U.S. WHEAT & BARLEY SCAB INITIATIVE

Fusarium Focus

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FHB Forum Emphasizes Cooperation & Tangible Results in Fight Against Scab

Action, Accountability, Results. Those three words permeated the atmosphere throughout the 2006 National Fusarium Head Blight Forum, sponsored by the U.S. Wheat & Barley Scab Initiative (USWBSI). More than 170 crop scientists, grain growers and industry representatives from around the United States met in Durham, N.C., in mid-December for the 9th annual gathering of those working on the "front lines" in the effort to find solutions to problems caused by Fusarium head blight (scab).

The '06 meeting format deviated from the traditional scientific talks emphasizing research results followed by question/answer periods. Instead, the forum was devoted largely to the development of a USWBSI cohesive action plan for the next three to five years — an action plan emphasizing tangible results in the national program to reduce the incidence of FHB and the most common mycotoxin produced by FHB-infected grain: deoxynivalenol, or DON (vomitoxin). "Protecting crop yield and test weight is only part of the battle against scab," pointed out David Van Sanford, a University of Kentucky wheat breeder and USWBSI co-chair. "Dramatically lowering DON levels is equally as important."

Mark Your Calendar!

2007 National Fusarium Head Blight Forum

December 2-4 • Kansas City, Mo.

http://www.scabusa.org/forum07.html

Toward that end, participants at the 2006 National Fusarium Head Blight Forum spent much of their time meeting on a discipline group or commodity-based level to: (1) discuss the need for — and avenues of — increased collaboration among involved scientists, (2) develop improved performance measures for those conducting scab-related research, and (3) determine how to enhance the communication of research results and recommendations to stakeholders (*e.g.*, grain growers, millers, maltsters, exporters). Representatives of each discipline then reported back to the entire gathering, outlining their committee's conclusions and projected action plan.

"Stakeholders are 'holding our feet to the fire' " — and justifiably so, Van Sanford stated to the assembled research community. He stressed the need for useable, near-term solutions to the FHB problem. Finding and developing such solutions is critical to the viability and long-term health of the nation's wheat and barley industries, Van Sanford emphasized.

Following the December forum, USWBSI has posted the committee action plans on its web site and invited anyone with a stake in combating this disease to provide feedback. The second draft of the USWBSI's overall action plan was completed in early March and is presently being reviewed by the USWBSI Executive Committee. The goal is to have the action plan, and a draft of the format for fiscal year 2008 research proposals, ready by late May.

Additional details and photos from the 2006 National Fusarium Head Blight Forum appear on pages 4 & 5 of this issue of *Fusarium Focus*. ◆

Barley Variety Candidates Rated Satisfactory in Quality Evaluations

Table 1. Agronomic Comparisons of ND20448, Robust & Drummond Grown in North Dakota Yield Trials, 2002-06.

Entry	Grain Yield *(bu/ac)*	Days to Heading *(days after 5/31)*	Plant Height *(inches)*	Lodging *(1-9*)*	Stem Breakage *(1-5**)*	DON *(ppm#)*
Station Years	30	29	27	9	7	7
ND20448	**79.0**	**27.3**	**31.3**	**3.1**	**2.6**	**5.5**
Robust	77.1	27.9	31.3	4.1	3.2	7.8
Drummond	83.0	27.1	30.3	2.5	2.6	—

** Lodging of 1 = no lodging; lodging of 9 = severe lodging.*
*** Stem breakage of 1 = no breakage at harvest; 5 = severe breakage at harvest.*
 # DON = deoxynivalenol
Data Provided by Dr. Paul Schwartz, Dept. of Plant Sciences, NDSU

Table 2. Malt Quality* Comparisons of ND20448, Robust & Drummond Grown in North Dakota Yield Trials, 2003-05.

Entry	Barley Protein *(%)*	Plump Kernels *(%)*	Malt Extract *(%)*	Wort Protein *(%)*	S/T *(%)*	Diastatic Power *(°L)*	Alpha-amylase *(20° DU)*
Station Years	9	9	9	9	9	9	9
ND20448	**12.9**	**90.8**	**79.5**	**5.89**	**48.5**	**153**	**71.0**
Robust	13.7	81.3	79.0	5.80	43.9	171	56.1
Drummond	13.2	85.3	79.2	5.68	44.7	181	65.8

** Data courtesy of the USDA-ARS Cereal Crops Research Unit, Madison, Wis.*

Table 3. Agronomic & FHB Performance of M122 Compared to Check Varieties, 2003-06.

Variety/Line	Yield *(bu/ac)*	Lodging *(%)*	Days to Heading	Plant Height *(inches)*	FHB Severity *(% of Robust)*	DON *(% of Robust)*
Station Years	16	9	16	15	23	24
M122	**105**	**41**	**58**	**34**	**42**	**51**
Robust	96	39	58	34	100	100
Stander	99	29	58	31	135	155
Lacey	100	28	58	32	—	—

Table 4. Malt Quality* of M122 Compared to Other Varieties Grown in Minnesota, 2003-05.

Entry	Kernel Plumpness *(% on 6/64")*	Grain Protein *(%)*	Malt Extract *(%)*	Wort Protein *(%)*	S/T *(%)*	Diastatic Power *(°L)*	Alpha-amylase *(20° DU)*
Station Years	11	11	11	11	11	11	11
M122	**81**	**13.3**	**78.6**	**5.64**	**44.5**	**167**	**66.5**
Robust	86	13.8	78.2	5.75	43.8	172	55.5
Stander	89	13.6	79.4	6.71	52.1	165	90.1
Lacey	88	13.8	78.4	5.78	43.9	172	64.8

** Data courtesy of the USDA-ARS Cereal Crops Research Unit, Madison, Wis.*

*By Kevin Smith & Richard Horsley**

For the first time, two lines from the North Dakota State University and University of Minnesota barley breeding projects with improved FHB resistance were found satisfactory in American Malting Barley Association (AMBA) pilot-scale malting evaluation.

Previous lines with enhanced FHB resistance from these two programs were accompanied by poor agronomic performance and inferior malting quality. This is because the few available sources of FHB resistance used in breeding are not adapted to the Midwest and have very poor malting quality.

These new lines — ND20448 and M122 — represent the leading edge of a pipeline that now contains lines that put together the complete package of disease resistance, yield and quality. Neither line will out-yield the most recently released barley varieties. However, both will perform better than Robust, which is still the most commonly grown variety in the Upper Midwest. Also, these two lines reduce levels of the mycotoxin deoxynivalenol (DON) by 30-50% compared to Robust.

For new varieties to be grown in the Midwest, they must be approved by AMBA and added to their list of malting varieties (www.ambainc.org). Approval by AMBA requires evaluation in a pilot-scale malting program and a plant-scale brewing program. Typically, experimental lines must be rated satisfactory twice in the pilot-scale malting program to advance to the plant-scale brewing program. Each breeding program is allowed to submit up to four entries into the pilot program each year.

Both ND20448 and M122 are currently being evaluated for the second year in the pilot program with the 2006 crop. If these lines continue to be rated satisfactory through the pilot and plant scale program, they could be released as new varieties in January of 2010.

ND20448 is an advance breeding line

** Kevin Smith and Richard Horsley are barley breeders with the University of Minnesota and North Dakota State University, respectively.*

Vom in ’06 Wheat: One Mill’s Story

By Don Mennel / President
Mennel Milling Company / Fostoria, Ohio

While the 2006 wheat crop was nowhere near the disaster of the 1996 crop in terms of head scab and DON levels, it was a bad year for at least one mill.

The Mennel Milling Company completed its new flour mill in Bucyrus, Ohio, late in 2005. This mill was built next door to an existing grain elevator which originated wheat, corn and soybeans from growers. While we discontinued taking corn and soybeans, we made the conscious decision early in the harvest to accept all of the wheat delivered from the growers for that crop year. Our average vomitoxin levels for the 2006 wheat crop were 2.4 ppm.

As a quick aside, one of our larger growers is married to our administrative assistant at the mill. She was grading the wheat during harvest, and her husband had just delivered a load of wheat that graded zero vom. She quickly called him to ask if he had changed fields. His reply was no; he had turned up the air on the combine and blown all of the small and shriveled kernels out the back. He also stated that he couldn’t afford to continue doing this because he would be able to see the volunteer wheat growing in another month.

Wheat that runs 2.0 ppm will, in most years, reduce to 1.0 ppm in the flour. However, in this case the vom penetrated into the flour and the reduction was not significant. It became obvious very early in the crop year that we would not be able to mill this crop without originating a major portion of the mill run from zero-vom wheat.

In addition, we made the immediate decision to order a high-capacity density grader Gravomat MTCF-30/170 from Buhler to clean the wheat prior to the milling process. To our surprise and shock, this machine came in with the “Number 1” on it, as it was the very first machine manufactured to this size. The learning curve was longer than anticipated because the machine was extremely sensitive, and we had to make lots of modifications to the machine and to other control areas in order to optimize the cleaning of the wheat. Even so, we were not able to remove all of the vom.

Thus far this crop year, we have spent $150,000 for the new machine and the complete installation; plus $39,000 for Neogen testing kits to test all of the inbound wheat and outbound flour and feed; plus a premium of 65¢ per bushel on the 1.35 million bushels of zero-vom wheat that had to be blended with the local wheat crop.

As a result, we are not seeing the return on investment that we anticipated on a new flour mill. Vomitoxin problems are still a major cost to the milling industry and a challenge for grower and miller alike. ◆

from the NDSU program that accumulates about 30% less DON than Robust, has yields intermediate to Robust and Drummond, and appears to have acceptable malt quality (Tables 1 and 2). Seed increases of ND20448 will be done this summer in North Dakota and next winter in Arizona to produce sufficient seed if plant-scale testing in 2008 is approved by AMBA.

M122 is an advance breeding line from the UM program that accumulates about 50% less DON than Robust and appears to have acceptable malt quality (Tables 3 and 4). While the yield summary in Table 3 indicated M122 is superior to Lacey, larger data sets indicate M122 is intermediate to Robust and Lacey. Seed increases of M122 will be done this summer in Minnesota to produce sufficient seed if plant-scale testing in 2008 is approved by AMBA. ◆

Kentucky Again Gains Section 18 for Folicur & Orius for FHB in Wheat

The Environmental Protection Agency has re-issued a Section 18 specific exemption to permit the use of the fungicides Folicur 3.6F and Orius 3.6F to help control Fusarium head blight in wheat in Kentucky, the state’s ag commissioner, Richie Farmer, announced in late March.

“Kentucky Department of Agriculture staff and the University of Kentucky Cooperative Extension Service had to go the extra mile to get this approval through the EPA’s new three-tier process,” Farmer said. “Their hard work paid off, and Kentucky wheat growers have another weapon in their arsenal against Fusarium head blight.”

The products may be applied as a preventive foliar spray when the earliest disease appears on the stem. A maximum of one application may be made using ground or aerial equipment at a rate of 4.0 fluid ounces of formulation per acre per season. Application may be made from the time the head is half-emerged to the end of the flowering stage. Applications may not be made within 30 days of harvest. The Section 18 will expire May 30, and no applications of Folicur 3.6F or Orius 3.6F may be made after that date.

Don Hershman, wheat specialist at the UK Research and Education Center at Princeton, said the products will suppress Fusarium head blight. He indicated a 40-50% control. Data indicate that Fusarium head blight suppression with these products results in higher wheat yields, Hershman said.

Commissioner Farmer emphasized that applicators must follow the label for all pesticide use and applications. Folicur and Orius fungicides may not be applied directly to water or an area where surface water is present. Pesticide runoff may be hazardous to aquatic life, so any rinsate must be disposed of in a manner that does not contaminate a water resource.

For more information, contact Don Hershman at (270) 365-7541, Ext. 215. ◆

Highlights from 9th FHB Forum

As noted on page 1, more than 170 scientists, growers and grain industry representatives gathered in Durham, N.C., late last year — on December 10-12, to be exact — for the 9th annual National Fusarium Head Blight Forum.

The 2006 event mirrored its predecessor forums in certain ways. The always-popular poster room attracted a steady flow of visitors throughout the three days of the meeting, for instance, and hallway conversation among attendees was frequent and lively.

But it was a very different forum as well. Deviating from the traditional format featuring scientific talks, the '06 gathering focused on the development of a comprehensive USWBSI action plan for the next several years. Responding to the urgent needs of growers and industry impacted by scab and DON, forum participants spent much of their time meeting on a discipline-group level to brainstorm on how to provide growers and industry with more answers/solutions to their scab/DON-related problems as quickly as possible.

Out of these intensive discussions over the three days of the 2006 Fusarium Head Blight Forum came first-draft action plans for the research emphases of the USWBSI. Substantial feedback was received; and, more recently, a revised second draft was released to scientists and stakeholders. *(Excerpts from the second draft appears on pages 6 and 7 of this newsletter. The entire draft can be viewed at www.scabusa.org.)*

Speaking to the Durham audience via satellite hookup, USWBSI co-chairman Tom Anderson, a grain producer from Barnesville, Minn., encouraged the group to "think outside the box" during the forum and beyond in searching for solutions to the Fusarium head blight problem. "We as producers have lost revenue at the farm gate each year since 1993" because of scab, he noted, adding that both farmers and industry are relying upon the FHB research community for substantive help in battling scab/DON. ◆

Kay Simmons serves as the USDA-ARS National Program Staff liaison to the U.S. Wheat & Barley Scab Initiative. Speaking to the overall FHB Forum audience, she emphasized the growing need "for tangible results from USWBSI in reducing DON." Simmons said ARS has been receiving an increasing number of questions as to the progress and strategies of the Initiative. She spoke to the theme of the meeting in asking, "What is our action plan?," noting that it needs to encompass clear goals and measurable results. Cooperation is vital among all entities involved, Simmons stressed.

Don Mennel, president of Mennel Milling Company of Fostoria, Ohio, spoke as an industry stakeholder. Outlining the impact of DON on the milling industry, he noted there is a perception among many that the effort to rein in scab and DON has not yet turned the corner into the success stretch. Mennel challenged the USWBSI audience to achieve a 50% reduction in DON levels within the next three years.

Dr. Bill Wilson, North Dakota State University agricultural economist, addressed the forum's opening session on the subject of "Economic & Marketing Implications of Excessive DON in Wheat." He noted that North Dakota has lost about 30% of its wheat area since the mid-1990s due primarily to three factors: vomitoxin, farm bill changes and the introduction of biotech crops (e.g., soybeans). DON levels in the state's hard red spring wheat crop averaged between 2.0 to 5.0 ppm in eastern districts in 2005, and from 0.5 to 1.5 ppm in western districts. Levels were very minimal in 2006, however — due to climatic conditions and, as well, improving tolerance of wheat varieties.

Despite the 2005 DON levels, the direct economic impact on North Dakota hard red spring wheat, durum and barley — $95 million — was still significantly less than than in 1993, 1994 or 1997, when losses of $205 million, $125 million and $134 million, respectively, were incurred, Wilson noted.

The NDSU economist discussed the market's response to scab and also addressed the prospect of genetically modified wheat varieties as one solution to the scab problem. For GM wheat to be accepted in the marketplace, there would need to be a reliable system in place for product identification and segregation, Wilson emphasized. He predicted that if GM wheat does come about, its adoption — regardless of the trait — will vary substantially according to geography, and that buyers' acceptance will also vary.

Above Left: Marty Draper (standing, left) of USDA-CSREES-PAS and Erick DeWolf (standing, right), now with Kansas State University, served as facilitators for the Chemical, Biological & Cultural Control / Etiology, Epidemiology & Disease Forecasting discipline group during the breakout session on December 10.

Above Right: One of the drop-in sessions on the afternoon of the 11th. The sessions focused on one of four subject areas: "Translating Basic Information into Useful Controls," "Reinventing the Initiative," "Nuts and Bolts of Scab Screening" and "Communicating with the Real World."

Left: Dave Van Sanford, USWBSI co-chairman and University of Kentucky wheat breeder, summarizes the forum's challenges and accomplishments during his closing remarks on the 12th.

Below Left: Minnesota barley breeder Kevin Smith reports on the "Breeders" discipline group's summary of its goals, performance measures, needs, outputs and anticipated impacts.

Below: More than 70 posters awaited visitors who came and went as schedules allowed during the three-day forum.

— Excerpts from USWBSI Action Plan (2nd Draft) —

Variety Development & Uniform Nurseries | **Pathogen Genetics & Genomics** | **Genetics / Biotechnology**

To view the full updated Action Plan, go to www.scabusa.org. Under 'Hot Items,' click on 'Action Plan - 2nd Draft'

Variety Development & Uniform Nurseries

Goal #1 — Increase acreage planted with varieties exhibiting improved FHB resistance.

One key research need is a comprehensive evaluation of advanced lines for all important traits under best management practices. Also, there needs to be an accurate assessment of the economic return to producers and end-users for planting/using FHB-resistant varieties.

Among the anticipated impacts are (1) widespread adoption of FHB-resistant varieties with competitive agronomic and end-use performance; (2) lower DON levels in wheat and barley; and (3) a more-stable supply of high-quality wheat and barley for end-users.

Goal #2 — Increase the efficiency of individual breeding programs to develop FHB-resistant varieties.

Needs include information to determine whether "new" sources of resistance are truly "novel" (marker haplotyping allelism testing, etc.). Also, coordination is needed to strategically distribute new sources to various breeding programs for crossing and first-generation "pre-breeding." Sharing of pre-breeding populations is important, as is the enhanced phenotyping of mapping populations (more environments in fewer years.)

The main impact should be more varieties with enhanced FHB resistance coupled with a complete agronomic/quality/disease resistance package.

Goal #3 — Efficiently introgress effective resistance genes into breeding germplasm.

Success would lead to germplasm with higher levels of resistance to FHB and lower DON concentrations. Enhanced germplasm exchange among breeding programs would more quickly exploit diverse resistance sources. ◆

Pathogen Genetics & Genomics

Goal #1 — Characterize genetic variation in FHB pathogen populations with regard to aggressiveness toward plants and mycotoxin potential.

The research thrust to achieve this goal would be to identify (1) FHB pathogen populations that already exist in the U.S. as well as (2) strains that are likely to travel here; concurrently, to characterize their relative threat to plant varieties being developed by USWBSI.

Goal #2 — Characterize plant-fungal interactions in plant lines being developed by USWBSI.

Studies would be conducted on pathogen infection, movement and DON accumulation during grain maturation and when resistance is expressed. Among the results would be the development of standardized techniques for screening, sampling and testing varieties based on knowledge of pathogen biology.

Goal #3 — Develop new strategies for reducing the impact of FHB disease and mycotoxin contamination in barley and wheat.

Research foci would include the discovery of genes for pathogenesis, trichothecene reduction, novel antifungal compounds, etc. Also, develop molecular approaches to modulate pathogen genes for disease control and mycotoxin reduction; plus, develop new strategies to reduce sporulation on potential inoculum sources of the pathogen (*e.g.*, corn residue).

Among the benefits of this work would be the ability to identify genes potential useful to reduce disease or mycotoxin contamination when introduced into transgenic plants; also, the development of new strategies for pathogen gene silencing. ◆

Genetics / Biotechnology

FHB Resistance Mapping

Goal — Improve the efficiency of identification and characterization of novel loci for FHB resistance.

Principal investigators need to utilize the best existing molecular markers to demonstrate that any new FHB resistance loci they propose to map is distinct from 3BS in wheat or Chr 2 in barley. Developing genome-wide marker fingerprints of FHB-resistant material will facilitate rapid incorporation of new resistance loci into breeding programs. A concurrent benefit is to increase the capacity to evaluate segregating populations.

Gene Discovery

Goal — Increased efficiency of identification of candidate genes for resistance against FHB and reduced DON accumulation.

If genes that confer susceptibility to FHB can be rapidly identified, incorporation of nonexpressing alleles or silencing via transgenic approaches may provide a novel path to FHB resistance. More genes and transgenes that can be incorporated in new wheat and barley lines with better FHB resistance or reduced DON accumulation would then be available.

Plant Transformation

Goal — Develop effective FHB resistance through transgenic strategies.

There's a need for centralized transformation facility(ies) for more-efficient generation of transgenic plants and seed stocks for USWBSI-funded research projects. Establishing and optimizing wheat and barley transformation is expensive, requiring much time and specialized skills. Individual lab time and resources would be used more efficiently if one or more centralized transformation facilities existed. ◆

— Excerpts from USWBSI Action Plan (2nd Draft) —

To view the full updated Action Plan, go to www.scabusa.org. Under 'Hot Items,' click on 'Action Plan - 2nd Draft'

Chemical, Biological & Cultural Control / Etiology, Eidemiology & Disease

Goal #1 — Validate integrated management strategies for FHB and DON.

A key research need is to identify Good Farming Practices (GFP) for FHB/DON management through integrated studies. Examples of study areas are: impact of tillage and cropping sequence on disease risk and potential for control aid; optimal fungicide application timing and methodology; and deployment of improved FHB/DON forecasting systems.

The main impact from the successful achievement of this goal would be producers making decisions based on regionally validated science-based information.

Goal #2 — Enhance communication and end-user education/outreach.

Among the research needed would be identifying sociological and economic influences on FHB/DON behavior; developing "ScabSmart" outreach materials and platforms for information exchange; and development of economic assessment tools based on discounts/premiums assessed by millers and maltsters, terminal market prices and other factors.

Another research need is the improvement of communication within the scientific community via professional journals and other means.

Goal #3 — Develop the next generation of management tools for FHB/DON control.

This would include enhancing forecasting capabilities; developing control methods that include biological agents; determining factors influencing DON accumulation in wheat and barley grain; screening new fungicide compounds across multiple environments; and more.

Goal #4 — Evaluate and quantify factors influencing DON accumulation in asymptomatic wheat and barley.

The objective is to identify — in the absence of visual symptoms or when severity is low — those host-, weather- and pathogen-related factors and interactions that are associated with DON accumulaton. Such information is important in developing the next generation of scab and DON risk assessment models.

Food Safety, Toxicology & Utilization / Diagnostic Services

Goal #1 — Provide analytical support for DON/trichothecene quantitation for Initiative stakeholders.

A. There's a lack of awareness about optimal sampling and grinding protocols among the grain industry, milling sector and Initiative researchers. This situation can result in incorrect data and inhibit the overall effort to reduce DON.

Addressing this issue would initially involve clarifying stakeholder concerns and developing standardized sampling and grinding protocols — all toward improving data quality and comparability.

B. There's also a need for increased capacity for the analysis of DON and other trichothecenes. This effort would seek funding for expanded capacity (at existing labs or a new lab) and also facilitate on-site rapid testing.

C. Another effort would be to have diagnostic labs including measurement of ADONs, other tricho and glycosidic forms in selected surveillance samples. There is concern about changes in *Fusarium* genotypes and masked (glycosidic) trichothecene forms; however, there are limited data on occurrence of individual toxins other than DON.

Goal #2 — Provide requisite information on DON/trichothecene safety issues to producers, millers, researchers, risk assessors and regulators.

A. The EU has established DON regulatory standards that are much lower than those of the U.S., and there is pressure on CODEX to follow suit, due in good part to new concerns regarding changes in Fusarium genotypes and mycotoxin profiles. This goal calls for research on the adverse effects of consuming DON and related trichothecenes that allow extrapolation from animals to humans; and then informing regulators — thus enabling science-based risk assessment. Key considerations would be (1) groups at high risk and (2) biomarkers of exposure/toxicity.

Research/reviews would appear in high-impact journals to inform risk assessors and regulators. There also would be participation in national and international research meetings, and development of preliminary data for NIH-funded human epidemiology studies.

This work would provide risk assessors and regulators with data that will help them make scientifically sound decisions that ensure public health while concurrently minimize the economic impact on the wheat and barley industries.

B. The second part would be to summarize known toxicology information on DON and other trichothecenes, their risks and rationale for regulations. The information would be provided to affected producers, millers, researchers and government to enhance understanding and communication on the topic.

C. Finally, the inhalation of DON and other trichothecenes poses unknown hazard to farmers, grain handlers, millers and researchers. Inhaling these toxins may lead to increased infection, inflammation and asthma. New, useful research data — and publication of these data for use by those affected — would help ensure the safety of wheat and barley industry stakeholders.

Spores of FHB Pathogen Travel Long Distances in Atmosphere

By David G. Schmale III, Virginia Polytechnic Institute & State University, and Gary C. Bergstrom, Cornell University

Over the past decade, researchers at Cornell University, and more recently at Virginia Polytechnic Institute and State University (VPI & SU), have studied the long distance transport of the Fusarium head blight pathogen, *Gibberella zeae*, in the atmosphere. Remote-piloted aircraft were used to collect viable spores of *G. zeae* in the lower atmosphere, tens to hundreds of meters above agricultural fields. Viable spores of *G. zeae* were abundant 60m above the surface of the earth during all times of the day and night under a broad range of environmental conditions during the periods of wheat flowering and grain development. Well-mixed populations of *G. zeae* in the atmosphere — even over lakes and forests — suggest that Fusarium head blight in a local wheat or barley field likely results from spores that are released from distant as well as local inoculum sources. Application of tillage and other inoculum control methods in individual fields may have only minor impact on FHB when levels of regional atmospheric inoculum are high.

At VPI & SU, a new generation of autonomous (self-controlling) unmanned aerial vehicles (UAVs) are being used to determine the relative contribution of clonal inoculum sources of *G. zeae* to regional atmospheric populations of the pathogen and to forecast the movement of *G. zeae* across broad geographical regions. Autonomous UAVs have the potential to extend the range of atmospheric sampling, improve positional accuracy of sampling paths, and enable coordinated flight with multiple aircraft at different altitudes. These autonomous UAVs have been used to collect viable spores of *G. zeae* 100m above agricultural fields during fall and winter months, expanding the temporal range of spore transport for this important plant pathogen. ◆

An autonomous unmanned aerial vehicle (UAV) used to collect viable spores of Gibberella zeae tens to hundreds of meters above agricultural fields. The UAV has spore-sampling devices mounted underneath the wings that are opened and closed by remote control from the ground once the UAV is aloft.

NDSU Develops Scab Info Piece for State Legislators

With the North Dakota Legislature meeting this winter for its biennial session, the North Dakota Agricultural Experiment Station and NDSU Extension Service decided to educate legislators on the problem of Fusarium head blight (FHB) and NDSU's ongoing efforts to address scab. Scab research funding is one of the areas being addressed during this year's state legislative session.

"Solving Scab" was the name of a handout developed for and distributed to state legislators early in the 2007 session. Along with a brief description of scab, the flyer pointed out the economic impact attributed to scab in North Dakota alone. "[L]osses caused by FHB in wheat, barley and durum from 1993 - 2005 have been estimated at $4.49 billion," it said. "Estimated losses in 2005 were $157 million (direct loss to farmers' income), impacting the state's economy with more than a $500 million loss."

The majority of the flyer consisted of a summary of NDSU research, along with comments from several North Dakota grain producers on the importance of this research. Highlighted research areas were variety development, fungicide technologies, fungicide evaluation, disease forecasting, rotation recommendations and outreach activities. Describing the wheat varieties "Alsen" and "Glenn," both of which carry FHB resistance, NDSU noted that based on quality alone, "NDSU's resistant HRSW varieties received 60 cents to 80 cents per bushel more at markets than susceptible varieties in northeast North Dakota in 2005. Increased income for a producer, because of improved grain quality, was between $6,000 and $8,000 per 10,000 bushels."

Dazey, N.D., barley producer Jim Broten was among the eight farmers quoted in the flyer. "Better varieties, as well as improvements in crop models and disease forecasting, have helped growers make better use of fungicides," Broten stated. "Farmers have been provided the tools to manage better, thanks to research conducted at NDSU." ◆

Progress in Development & Marker-Assisted Breeding of FHB-Resistant Wheat Cultivars & Germplasm at Virginia Tech

By Carl A. Griffey and Jianli Chen

To accelerate development of high-yielding, FHB-resistant SRW wheat lines, the Virginia Wheat Genetics and Breeding Program has deployed a combination of top-cross, doubled-haploid, backcross and marker-assisted breeding methods. Several widely used scab-resistant germplasm lines having multiple QTL and enhanced resistance were developed and genetically characterized.

(Editor's Note: "Table 1. Grain yield, FHB resistance and marker haplotypes of six FHB resistance QTL in 17 advanced lines developed via top-crossing, backcrossing and doubled haploid breeding methods at Virginia Tech" can be accessed at: http://www.scabusa.org/pdfs/va-tech_qtl-article_table.pdf

The SRW wheat cultivar JAMESTOWN, derived from the cross 'Roane'/Pioneer Brand '2691', was released in 2007. JAMESTOWN is a distinctly early heading, high-yielding, short-stature, awned cultivar possessing resistance to the predominant insect and disease pests in the soft wheat region — and, most notably, resistance to Fusarium head blight, Hessian fly and stripe rust.

An elite scab-resistant line, VA02W-713 (Ning7840/Pioneer 2691/Roane), positioned for release in 2008, ranked among the top 10 entries out of 42 traditional SRW wheat lines evaluated over 21 state locations in the 2005/06 USDA-ARS Uniform Southern SRW Wheat Nursery. Ten additional lines — VA04W-389, VA04W-433, VA04W-474, VA05W-425, VA05W-523, VA05W-581, VA05W-641, VA05W-693, VA05W-673 and VA05W-718 — are potential germplasm releases having good FHB resistance with target marker alleles for at least two QTL on chromosomes 2B, 2D, 3AS, 3BS, 5AS and 6B. These and other VT FHB-resistant lines are being used as parents in several breeding programs and in pyramiding multiple QTL in adapted wheat backgrounds in our breeding program.

Dr. Jianli Chen, a Virginia Tech research scientist, is optimizing the protocol for MAS of six FHB resistance QTL in soft red winter wheat backgrounds. Molecular markers associated with the six QTL are being used in parental profiling, early generation selection and evaluation of advanced lines.

Bayer's 'Proline' Labeled For Use on Cereal Grains

Bayer CropScience announced in early April the registration of its Proline™ fungicide for the cereal grains market. The new active ingredient, prothioconazole, is the most powerful tool available to growers to reduce the damage scab and leaf diseases cause in wheat and barley, the company states.

"This is an immensely valuable tool for growers," says Randy Myers, Bayer CropScience fungicide portfolio manager. "There has never been a treatment for head scab that provides this level of activity and increases the quality of wheat and barley crops."

In trials across North America and around the world looking at the activity of Proline on head scab, wheat and barley fields have shown an increase in crop quality as a direct result of decreased DON levels.

More details on Proline are available at www.cerealexperts.com. ◆

Recent Scab-Related Peer-Reviewed Publications

- Paul, P.A., Lipps, P.E., and Madden, L.V. Lipps, P.E., Hershman, D.E., McMullen, M.P., Draper, M.A., and Milus, E.A. 2007 A quantitative review of tebuconazole effect on Fusarium head blight and deoxynivalenol content in wheat. *Phytopathology* 97:211-220.

- Paul, P.A., Lipps, P.E., and Madden, L.V. 2006. Meta-analysis of regression coefficients for the relationship between Fusarium head blight and deoxynivalenol content of wheat. *Phytopathology* 96:951-961.

Fusarium Focus welcomes your submissions for listing in future issues of this newsletter. Please send to:

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Fusarium Focus

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