U.S. Wheat & Barley
Scab Initiative

MINUTES

Approved: 12/9/10

USWBSI Steering Committee Meeting

Tuesday, April 25, 2010
UMN's Continuing Education and Conference Center
St. Paul, MN

Co-Chairs: Art Brandli (Grower from Warroad, MN) and Dave Van Sanford (Univ. of Kentucky)
Members Present: Bill Berzonsky (South Dakota State Univ.), Mike Davis (American Malting Barley Association), Jane DeMarchi (NAMA), Ruth Dill-Macky (Univ. of Minnesota), Karl Glover (South Dakota State Univ.), Calvin Haile (Grower from Dunnsville, VA), Rich Horsley (North Dakota State Univ.), Fred Kolb (Univ. of Illinois), Larry Lee (Grower from Minot, ND), CJ Lin (Mennel Milling Co.), Brad Miller (Dakota Pasta Growers, Co.), Gene Milus (Univ. of Arkansas), Charles Ottem (North Dakota Barley Growers), Pierce Paul (Ohio State Univ.), Dana Peterson (National Assoc. of Wheat Growers, DC), Steve Scofield (USDA-ARS, IN), Kevin Smith (Univ. of Minnesota), Jeff Stein (South Dakota State Univ.), Steven Xu (USDA-ARS, ND), and Marv Zutz (Minnesota Barley Growers)
Participating via Interactive Video – North Carolina State Univ. (NCSU): Christina Cowger (USDA-ARS) and Winston Hagler (NCSU)
Participating via Telephone: Jose Costa (Univ. of Maryland) and Frances Trail (Michigan State Univ.)
USDA-ARS-NPS ADODR: Kay Simmons, Beltsville, MD
Guest: Deb Fravel (USDA-ARS-NPS)
Staff: Don Lilleboe (Lilleboe Communications) and Sue Canty (USWBSI-NFO)

1. **Introductions and Opening Remarks.**

2. **Approval of the Agenda.**
   Motion: Motion made and seconded to accept the Agenda as amended.
   Discussion: None
   Action: Motion passed.

3. **Approval of Minutes from 12/09/09 Steering Committee Meeting.**
   Motion: Motion made and seconded to accept the minutes as presented.
   Discussion: None
   Action: Motion passed.

4. **FY10 and FY11 Federal Funding Updates.**

   Mike Davis – Update on FY11 Federal Budget: Mike Davis pointed out that all USWBSI funding is now part of ARS base funding with no portions any longer considered a Congressional earmark proposed for elimination in the President's budget. If Congress approves adequate overall funding for ARS for FY2011, funding for the USWBSI at its current level should be maintained. He

reiterated what he said at the December, 2009 SC meeting – funding for the USWBSI is now entirely dependent on ARS and therefore we must continue to show need for funding and that it is being utilized to fund an integrated, coordinated, and productive program with accountability. This will be a difficult budget year because of the deficit and political divide in Washington DC. A final budget will likely not be passed until after the election. The President's budget proposes funding increases for its high priority initiatives such as Crop Breeding and Protection, Human Nutrition, and addressing World Hunger, and may provide increased funding for small grains research if approved by Congress. Small grains groups lobbied this year in support of Administration initiatives and for Congressional earmarks. However, it is much more difficult than in the past to secure funding via Congressional earmarks.

Kay Simmons – Update on USDA-ARS issues including FY10 funding allocation: USDA-ARS distributed the awards for the FY10 USWBSI grants in April – May 2010. The FY11 President's Budget has no changes in the funding level for the USWBSI. Many believe that Congress will not complete appropriation of the Agriculture budget until after the November elections. If that is correct, USDA-ARS may be on a Continuing Resolution for the early part of FY11. Review of the USWBSI pre-proposals should continue as planned, but ARS will not be able to distribute all the USWBSI funding until the Agriculture appropriation is finalized.

Kay Simmons noted that it is important to demonstrate that USWBSI research is benefiting producers and industry and to document that impact. Thus, any release of FHB-resistant varieties developed in part through USWBSI funding should be recognized and reported in annual progress reports. Kay Simmons is seeking examples of impact such as new FHB varieties, acres grown in scab-resistant varieties or evidence that DON levels are reduced. Such examples are valuable to ARS in reporting on the value of the USWBSI to Congress. She also noted that new efforts supported by USWBSI including the FHB risk models, new cell phone alerts and Scab Smart, are very helpful.

5. Updates from the NFO and EC.

- **Breeders' Database**
  Dave Van Sanford updated the SC on the progress with the development of the Breeders' Database. Mark Hughes in the USDA-ARS Cereal Disease Lab has taken on additional responsibilities, and therefore will not be able to finish the development of the database, specifically the web-interface. The NFO will work to find someone else to finish developing the database/web interface, and does have a possible lead. The NFO has hired a graduate student at Ohio State Univ. on a part-time basis to standardize the data received from breeding programs/uniform nurseries. A suggestion was made to investigate the possibility of modifying the Hordeum Tool Box – a web-based database used by Barley breeders (now being curated by GrainGenes).

- **Scab Smart** – Scab Smart (http://www.scabsmart.org) was launched last September by the USWBSI to help growers manage scab with variety selection/management strategies. NFO is looking to hire someone on a part-time basis to keep the content updated, and make sure the content and breeder data is uniformly presented. The NFO is still planning to move Scab Smart from NDSU's Ag. server to the Scabusa server.

- **Report on the Review of Biological Control Research** – A total of 5 individuals agreed to review the USWBSI' biocontrol research. One thing that resonated among all the reviewers was

that the focus of research needs to change. The EC is unanimous in its recommendation that the following three criteria are needed in order to move forward with any biocontrol research:

1) Demonstration of efficacy in the field;
2) Formation of productive collaboration; and
3) Willingness to explore other organisms or a combination of organisms.

- **Improving Communication with Stakeholders** - Marcia McMullen gave an overview of a meeting (hosted by the NFO) that took place in Nashville this past March. The purpose of the meeting was to strategize on ways to improve the USWBSI's communication with stakeholders. The group discussed at length developing a system that would push out FHB info/updates on a timely basis.

  Dave Van Sanford gave an over view of the new FHB Alert System:

  1) System takes commentary submitted by state specialists to the FHB Forecasting Tool (http://www.wheatscab.psu.edu/riskTool_2010.html) and sends it out to subscribers via e-mail and/or SMS (text message to cell phone) as well as posts it on the Scab Blog (http://scabusa.org/modules/wordpress/).
  2) System officially launched on 5/6/10 with an e-mail to the FHB Listserv which includes AMBA, NAMA and NAWG.
  3) News Release went out on 5/11/10
  4) Summary of subscribers to date (as of 5/21/10):
     - ✓ 215
     - ✓ 150 signed up for e-mail, 6 for text and 59 signed up for both text and e-mail alerts.
     - ✓ Farmers are the top subscribers for all three methods of receiving alerts: 20 have signed up for text (SMS) alerts, 17 of which also receive by e-mail; and 47 for e-mails only.
     - ✓ 52 out of the 215 subscribers signed up for multiple regions.

  Jeff Stein provided an update on the development of the Barley DON model. The plan is to test it out this year with private/restricted access available only to researchers/extension specialist, and then go public-wide next year.

- **Sending researchers to NAWG, NAMA and NBIC** meetings to present an update on what is happening with the USWBSI. The NFO will put together short slide sets for researchers to use when they are making presentations (field days, scientific meetings, etc.).

6. News from the World: Stakeholder Issues, etc.

- Steve Scofield gave a presentation on USWBSI researchers partnering with private companies in order to commercialize the work of the GDER research area. There are several companies investing large dollar amounts on research & development. Partnering with industry could potentially produce winning combinations:
  1) Scab Initiative gets additional financial support.
  2) Ag Biotech companies get more direct access to the public efforts in GDER for Fusarium.
  3) Farmers/Producers and end users get additional tools to fight against scab-related losses.

  The SC will discuss this in more detail during the group discussion period.

- Jane DeMarchi gave an update on the following:

- FDA announced at the end of March they are planning to go out to food mills and feed operations to sample products for DON. Regulatory level for food is 1 ppm for milled products; no limit for raw wheat (as the processing can reduce DON to get below the limit). Mills are taking their own samples and results are looking okay.
- Wheat Quality Council (WQC): What the Wheat Quality Council does is grow out lines submitted by breeders that are near to being released for Millers' and the Wheat Quality Labs to run quality tests to see how the lines perform. Participants in the WQC have requested that more information on the FHB resistance of the lines be included with the samples that get submitted. Also, the way data is presented needs to be uniform within each of the wheat classes (HRS, HRW and SRW). This topic will be discussed in more detail during the SC breakouts.

- Gene Milus - Branded Varieties: "Disease resistance should be the first line of defense in wheat varieties" stated Milus. In 2005, Milus noticed that he could not tie data he had collected on evaluation of disease resistance to specific branded varieties. Each state has its own seed laws on how seed can be sold. Marketing agents and seed brokers can buy rights to public varieties and call them any name they choose. There are drawbacks for growers buying branded varieties – they cost more and no information on agronomic traits is available. The branding of varieties affects the USWBSI because of the inability to include resistance information about these branded varieties on Scab Smart. This will be discussed in more detail during the small group discussions.

7. RA Leaders present recommendation for FY11 Working Caps.
See questionnaires completed by Research (RA) leaders prior to SC meeting (Addendum A).

8. Small Discussion Groups.

Research Area based discussion - Each group reviewed their action plans.

MGMT –Proposed modifications were agreed upon including items that have been completed as well as simplifying the document (i.e. eliminate redundancy). Christina Cowger will incorporate edits into the documents, and then distribute back to the group for final review. One thing of note, under Goal 4 which deals with end-user education/outreach, the group had a significant discussion about developing a survey that would gather information such as number of acres grown to FHB resistant varieties. Further discussion is needed on working out the details for development of the survey.

FSTU – Made a number of small changes to the Action Plan. The group was able to 'check-off' several items including "increasing coordination amongst the labs" and "holding a meeting/session at Forum on sampling/analytical methods." Under 'Long-term Outputs' (Goal 1, Performance Measure 1.1), the group removed "Recommended methods will be updated/modified taking into account FGIS and EU recommended protocols." The group thought there was no need to become involved with commercial testing/sampling protocol. Two items need to be developed and posted on the USWBSI's website: 1) A review on the glycosidic forms of DON; and 2) Worker safety guidelines for handling FHB/DON infected grain.

GDER and PBG met as a single group:
GDER – The group made a few changes; the majority of time was spent discussing PBG's action plan.

PBG – There are three goals in PBG. Goal 1 is characterization of the pathogen population. In the next year or so, the research group will have a pretty good handle on the current populations and whether they will be a real threat or any variations that could cause problems. The second goal (Characterize plant-fungal interactions in plant lines being developed by USWBSI) is fairly diffuse, and needs to be more sharply focused as well as the outputs prioritized. Numerous changes are expected to be made to this goal (PBG RAC will work on revisions). The third goal has to do with development of/or search for genes in the fungus that can specifically be developed for control strategies). Most of the funding for PBG goes into this goal. This goal should provide a mechanism for collaboration with GDER; The USWBSI will plan to include a request for collaborative projects in the FY11 Call for Pre-Proposals.

Topic–based discussions:

Branded Varieties - The group discussed the negative effects of branded varieties, primarily the fact that any data on FHB resistance generated prior to the branding of a variety is lost and cannot be used to accurately characterize resistance of varieties or to track the adoption of FHB resistant varieties by growers. The former is a core goal of the USWBSI and the latter is a key metric for measuring success of the initiative. Fred Kolb explained the value of branding in terms of marketing new varieties and getting them in to the hands of growers. In many regions, public varieties cannot compete with brand named varieties because many breeding programs market their best lines or all of their lines as branded varieties rather than public varieties. Furthermore, many seed dealers in the soft red winter wheat region only sell branded varieties. The group thought that when possible, the data associated with a branded variety could be used to develop recommendations for the variety and posted on Scab Smart without revealing the prior identity of the branded variety. Each institution is different, but the group felt that if possible researchers should work to use these prior data to serve the goals of the initiative and not compromise private marketing. However, there is no currently available mechanism in place to make these data available and no incentive for those involved with branded varieties to revise the current system. The group also appreciated that if new varieties are not marketed effectively and planted, then it doesn't matter how scab resistant they are. It was also noted that some branded varieties are susceptible to FHB, and these pose a risk to growers and consumers.

Given that i) perhaps 75% of the soft red winter wheat acreage is currently planted to branded varieties, ii) this percentage is likely to increase as older public varieties are no longer grown and few new public varieties are released, and iii) FHB epidemics and mycotoxin contamination of grain are common in the soft red winter wheat region, the current policies and practices of the USWBSI do not allow for the timely dissemination of FHB reactions for commonly grown varieties to growers in the soft red winter wheat region. Furthermore, given that federal funds are used to develop, phenotype and genotype breeding lines that are released as branded varieties, the data generated with federal funds should be publically available.

Breeders Database - There was some discussion of the Barley CAP database THT and the fact that the new AFRI proposal for wheat and barley would include expansion of THT to include wheat. As it currently exists, this database stores phenotypic and marker data and allows users to download subsets of data for association mapping analysis. This seemed to be similar to the needs of the initiative. Users would likely want to download specific sets of lines for comparison and making breeding decisions. If the user needs and database functionality are similar enough, it does not seem necessary or prudent for the initiative to develop its own specialized database. Kevin Smith currently participates in bi-weekly conference calls on THT and would investigate the possibility of

using the new version of THT to accommodate users from the USWBSI.

Pushing Info to Growers – (summary provided by Marcia McMullen) Much of the discussion was a continuation of the MGMT discussion earlier in the day:

- Improving communication with growers/stakeholders is ongoing.
- Summarized current "push" efforts with FHB alert messages available through email or phone.
- Make sure this message of availability has gotten out via commodity groups, farm news publications in region; NAWG, NAMA, etc.
- Get feedback from participants on success of the Alert System, what is the value of the "push" technology; are there improvements that could be made?
- Find out how many hits or subscribers, same for Scab Smart - how many hits?
- Producers in group listen to radio while working during day, so make sure farm radio stations have information. Also, there is increased use of Smart phones among producers, so should be able to get alerts on phone; producers generally only check email 1x/day, usually late at night.
- FHB alerts now go out on a regional basis; would like to explore if alerts can go to a single state (i.e. subscribe by state and/or region);
- Find interesting ways to get attention of audience, such as using "gushing beer, barfing pig" or other such attention getters.

Transgenic – partnering with Private Industry (summary provided by Steve Scofield) – The consensus of the breakout discussion was very positive about encouraging contact with the Biotech Industry. A big effort will be made to invite them to the next forum. However, the feeling was also strong that the Initiative had no claim to any of the IP that came from its funding - this all resided with the PI's home institution. The belief was that the companies would sidestep the Initiative and negotiate directly with the PI developing the IP they were interested in.

The group spent a lot of time discussing what sort of partnerships would be desirable for initiative-funded scientists. The suggestions were:

1. Agreements that would speed the development and movement of the anti-FHB technology to the growers.
2. Something like Industry providing plant transformation capability was seen as very desirable as we are so short on this capability now.
3. It was related that the ARS always seeks agreements in which the rights to the IP revert to the ARS if the company does not commercialize the technology within a set period of time, so that IP does not get bought only to be locked up.

Wheat Quality Council request to include FHB Resistance information with released varieties (summary provided by Jane DeMarchi) – the USWBSI breeders have all agreed to include some form of scab resistance information with the variety descriptions they submit to the Wheat Quality Council (WQC), and WQC has agreed that this information should be included in each of the reports that are produced for the review in February of each year. However, the three classes have not yet agreed on a single format. Coordinators should include this request [for FHB resistance info] when they send out their request to the breeders for the submission of samples for the WQC. A breeder can also choose to indicate where the variety is meant to be grown, if it does not have any scab resistance. Ed Souza's group has gone ahead and sent out his request for WQC samples, and this information was incorporated into that request. Additional questions from the USWBSI can be submitted to one of the following:

- Hard Red Spring (HRS) – will indicate susceptible, moderately susceptible, etc and give a comparable variety. (USWBSI Contact: Karl Glover, SDSU)
- Hard Red Winter (HRW) – will give an FHB resistance rating between 1-9 (with 9 being the worst). (USWBSI Contact: Bill Berzonsky, SDSU)
- Soft Red Winter (SRW) – will submit nursery rating data. Will discuss this further, might be better to use 1-9 rating scale. (USWBSI Contact: Ed Souza)

9. Discuss FY11 Request for Pre-Proposals and Review Process.

- Changes to the Request for and Review of Research Area based Pre-Proposals (includes MGMT Coordinated projects) – No changes to current process.
  Transition year – FY11 Request for Pre-Proposals are for Research Areas only and only for one year. Beginning with FY12, CPs and RAs will be on the same two year funding cycle.
- Changes to the process for reviewing Year 2 request for Coordinated Projects – No major changes to the current process.
- FY11 Working Caps – Will follow the process detailed in the Policies and Procedures. The Coordinated Projects are capped at their FY10 funding levels (although CP's may chose to reallocate funding within the coordinated project); only the Research Areas and EC-Headquarters will be part of the Working Cap process.

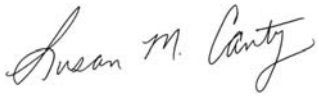
10. 2010 and 2011 National FHB Forums.

- 2010 National FHB Forum
  - Program Format
    - Combination of talks, discussion groups and poster sessions
  - Makeup of Organizing Committee
    - Chairs – Mike Davis and Jane DeMarchi
      Will ask Research Leaders to make recommendation
  - Schedule of Administrative Meetings
    - EC and Review Panel/Research Leaders meet on Monday (12/6) afternoon/evening
    - EC Executive Session – Tuesday morning (12/7) and Wednesday evening (12/8)
    - SC meets on Thursday afternoon (12/9) following the close of the Forum

- 2011 National FHB Forum – original dates recommended by the EC (12/6-12/8) conflict with the Prairie Grains meetings. Therefore, the USWBSI will move the forum to begin earlier in the week (Sunday through Tuesday); Dates are 12/4-12/6 in either St. Louis or Kansas City, MO.

Meeting Adjourned at 3:10 p.m.

Minutes were recorded and then transcribed by:



Susan M. Canty, Manager
USWBSI's Networking & Facilitation Office

ADDENDUM A

RESEARCH AREA UPDATE –
FHB Management (MGMT)

Summary of Funding (FY09-10)	
Total # of Projects (inc. renewals)	Total Amount Awarded
86	$ 1,188,143

For each of your Action Plan Goals, answer the following questions

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

1. What progress has been made?

Uniform fungicide and biocontrol trials have been conducted and 12 years of data from 14 states have been analyzed (Paul et al, 2010, Phytopathology). In wheat, the greatest yield and test-weight responses were obtained from applications of prothioconazole (Proline), metconazole (Caramba), and prothioconazole + tebuconazole (Prosaro). This information is being widely disseminated to growers.

Integrated management (IM) experiments are currently being conducted in at least 13 states (12 as part of the IM CP plus a new one in North Carolina). Variety resistance and fungicide are the factors, and in some locations crop rotation is also being tested. In 2008, we noted a concern about 60-70% of IM trials being too dry to generate useful data in the previous 2-3 years. The perspective has developed that at least some locations should be inoculated and/or misted. In combination with naturally favorable conditions in some areas in 2008 and 2009, that has led to acquisition of data under moderate to severe FHB pressure in several locations. In several locations, the additive impact of variety resistance and fungicide in reducing disease and DON has been demonstrated.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

- The USWBSI-funded scab risk forecasting tool is available at the website maintained by Pennsylvania State University (PSU). It provides forecasts for 22 states, and has become increasingly widely used. Researchers in AL are requesting to have their state added to those for which forecasts are available.
- The ScabSmart website has been made available, with links to useful information on overall scab management approach and information relevant by state, including variety ratings. It links to the PSU forecasting site and to forecasts specific for MN, ND and SD.

3. Has the 'Anticipated Impact' been achieved?

Yes, we are on our way to demonstrating the benefits of integrated FHB management for lowering vulnerability to disease and DON.

Additional Comments:

FHB MGMT *(cont.)*

Goal #2: *Develop the next generation of management tools for FHB/DON control.*

To accurately reflect the work being done, this goal should probably be rewritten to read: "Maximize our ability to implement current-generation tools, and develop the next generation of management tools for FHB/DON control."

1. What progress has been made?

- The current round of uniform fungicide testing focuses on comparing Caramba, Prosaro, and Caramba+Proline at various timings and on various market classes of wheat. The timings are heading, early flowering, and five days after early flowering. Initial results indicate that some timings result in better fungicide performance than others, depending on location. The results suggest that the window for effective fungicide application may be slightly wider than previously believed.
- For wheat, researchers at Ohio State University and Kansas State University are working on a model that will predict both disease and DON.
- For barley, researchers at South Dakota State University are identifying weather variables that are predictive of economic DON levels and developing risk model(s) to predict FHB and/or DON

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

- To increase and improve use of the commentary feature of the Penn State forecasting model, two measures have been taken. An email listserve for USWBSI researchers has been set up. Also, a blog at the USWBSI website allows people to see all the state commentaries as they are posted.

3. Has the 'Anticipated Impact' been achieved?

This work is still in progress.

Additional Comments:

FHB MGMT *(cont.)*

Goal #3: *Develop a full understanding of specific factors influencing infection and toxin accumulation that can be used to develop the next generation of scab and DON risk assessment measures.*

1. What progress has been made?

We have a clearer understanding of:

- the effects of within-field corn debris on FHB and DON levels
- the effects of moisture in the post-flowering period on various measures associated with FHB
- the period in which wheat is most vulnerable to FHB infection. A higher-resolution study with both wheat and barley is underway.
- the phenomenon of apparently sound wheat with excessive DON, which is likely related to late infections, post-flowering moisture, and marginal disease conditions
- how the reactions of wheat cultivars to NIV and DON compare

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

The "outputs" here are mostly knowledge that aids in optimizing management tactics. The first two items in particular are relevant to providing DON forecasts. We are demonstrating that:

- In a major corn-producing region, elimination of corn debris from single wheat fields may have limited benefit in reducing FHB and especially in reducing DON contamination of grain
- Post-flowering moisture can significantly increase levels of FHB and/or DON (although extreme post-flowering moisture, exceeding certain amounts or durations, may have a lowering effect on FHB and DON).
- Problematic levels of FHB and DON can result from infections occurring as late as 10 days after mid-anthesis in common wheat, and possibly even later in durum wheat, suggesting there could be effects from rain during and slightly after flowering, as well as before flowering.
- Fungicide application before flowering is not beneficial in controlling FHB.
- Given the possibility of "late" infections, which may not produce the same degree of visual field symptoms, cultivar evaluation should continue to include FDK and DON data.
- Relative resistance of a given wheat genotype to DON corresponds sufficiently to the resistance of that genotype to NIV that screening against both is unnecessary.

3. Has the 'Anticipated Impact' been achieved?

Some of this work has been published, some is in review, and some is still in progress.

Additional Comments:

FHB MGMT *(cont.)*

Goal #4: *Enhance communication and end user education/outreach.*

1. What progress has been made?

- In most wheat-producing states east of the Rockies, integrated management of FHB is one of the major topics at winter growers' meetings, field days, and trainings for county agents and certified crop advisors.
- In North Dakota, some survey work has been done to determine where growers get their information on FHB management. Initial results indicate the top three sources were extension meetings, crop consultants, and articles in farm press. The disease forecasting model was reportedly little used in 2009 in ND. This work suggests the possibility of conducting similar surveys in other parts of the U.S. in order to maximize our ability to get timely information out.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

- ScabSmart (already discussed above)
- Most affected states have produced and disseminated state-specific web pages, brochures, fliers, newsletters, and other outreach materials on FHB management.
- Growers and others can now subscribe to the USWBSI FHB Alerts, and receive the alerts either as text messages or as emails

3. Has the 'Anticipated Impact' been achieved?

- Across the Midwest and eastern U.S., growers have significantly more access to information about scab biology and epidemiology, residue effects, variety resistance, and fungicide application than they did 4 years ago.
- Actual adoption is of course the most important impact. Without state-by-state survey data, it is difficult to compare current adoption of "best FHB management practices" with the level of adoption that existed 4 years ago.

Additional Comments:

RESEARCH AREA UPDATE – Food Safety, Toxicology and Utilization of Mycotoxin-contaminated Grain (FSTU)

Summary of Funding (FY09-10)		
	Total # of Projects (inc. renewals)	Total Amount Awarded
DON Testing Services	8	$ 1,071,818
Competitive Research	3	$ 200,335

For each of your Action Plan Goals, answer the following questions
2010: Total amount funded for these search criteria: $624,304 (4 diagnostic, 1 research project)
2009: Total amount funded for these search criteria: $647,849 (4 diagnostic, 2 research projects)

Goal #1: *Provide analytical support for DON/trichothecene quantitation for Initiative's stakeholders.*

1. What progress has been made?

   - Four diagnostic laboratories have provided services to over 50 researchers.
   - Over 60,000 analyses are performed on an annual basis.
     - These analyzes are principally DON, but also include 3-ADON, 15-ADON, NIV and ZEA.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

   - Sampling/analytical protocol prepared and posted
   - Expanded number of analysis performed/year
     - Increased measurement of ADONs

3. Has the 'Anticipated Impact' been achieved?

- Efforts have been made to clarify stakeholder concerns over test accuracy
- Increased analysis capacity has aided breeder's efforts.
- Data on mycotoxin profile shifts is being collected

Additional Comments:

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

4. What progress has been made?

   - Current safety documents have been made available on USWBSI site
   - Research results have shown that oral DON exposure rapidly induces proinflammatory cytokine, and suppressor of cytokine signaling-3 (SOCS-3), a protein known to downregulate the liver's responses to growth hormone (GH).
     i. This is a long term project, and use of data by regulators may be some time away. Nevertheless, the work is necessary for improvements in risk assessment.

5. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

   - DON white paper
   - Posting of CODEX document on DON
   - Extensive publication of research results

6. Has the 'Anticipated Impact' been achieved?

   - Research data is not yet at a point where it can be directly used by regulators
   - Awareness of safety issues has been increased

RESEARCH AREA UPDATE –
Gene Discovery and Engineering Resistance (GDER)

Summary of Funding (FY09-10)	
Total # of Projects (inc. renewals)	Total Amount Awarded
16	$ 571,811

For each of your Action Plan Goals, answer the following questions

Goal #1: *Increased efficiency of identification of candidate genes for resistance against FHB and reduced DON accumulation.*

1. What progress has been made?

Discovery of genes for FHB resistance:

The Shah group uses the Arabidopsis-*Fusarium graminearum* pathosystem to initially evaluate the role of candidate genes in FHB resistance or susceptibility. This work indicated that the regulator a salicylic acid induced defenses, NPR1, plays a key role in FHB resistance. The key role for NPR1 has been confirmed in transgenic wheat plants. Recently, the Shah group has identified important roles for the PAD4, WRKY18 and LOX genes in FHB resistance in the Arabidopsis-FHB system. Transgenic wheat lines are now being generated that overexpress PAD4 and WRKY18 and silence LOX expression.

The Lawton group is employing the moss, *Physcomitrella patens*, as a genetic system to dissect FHB resistance. Because of the many tools available in this system they are able to examine the effects of knocking out and overexpressing genes on FHB interactions. Through this approach they have identified a range of genes involved in programmed cell death, reactive oxygen and basal defense that significantly impact FHB interactions.

The Tumer group has previously demonstrated that engineering resistance to DON results in improved FHB resistance. They are now employing high throughput yeast and Arabidopsis screens to identify genes that when overexpressed or knocked-out confer tolerance to tricothecenes. In future work these genes will be tested for the ability to confer FHB resistance in wheat and barley.

The Scofield group is employing a gene silencing assay that permits direct testing in wheat to identify genes contributing to FHB resistance. Their hypothesis is that such genes can be used to engineer improved FHB resistance in wheat and barley. Their work has identified genes in the ethylene signaling and basal defense pathways that make crucial contributions to FHB resistance in wheat. They are now generating sets of transgenic wheat plants that will be used to test whether overexpression of four genes identified in this work can confer improved FHB resistance.

GDER *(cont.)*

Discovery of genes to decrease DON accumulation:

The Muehlbauer, and Dahleen/Rayment groups are exploring the rationale that genes that detoxify DON will prove useful for engineering resistance to FHB.

The Muehlbauer group has investigated the function of UDP-glucosyltransferases that are induced during interactions with *Fusarium graminearum*. This enzyme detoxifies DON by converting it to a DON-3-glucoside. They demonstrated that expressing UDP-glucosyltransferase in Arabidopsis leads to resistance to both DON and NIV. They are now in the process of generating transgenic wheat lines to test if this strategy leads to lower levels of DON and resistance to FHB.

The Rayment and Dahleen groups are collaborating to develop transgenic barley plants that express an optimized form of the *F. graminearum* Tri101 gene, which degrades trichothecenes. The barley transformations with these new constructs are currently underway.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

The GDER RA has directed its efforts quite effectively at achieving the goals of identifying genes that can be used to improve FHB resistance and lower DON accumulation. The RA is supporting three general approaches to achieving this goal.

1. High throughput screens of yeast and model plants for genes involved in FHB resistance or DON tolerance.
2. Direct functional tests for genes involved in FHB resistance in wheat.
3. Rational mutagenesis of genes already known to be involved in DON degradation.

From this broad range of exploration a promising list of leads is emerging that will be tested in transgenic wheat and barley plants.

3. Has the 'Anticipated Impact' been achieved?

Yes, the number of leads for testing in transgenic wheat and barley, and the strength of the experimental data supporting their potential efficacy are very significant.

Additional Comments:

Goal #2: *Develop effective FHB resistance through transgenic strategies.*

1. What progress has been made?

   To avoid repeating much of what was written above, the prime objective of all the work described under Goal #1 is to discover genes that show significant promise for use in transgenic strategies to engineer resistance to FHB. With the exception of the Lawton and Tumer projects, all the currently funded GDER projects are working to test candidate genes for efficacy in generating FHB resistance in transgenic wheat or barley plants.

   Ultimately, all transgenic lines generated by the GDER projects will be evaluated along side the best existing FHB resistant lines in the transgenic FHB field trials run by Dr. Dill-Macky.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

   The Muehlbauer, Shah, Scofield and Rayment/Dahleen projects are all currently generating wheat or barley transgenic plants expressing potential anti-FHB genes. Significant leads are being identified as well in the Lawton and Tumer projects that will be tested in wheat and/or barley in future work.

3. Has the 'Anticipated Impact' been achieved?

   The experimental data supporting the potential efficacy for the anti-FHB strategies being tested is very strong, however we will not know the ultimate success of these efforts until the transgenic plants can be tested during years 4 and 5.

Additional Comments:

RESEARCH AREA UPDATE –
Pathogen Biology and Genetics (PBG)

Summary of Funding (FY09-10)	
Total # of Projects (inc. renewals)	Total Amount Awarded
22	$ 541,768

For each of your Action Plan Goals, answer the following questions

Goal #1: *Characterize genetic variation in FHB pathogen population especially with regards to aggressiveness toward plants and mycotoxin potential.*

1. What progress has been made?
   - Demonstrated the presence of 4 species within the *F. graminearum* species complex in the U.S. Showed that within the species complex, the U.S. is home to genetically distinct populations that also differ from each other in chemotype, toxigenic potential and aggressiveness.
   - Phenotypic characterization of these diverse populations in greenhouse and field experiments show that nivalenol producers are prevalent in Louisiana, Arkansas and some other states. Emergent populations generally produce higher mycotoxin levels in wheat in greenhouse experiments and under some conditions in wheat and barley in field experiments.
   - Found that a 3-ADON population from North Dakota has an advantage in causing higher levels of disease than a 15-ADON population regardless of the wheat cultivar or the use of fungicides in the field, and produces higher levels of disease in greenhouse testing.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

   - Have entered into collaborations with USWBSI researchers from other RACs for field testing the aggressiveness and mycotoxin production of NIV-producers
   - Numerous interactions and collaborations with diverse members of the USWBSI and other scientists on a national and international level have contributed substantially to an increased awareness of the target organisms. As a result, research questions by members of the USWBSI can be addressed in a much more sophisticated manner, through use of characterized isolates.
   - Publications and presentations (see Addendum for list)

3. Has the 'Anticipated Impact' been achieved?

   - Knowledge of the composition and the spatial and temporal dynamics of U.S populations of *F. graminearum* has enabled us to design and conduct biologically relevant experiments that generate relevant information for many members of the USWBSI, including breeders, epidemiologists, field pathologists, plant management personnel.
   - The detection of nivalenol-producing populations in the southern U.S. is important for regulatory programs, such as GIPSA.

PBG *(cont).*

Additional Comments:

- Fg populations in the U.S. are changing. This has important implications for FHB. Screening for FHB resistance should consider these changes.
- New genetic types within the Fg species complex are turning up, and we need to know more about them. Where are they coming from? Can they invade new wheat production regions?
- Some states have NIV producers. Many mills and elevators are not currently testing for NIV. Should grain buyers be testing for NIV when purchasing grains from certain regions in the U.S.?

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

1. What progress has been made?

- Characterization of cultivar/strain interactions with new populations are in progress. A 3-ADON population has been shown to produce higher levels of disease in greenhouse testing. Still unknown is if 3-ADON is more toxic to wheat.

- Expression of *Tri5* and DON levels have been monitored during grain infection and colonization of in susceptible and resistant cultivars. Use of strobilurins does not appear to increase *Tri5* expression or DON levels. Highest expression of *Tri5* is just behind the infection front and lowest in older infected grains. *Tri5* levels appear to get shut down in resistant cultivars after initial infection.

- Have received 42 strains of *F. graminearum* from 10 USWBSI researchers in 6 states and have set up uniform testing conditions to measure aggressiveness on sensitive and moderately-sensitive cultivars of wheat and barley.

- Defined the temperature, light and moisture parameters for the development of perithecia and ascospores on plant residues. Dormant structures are perithecium initials NOT perithecia. Fungus is a weak saprophyte.

- Effective resistance response in Norm involves xylem blockage. Genetics unclear.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?

- Detailed analysis of DON accumulation over the course of infection in a susceptible and a resistant cultivar of wheat.

- Communication with GDER and MGMT to coordinate use of discoveries.

- Better understanding of survival of fungus over winter.

PBG *(cont.)*

- Identified *F. graminearum* mutants that may be used as agents for biocontrol studies
- Papers and Presentations- see Addendum

3. Has the 'Anticipated Impact' been achieved?
   - Increased understanding of how and when DON appears during grain colonization.
   - Increased understanding of how fungus survives overwinter.

Goal #3: *Develop new strategies for reducing impact of FHB disease and mycotoxin contamination in barley and wheat. Focus on pathogen genes and responses, including specific host target genes .*

1. What progress has been made?
   The greatest number of proposals falls within this goal. A multi-faceted approach has produced numerous results yet all lead toward development of new strategies for reducing FHB disease.
   - Identified, cloned, and tested mating pheromones of *F. graminearum*; inhibit ascospore germination
   - Methods designed for peptide efficacy testing
   - Identified the first inhibitory peptides to be used in defense of *F. graminearum.*
   - Inhibitory peptides have been fused with a scaffold protein (derived from a naturally occurring plant protein); germling inhibition is being evaluated.
   - Found path$^-$ *F. graminearum* that can colonize wheat as an endophyte. Increases yield. Protective capabilities under study.
   - Identified 2 fungal genes important for regulation of DON accumulation in plants and in culture. Localized the proteins produced by the 2 genes to subcellular location in the fungal cell.
   - Identified a gene that plays an important role in DON production and plant infection; identified regulation patterns; functionally characterized genes regulated by this one gene.
   - Have studied the physicochemical reactions of trichothecene enzymes with mycotoxins; constructed a mycotoxin-self-protection enzyme (TRI101p) that is more thermally stable by altering the sequence of the gene; have put the gene into plant plasmids.

2. As we enter into year 4 of the Action Plan, what 'Outputs' have been produced?
   - Have identified novel genes as potential mechanisms for reducing FHB
   - Have identified novel peptides as potential mechanisms for reducing FHB
   - Provided barley researcher with plasmids carrying modified *TRI101* genes that can be used for inactivating fungal mycotoxins
   - Have entered into discussions with GDER for providing material for transgenic wheat.
   - Manuscripts and Presentations- see Addendum

3. Has the 'Anticipated Impact' been achieved?
    - Have provided genetic material for other researchers
    - Have obtained data that has lead to substantial funding from other government agencies to further the studies of controlling FHB

Addendum

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