been identified that contribute to FHB resistance. However, the underlying genes that confer the resistance are largely unknown."

Sean Walkowiak

With the completion of the genome sequence of Chinese Spring, scientists now have new resources for refining genetic intervals and identifying gene candidates for resistance. "Unfortunately, Chinese Spring does not carry FHB resistance genes of interest to North American breeders," Walkowiak observed. "Therefore, additional genomic resources are required to identify FHB resistance genes. These additional resources will not only generate improved markers for breeding, but also help uncover how wheat can best defend itself against FHB fungi."

Walkowiak described how the wheat breeding programs at the University of Saskatchewan are utilizing the latest sequencing and assembly technologies to generate whole genome assemblies for both bread (hexaploid) wheat and durum (tetraploid) wheat. The overriding goal is to "uncover the genetic cause of important traits in wheat, including resistance to FHB," he stated.

To date, the Saskatchewan group and members of the 10+ Wheat Genome Project have performed genome sequencing and assembly at different levels of quality and depth, including >10 high-quality reference genome assemblies at a quality level similar to Chinese Spring, as well more than 100 mid-low coverage reference-guided genome assemblies. ❖

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 of their research. Several postdoctoral scientists and graduate students piqued interest in their posters by presenting mini-talks about their work in the 'Flash & Dash' sessions leading up to each afternoon's poster session.

2018 National FHB Forum Photo Credits:

Dave Hane
USWBSI, Albany, Calif.

— 2018 FHB Forum —

Scab Management Adoption in the Mid-Atlantic

Small grain production in the Mid-Atlantic is very different from that of a region like the Great Plains in terms of environment, field sizes and shapes — and cropping rotations. Penn State University's **Alyssa Collins** *(at left in photo)* and **Paul Esker** *(right)* provided insight on grain producers in their state, as well as how they deal with Fusarium Head Blight.

Farms in Pennsylvania and adjacent districts of nearby states tend to be smaller and more diverse compared to more-westerly regions — and they commonly center around dairy production. That translates into plenty of corn, Collins said, meaning in turn that "we have high inoculum levels all the time."

Collins, who is a plant pathologist and director of the PSU Southeast Agricultural Research & Extension Center at Manheim, said 2018's scab-conducive weather conditions brought into focus the differences among Pennsylvania small grains producers in terms of their approach to management intensity. "Low-input growers who in the past may have benefitted from the alignment of anthesis with minimal risk conditions were not able to avoid infection [this past season]," she noted. "As a consequence, increased scab and deoxynivalenol levels were reported by grain buyers across the region."

By comparison, Pennsylvania growers who have become more proactive in their grain crop management "anticipated scab and other quality issues in their crops in 2018." Those growers sought information from, and worked with, Extension professionals and crop consultants to avoid and/or manage FHB infections as effectively as possible.

Esker, PSU epidemiologist and field crop extension plant pathologist, emphasized Extension's responsibility to better understand the educational needs of all stakeholders in the FHB equation — not just growers, but also millers, maltsters and brewing/distilling groups. Extension is in a special position to "weave together these supply chains," he noted, in order to develop the most effective responses possible to both FHB and DON. ❖

Southern Brazil & FHB Resistance

The cultivated area of wheat in Brazil has declined from around 4.0 million hectares (about 10 million acres) annually in the 1990s to approximately 2.1 million hectares (5.2 million acres) as of 2018. Fusarium Head Blight has been a big reason for this reduction, **André Rosa** told his National FHB Forum listeners. Rosa is the director and breeder for Biotrigo Genética Ltda., a major provider of wheat seed in Brazil.

FHB has proven a major problem for wheat production in Southern Brazil, where most of the nation's wheat is concentrated. "Epidemics have been reported in Southern Brazil approximately seven out of 10 years," Rosa noted, "due to the fact that flowering occurs usually under warm and wet conditions favoring FHB development." So FHB resistance, not surprisingly, has become a key trait sought by all wheat breeding programs in the region.

Conventional breeding techniques (phenotyping, selection under natural field conditions) allowed Brazilian breeders to make progress in FHB resistance, with that resistance mainly derived from native sources (*e.g.*, the cultivar Fontana). Some Chinese and CIMMYT sources also were utilized, though few genes or QTL from those sources seem to have been retained in the germplasm, Rose noted.

The progress made was not sufficient to sustain production every year and, much less, to meet the requirements of the newer Brazilian mycotoxin legislation, Rosa observed. (Brazil is lowering the acceptable DON level to 0.75 ppm as of 2019.) His company's breeding program has, in recent years, intensified its efforts to improve FHB resistance by incorporating 'new' genes and QTL, especially *Fhb1*, from different sources — particularly Sumai 3. Marker assisted selection has been adopted to improve trait selection.

To date, while some improvement has occurred, Biotrigo Genética has not yet released new FHB-resistant cultivars. But, Rosa said, "we keep getting closer to a commercial release that offers a substantial improvement over a wide area." As Brazilian FHB resistance breeding efforts continue, increased attention likewise will be focused on the development and use of fungicides, he added. ❖

— 2018 FHB Forum —

Practical FHB Management Strategies for Michigan Growers

Martin Nagelkirk's presentation at the 2018 National FHB Forum had a lengthy but to-the-point title: *"Integrating the Management of Fusarium Head Blight and Foliar Diseases Through Fungicide Use and Variety Selection to Develop Practical Strategies for Winter Wheat Growers."* Nagelkirk, Michigan State University's Sandusky-based state extension educator for wheat, discussed the Michigan experience in balancing wheat disease management strategies under varying environments and disease-pressure conditions.

Michigan growers plant approximately 500,000 acres of wheat annually, encompassing about 40 different varieties of soft red and soft white winter wheats. Historically, the soft white varieties have tended to be more susceptible to both foliar diseases and Fusarium Head Blight, Nagelkirk noted. He estimated that at least 95% of the state's soft white winter wheat acreage receives a fungicide application at flowering, with the corresponding number for soft red acreage being around 60%.

In the past, Nagelkirk said, Michigan growers often were encouraged to consider applying a fungicide at flag leaf to thwart common leaf diseases like Powdery mildew, Septoria leaf spot, Stagonospora leaf spot and leaf rust. More recently, however, "presumably because of improved varietal resistance and, in some cases, an early fungicide application at jointing, this flag leaf timing is being postponed until flowering, thereby syncing with the optimal application timing of Prosaro® or Caramba® against FHB." This delayed timing has been effective, particularly in high yield environments, often resulting in several bu/ac in increased yield due to leaf disease suppression while significantly reducing the risk of elevated DON levels from FHB.

Martin Nagelkirk

The above application strategy did not serve Michigan growers well during the 2016 season, however — one in which the region experienced a severe stripe rust epidemic. "The disease developed early (jointing stages) and much more aggressively than the more-common leaf diseases," Nagelkirk recounted. "Consequently, the routine fungicide application at flowering was too late to provide adequate protection again stripe rust for some fields with susceptible, moderately susceptible and moderately resistant varieties."

Given the very real possibility that stripe rust will "occasionally strike with equal ferocity in seasons to come," Nagelkirk said wheat researchers and industry would do well to develop more-comprehensive and –robust disease management recommendations. Among his suggestions were:

• *Variety Selection* — Placing greater emphasis on avoiding varieties susceptible to both FHB and stripe rust.

• *Fungicide Use* — Develop alternative fungicide strategies that encompass stripe rust (and the more-common leaf diseases) as well as FHB.

• *Field Scouting* — Emphasize statewide communications networks that alert industry and growers of pending threats from stripe rust and/or FHB.

"It might also be helpful to create a strategy grid that helps visualize variety *x* fungicide schemes and vulnerabilities," Nagelkirk suggested. ❖

Left: Though not a scheduled speaker, Michigan State University professor of fungal biology Frances Trail stepped up at the last minute when the scheduled presentor was unable to make it to St. Louis due to inclement weather. Trail's presentation was titled 'A Mycologist's View of the Plant Microbiome.'

Mark Your Calendar!

2019 National FHB Forum

December 8-10

Hyatt Regency Milwaukee

Milwaukee, Wisc.

FHB in Idaho; Working to Keep DON Down

Juliet Marshall's 2018 FHB Forum presentation, titled *"FHB Now Westward Bound, and New Struggles to Keep DON Down,"* updated her audience regarding the recent increase of Fusarium Head Blight in Idaho and corresponding research geared toward limiting its impact.

Marshall, an Idaho Falls-based cereal specialist and pathologist with the University of Idaho, pointed out that the substantial expansion of the region's dairy industry has triggered increased production of corn, to the point where there are now more corn acres in Idaho than potato. The additional corn acreage has led, in turn, to more FHB, given corn's propensity to serve as a host for this fungus.

Testing of grain being delivered to local elevators for DON has now become a standard practice in Idaho, Marshall noted — "especially for malt barley, with increasing frequencies of barley discounted or rejected for exceeding DON tolerances." Research under irrigation systems is aiding the development of effective control strategies, she added, as, unlike most U.S. small grain areas, "western producers have irrigation management tools to increase control of FHB and potentially mitigate damage."

Juliet Marshall

As in other regions, Idaho grain producers are strongly encouraged to plant varieties with resistance to scab. Complicating that strategy, though, is the fact that "many preferred malt barley and wheat varieties with specific end-use qualities do not have the level of resistance required to control FHB," Marshall stated. "Combinations of fungicide and irrigation management are still required and need fine-tuning for those varieties without adequate levels of host resistance."

Due to the increased presence of Fusarium Head Blight in the region, Pacific Northwest breeding efforts now incorporate FHB resistance as an additional target in variety development, Marshall emphasized. ❖

Upper Left: Esten Mason, University of Arkansas, and Eric Olson, Michigan State University, facilitated this joint session of Northern and Southern Soft Winter Wheat Coordinated Projects.

Lower Left: This breakout of the Durum Coordinated Project was led by Steven Xu, USDA-ARS, Fargo.

— 2018 FHB Forum —

Breeding for FHB Resistance in North Dakota: Plenty of Questions

Research often brings forth many more questions than answers — and that was the theme of **Andrew Green**'s presentation at the 2018 National FHB Forum: *"Breeding for FHB Resistance in North Dakota: More Questions Than Answers."*

Green, hard red spring wheat breeder with North Dakota State University, noted that breeding for Fusarium Head Blight resistance has been a primary objective of the NDSU spring wheat program for more than two decades. While much progress has been made, the quest to uncover and integrate resistance genes remains ongoing and intensive.

"Fusarium Head Blight has long been thought of as a problem for production environments in eastern North Dakota, where annual rainfall is higher," Green remarked. "However, in recent years, FHB outbreaks have caused problems across the state, taking many by surprise." Since the central and western North Dakota environments typically show lower yield potential, "genetic disease resistance is even more crucial from an economic standpoint."

That begs the question, Green said, of "how we balance selection for diverse environments where environmental conditions, abiotic stress factors and acceptance for chemical inputs all vary."

Andrew Green

The newer generations of wheat varieties in North Dakota, more of which are now being developed by private seed companies, bring a wide range of FHB resistance to the table, Green noted. "In order to provide timely information to producers, the question is," he continued, "How do we test genotypes in a limited number of environments and confidently report their level of resistance? And, what data do we provide to [growers]? Visual scores are easily understood, but don't always correlate with DON or FDK (*Fusarium* damaged kernels) levels, which can be highly variable as well."

As an example of "more questions than answers," Green cited the hard red spring wheat variety Glenn, developed by NDSU and released back in 2005. It has provided statewide adaptability and extremely good baking quality — and, in addition, has displayed a strong level of resistance to FHB.

Yet, Glenn does not amplify for *Fhb1*, Green pointed out. A genome-wide association analysis of advanced and elite breeding lines revealed that *Fhb1* appears in fewer than half of the lines in the NDSU spring wheat breeding program — "and yet it is considered our most widely used resistance gene," Green observed. "This prompted the question: Where does the resistance in Glenn come from, and how did it get there?" ❖

Left: A very informative panel discussion by DON testing lab leaders was moderated by Dave Kendra of BASF, Research Triangle Park, N.C. The panel was comprised of, left to right: Yanhong Dong, University of Minnesota; Paul Schwarz, North Dakota State University; David Schmale, Virginia Tech University; and Senay Simsek, North Dakota State University.

The DON lab leaders responded to queries about each lab's mission, workload and procedures, as well as the overall importance of these USWBSI-supported labs to the mission of the Initiative. The USWBSI currently funds the four testing labs at a cumulative annual level of nearly $684,000.

— 2018 FHB Forum —

Establishing a Wheat Breeding Program in the U.S.

Jana Murche, head of wheat breeding for KWS Cereals USA, outlined for FHB Forum attendees her company's path in establishing a U.S. wheat breeding program. Its parent, German-based KWS, is active in about 70 countries, producing seed varieties for cereals, sugarbeets, corn, rapeseed and potatoes.

KWS Cereals USA initially started a soft winter wheat program at Wooster, Ohio, in 2011. "After a 'tough' start under challenging conditions, the program was relocated to Champaign, Ill., where we found near-ideal conditions for our main breeding location and activities," Murche recounted. The Illinois operation has since advanced with additional personnel, new equipment and the use of new breeding technologies to where it is "starting to produce competitive, broadly adapted and regional varieties for the eastern U.S. wheat market," according to Murche.

During the past eight years, Murche said, KWS Cereals USA has focused on high yield performance and low FHB susceptibility. Participation in collaborative regional scab nurseries has been an important component. "Through intensive breeding efforts, we lowered the susceptibility level of our material to be in the range of the moderately resistant check varieties, with single lines reaching the resistance level of Truman," she stated.

Jana Murche

"Not surprisingly," Murche continued, "the most challenging part lies in identifying breeding lines possessing the combination of commercially competitive yields with good FHB resistance. To address this, we continue to phenotypically screen our most-advanced high-yielding lines in an internal scab nursery, as well as in the regional scab nurseries."

KWS likewise utilizes marker data provided by the USWBSI-supported USDA-ARS genotyping lab in Raleigh, N.C., to track individual marker loci. "In addition, we use genome-wide SNP data in the implementation of Genomic Selection to receive additional performance indications — which proves especially valuable in years with low scab disease pressure," she noted.

"It has been a rewarding first eight years," Murche concluded. "Together with the wheat community, we strive to improve the 'perception' of wheat and increase the acreage of high-performing varieties combined with a competitive disease resistance package." ❖

Below: Morning and afternoon refreshment breaks are always a great venue for enjoying discussions of both a professional and personal nature at the annual National FHB Forum.

Recent Peer-Reviewed Scab-Related Publications

• Sarowar S, Alam ST, Makandar R, Lee H, Trick HN, Dong Y, Shah J. Targeting the pattern-triggered immunity pathway to enhance resistance to Fusarium graminearum. Mol Plant Pathol. 2018 Dec 30. doi: 10.1111/mpp.12781.

• Wegulo, S.N., Valverde-Bogantes, E., Bolanos-Carriel, C., Hallen-Adams, H., Bianchini, A., McMaster, N., and Schmale, D.G. 2018. First Report of Fusarium boothii Causing Head Blight of Wheat in the United States. Plant Disease. December 2018, Vol. 102, No. 12, Page 2646. https://apsjournals.apsnet.org/doi/full/10.1094/PDIS-04-18-0696-PDN.

• Wilson, N., Dashiell, S., McMaster, N., Bohland, C., and Schmale, D. 2018. Could Your Food be Contaminated with Toxins? Educating High School Students about Mycotoxins in Feed and Food Products. The Science Teacher 86 (1): 46-52. https://learningcenter.nsta.org/ resource/?id=10.2505/4/tst18_086_01_46.

Listings of recent FHB-related publications by USWBSI-associated principal investigators are invited for submission for future issues of Fusarium Focus. Send listings to Don Lilleboe at lill-comm@yahoo.com.

New Western Canada FHB Research Project Underway

Funded By Multiple Sponsors; Research Being Conducted By Several Universities & Institutes

A five-year (2018-2023) research project is underway in Western Canada to improve the management of Fusarium Head Blight (FHB) in major cereal crops.

The research is funded by multiple sponsors: the Western Grains Research Foundation, Agriculture and Agri-Food Canada, Canadian Agricultural Partnership, Integrated Crop Agronomy Cluster; the Saskatchewan Wheat Development Commission, Manitoba Wheat and Barley Growers Association, Alberta Wheat Commission, Prairie Oat Growers Association, and the Brewing and Malting Barley Research Institute.

FHB is a very important disease to the agricultural industry. Production of spring wheat, winter wheat and barley in Western Canada has averaged 21.0, 1.3 and 8.0 million metric tons per year, respectively (2012-16), with a farm gate value that exceeds $10 billion (CDN) annually.

Thirty years ago, FHB was found mainly in Eastern Canada and a small area in southern Manitoba. During the past three decades, it has steadily spread westward throughout Manitoba into much of the crop area of Saskatchewan and is now found frequently in cereal crops in many areas of Alberta. Farm management decisions for FHB control that could facilitate improved crop production, lower toxin levels and marketability of these grains by as little as 1% would add hundreds of millions of dollars to the economy.

The new project brings a unique approach by taking a pan-provincial perspective and engaging collaborators from universities and institutes in Alberta, Saskatchewan and Manitoba, as well as from Agriculture and Agri-Food Canada and other industry partners. The ultimate aim is to provide reliable information for FHB management decisions across all three Prairie Provinces in Canada.

The project has four pillars, each representing unique areas of specialization by the principal investigators and each supported by a team of collaborators.

Pillar 1 — Evaluation of Canadian population structure and chemotype dynamics of *Fusarium graminearum* in cereals is led by Professor Dilantha Fernando (University of Manitoba).

The main objective of this pillar is to determine the current Fusarium population structure and trichothecene chemotype diversity from wheat, barley, corn and oats, not just on the prairies but across Canada. This will provide new insight into the nature of population shifts that have occurred in recent years.

Pillar 2 — Prevalence, population structure and mycotoxins of *Fusarium poae* affecting small grain cereals in western Canada is led by Dr. Xiben Wang (Agriculture and Agri-Food Canada). The main objective of this pillar is to determine the abundance and characterize the population of *F. poae* in commercial wheat, barley and oat fields in western Canada. This species occurs frequently in barley and oats, but most of FHB research on barley and oats has focused on *F. graminearum* due to its dominance.

Pillar 3 — Crop sequence effects on FHB of cereals is led by Professor Randy Kutcher (University of Saskatchewan). The objective of this pillar is to determine optimum crop sequences to minimize FHB in wheat and barley. This will provide an added management tool beyond fungicide applications to mitigate the disease.

Pillar 4 — Development of decision support tools for FHB management in Western Canada is led by Professor Paul Bullock (University of Manitoba). The objective is to develop weather-based models to assess the risk of FHB occurrence and DON level in spring wheat, winter wheat, barley and durum as well as to produce a prairie-wide FHB/DON risk mapping and information tool. This pillar is aimed at developing a risk assessment tool similar to the one that is available through the U.S. Wheat & Barley Scab Initiative FHB Prediction Center (www.wheatscab.psu.edu/fusarium).

The ultimate goal of these projects is to lower FHB severity and mycotoxin levels in cereal crops in Western Canada using management practices that improve FHB control and increase the profitability of cereal crop production in this region.

For more information about this project, contact Dr. Manasah Mkhabela at the University of Manitoba (Manasah.Mkhabela@umanitoba.ca). ❖

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 producers, processors and consumers of wheat and barley. Contact information is as follows:*

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