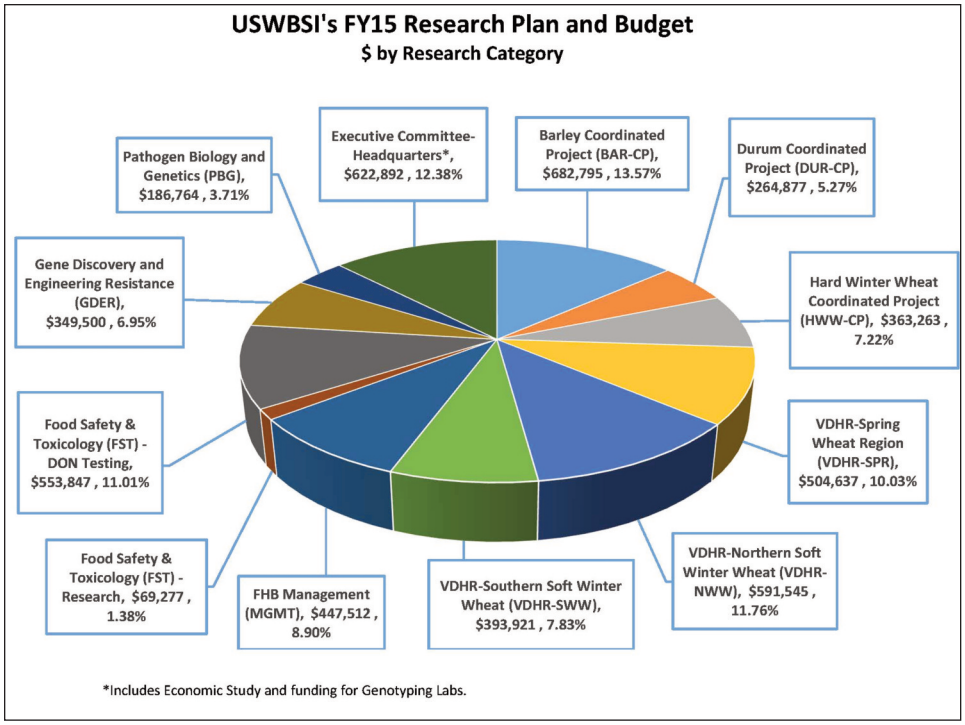
U.S. WHEAT & BARLEY SCAB INITIATIVE

Fusarium Focus

Volume 15 Issue 2 Summer 2015

USWBSI Research Funding: FY15



The U.S. Wheat & Barley Scab Initiative (USWBSI) has submitted its fiscal year 2015 Research Plan and Budget to the USDA Agricultural Research Service, totaling $5,030,830 in scab-related research projects. The total includes 125 projects in 26 states and encompasses 24 land grant universities plus USDA-ARS.

The above pie chart depicts the percentage of recommended funding broken down by research area, plus the actual amount for each area. The dollar level recommendation and number of projects for each area are as follows:

- *Barley Coordinated Project* - $682,795 / 12 research projects
- *Durum Coordinated Project* - $264,877 / 7 projects
- *Hard Winter Wheat Coordinated Project* - $363,263 / 12 projects
- *Variety Development & Host Resistance (VDHR) / Spring Wheat Region* - $504,637 / 11 projects
- *VDHR / Northern Winter Wheat Region* - $591,545 / 23 projects
- *VDHR / Southern Winter Wheat Region* - $393,921 / 10 projects
- *FHB Management* - $447,512 / 24 projects
- *Food Safety & Toxicology / Research* - $69,277 / 1 project
- *Food Safety & Toxicology / DON Testing Labs* - $553,847 / 4 projects (labs)
- *Gene Discovery & Engineering Resistance* - $349,500 / 8 projects
- *Pathogen Biology & Genomics* - $186,764 / 4 projects
- *Executive Committee & USWBSI Headquarters* - $622,892* / 9 projects

** Includes funding for four USDA-ARS genotyping labs (located in North Carolina, Minnesota, North Dakota and Washington); also includes funding for initiation of a study on the economic impact of USWBSI work to reduce FHB.*

Each year, the U.S. Wheat & Barley Scab Initiative is charged with developing a comprehensive research plan and budget recommendation that is aimed at achieving the Initiative's primary mission — *i.e.*, that of enhancing food safety and supply by reducing the impact of Fusarium Head Blight (scab) on wheat and barley.

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), which is comprised of wheat and barley growers, farm organization representatives, food processors, public and private scientists and consumer groups. The USWBSI's

Networking and Facilitation Office coordinated this process in close consultation with the organization's Executive Committee (EC) and the chairs of each individual research area and coordinated project.

The Executive Committee's recommended plan and budget were presented to the Steering Committee at its meeting following the 2014 National Fusarium Head Blight Forum in St. Louis last December. In its entirety, the recommendation encompassed 125 preproposals (including several multi-PI ones) from 871 PIs. The sum of all recommended award amounts was equal to the $5,030,830 anticipated to be available to USDA-ARS for collaborative scab research for FY15.

Following a briefing and study of the plan, the Steering Committee passed it by a unanimous vote. So the plan then became the official USWBSI comprehensive research plan and budget for fiscal year 2015. Subsequently, the plan was translated into individual USDA-ARS grant applications, which were submitted en mass in February as USWBSI's recommendation for how ARS could allocate the $5,030,830 awarded it for scab research by Congress.

For more information about the U.S. Wheat & Barley Scab Initiative's funding application and approval process, go to its website — www.scabusa.org — and then click on the "About USWBSI" and "Research Categories." ❖

50th International Symposium on Fusarium Head Blight

And

2nd International Workshop on Wheat Blast

April 6-10, 2016

Costao do Santinho
Florianopolis, Brazil

http://scabandblastofwheat2016.org/

USWBSI's Contributions In Progress Against FHB

An Interview With Dave Van Sanford

Editor's Note: *The following interview with Dave Van Sanford, co-chair of the U.S. Wheat & Barley Scab Initiative and University of Kentucky wheat breeder, appeared in a July newsletter of the Neogen Corporation Milling and Grain Department. Neogen, headquartered in Lansing, Mich., has more than 1,000 employees in multiple U.S. and international locations. The company develops, manufactures and markets a diverse line of products dedicated to food and animal safety.*

Can you describe the significance of Fusarium Head Blight as it relates to DON accumulation in the U.S. grain and milling industries?

The U.S. wheat and barley industries are extremely important to our nation's citizenry and its economy. The average annual value of the U.S. wheat crop is nearly $14 billion, and the annual value of the U.S. barley crop is about $800 million.

Fusarium Head Blight (FHB) — commonly referred to as "scab" — is a very serious threat. It is a fungus disease that can occur on all small grain crops, but most commonly in wheat and barley. FHB can result in significant crop yield loss and lower test weight, and infected grain may be downgraded at market.

DON (deoxynivalenol), commonly referred to as "vomitoxin," is a mycotoxin that can be produced in wheat and barley infected by FHB. DON can impair the health of animals and impact functionality of products.

What is the U.S. Wheat & Barley Scab Initiative, and what significant breakthroughs has the Initiative helped bring about?

The U.S. Wheat & Barley Scab Initiative was formed in the latter 1990s in response to the very serious outbreaks of FHB earlier in the decade. It is a partnership of federal, state, grower and industry entities working through federal and state research infrastructures to most effectively coordinate FHB- and DON-focused research by state university and USDA-ARS scientists. The USWBSI employs a competitive grant process to help fund these researchers. In fiscal year 2014, funding awarded to USWBSI via USDA-ARS totaled about $4.9 million. With those monies, the USWBSI funded about 130 research projects in 24 states, led by 81 scientists.

Dave Van Sanford

Progress to date in managing Fusarium Head Blight has been very significant. The development of wheat and barley varieties with improved resistance to FHB has been a major priority, involving more than half of USWBSI's total funding.

Each year, numerous new wheat varieties with higher levels of resistance to FHB are released by public and private breeding programs in the hard red spring, soft red winter and hard red winter wheat regions. In some areas,

such varieties now comprise the majority of wheat acreage plantings. While resistance in durum wheat and barley has come more slowly, USWBSI-funded breeders in these classes are releasing improved varieties as well.

The USWBSI also has played an important role in the availability of effective fungicides for protection against FHB. USWBSI-funded plant pathologists have conducted — and continue to conduct — replicated, multi-location field trials to evaluate and demonstrate the effectiveness of various fungicides. Because of such work, wheat and barley growers now have a choice of effective chemistries to help them protect their crops against FHB.

Connected to fungicide use is disease forecasting developed by USWBSI scientists. This allows farmers to gauge the outlook for FHB infection in a given area (and apply fungicides at the correct time to reduce incidence).

The USWBSI also supports four regional USDA-ARS small grains genotyping laboratories (in North Carolina, Minnesota, North Dakota and Washington). These labs use sophisticated gene marker technology to analyze tens of thousands of samples sent in by wheat and barley breeders around the country, looking for traits of interest. Their findings, back in the hands of the breeders, are extremely useful as the breeders focus on incorporating the desired trait(s) into new varieties.

What is some of the cutting-edge research being done for controlling Fusarium Head Blight and DON?

The above-noted genotyping labs facilitate most of our cutting-edge research; their efforts are being extended to genomic selection in which segments of the genomes associated with FHB resistance traits can be selected, thus expediting progress.

The most important and effective tools available for grower management of FHB are: (1) varieties with improved resistance, and (2) well timed, effective fungicides applied when conditions warrant. Excellent progress has been made in the development and release of wheat varieties with at least moderate resistance to FHB, and progress is accelerating in the durum wheat and barley grain classes.

Several fungicides providing good suppression of FHB have been registered in recent years as well, and many growers have achieved good control with them. Under optimal application conditions, fungicides have shown an ability to reduce FHB severity by 50 to 60% and DON levels by 30 to 50%.

What are some future research needs relating to FHB and DON control?

Despite the excellent progress that has been achieved to date, the campaign toward defeating Fusarium Head Blight is far from finished. The USWBSI, as of 2015, is supporting research in several areas, including: the breeding of new wheat and barley varieties with continually improving resistance to FHB; ongoing evaluations into best management practices; gene discovery and engineering resistance; pathogen biology and genetics; and food safety and toxicology.

Together, the research in all these areas is designed to further the USWBSI's stated mission: to enhance food safety and supply by reducing the impact of Fusarium Head Blight (scab) on wheat and barley.

As examples, here are just a few of the research projects currently supported by the USWBSI:

(1) Developing 6- and 2-Rowed Malting Barley Cultivars with Enhanced FHB Resistance and Reduced DON Accumulation (North Dakota State University)

(2) Breeding Fusarium Head Blight Resistant Spring Wheat (University of Minnesota)

(3) Development of Scab Resistant Soft Red Winter Wheat Varieties (University of Illinois)

(4) Novel Plant Genes for FHB Resistance (Rutgers University)

(5) Use of Genes Important to Penetration for Control of FHB in Wheat and Barley (Michigan State University). ❖

2015 FHB Forum Set for St. Louis December 6-8

The National Fusarium Head Blight Forum returns again to St. Louis this year. The Hyatt Regency St. Louis at the Arch, site of the FHB Forum in both 2011 and 2014, is the venue for the 2015 event, which is scheduled for December 6-8. This will be the 18th National Fusarium Head Blight Forum.

Hosted by the U.S. Wheat & Barley Scab Initiative, the annual Forum is geared toward public and private scientists, millers, maltsters and brewers, additional food processors, wheat and barley growers, grower group representatives, consumers and others with interest in Fusarium Head Blight (scab) and its impact.

The 2015 FHB Forum begins at 1:00 p.m. on Sunday, December 6, and concludes at noon on Tuesday, the 8th. The program will consist of oral and poster presentations, along with focus group discussions. The popular Flah & Dash presentations for graduate students, post-docs and early career professionals will be held as well.

A draft of the full program should be available by early September. For updates, visit www.scabusa.org. The USWBSI website also includes details on registration and making hotel reservations.

Here's a summary of key dates:

• *Nov. 4* - Deadline for registration of posters/papers/abstracts.

• *Nov. 6* - Deadline for submission of abstract and paper content for the Forum proceedings.

• *Nov. 10* - Deadline for early registration; last day for full refund.

• *Nov. 16* - Last day to reserve hotel room with guaranteed availability and rate.

• *Nov. 21* - Last day to receive a partial refund.

• *Nov. 30* - Online registration ends. ❖

New Tool to Predict Genetic Variation & Correlated Response of Multiple Traits in Breeding Populations

One of the most important decisions that breeders make is selecting combinations of parents to cross to develop new breeding populations. In breeding for FHB resistance, this often involves crossing two parents with moderate levels of resistance with the goal of producing superior progeny that carry resistance from both parents. The challenge is determining which pairs of parents will complement each other in such a way.

Researchers at the University of Minnesota have developed a new tool that uses genome-wide marker information and simulation to predict the genetic variance (V_G) and correlated response between pairwise sets of traits. This tool, called PopVar, relies on the established machinery of population simulation and the statistical models of genomic selection to calculate genome-estimated breeding values (GEBVs) across a set of simulated progeny resulting from a bi-parental cross. Predictions of the following parameters of the bi-parental population can then be derived from the GEBVs themselves: *a)* the population mean, *b)* V_G, *c)* the mean of the best performing, *i.e.*, superior progeny, and *d)* the correlated response and simple correlation of pairwise sets of traits, when available. This last prediction is important when trying to reduce or eliminate unfavorable correlations, such as high disease resistance and low grain yield that are common in FHB breeding.

The data needed to implement PopVar is routinely generated in small grains breeding programs that are supported by the U.S. Wheat & Barley Scab Initiative and include: *a)* a training population (TP), that is a set of genotyped entries phenotyped for the trait(s) of interest, *b)* a set of genotyped parent candidates, and *c)* a linkage map ordering the markers used.

To briefly illustrate the utility of PopVar, consider the following scenario: you, the breeder, have a set of 50 parents, elite for grain yield and deoxynivalenol (DON) concentration entered into the crossing block. Making all pairwise crosses would require 1,225 crosses. In such a scenario, PopVar could be utilized to predict the superior progeny values and trait correlations for all of the possible 1,225 crosses, information you could then use to identify the highest priority crosses to actually make. Studies to validate this new tool are underway, and others are encouraged to validate this approach.

A complete description of PopVar utilizing barley grain yield and DON data has recently been published (Mohammadi, M., T. Tiede, and K.P. Smith, 2015; doi:10.2135/ cropsci2015.01.0030) and its methodology has been developed into an R package (R Core Team, 2013) that is available on CRAN (http://cran.r-project.org/package=PopVar).

For an easy installation and to ensure the most recent version is being used, use the R function install.packages("PopVar") followed by library(PopVar). Questions, bug reports and suggestions can be directed to tyler.tiede7@gmail.com. ❖

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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Fusarium Focus *is produced by Lilleboe Communications, P.O. Box 2684, Fargo, ND 58108. Phone: (701) 238-2393. Email: dlilleboe@forumprinting.com*

Recent Peer-Reviewed Scab-Related Publications

• Makandar, R., Nalam, V.J., Chowdhury, Z., Sarowar, S., Klossner, G., Lee, H., Burdan, D., Trick, H.N., Gobbato, E., Parker, J. and Shah, J. The combined action of ENHANCED DISEASE SUSCEPTIBILITY1, PHYTOALEXIN DEFICIENT4 and SENESCENCE-ASSOCIATED101 promotes salicylic acid-mediated defenses to limit *Fusarium graminearum* infection in *Arabidopsis thaliana*. Mol. Plant-Microbe Interact. April 27 [Epub ahead of print]; http://dx.doi.org/10.1094/MPMI-04-15-0079-R

• Nalam, V. J., Alam, S., Keereetaweep, J., Venables, B., Burdan, D., Lee, H., Trick, H.N., Sarowar, S., Makandar, R., and Shah, J. (2015) Facilitation of *Fusarium graminearum* infection by 9-lipoxygenases in *Arabidopsis* and wheat. Mol. Plant-Microbe Interact. Jun 15. [Epub ahead of print]; http://dx.doi.org/10.1094/MPMI-04-15-0096-R

• Prussin, A.J., Marr, L.C., Schmale, D.G., and Ross, S.D. 2015. Experimental validation of a long-distance transport model for plant pathogens: Application to *Fusarium graminearum*. Agricultural and Forest Meteorology 203:118-130. http://www.sciencedirect.com/science/article/pii/S0168192314003190

Listings of recent FHB-related publications by USWBSI-associated principal investigators are invited for submission to be listed in future issues. Listings can be sent to Don Lilleboe at dlilleboe@forumprinting.com.