



Fusarium Focus

Volume 17 Issue 1

Winter 2017

2016 FHB Forum Draws 180+

More than 180 scientists, graduate students, growers and industry representatives from the U.S. and foreign countries attended the 2016 National FHB Forum in early December. The 19th FHB Forum took place at the Hyatt Regency St. Louis at the Arch.

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 fourth 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 Forum provides a key 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 2017 National FHB Forum will take place at the Hyatt Regency in Milwaukee. Dates are December 3-5.

The following pages contain photos and talk summaries from some of the invited speaker presentations at the 2016 Forum. PDF copies of the following presentations are posted on the USWBSI’s website — www.scabusa.org — as are the full Forum Proceedings:



- *Economic Impact of USWBSI’s Research on Reducing FHB* / Bill Wilson, North Dakota State University, Fargo
- *Born, Bred, and Brewed for New York* / Mark Sorrells, Cornell University, Ithaca, N.Y.
- *A Meta-analysis of the Genetics of Fusarium Head Blight Resistance in Barley* / Brian Steffenson, University of Minnesota, St. Paul
- *National Survey of Wheat & Barley Producers: Where Do They Get Information About Scab? How Does That Affect Adoption of Management?* / Christina Cowger, USDA-ARS, Raleigh, N.C.

New USWBSI Co-Chair
Doyle Lentz Replaces Art Brandli
— See Article on Page 2 —

- *Characterization of Fusarium Head Blight Resistance in Aegilops tauschii and QTL Discovery in Hexaploid Wheat* / Eric Olson, Michigan State University, East Lansing
- *Host-Induced Silencing of Fusarium culmorum Genes Protects Wheat from Infection* / Wanxin Chen, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Sachsen-Anhalt, Germany
- *Simultaneous Mapping and Pyramiding Loci in Wheat Breeding Populations: Identity by Descent Mapping Approaches* / Jose Gonzalez, South Dakota State University, Brookings
- *Antifungal Plant Defensins: Mechanisms of Action and Engineering Resistance to Fungal Pathogens in Transgenic Wheat* / Dilip Shah, Donald Danforth Plant Science Ctr., St. Louis
- *Tissue Culture Induced Variability: Critical Issues that Impact the Evaluation and Use of Transgenic Parents* / Phil Bregitzer, USDA-ARS, Aberdeen, Idaho
- *Are DON Congeners a Food Safety Concern?* / Jim Pestka, Michigan State University, East Lansing
- *Growers’ Needs and Industry Wants: A Retrospective of Two Decades in the Trenches in the Battle with FHB* / Jochum Wiersma, University of Minnesota, Crookston



Lentz Takes Reins From Brandli As Initiative Co-Chair

North Dakotan Replaces Minnesotan As Stakeholder Leader

North central North Dakota farmer Doyle Lentz is the new grower/ stakeholder co-chairman of the U.S. Wheat & Barley Scab Initiative. Lentz assumed the post as of January 1, 2017. He succeeds Minnesota producer Art Brandli, who had served as USWBSI co-chair since early 2008. David Van Sanford, University of Kentucky wheat breeder, is the research community co-chair.

Members of the Lentz family farm near Rolla, N.D., include Doyle's wife, Kerry, their two daughters and his parents. "We're going to put in our 119th crop this spring," he says. The Lentz crop rotation includes barley, spring wheat, soybeans and canola.

Doyle has been very active in farm organizations over the past quarter century. He's been a multi-term member (and current chairman) of the North Dakota Barley Council, and is currently serving his final four-year term on the NDBC. He is the immediate past chairman of the National Barley Growers Association; former chairman of International Market Development for the U.S. Grains Council; has served on the board of the Northern Crops Council; and recently completed two terms on the North Dakota State Board of Agricultural Research and Extension.

Lentz also was among those instru-

mental in the formation of the U.S. Wheat & Barley Scab Initiative in the mid-1990s, and he served on the Initiative's Steering Committee from 1998 through 2002. His direct interest in Fusarium Head Blight dates back to 1993, when he and numerous other Northern Plains producers suffered major crop damage from the disease. "That was how all this began," Lentz relates. "In 1993 I basically lost my crop to scab." He and other North Dakota farmers successfully lobbied the state legislature to fund additional North Dakota State University research on scab. The group also initiated discussions with producers and industry from surrounding states, and together the consortium laid the foundation for what would eventually become the U.S. Wheat & Barley Scab Initiative.

Today, nearly 25 years later, the scab/DON problem obviously persists. But Lentz is pleased with the progress made to date by the research community, and he looks forward to playing a role in the Scab Initiative's mission going forward. "The researchers are a hardworking group, super dedicated," he affirms. "They just put their heads down and

'We need to remain very vigilant in both the development of resistance and use of fungicides. Together, they'll keep us in the game.'

work hard." There probably will never be a complete solution for FHB, he acknowledges, "but we've learned to manage it better due in good part to the research sponsored by the Initiative. We have numerous varieties with improved scab resistance, and we've learned to use fungicides more effectively.

"We need to remain very vigilant in both the development of resistance and use of fungicides. Together, they'll keep us in the game.'"

Art Brandli became the USWBSI grower/stakeholder co-chairman in January 2008, succeeding Tom Anderson of Barnesville, Minn. Anderson passed away in July of the previous year, having served as the Initiative's co-chair since its inception in 1997.

Brandli is a third-generation farmer from the far-northern Minnesota community of Warroad. A U.S. Navy veteran, he graduated from the University of Minnesota with a bachelor's degree in electrical engineering and master's in business administration. After positions in the corporate sector, he and his wife, Nancy, returned to Warroad in 1973 to farm. They produced wheat primarily, but also grew barley, sunflower, canola, soybeans and grass seed through the years. The Brandlis sold their Roseau County farm in 2005, with Art then helping direct its transition into forest and wildlife production for the farm's new owner.

Brandli has served on a broad range of local, state and national organization boards during the past 45 years, among them: former chairman of the Minnesota Wheat Research and Promotion Council; former chairman of the national Wheat Foods Council; former director of U.S. Wheat Associates; and current board member of Minnesota's Agricultural Utilization Research Institute (AURI).

One of Brandli's primary goals upon becoming USWBSI co-chair in early



Doyle Lentz



Art Brandli



— 2016 FHB Forum

2008 was to serve as a communications conduit “not only to and from growers, but also between researchers and industry.” Nine years later, he believes communication channels within the Initiative — and outreach efforts as well — are certainly stronger. “I had this feeling, when I first got involved, that while there were individual research areas, there wasn’t very much interaction between them, except at the annual Forum,” Brandli says. Since then, “we’ve originated coordinated project activity. We have a better feel of researchers talking to each other, rather than [just within] individual research programs across the United States. There’s compilation and sharing of data to a degree that wasn’t there before. I think that’s very positive.”

Another of Brandli’s impressions upon becoming co-chair was that biotechnology could serve as a “silver bullet” of sorts . . . that “there had to be a way that genetic transfer could kill this disease.” While biotechnology has provided important gains and will continue to do so, the answer to scab and DON for at least the foreseeable future, he now says, will likely revolve around “living with better and better varieties, good fungicides, good management practices — all things that make this a disease we can control, if not eliminate.”

One of the most impressive features of the USWBSI, Brandli reflects, is “the dedication of all the researchers across the United States. We have very dedicated people who have worked on hundreds of projects over the years, trying to make things better for the producer, the miller, the maltster and other end users.

“As long as adequate funding is there, I envision continued headway against this disease. We are definitely making progress.” ❖

“Born, Bred and Brewed in New York” was the title of the presentation delivered by Cornell University small grains breeder **Mark Sorrells** to the 2016 National FHB Forum audience.

Sorrells’ presentation focused on the status of the evolving malting barley breeding program at Cornell. This program was initiated in response to the rapidly expanding craft brewing industry in New York and nearby New England. A 2012 New York law aimed at boosting the state’s micro-brewing industry provided a major stimulus. For farm breweries to qualify for tax and marketing incentives, the law calls for at least 20% of these beers’ ingredients to be grown in New York through the end of 2018. That requirement jumps to 60% in 2019 — and then, by the end of 2024, to a minimum of 90%.

Testing of barley varieties from other states and regions during 2014-16 did not identify any cultivars with adequate FHB resistance and agronomics for New York; thus the establishment of the Cornell program, which focuses on spring two-row malting barley varieties. In addition to yield, primary traits of interest being pursued by the Cornell group — which includes plant pathologist Gary Bergstrom, a longtime FHB researcher — are Fusarium Head Blight resistance, Spot Blotch resistance, preharvest sprouting and, of course, malt quality. Collaboration with other barley breeding programs like those at the University of Minnesota, North Dakota State University and Oregon State University, as well as in Canada and Europe, has been

invaluable to the startup, Sorrells noted.

The Cornell team made their initial crosses in April of 2016 from a base population of seven biparentals linked by a common female parent. F₁ seeds from the crosses were planted in June and harvested in late August. A special single seed analyzer was used to make selections, and F₂ seeds were planted in early October. That generation was harvested in December and another round of selection conducted in January, followed by planting of the F₃ seeds. Plans call for harvest to occur in April, followed by field planting of the F₄. Next will come phenotyping and seed increase for state-wide evaluation in 2018.

The team is using a single kernel near-infrared spectroscopy machine to phenotype large quantities of seed for malt quality traits. They also will be implementing multivariate genomic selection for disease traits, including FHB and DON, to rapidly advance superior breeding material to the evaluation stage.

The Cornell barley breeding project is partially funded by the U.S. Wheat & Barley Scab Initiative. ❖



Mark Sorrells

**2016
National FHB Forum
Photo Credits:**

**Dave Hane
USDA-ARS, Albany, Calif.**

Mark Your Calendar!

**2017 National
FHB Forum**

December 3-5

**Hyatt Regency
Downtown**

Milwaukee, Wisc.



— 2016 FHB Forum —

The U.S. Wheat & Barley Scab Initiative (USWBSI) has been in existence for almost two decades, investing tens of millions of dollars into research to help understand and control Fusarium Head Blight (scab) and DON, the vomitoxin associated with this disease. Has the USWBSI had a quantifiable economic impact in that regard—and, if so, how much?

Such was the motivating question behind a North Dakota State University study commissioned by the USWBSI and reported upon at the 2016 National FHB Forum. The study's lead author — and Forum keynote speaker — was **William Wilson**, longtime NDSU agricultural economist and University Distinguished Professor and CHS Chair in Risk Management and Trading.

The study's primary objective was to estimate the economic impacts of reducing FHB on cereal grain producers, traders, and handlers and processors. Wilson and his associates developed economic models, analyzed extensive data and also conducted surveys of wheat flour millers, barley maltsters and grain handlers. They focused on six primary

areas: (1) the costs of FHB; (2) the impact of mitigating strategies — e.g., resistant varieties, fungicides, disease forecasting — on grain yields and DON levels; (3) supply chain marketing practices; (4) the impact of the USWBSI on reducing yield losses; (5) return on investment of the Scab Initiative; and (6) secondary impacts of the Initiative.

The NDSU investigators reported substantial growth in the use of “moderate” or “moderately resistant” varieties across the past one and one-half decades: from 40% of planted area in 2000 to 70% as of 2014 (majority of that being “moderate”). They also noted a dramatic increase in fungicide use during the past decade to help manage scab. While fungicide application levels vary widely from state to state, it is clear, they observe, that fungicide use has played an important role in reducing aggregate DON levels.

Not using the above technologies leads to increased risk and lower returns for the producer. In the hard red spring wheat area, for example, Wilson, et al calculated a risk/return mean of 44.73 for those situations

where neither a resistant variety nor fungicide was employed. Where both strategies were used, the mean was 140.78; for fungicide alone, 133.57; and for moderately resistant variety alone, 118.09.

Wilson briefly reviewed DON specifications (limits) for both the domestic and export markets. Domestically, he noted, discounts tend to be larger and more variable at the country elevator or origin mill levels. Cash discounts at mills vary, depending upon whether it is an origin or destination mill. Importers often are more stringent than domestic buyers; a number of countries allow a maximum of 2.0 ppm DON; several others are closer to 1.0.

In their survey of U.S. wheat flour mills, the NDSU researchers found that DON impacted 90% of responding mills to one degree or another. To meet their purchasing needs in higher-scab/-DON years, they often increased their draw area, sometimes by a substantial distance. The added cost of dealing with DON (e.g., testing, segregating or blending, expanding the draw area range) ranged from 10 to 30 cents/bushel in a “normal” year up to \$2.50-3.00/bushel in an “epidemic” year. Discounts to the grower ranged from 5 cents/bushel all the way up to \$3.00.

As a group, the wheat flour mills indicated that the innovations most important for achieving improvement with DON were: (1) fungicide, (2) farm management, (3) varieties, (4) crop rotation, and (5) milling practices.

Surveyed barley buyers most often indicated maximum DON limit of 0.4-0.5 ppm for malting barley. Most commonly noted discounts ran between 10 and 50 cents/bushel. They, too, expanded targeted purchase area in problematic DON years — by as far as 1,000 miles in some instances.

Barley end-users ranked the five factors most important to reducing DON in this order: farm management practices, fungicide, crop rotations, varieties and malting processing practices.



Bill Wilson (left) and William Njanje respond to Forum audience questions regarding their study of the economic impact of the U.S. Wheat & Barley Scab Initiative.



— 2016 FHB Forum —

William Nganje, chairman of the NDSU Department of Agribusiness and Applied Economics, was a co-author of the USWBSI study, along with Greg McKee. Nganje compiled estimates of production losses — and the value of those losses — due to FHB for the past two decades for the hard wheats (six states), soft wheats (11 states), durum (three states) and barley (four states). He used the four-year period of 1993-96 (prior to the establishment of the national Scab Initiative) as the base period for determining subsequent years' losses and savings due to the Initiative.

The table at right shows the estimated costs accrued by the U.S. wheat and barley industries due to DON during 2015/16. The most important costs consisted of (1) the value of yield forgone and (2) risk premium past to induce the adoption of DON-reducing technologies.

Nganje's calculations indicate that Net Present Value ("net savings") for the period 1997 through 2014 attributable to the USWBSI totals **nearly \$5.4 billion**. During the same 18-year period, direct funding of research through USWBSI totaled \$76 million (for an average of \$4.23 million per year). The \$76 million triggered other investments in fungicide use, extension and other research. Internal Rate on Return (IRR) for the USWBSI-funded research averaged **34%** annually. The secondary impact analysis remains ongoing as of this writing.

Those numbers — \$5.4 billion in net savings and a ROI of 34% annually, stemming from a research investment of \$76 million — tell a "very positive story" in terms of the U.S. Wheat & Barley Scab Initiative's impact and effectiveness, conclude the NDSU researchers.

Yet there obviously remain substantial challenges and opportunities going forward, as the scab/DON problem continues to hold serious implications both for affected growers and for the supply chain. "Fungicide and resistant varieties are complementary and have an

Summary of Annual Costs Accrued by Wheat & Barley Industries Due to DON (2015/16)

	Wheat	Malting Barley — Millions of \$ —	Total
Value of Yield Forgone	1,176	293	1,469
Costs Accrued By Growers (Market)			
Fungicide	197	14	211
Risk premium implied	2,744	81	2,825
Discounts to growers	24		24
Testing Costs by Elevators	21	2	23
Testing Costs & Discounts for Trading Firms			
Testing costs Traders (exporters - inbound)	0.78		0.78
Testing at export loading	4.53	0.08	4.61
Discounts			
Added Costs Accrued at Flour Mills & Malt Plants	8	1	9
Discounts	11	4	15
Testing	5	11	16
Segregation	15	10	25

interdependent impact on reducing DON," the NDSU ag economists emphasize, adding that "other breeding technologies are emerging which [also may help] reduce DON." Grower education

should be a priority focus for the Scab Initiative, they note in reference to the need for even-greater adoption of moderately resistant varieties, fungicide use and other management strategies. ❖



The poster sessions once again were a popular feature at the National FHB Forum, with most authors present for questions and discussion. Postdoctoral scientists and graduate students piqued interest in their posters by presenting mini-talks about their research at 'Flash & Dash' sessions leading up to the poster breaks.



Source: Economic Impact of USWBSI's Research on Reducing FHB

— 2016 FHB Forum —

How important is scab to wheat and barley producers? Which scab management tools are producers using. What hinders use of these tools?

There are lots of anecdotal answers to these three questions, but the U.S. Wheat & Barley Scab Initiative sought something more quantitative when it authorized a national survey of producers in 2014. An ad hoc committee convened by the USWBSI and led by **Christina Cowger**, North Carolina-based USDA-ARS plant pathologist, developed the survey questions. Cowger, who first reported on the overall survey results at the 2015 National FHB Forum, provided an update at the 2016 Forum during which she focused on growers' adoption (or lack thereof) of available scab management tools.

The USDA's National Agricultural Statistics Service (NASS), under a contract with the USWBSI, sent the survey to 15,900 growers in 17 states. The four-page questionnaire was mailed in February-March 2014, after which follow-up phone calls were made to encourage response. About 32% (5,107) of the mailed surveys eventually resulted in "useable" responses from producers. On a state-by-state basis, the percentage of useable responses ranged from a high of 44% in Ohio to a low of 17% in Virginia.

Respondents represented five market classes: hard red spring wheat, hard red winter wheat, soft red winter wheat, durum wheat and barley. In the hard red spring wheat category, 47% of respondents said they were planting varieties moderately resistant to scab. The number was 29% for durum producers, 21% of the soft winter wheat growers, 15% of responding soft red wheat producers and 11% of hard red wheat growers. The level for barley growers — who have fewer moderately resistant cultivar options — was 8%.

Respondents also were asked which fungicides they applied the most recent time that scab was their primary target. North Dakota had the highest percentage of growers who listed a specific scab-targeting product (just under 50%); the lowest occurred in Kansas and Nebraska (less than 10%). A fair percentage of



Christina Cowger

growers (7% across all states) used a strobilurin-containing fungicide for scab control, which is not recommended.

Where do producers get information on risk and management of scab? Averaged across the 17 states, 40% of respondents said print publications were "a source," with 36% saying it was their "primary" source. Email alerts were 12% and 7%, respectively, with texts or emails on cell phone coming in at 10% and 7%. The scab risk forecasting website — <http://www.wheatcab.psu.edu/riskTool.html> — was a source for 7% of respondents and the primary one for 4%.

When it came to sources that were important providers of information about scab development and its control on wheat and barley, "crop consultants" ranked highest: 44% of responding growers said consultant were "important," and 34% ranked them as their "primary" information source. (The "primary" ranking ranged, by state, from a high of 44% in Illinois to a low of 13% in North Carolina.) University extension personnel came in at 30% and 16%, respectively, while "other farmers" were important for 28% and primary for 12%. Chemical companies received an "important" designation from 23% of respondents and "primary" from 11%.

How does one's "primary" source of information affect scab management practices? When it came to crop consultants, 65.2% of grower respondents said their consultant moved them toward planting moderately resistant varieties, while 44.7% said their consultant aided

in their use of a recommended fungicide.

For those listing university extension personnel as their primary information source, 62.0% said the influence moved them toward planting moderately resistant varieties; 25.8% noted fungicide use. For chemical companies, the percentages were 56.0% and 33.9%, respectively.

Growers who had dealt with DON problems in past years were more likely to utilize moderately resistant varieties. Of those listing crop consultants as their primary information source and having had DON problems, 74.4% said they use moderately resistant varieties; for those without a history of DON, the use level was 56.0%. The trend was similar for the university extension primary group: 71.9% and 52.1%. Interestingly, however, the percentages that could actually name one moderately resistant variety they had planted were much lower.

The above trends followed a roughly similar pattern when it came to the use of recommended fungicides. For example, of those who had DON problems and considered their crop consultant their primary source of information, 55.0% said they had applied a recommended fungicide. However, only about 30% could name one of the three recommended triazoles (Prosaro, Proline or Caramba) as being the fungicide used.

Cowger summarized as follows:

- Print publications are an important way growers get their information on scab and DON.
- Crop consultants and university extension personnel are the two most important information sources.
- Growers who rely upon these sources for information are more likely to endorse use of moderately resistant varieties and recommended fungicides.
- However, there often is a gap between "awareness" and "utilization."

"The details of correctly managing scab aren't reaching beyond a core group of growers," Cowger concluded. "We need better strategies to promote moderately resistant varieties beyond that core group." Also, the message regarding the undesirability of strobilurin fungicide use for scab needs to be consistently reaffirmed, she added. ❖



— 2016 FHB Forum —

Barley cultivars with moderate resistance to Fusarium Head Blight do exist, though their number remains very small. The best-known one is Quest, a six-row variety from the University of Minnesota.

UM plant pathologist **Brian Steffenson** addressed that subject in his presentation at the 2016 National FHB Forum titled “A Meta-Analysis of the Genetics of Fusarium Head Blight Resistance in Barley.”

Barley improvement programs in various states have, during the past two-plus decades, worked steadily on breeding for resistance to FHB and mycotoxin accumulation, Steffenson pointed out. However, extensive screening in both U.S. and foreign nurseries (e.g., China) of more than 30,000 *Hordeum* accessions — including wild barley — revealed very few sources of resistance to FHB. Less than 1% had resistance comparable to the six- and two-row controls of Chevron and Clho4196, respectively.

“Early classical genetic studies revealed the quantitative nature of FHB resistance in barley. Subsequently, a number of molecular mapping studies were initiated to elucidate the number, chromosomal location and effect of resistance loci in these sources,” Steffenson noted. To summarize that research, he and his associates conduct-

ed a meta-analysis of quantitative trait loci (QTL) reported for reduced FHB severity and DON accumulation. They also examined various agro-morphological traits thought to affect them. This evaluation was based on a single consensus map constructed using marker data from eight mapping populations, “plus two previously developed consensus maps based on simple sequence repeat and single nucleotide polymorphism markers.”

From this analysis, Steffenson and his associates compiled a list of 67 and 40 unique QTL for low FHB severity and DON accumulation, respectively. “These QTL were found across each of the seven barley chromosomes, with most explaining just a small portion of the total phenotypic variation,” he said. “Additionally, many of these QTL were not robust because they were detected in only one of several trials conducted at various locations over multiple years.”

Agro-morphological traits are widely believed to influence the level of FHB severity developing on barley. Steffenson et al investigated this aspect

by considering those traits in conjunction with FHB severity and DON concentration on the consensus map. They found that in chromosome 2H, several major effect genes (e.g., for heading date, for two-rowed versus six-rowed spike type, for chasmogamous vs. cleistogamous florets) “map to locations coincident for QTL controlling low FHB severity and DON.” The same was true for the *Nud/nud* gene controlling the hulled vs. hullless character in chromosome 7H. “These results suggest that some genes controlling agro-morphological traits may have a pleiotropic effect on FHB severity and the subsequent accumulation of mycotoxins,” Steffenson observed.

In summary, the UM plant pathologist said the rate of progress in developing barley cultivars with moderate resistance to FHB has been slow “due to a lack of good resistance sources, the complex genetics underlying the trait, the variability associated with screening and selecting for FHB resistance in the field — and the pleiotropic effect of various agro-morphological traits.” Genomic selection offers a promising new approach to increase the accuracy and shorten the breeding cycle for selection of FHB resistance, Steffenson concluded, thereby hastening the release of new, improved barley varieties. ❖



Brian Steffenson

Below: Bill Berzonsky (right) of Bayer CropScience moderated the Hard Winter Wheat Coordinated Project discussion. Forum attendees participated in breakout sessions for six Coordinated Project areas and five Research Area-based groups.



Above: USWBSI research co-chair Dave Van Sanford (left) reads the citation on a plaque presented to retiring grower/stakeholder co-chair Art Brandli (right) during a special award ceremony.



A Novel Technology for Developing Fusarium Head Blight Resistant Wheat

Project Leader: Mariam Sticklen (www.msu.edu/~sticklen1)

Duration: 01.09.2013 to 31.12.2016

Type of Research: Biotechnology; Over-expressions of crop endogenous genes for disease resistance

Collaborators: Hussien Allameldin, Postdoctoral Research Associate; Eric Olson, Assistant Professor; Elizabeth Brisco, Postdoctoral Research Associate; Hayley West, Undergraduate Assistant; Tahir Javaid, PhD. Research Scholar; Julian Liber, Undergraduate Assistant

Research Unit: Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI 48823 (http://www.psm.msu.edu)

Funded By: Michigan Wheat Program (http://www.miwheat.org)

Keywords: biotechnology; wheat; molecular biology; plant protection;

gene expression; DON; deoxynivalenol;

SUMMARY

The wheat Fusarium head blight (FHB) is mostly caused by the pathogen *Fusarium graminearum*, resulting in ~\$3 billion loss in North America. This pathogen reduces the wheat yield, but also contains the deoxynivalenol (DON) mycotoxin that is toxic to the human and animal health. To solve the above problems, an MSU team designed and synthesized two of the wheat endogenous genes (namely, *Plt1* and *Coi1*), developed two transgenes assemblies

that were regulated by a cereal-specific strong overexpression control system, transferred the two gene assemblies into the wheat genome, grew plants in greenhouses up to their third generations while inoculating the plant spike florets of each generation with cell-free isolate of the pathogen, and rated the disease progress of the plants that showed the over-expressions of the two endogenous genes as compared with their control plants. The team recently reported (Alameldin et al., 2016) that the wheat spikes that showed the over-expression of a combination of both endogenous genes presented an impressive level of resistance against the pathogen (Figure 1) with a statistically significant difference of ~89% lower disease severity rating as compared to their control plants (Figure 2). ❖



Figure 1. Greenhouse level symptoms of *Fusarium graminearum* cell-free mycotoxin in single spot microinjection of the wild-type non-transgenic spike (left) versus the first generation (T_0) *tlp1-coi1* real-time overexpressed spike (right) 21 days after inoculation. Note the site of inoculation (SOI) as single black spot on each spike. (Permission from the Proceedings of the 2016 National FHB Forum)

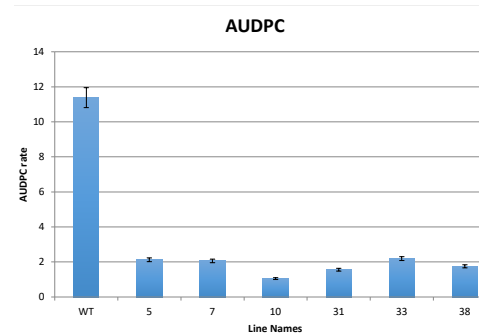


Figure 2: The area under disease progress curve (AUDPC) rates for the wild-type non-transgenic versus each of the six T_1 (second generation) *Tlp1-Coi1* genetic lines.

Related Publication: Developing Fusarium Head Blight (FHB) resistant wheat via the overexpression of two wheat native transgenes. Proceedings of the 2016 National FHB Forum, Pages 41-45.



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:

U.S. Wheat & Barley Scab Initiative
Networking & Facilitation Office
1066 Bogue St. Rm. 372 MSU
East Lansing, MI 48824

Phone — (517) 353-0201

Email — nfo@scabusa.org

Web — <https://www.scabusa.org>

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

Recent Scab-Related Peer-Reviewed Publications

- David, R.F., Reinisch, M., Trail, F., Marr, L.C., and Schmale, D.G. 2016. Compression tests of *Fusarium graminearum* ascocarps provide insights into the strength of the perithecial wall and the quantity of ascospores. *Fungal Genetics and Biology* 96:25-32. <http://www.sciencedirect.com/science/article/pii/S1087184516301086>

Additional Note from David Schmale:

Also, we had a feature story published in *Scientific American*. In this article, we specifi-

cally reference the USWBSI as a key source of support for our work.

<https://www.scientificamerican.com/article/how-plant-diseases-travel-around-the-globe-on-highways-in-the-air/>

<https://vtnews.vt.edu/articles/2017/01/cals-sciamerican.html>

Listings of recent FHB-related publications by USWBSI-associated principal investigators are invited. Listings should be sent to Don Lilleboe at lillcomm@yahoo.com

