



U.S. Wheat & Barley  
Scab Initiative

## MINUTES

### USWBSI Steering Committee Meeting

Wednesday, April 13, 2011, 8:30 AM – 4:00 PM

University of Minnesota - Continuing

Education and Conference Center

St. Paul, MN

**Co-Chairs:** Art Brandli (Private Grower, MN) and Dave Van Sanford (Univ. of Kentucky)

**Members Present:** Jim Anderson (Univ. of Minnesota), Bill Berzonsky (South Dakota State Univ.), Bob Brunick (MillerCoors, OR), Xiwen Cai (North Dakota State Univ.), Blake Cooper (Limagrains Cereal Seeds, CO), Mike Davis (American Malting Barley Association), Jane DeMarchi (National Association of Wheat Growers), Ruth Dill-Macky (Univ. of Minnesota), Elias Elias (ND State University), Julius Fajardo (Bayer CropScience, NC), Karl Glover (SD State University), Rich Horsley (North Dakota State Univ.), Fred Kolb (Univ. of Illinois), Laird Larson (Private Grower and South Dakota Wheat Commission), Larry Lee (Private Grower, ND), CJ Lin (Mennel Milling Co., OH), Brad Miller (North Dakota Pasta Company), Jolanta Menert (Busch Agricultural Resources, Inc., CO), Gene Milus (University of AR), Charles Ottem (ND Barley Council), Pierce Paul (OH State University), Paul Schwarz (North Dakota State Univ.), Carl Schwinke (Siemer Milling Co., IL), Steve Scofield (USDA-ARS, IN), Kevin Smith (Univ. of Minnesota), Clay Sneller (Ohio State Univ.) and Frances Trail (Michigan State Univ.)

**Participating via Interactive Video** – Deb Fravel (USDA-ARS-NPS, Beltsville, MD), Jose Costa (Univ. of Maryland, College Park, MD) and Christina Cowger (USDA-ARS, Raleigh, NC)

**Staff:** Sue Canty (USWBSI-NFO) and Don Lilleboe (Lilleboe Communications)

#### 1. Introductions and Opening Remarks

#### 2. Review of the Agenda

#### 3. Approval of Minutes from 12/09/10 Steering Committee Meeting

**Motion:** Motion made and seconded to accept the minutes as presented.

**Discussion:** None

**Action:** Motion passed.

#### 4. FY11 and FY12 Federal Funding Updates

Mike Davis – Update on FY11 Federal Budget: A final budget, via a Continuing Resolution, should be finalized this week. The USDA-ARS budget will be cut by approximately \$44 million, primarily to programs still considered earmarks (USWBSI is no longer an earmark) plus an additional 0.2% applied to all federal discretionary programs.

ARS imposed an additional one-time across the board 1.1% cut to all programs within the agency to offset costs for relocating ARS personnel at locations or in projects to be closed. ARS also imposed

an additional cut of 5% to National Program Administrative funding. Deb Fravel, USDA-ARS-NPS confirmed these numbers.

Jane DeMarchi added that it is important that we focus on what we have accomplished to date with the money we have been given. We need to show Congress (and ARS) that we are being good stewards with the funds we have been given, but still have more to do.

## 5. Updates from the NFO and EC

- Status of Current Agreements

- *FY11 Funding Notifications*: Because the FY11 Federal Budget had not been finalized, and we were looking at a significant cut to our funding, PIs being recommended for funding have not yet been notified. Those PIs that were not recommended for funding, or have at least one project that was not being recommended for funding, have been notified.
- *No Cost Extensions (NCE)*: One-year No Cost Extensions have been processed for all eligible agreements due to expire before the end of May so that they remain active until the FY11 awards can be processed. If we get to May and still don't have a final budget, we will process NCEs for all eligible agreements that will expire in June.
- *Adjustment to FY11 Final Budget*: After the SC meeting last December, we discovered that a PI funded solely under the MGMT area had carryover from an expired agreement that must be used to supplement his FY11 award. That brought the total amount for MGMT down to \$503,394. These 'freed up' funds (approximately \$12,000) were applied towards the transformation bottleneck.

- Breeders Database

*Status of Development* - Sneller reported that he believes he has found someone to finish the development of the web interface which we plan to base on the T3 database (formerly Hordeum Toolbox). We still need to find someone to standardize the data across all wheat classes; only soft winter wheat has been standardized thus far.

*Hosting* – The NFO has contacted Olin Anderson requesting an estimate on what he would charge for hosting the database; have not yet received a response.

- FHB Alert System including changes for 2011

- Currently have 500+ subscribers.
- Added two states – Louisiana and Mississippi
- DON Forecasting tool at Penn. State went live about a month earlier than in past years primarily due to the additions of the southern states.
- Expanded from five regions to seven – split the Mid West/Northern, Soft Winter Wheat into two regions - Mid West/Mid South and Northern; split the Mid Atlantic Soft Winter Wheat Region into two regions – Southern Atlantic and Mid Atlantic.
- These changes were made so that growers and other users would receive information that is more customized to their geographic area.
- Christina Cowger requested a summary of the subscribers by state be sent to the state specialists/commentary contacts.

- Review of DON Labs

1. An e-mail has been sent out to PIs/researchers utilizing the lab services, informing them what they need to do before they submit samples:

- Refer to DON Testing website for maximum number of samples they may submit. Also, review grain sampling protocols posted on the same website.

- Be selective with the samples they do submit (i.e. send resistance and susceptible checks first to determine whether entire experiment needs to be submitted).
  - Future pre-proposals submitted to USWBSI must include estimated number of samples planned to submit to lab(s).
2. The labs were only using low DON samples for across lab quality checks. Want labs to run high, medium and low DON samples, but have not been able to obtain samples from FY10 harvested wheat. Dave Van Sanford will try to get samples (with low, medium and high DON) from early harvested winter wheat (next month) to run across-lab quality checks.
- Templates for use by PIs/Extension Specialists  
At the December SC Meeting, Christina Cowger reported that the MGMT group wanted templates developed for use by state specialists/PIs:
    - Press Release for FHB Alerts.
    - Scab Smart Brochure – one side would be generic info relevant to all states; the other side is structured for each state to individualize. The suggestion was made for the NFO to print copies with just the one generic side in color, and then send to specialist.
 These two items have been developed and will be circulated for use by state specialist.

In addition to the aforementioned templates, the NFO has also developed several slide sets for PIs to use when giving presentations to producers/stakeholders on their research. These slides sets are available for registered users to download from the Scabusa website under 'My Scab Documents'. Once we finalize the slide sets, will send out an e-mail to the FHB listserv letting people know these are available for download, and if they have any slides on their research, etc. they would like to share, they can upload to the same folder.

## 6. Research Leaders present recommendation for FY12 Working Caps

See questionnaires completed by Research leaders prior to SC meeting (Addendum A).

## 7. Discuss FY12 Request for Pre-Proposals and Review Process

- Biocontrol Research – An extensive external review of USWBSI biocontrol research led to the recommendation by the EC that only one integrated, collaborative biocontrol proposal be solicited in FY11. This request was disregarded by biocontrol researchers. Therefore the EC makes the following recommendation: Remove from the MGMT section of the action plan any reference to the development/discovery of new biological control agents.  
Action: Motion approved.
- FY12 Working Caps
  - Proposed Timetable for setting of FY12 Working Caps within the RFP Process:
 

May 17:	Start Poll 1 of SC on Working Caps
June 1:	Call goes out for Pre-Proposals
	First Poll Ends
June 1:	Discussion Period Opens
June 15:	Discussion Period Closes
June 16:	Poll 2 begins
July 1:	Deadline for submission of LOIs – CPs (Category 1)
	Poll 2 Ends.

Jun 29-Jul. 1:	EC conference call to finalize recommendation
July 5-15:	SC votes on WC recommendation
July 29:	Deadline for submission of LOIs – MGMT-CPs (Category 2)
Aug 1:	CP chairs notify PIs who submitted LOI whether their project has been accepted into CP.
Aug 12:	MGMT-CP chairs notify PIs who submitted LOI whether their project has been accepted into CP.
Sept. 2:	PIs submit PRPs to CPs. (Category 1)
Sept. 9:	PIs submit PRPs to MGMT-CPs. (Category 2)

- SC Members' Responsibility - Both Co-Chairs stressed the importance of SC members participating in the working cap process. For FY12, this will be the first time in several years that all RAs and CPs will be on the same two year funding cycle. As members of the SC, we need to base our recommendation on the greater good, what will get us to our goal the quickest, and not on our own self-interest.

- Overview of Review Process

Dave Van Sanford summarized (see below) the Review Process for FY12, and indicated that the process would be discussed further during the breakout sessions:

**Category 1** – Commodity-based and VDHR-based Coordinated Projects (5-step review process).

**Step 1:** Submitted Letters of Intent (LOIs) are reviewed for acceptance into the CP.

**Step 2:** Proposed Research Projects (PRP) accepted into a CP are reviewed by the CP committee.

**Step 3:** Review of CP Pre-Proposal by the Networking & Facilitation Office (NFO) for conformance to instructions provided in the FY12 Request for Pre-Proposals.

**Step 4:** Review of CP Pre-Proposal by Review Panel (RP).

**Step 5:** Review of CP Pre-Proposal by Executive Committee (EC).

**Category 2** – FHB Management (MGMT) Coordinated Projects (5-step review process)

**Step 1:** Submitted Letters of Intent (LOIs) are reviewed for acceptance into the MGMT-CP.

**Step 2:** Proposed Research Projects (PRP) accepted into a CP are reviewed by the MGMT-CP committee.

**Step 3:** Review of MGMT-CP Pre-Proposal by the Networking & Facilitation Office (NFO) for conformance to instructions provided in the FY12 Request for Pre-Proposals.

**Step 4:** Review of MGMT-CP Pre-Proposal by Review Panel (RP).

**Step 5:** Review of MGMT-CP Pre-Proposal by Executive Committee (EC).

**Category 3** - Individual Research Area Pre-Proposals (3-step review process)

**Step 1:** Review of Individual Research Area Pre-Proposals by the Networking & Facilitation Office (NFO) for conformance to instructions provided in the FY12 Request for Pre-Proposals.

**Step 2:** Review of Individual Research Area Pre-Proposals by Review Panels (RP).

**Step 3:** Review of Individual Research Area Pre-proposals by the Executive Committee (EC).

## 8. Small Discussion Groups

FY12 Review Process – Dave Van Sanford summarized the timeline for submission of pre-proposals and the review process. Regarding the CPs, the NFO/EC will seek input from the CP committees on possible reviewers for their CP pre-proposal. Regarding the RAs, the suggestion was made that the Panel Chair make sure the comments on the overall summary forms match the Review Panel's recommendation (i.e. comments are negative, but project ranked highly for recommended funding within the working cap).

Transformation Bottleneck – Steve Scofield and Frances Trail led this discussion. Only a few people in the US do transformation research on small grains: Lynn Dahleen (USDA-ARS, ND) for Barley, Harold Trick (KSU) and Tom Clemente (UNE) for wheat. These people will be contacted to discuss what they need to increase through-put, and what their limitations are.

MTA/Uniform Scab Nurseries – Discussed the evolution of this issue and what form of MTAs would be best for the Scab Nurseries. The group may start using MTAs prior to the planting of the FY12 winter wheat nurseries.

Action Plan – MGMT made changes to the Action Plan that would eliminate the development of biological controls; testing of biological controls would remain. Final edits will be circulated among MGMT RAC members before being finalized (prior to distribution of the FY12 Request for Pre-Proposals).

## 9. New Items

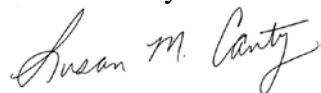
FDA DON Sampling – Several USWBSI researchers had an issue with the data that was presented at the 2010 Forum by the FDA: basing data on insufficient number of samples.

## 10. 2011 and 2012 National FHB Forums

- 2011 National FHB Forum – December 4-6, St. Louis, MO
  - Program Format
    - Combination of talks, discussion groups and poster sessions
  - Schedule of Administrative Meetings
    - EC and Review Panel/Research Leaders meet on Saturday (12/3) afternoon/evening
    - EC Executive Session – Sunday morning (12/4) and Monday evening (12/5)
    - SC meets on Tuesday afternoon (12/6) following the close of the Forum
- 2012 National FHB Forum – EC recommended Dates and Location: 12/4-6, Orlando, Florida

**Meeting Adjourned:** 3:52 pm CT

Submitted by:



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

**RESEARCH UPDATE AND QUESTIONNAIRE FOR MGMT  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for MGMT</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
41 (includes all components of multi-PI projects)	\$ 526,448

**1. How do you define success for your RA/CP? Please be specific.**

- Models to forecast FHB risk in wheat and barley are deployed and available to all affected stakeholders along with state commentaries
- Variety of management tactics are clearly defined and routinely promoted to producers via multiple methods (internet, agent trainings, newsletters, alerts, etc.)
- Barriers to adoption of management tactics are clearly identified in different regions and market classes and appropriate measures are developed to address the barriers

**2. As we enter into year 5 of the Action Plan, what ‘Outputs’ have been produced?**

- Scab risk forecasting model has been improved and made available to 25 states
- Integrated management practices have been evaluated and promoted
- Fungicide timing has largely been optimized
- ScabSmart has been created and updated with management information for various regions and market classes
- Commentaries from FHB forecasting site have become available to users via smart phones and email
- Influences of post-anthesis weather and late infections on disease and DON have been documented

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

- Scab risk forecasts will be enhanced with the addition of variety resistance in winter wheat, as well as DON forecasts.
- Subscriptions to scab alerts will significantly increase throughout Central & Eastern U.S.
- Regionally appropriate, specific recommendations will be made available for corn and small-grain debris management based on full understanding of relative contributions of inoculum from in-field debris vs. nearby and distant sources (including recommendations for ScabSmart).
- Producers and crop advisors in ~15 states will be surveyed to identify levels of adoption of techniques and barriers to adoption.
- Using the information from the survey about barriers to adoption and involving social scientists, appropriate extension-outreach objectives and plans will be developed and implemented.
- USWBSI brochure will be designed and customized by state.
- Additional fungicide optimization will occur (e.g., do strobilurins applied earlier for foliar diseases increase DON? Strobilurin at flag leaf followed by a triazole at flowering?)

Are all strobis equal in increasing DON when applied at flag, and does the effect differ between MR and S cultivars? Possible benefit of late applications to S varieties).

- We will better understand how “less-than-optimum” conditions affect FHB and DON levels (e.g., intermittent pre-anthesis rain/moisture, late infections and post-anthesis moisture), and how to use that information in risk forecasting and management (e.g., pre-harvest DON testing, extra grain cleaning, exploring alternative grain markets prior to transport of grain to flour mills).

#### **4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

- State specialists feel that funds for IM and fungicide testing are sliced into too-small portions; hard to know whether to allocate more to those multi-state experiments within MGMT’s overall budget, involve fewer states, or leave as-is. But obviously a larger overall budget would help.
- RAC seems to be functioning well: leadership is contributed broadly and people work well together (this is not a change, just an observation FYI)

#### **Additional Comments:**

Additional issues we have identified as needing to be addressed:

- Increasing our capacity to provide a continuous stream of timely characterizations of DON resistance in commercial varieties, especially those with intermediate performance. In the MS-MR range that characterizes the majority of available soft winter varieties, there is a not a tremendously tight correlation between index and toxin. This might require increased USWBSI-supported DON testing capacity.
- We may need to expand the information on grain handling and marketing decision-making in our recommendations, as we gain information on post-anthesis conditions and how DON levels are affected by harvest weather conditions and timing. This may require some additional research on mitigation techniques.

**RESEARCH UPDATE AND QUESTIONNAIRE FOR FSTU  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for FSTU</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
5	\$ 639,912

**1. How do you define success for your RA/CP? Please be specific.**

Diagnostics: Providing timely and accurate measurements of DON and other tricothecenes to barley and wheat breeders and researchers conducting work on FHB.

Research: Fills gaps for risk assessment and regulatory decisions. We are obtaining a better understanding of the mode of action of DON, improving exposure assessments, and developing mechanistic biomarkers.

**2. As we enter into year 5 of the Action Plan, what ‘Outputs’ have been produced?**

**To date:**

Diagnostics: Analytical support has been continuously provided timely and accurate measurements of DON and other tricothecenes to barley and wheat breeders and researchers and other researchers conducting work on FHB. The analytical support is absolutely critical for the development of cultivars that are resistant or tolerant of FHB.

Research: A candidate physiological based biomarker of growth retardation in mice has been identified. This is important for future risk/safety assessments.

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

Diagnostics: Continue to provide rapid, accurate analyses of DON and related compounds.

Research:

a) Improve the understanding of mechanism of action of DON in mouse models, which is relevant to the development of appropriate risk assessment models. Gain insight into the bioavailability of DON from DON conjugates. This again is relevant to accurate exposure estimations and risk/safety evaluations.



b) Improve understanding of DON's fate during milling and baking, especially the extent to which conjugated or "hidden" DON forms in grain or flour contribute to DON content of products: relevant to accurate assessment of exposures.

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

Proposed funds for 2011-12 did not come close to covering requests. Diagnostic laboratories have been serving the UWSBSI for over 15 years, and some equipment may be reaching the end of its useful life. The EC and SC should consider depreciation of equipment. Past research funding has largely been directed towards toxicology research. This research, however, is costly. The EC and SC need to consider future priorities for the research area of FTSU.

**Additional Comments:**

Several of the diagnostic laboratory PI's have expressed concern over the recent efforts of USWBSI leadership to direct and harmonize some operations in the four laboratories. The consensus seems to be that after 15 years each laboratory has established methodology and procedures that best serve their client base.

**RESEARCH UPDATE AND QUESTIONNAIRE FOR GDER  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for GDER</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
8	\$ 308,476

**1. How do you define success for your RA/CP? Please be specific.**

- a. Identification and validation of genes and transgenes that improve FHB resistance and/or reduce DON accumulation.
- b. The development of transgenic wheat and/or barley plants that have improved FHB resistance and/or reduced DON content.

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

- a. A range of genes have been identified that can degrade DON or increase the tolerance to DON *in planta*. These are being tested for efficacy in wheat and/or barley in currently funded USWBSI projects.
- b. Two major plant signal transduction pathways have been demonstrated to play essential roles in Type II resistance to FHB: ethylene signaling and signaling activated by Pathogen-Associated Molecular Pattern (PAMP) receptors. Strategies for engineering FHB resistance based on manipulation of these pathways are currently being explored in USWBSI-funded research.

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

- a. Within the next two years data should be obtained from transgenic wheat and/or barley that can be used to critically judge the viability of FHB resistance strategies based on the two outputs listed above.
- b. It is strongly believed that on-going discovery work will generate important new leads for engineering FHB resistance during the next two years.

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

The EC has already acknowledged this need, however I will put it on the record again. Most of the GDER projects, as well as some from PBG will culminate in the generation of transgenic wheat and/or barley plants that will express a gene that improves FHB resistance and/or lowers DON content. We are greatly limited in the ability to generate the transgenic plants that will provide the proof-of-concept for our projects, as well as the additional transgenics that will permit the fine-tuning of the strategies. Any increase in the capacity to generate transgenic wheat and/or barley plants will have significant benefit to the GDER projects.

**Additional Comments:**

**RESEARCH UPDATE AND QUESTIONNAIRE FOR PBG  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for PBG</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
11 <small>(includes all components of multi-PI projects)</small>	\$ 296,677

**1. How do you define success for your RA/CP? Please be specific.**

- A. Providing support to other RACs in form of research.
  
- B. Leverage scab funds to obtain larger funding to study scab from competitive grants programs. PBG has a strong record of leveraging competitive funds from preliminary data generated from USWBSI funding.
  
- C. Production of new understanding of the pathogen biology and pathogen-host interactions. This basic research supports the generation of new ideas and approaches for control.
  
- D. Implementation of newly discovered genes for the development of resistant transgenic plants.
  
- E. Increased collaboration with VDHR, GDER and MGMT RACs.

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

- 1. New pathogen-based targets that may help control FHB in the future. For example: improved enzymes to detoxify DON (e.g. TRI101) for use in transgenics.
  
- 2. An increased understanding of the FHB pathogen populations including: (1) knowledge that some populations are shifting, (2) strains and/or populations vary in their mycotoxin potential, (3) NIV producers are present in some regions of the U.S. (particularly in southern states such as Louisiana), and (4) high frequencies of 15ADON and 3ADON genotypes have been observed in the Midwest, and the 3ADON genotype appears to be associated with at least one divergent population. The increasing interest in the frequency and distribution of trichothecene genotypes such as 15ADON and 3ADON led to some recent work elucidating the role of Tri8 in determining acetylated derivatives of DON.

4. Ability to monitor shifts in populations and assessing their threat should that be necessary. We have a solid baseline of the populations now and how fast they shift.

3. Identification of accumulation pattern of DON during infections. Recent work has shown that DON biosynthetic genes are expressed in the asymptomatic infection front. Furthermore, infection is initiated in Alsen, but retreats as grain develops.

4. Identification of genes involved in spore germination and infection, understanding of how pheromones and pheromone receptors affect spore germination.

5. Development of a pathogen gene silencing procedure. This is now being investigated for use *In planta* using outside funding sources.

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

1. Focus on discovering genes for pathogenesis and trichothecene reduction and generating material for the development of resistant, transgenic plants.

2. Develop an increased understanding of how asymptomatic grain with high DON develops and how infection and grain colonization occurs.

3. Enhance USWBSI web-based resources for access to information on mutants created through this RAC and their respective phenotypes.

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

1. More support for transgenic plant /VIGS to test efficacy.

2. Additional opportunities to foster collaboration with other RACs (e.g., VDHR, GDER and MGMT) to incorporate PBG discoveries into control programs.

**Additional Comments:**

**RESEARCH UPDATE AND QUESTIONNAIRE FOR HWW-CP  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for HWW-CP</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
12 (includes all components of multi-PI projects)	\$ 362,706

**1. How do you define success for your RA/CP? Please be specific.**

Since its inception, the HWW-CP has had a clear measure of success. The HWW-CP measures success as reducing DON in the hard winter wheat grain supply to the current level required in the European Union (EU), which is lower than the US standard. We selected this target because half of HWW grain is exported and the majority of the grain shipped to the EU is sourced from areas prone to losses to FHB (e.g. the Eastern Great Plains). As whole grain products increase, our goal will be to ensure that the DON concentration in these products is also below established thresholds. The HWW-CP supports the activities of plant breeders, pathologists, geneticists, and those collaborating with these scientists to achieve the goal of reducing DON in the grain supply.

**2. As we enter into year 5 of the Action Plan, what ‘Outputs’ have been produced?**

Four hard winter wheat varieties were released with above average resistance to FHB. Lyman was released from the South Dakota breeding program. It expresses perhaps the highest level of native resistance to FHB in the region. Because it is adapted to both eastern and western regions of South Dakota, Lyman is an excellent option for growers in areas prone to experiencing losses due to FHB. From the Nebraska breeding program, Overland, Camelot, Settler CL, Robidoux, and McGill were released. Overland has good native resistance to FHB. McGill appears to have above average native resistance. Camelot was identified as having an average level of resistance (no progress over what was grown previously). Settler CL and Robidoux will be grown in regions where FHB is rarely present. Everest, the first Kansas winter wheat cultivar with resistance to FHB was also released during this period of funding.

In addition to the release of varieties with resistance to FHB, individual and/or regional (Kansas, Nebraska, and South Dakota) HWW breeding lines have been phenotyped in the field for resistance to FHB each year since the 2000-2001 season. Field phenotyping nurseries for private company breeding programs in the HWW region have been established since the 2009-2010 season. Similar nursery trials have been conducted in North Dakota, and the results have been shared as part of structured outreach activities with growers.

Multiple fungicide field tests have been established since the 2004-2005 season, and many of these were conducted to determine the effect of genetic FHB resistance when combined with fungicide treatment. Much of these data have been shared with producers to help them make informed decisions when they face the risk of growing HWW in areas that typically result in losses due to FHB.

Breeders and the regional genotyping lab at Manhattan, KS collaborated to transfer *Fhb1* into Wesley, Harding and Trego using MAS, and resistant lines with *Fhb1* have been selected within each background. Selected lines have been released to several HWW breeding programs for yield evaluations and use as parents in crosses. The *Fhb1* QTL and several other FHB resistance QTL have been transferred into the HWW varieties Jagger, Overley and Overland. Additional selections for lines with resistance are in progress. Near-isogenic lines in a US winter wheat Clark background were developed with *Fhb1* using seven marker-assisted backcrosses. Selected backcross lines were used to determine a protein profile intended to identify a key protein that is associated with FHB resistance, and these lines are being tested for any potential yield drag that may be associated with the *Fhb1* QTL. The QTL from several Asian germplasm sources with resistance to FHB were mapped and several SNP markers were identified for *Fhb1*. These markers have been released to the USDA Genotyping Lab in North Carolina and to Pioneer International for their use in MAS as applied to soft winter wheat.

### **Representative Regional FHB Publications (2008-present):**

1. Amy N. Bernardo, Hongxiang Ma, Dadong Zhang, and Guihua Bai. 2011. Single Nucleotide Polymorphism in Wheat Chromosome Region Harboring *Fhb1* for Fusarium Head Blight Resistance. *Mol Breed.* (In press).
2. Graybosch, R. A. C.J. Peterson, P. S. Baenziger, D. D. Baltensperger, L. A. Nelson, Y. Jin, J. Kolmer, B. Seabourn, and B. Beecher. Registration of 'Anton' hard red winter wheat. *Journal of Plant Registrations.* (In Press).
3. Baenziger, P.S., R. A. Graybosch, L. A. Nelson, T. Regassa, R. N. Klein, D. D. Baltensperger, D. K. Santra, A. M. H. Ibrahim, W. Berzonsky, J. M. Krall, L. Xu, S. N. Wegulo, M. L. Bernards, Y. Jin, J. Kolmer, J. H. Hatchett, Ming-Shun Chen, and Guihua Bai. 2011. Registration of 'NH03614 CL' Wheat. *J. Plant Registrations* 5: 75-80.
4. Malla, S., A.M.H. Ibrahim, Y. Yen, W. Berzonsky, K.D. Glover, J. Stein. QTL Analysis of a Putative Novel Source of Resistance to *Fusarium* Head Blight in Hard Winter Wheat. *Int. J. Plant Breed.* (In press).
5. Tao Li, Guihua Bai, Shuangye Wu and Shiliang Gu. 2011. Quantitative Trait Loci for Resistance to Fusarium Head Blight in a Chinese Wheat Landrace Haiyanzhong. *Theor Appl Genet.* DOI 10.1007/s00122-011-1549-0.
6. Tao Li, Guihua Bai, Shuangye Wu and Shiliang Gu. 2011. Quantitative Trait Loci for Resistance to Fusarium Head Blight in a Chinese Wheat Landrace Huangfangzhu. *Mol Breed.* (Submitted).
7. Jayatilake DV, Bai GH, and Dong YH. 2011. A novel quantitative trait locus for Fusarium head blight resistance in chromosome 7A of wheat. *Theor Appl Genet.* 122:1189-1198.
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### **What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

The HWW-CP will determine if *Fhb1* is responsible for any yield drag in winter wheat, and this QTL along with the 5A QTL for resistance to FHB will be introduced into advanced breeding lines. A Wesley *Fhb1* backcross derived breeding line with suitable agronomic characteristics will be released for NE and SD or made available as FHB resistant germplasm.

All programs in the HWW region will continue to improve the levels of resistance to FHB in their breeding lines. Therefore, field nurseries and assessing the resistance of breeding lines will be continued at multiple locations within the region. These nurseries not only provide important information to the breeders and geneticists, but they provide wheat producers with up-to-date and accurate data on the reactions of regionally adapted varieties. Field fungicide testing experiments will be continued to enable the collection of important data for wheat extension specialists and producers.

Germplasm having *Fhb1* plus an additional QTL in Jagger, Overlay and Overland backgrounds will be released to breeders for additional yield tests and for use as parents in crosses. Linkage mapping and association mapping will be used to identify QTL in US HWW germplasm. Linkage mapping will focus on Heyne and association mapping will be conducted using elite HWW breeding lines and varieties. Using greenhouse and field evaluations, resistant lines will be identified from among 400 new HWW breeding lines and varieties, and these lines will be recommended for use as parents in breeding programs.

### **3. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

It is clear that relative to other CPs and regions, the HWW-CP has had less funding. This is disconcerting considering the acreage of hard winter wheat and the prevalent risk of FHB in the region as well as the importance of the crop to growers, millers, and bakers. It is difficult to compare or predict how the HWW-CP would reach its goals more quickly when one reflects on the difficulties that the spring wheat and barley RAs/CPs have had with more funding and much shorter breeding cycles.

The most recent individual funding request on behalf of the newly re-established breeding program at North Dakota State University was two times the amount of any of the existing programs in the region. The HWW-CP Committee considered this request disproportionately high, yet it recognizes the need to support this program as it is established, expands, and

addresses the FHB problems facing current and future winter wheat producers in both North Dakota and Minnesota. The HWW-CP has been successful and will continue to be successful by coupling activities that focus on plant genetics, application of MAS, fungicide efficacy, and cropping systems. These collaborations need to be strengthened in the region. If funding is not significantly increased to at least reflect the expanded nature of the collaborations, perhaps each program should breed for agronomic and end-use quality traits, seek genotyping of all parents and relevant populations for known FHB QTL, and establish a single, centralized structure to backcross these FHB sources into regionally adapted genotypes. Superior lines and backcross derivatives from this process could be evaluated for resistance in combination with fungicide applications and best management practices.

**Additional Comments:**

The HWW-CP Committee and its members suggest that the USWBSI consider a more logical way of allocating funding, one that is based upon expected future FHB incidence and loss. This might entail summarizing the potential number of production acres that could be affected, the frequency of FHB epidemics in a region, and the value of the crop throughout the grain industry. The USWBSI has been in existence for many years, and to maintain, if not increase funding to the initiative, it is imperative that each RA/CP document success. A reasonable progression of research that will benefit producers, millers, and bakers, would be evolving from an aggressive forward breeding effort, to a maintenance breeding effort. As part of this evolution, major resistance QTL in some of the wheat classes should be rapidly and efficiently pyramided and deployed throughout the germplasm base.

**RESEARCH UPDATE AND QUESTIONNAIRE FOR DUR-CP  
RA/CP LEADERS – FY12-13 WORKING CAPS**

Summary of Funding (FY10) for DUR-CP	
Total # of Projects	Total Amount Awarded
6	\$ 281,735

**1. How do you define success for your RA/CP? Please be specific.**

The DUR-CP has met periodically to discuss and plan our research each year. A productive collaboration network consisting of a durum breeder, geneticists, pathologists, and cereal quality and extension scientists has been established within this CP. The following have been identified as recent success for the DUR-CP:

- Variety and Germplasm Development
  - Released three durum cultivars with improved FHB resistance, including Divide, Alkabo, and Grenora. In 2010, collectively the three cultivars were grown on 43.1% of the durum acreage in North Dakota, **generating approximately 3.5 million dollars additional income to ND.** (Elias, Manthey)
  - Identified three Tunisian lines with FHB resistance from durum accessions maintained in ICARDA. One of them (Tun. 7) has exhibited a level of resistance comparable to Sumai 3 in the greenhouse. Hundreds of introgression lines have been developed from this resistance source. Some of them have been evaluated in the Preliminary, Advanced, and Elite Advanced Yield Trials and Uniform Regional Nursery. (Elias, Kianian, Manthey)
  - Identified 19 cultivated emmer and 5 Persian wheat accessions with FHB resistance in multiple greenhouse and field evaluations. Eight advanced durum lines with improved FHB resistance were developed from these sources and provided to durum breeding programs for cultivar development. (Xu, Elias, Cai, Zhong)
  - Developed several hundreds of introgression lines at different generations from hexaploid resistance sources, including Sumai 3, Wangshuibai, Frontana, and several other hexaploid wheat accessions with alien FHB resistance genes. Several advanced durum breeding lines have exhibited improved FHB resistance. Further improvement of these lines for quality is needed before releasing as cultivars. (Elias, Cai, Xu, Zhong, Chao)
  - Identified a hexaploid wheat line with FHB resistance comparable to Sumai 3, which was derived from *T. timopheevii*. Several advanced durum lines with improved FHB resistance have been developed from this resistance source. (Xu, Cai, Elias, Zhong)
  
- Molecular Mapping and Marker Development
  - A major FHB resistance QTL (*Qfhs.ndsu-5BL*) was identified and mapped in the Tunisian lines. Molecular markers tagging the QTL have been developed and used for MAS. (Kianian, Elias).
  - Identified three major FHB resistance QTL (*Qfhs.ndsu-3AS*, one on 7AL, and one on 6BS) from three wild emmer wheat accessions. A fine linkage map has been constructed for *Qfhs.ndsu-3AS* and user-friendly molecular markers have been developed and used for MAS. These three resistance QTL have been pyramided in the durum cultivar Divide. Evaluation of the Divide-derived introgression lines for FHB resistance is underway in the greenhouse and field. (Kianian, Cai, Xu, Faris, Elias, Zhong)

- Identified and mapped two major FHB resistance QTL on chromosome 5A possibly derived from *T. timopheevii*. Molecular markers tagging the QTL have been developed and used for MAS in germplasm and cultivar development. (Xu, Zhong)
- We have found that FHB resistant QTL exhibit less effectiveness of resistance in durum than hexaploid wheat and developed two working hypotheses based on these preliminary results. First hypothesis postulates that a suppressor gene, which suppresses the effect of FHB resistant QTL, might present in durum. Second hypothesis (i.e. D-genome booster) postulates that D genome of hexaploid wheat might contain a gene or genes to boost effectiveness of resistance QTL. We have been designing experiments to test these two hypotheses (Xu, Cai, Kianian).
- All molecular markers we have developed in this CP have been provided to the USDA-ARS Genotyping Center in Fargo for genotyping and MAS (Kianian, Cai, Xu, Chao)
- FHB Management
  - Demonstrated a 50% reduction in FHB severity and 25-100% reduction in DON with optimum fungicide use at Carrington and Langdon Research Extension Centers, in uniform fungicide trials in ND. (McMullen, Schatz)
  - Durum integrated management study demonstrated that the cultivar Divide gave the lowest DON and FHB severity among the durum cultivars. Prosaro fungicide significantly reduced FHB severity and DON, and canola as the previous crop significantly increased yield over wheat as previous crop. (McMullen, Halley)

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

- a) Released three cultivars Divide, Grenora, and Alkabo that are less susceptible to FHB than the older cultivars Since 2005. Collectively these three cultivars were grown on 43.1% of the durum acreage in ND 2010. (Elias, Manthy)
- b) Identified Tun. 7 durum line as a good source of FHB resistant that is being incorporated into adapted durum backgrounds. (Elias, Kianian, Zhong)
- c) Developed several hundreds of durum experimental lines with improved resistance to FHB from Sumai 3, Wangshuibai, and the Tunisian lines. (Elias, Zhong, Kianian, Chao)
- d) Identified FHB resistance from emmer and Persian wheat and developed eight durum germplasm lines with improved FHB resistance from these resistance sources. Four of them have been provided to durum breeders for cultivar development in the US and Europe. (Xu, Zhong, Elias, Cai)
- e) Identified and mapped six novel FHB resistance QTL, including *Qfhs.ndsu-3AS*, *Qfhs.ndsu-5BL*, two on chromosome 5A, one on chromosome 7A, and one on chromosome 6B. A fine linkage map has been constructed for *Qfhs.ndsu-3AS*. Molecular markers tagging these QTL have been developed and made available for MAS in the germplasm and cultivar development. (Kianian, Cai, Xu, Faris, Zhong, Elias)
- f) Developed several advanced introgression lines containing the novel resistance QTL on 5A in the 'Lebsock' background. (Xu, Elias, Cai, Zhong, Friesen, Halley, Chao)
- g) Developed a large number of introgression lines at different generations from several other sources of resistance. (Elias, Cai, Zhong, Xu, Kianian, Chao)
- h) Developed several introgression lines with three FHB resistance QTL derived from wild emmer wheat by MAS. (Xu, Faris, Zhong)
- i) Publications (FY09-10) (Peer-reviewed articles, proceeding papers, abstracts, and book chapters) – 15

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

The ultimate goal of the DUR-CP is to release durum cultivars with improved FHB resistance for producers and pasta industries. We will cooperatively work as a team to:

- a) Screen durum populations/experimental lines for FHB resistance in greenhouses and irrigated field nurseries (Action VDHR goal 2).
- b) Evaluate over 1,000 experimental lines for DON each year (Action VDHR goal 2).
- c) Collect and use 4-5 thousands molecular marker genotyping data points for selection by collaborating with the USDA-ARS genotyping center in Fargo, ND (Action VDHR goal 2).
- d) Evaluate 800 identified FHB resistant lines for quality (Action VDHR goal 2).
- e) Develop 15-20 new populations by crossing adapted germplasm to newly identified sources of resistance (Action VDHR goal 3).
- f) Evaluate 200 *T. timopheevii* accessions for FHB resistance to identify new sources of resistance (Action VDHR goals 3).
- g) Screen 2,000 durum accessions from ICARDA for FHB resistance in China (Action VDHR goal 3).
- h) Re-evaluate in the greenhouse the accessions that exhibited some level of resistance in the preliminary screening in China (Action VDHR goal 3).
- i) Haplotype and initiate mapping of identified sources of resistance.
- j) Develop 10-15 elite durum wheat germplasm lines with improved agronomic performance and FHB resistance from the emmer and Persian wheat accessions identified resistant to FHB.
- k) Continue developing durum germplasm lines with improved resistance from hexaploid wheat.
- l) Continue incorporating the source of resistance from the Tunisian lines into adapted germplasm (Action VDHR goal 1-3).
- m) Test two hypotheses – Suppressor gene on 2A and D-genome booster effect as explanation of durum's increased susceptibility comparing with hexaploid wheat.
- n) Continue promoting/updating ScabSmart ([www.scabsmart.org/](http://www.scabsmart.org/)), so producers can use the information effectively to grow cultivars that are less susceptible to FHB. Continue to support the sign-up for use of FHB Alerts
- o) Increase the acreage of the FHB less susceptible cultivars such as Divide, Grenora, and Alkabo.

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

- Do accounting in a two-year cycle rather than one-year.
- Allow at least 10% carryover without penalty to ensure continuity of employment of research personnel.

**Additional Comments:**

**RESEARCH UPDATE AND QUESTIONNAIRE FOR BAR-CP  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for BAR-CP</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
18 <small>(includes all components of multi-PI projects)</small>	\$ 691,301

**1. How do you define success for your RA/CP? Please be specific.**

- a. Production of effective tools by researchers that can be implemented by stakeholders to minimize risk of FHB to barley. These include varieties with enhanced resistance, effective management strategies, disease forecasting models, and effective communication tools (eg. ScabSmart)
  
- b. Adoption of tools by Stakeholders as measured by acres planted to varieties with enhanced resistance, adoption of best management practices, and use of DON forecasting models, ScabSmart, etc.
  
- c. Production of new knowledge that will sustain future progress toward improving and developing tools. These would include new genes for resistance, better strategies to select for resistance and accelerate breeding, better understanding of host pathogen interaction to provide insight into genetic disease resistance mechanisms, identification of transgenes that reduce FHB and/or DON in replicated field trials, new parents that carry novel resistance genes and associated marker information.

**2. As we enter into year 5 of the Action Plan, what ‘Outputs’ have been produced?**

New variety Quest with lower DON, multi-location transgenic nursery that produces reliable data, identified a barley UDP-glucosyltransferase gene that detoxifies DON, marker information that is being implemented for MAS and genomic selection, accurate DON forecasting model, two transgenic lines showing approx. 40% less DON than Conlon (4 years of inoculated field tests) have been crossed to Quest and ND20448, six-rowed mutant of two resistant source CI4196, and BAC contig covering Chr 2H bin 10 QTL region

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

Two new variety candidates with enhanced FHB resistance entered into industry plant-scale brewing evaluations, 10 new variety candidates entered

into industry pilot malt evaluations, evaluation of the effectiveness of genomic selection to enhance FHB resistance and lower DON, improved genomic selection model, recombinant lines carrying the resistance allele from CI4196 that are otherwise agronomically normal and diagnostic markers that tag the QTL, identification of 10 new genes as targets for barley transformation, evaluation of up to 10 genes for disease resistance in transgenic barley, initial evaluation of elite breeding lines carrying a transgene for lower DON, identification of resistant lines from advanced backcross mapping population used as parents in breeding with associated marker information, crossing additional transgenic lines with elite breeding lines, additional assessment of DON forecasting model accuracy, and better understanding of the role of trichomes in disease development in barley.

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

Current structure seems to work fine.

**Additional Comments:**



**RESEARCH UPDATE AND QUESTIONNAIRE FOR VDHR-SPR  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for VDHR-SPR</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
16	\$ 575,710

**1. How do you define success for your RA/CP? Please be specific.**

- Increased area planted to cultivars rated MR or better
- Release of new cultivars with MR rating as well as good agronomic and end-use quality characteristics
- Greater collaboration among research and breeding programs
- Increased disease screening nurseries
- Increased DON testing capacity
- Identification novel resistance sources

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

- Release of 'Tom', 'Sabin', 'Rollag' (MN); 'Faller', 'Barlow', 'Prosper' (ND); 'Brick', 'Select' (SD)
- Many potential releases are at various stages of the breeding programs
- Identified several non-FHB1 sources of resistance
- Germplasm exchange through URSN

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

- Continue to develop cultivars with better resistance
- Reduce prevalence of susceptible cultivars in the region to a minimum
- Identify new QTLs that contribute to resistance
- Incorporate / pyramid new sources of resistance into germplasm
- Continue to refine screening methods
- More emphasis on MAS
- Select germplasm with low DON accumulation
- Discover / validate new molecular markers for existing genes
- Continue with URSN participation
- Continue to pursue an integrated management approach, that includes cultivar resistance and agronomic management

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

- Recognize that the economic impact and potential for outbreaks is still the highest in the HRS region which should be reflected in funding allocations
- Further mechanisms to increase awareness for growers to eliminate susceptible cultivars and encourage them to grow more resistant cultivars through different channels (field days, flyers, Scab Smart,...etc)
- Two-year funding cycle seems preferred over single-year funding cycle

**Additional Comments:**

**RESEARCH UPDATE AND QUESTIONNAIRE FOR VDHR-NWW  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for VDHR-NWW</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
41 (includes all components of multi-PI projects)	\$ 657,704

**1. How do you define success for your RA/CP? Please be specific.**

Our CP covers both applied and basic objectives so our definition of success varies. For our most applied objectives our primary measure of success is release of new cultivars with FHB resistance. Related to that objective is increasing the frequency of breeding lines with good FHB resistance. We have had good success using either criteria. There is always an interest in judging success by the acreage planted to USWBSI developed varieties. Unfortunately such data is not available in most of our states.

Our more basic research generally involves genetic analysis of FHB resistance, particularly from native sources. Success in these endeavors can be defined as developing breeding-friendly marker systems that can be used to pyramid FHB resistance QTL or enhance breeding for FHB resistance. This requires testing relevant populations, identification of useful QTL and then development of suitable markers. We have been successful in developing the populations but do not control what QTL we discover, and thus their ultimate utility in breeding.

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

**Here are outputs relative to research priorities from the action plan in the three years we have been grouped into the CP.**

- 1. Increase acreage planted to varieties exhibiting improved FHB resistance.*

As mentioned above, we can not collect this information in most states in the eastern US. Several new cultivars have been released since the beginning of the CP, including eight reported in FY10. In addition, the seed of at least 30 promising breeding lines have been increased.

Each year I estimate that over 6,500 breeding lines are phenotyped in the field for FHB for a total of about 18,500 in the first three years of the CP. Many of these enter the uniform scab tests and other uniform trials. From the 2008 to the 2011 season the NUWWSNs have screened 447 entries for FHB resistance. In addition, our CP routinely screens entries in the Uniform Southern, Uniform Eastern, Five states, Mason-Dixon, and Uniform white wheat tests for FHB resistance. Using principal component analysis of 2010 data from these seven uniform trials, we estimate that 14% have resistance equal to Truman while 45% have resistance equal to Freedom. The figure below shows that FHB index and DON levels have steadily declined in the NUWWSNs since 2001. Much of this increase in resistance is due to phenotypic selection using native resistance. Marker-assisted selection for QTL on 3BS, 5AS, 3Bc, and a few others have had some impact and this should increase significantly in the next several years. Clearly our selection has greatly improved FHB resistance.

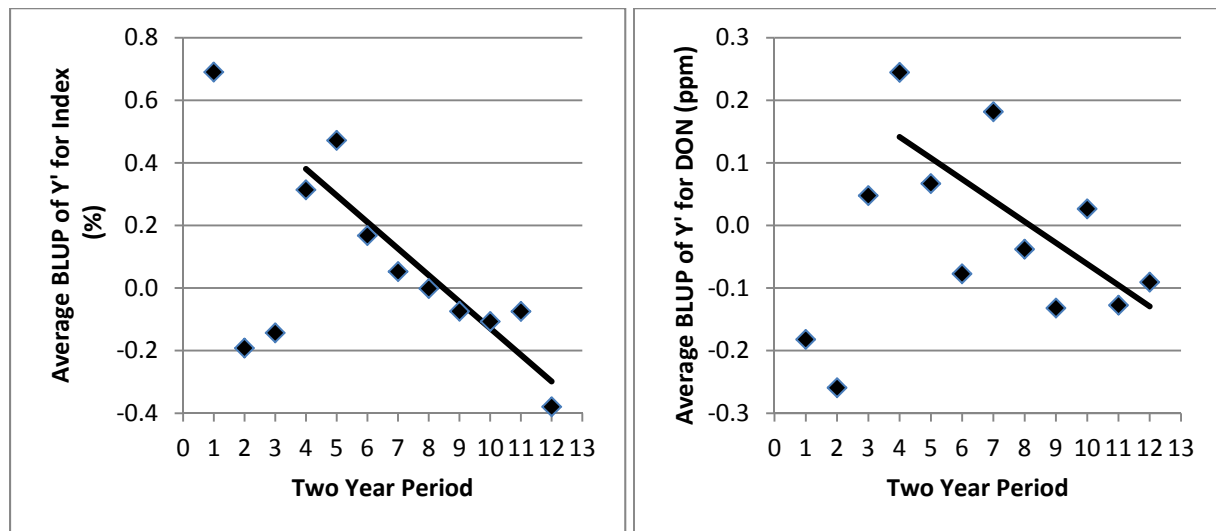


Figure 1. Average standardized Index and DON ( $Y'$  = value of a genotype - mean or MR checks) for lines in the NUWWSNs for two year periods starting in 1998 and going to 2010 (eg period 1 = 1998+99, 2=1999-00, ... 12=2009+10).  $R^2$  values for Index was 0.86 and it was 0.52 when the regression used periods 4-12.

In addition to screening breeding lines, each cooperator in the CP screens all the entries in their states official variety trial. That information is made available to all growers via state communication tools and Scab Smart.

## 2. Increase efficiency of individual breeding programs to develop and release FHB resistant varieties.

We are progressing on developing a database for soft wheat performance. Data from 1998-2010 from the three uniform scab nurseries, plus seven other uniform trials (those mentioned above plus the Gulf-Atlantic Wheat Nursery) has been collated into one data base. We are now close to contracting with a programmer to develop a user interface for the data base. The data base will make it easy to find all data on entries (FHB, Yield, Quality, etc) and that will improve parent selection.

We have used MAS in many F2-F4 and F2 enrichment schemes. In addition, many programs in the CP have been BCing FHB QTLs into multiple recurrent parents. We can now start to cross among these QTL-enhanced parents and forgo MAS in the progeny as all will have the desired QTL. This approach will reduce the average scab of the populations and improve our chance of finding truly superior FHB resistance. In our current CP we will be assessing the impact of these QTL on FHB resistance and yield in soft winter wheat (SWW) genetic backgrounds.

Soft winter wheat enjoys a high level of native resistance. We are attempting to map some of this resistance and determine if there are large-effect QTL suitable for MAS. With the three years of the CP we have mapped some additional FHB traits from Ernie, and assessed QTL in the populations Truman/MO94-317, IL97-1828/Clark and NY91017-8080/Caledonia population. Results to date indicate the resistance from IL97-1828 is mainly due to small effect QTL. Truman appears to have a large effect QTL for severity assessed in the greenhouse but the field data has not been analyzed. Determining the Truman QTLs is very important as many projects have used Truman or its resistant full-sibs as parents. Populations are in place to immediately use MAS for the Truman genes when they are reported.

We have conducted studies on the interaction of host genotypes with different levels of FHB resistance and fungicide on FHB and DON. This will help us determine what levels of host resistance are adequate to produce low DON in an integrated, best management practice program.

3. *Develop new breeding technologies and germplasm to further enhance short term and long term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding germplasm.*

The project has constructed germplasm to assess the value of the *Qfhs.pur-7EL* in the field and greenhouse. To date this QTL has been shown to complement *Fhb1* to improve type I and II resistance. Winter and spring germplasm will soon be available for crossing.

We have initiated a project to do association mapping and genomic selection for FHB resistance in SRWW. A set of 749 SWW have been assembled and planted for phenotyping this spring. The genetic base is nearly all SWW and derived from 14 SWW, including four that are parents of bi-parental mapping populations (see Fig 2). The lines will be genotyped with either DArT or SNP markers and genomic selection models will be trained. These models should have application to our SWW breeding programs and initiate our use of genomic selection to improve FHB resistance.

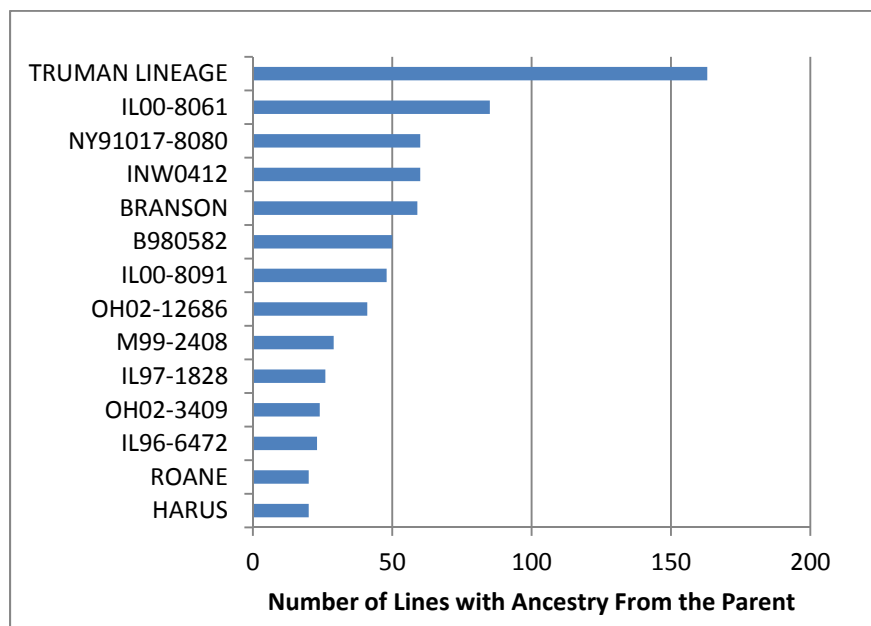


Fig 2. Source of resistant parentage of the 749 lines in the Association Mapping/Genomic Selection study

We developed male-sterile (MS) populations adapted to all regions of the SWW growing regions. These populations have been distributed to all PIs in the NWW and SWW CPs. The PIs will now mate the regional MS-population them to local high-yield lines with good FHB to initiate more recombination.

### 3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?

- Release four or more FHB resistant varieties
- Increase seed of 40 breeding lines that candidates for release due to their FHB resistance and yield
- Assess the FHB resistance of over 12,000 breeding lines

- Assess the FHB resistance of all commercially available cultivars
- Complete data base interface and keep updating the data base with new performance information
- Complete mapping of QTL from Truman and NY91017-8080
- Map type I resistance from INW0412
- Begin incorporating the *Qfhs.pur-7EL* into elite germplasm
- Begin selection in populations fixed for Fhb1 and other FHB QTLs
- Further populations that pyramid FHB QTL, including new QTL from Truman
- Complete association mapping of FHB QTL in adapted SWW populations
- Develop and begin using genomic selection models to improve FHB resistance
- Assess the extent of resistance to kernel infection and to toxin accumulation in SWW
- Initiate recurrent selection with the male-sterile populations

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

- Maintain current funding
- High-throughput SNP genotyping to facilitate genomic selection

**Additional Comments:**

**RESEARCH UPDATE AND QUESTIONNAIRE FOR VDHR-SWW  
RA/CP LEADERS – FY12-13 WORKING CAPS**

<b>Summary of Funding (FY10) for VDHR-SWW</b>	
<b>Total # of Projects</b>	<b>Total Amount Awarded</b>
6	\$ 397,479

**1. How do you define success for your RA/CP? Please be specific.**

Development and release of varieties with improved FHB resistance and breeding lines with improved FHB resistance being increased for commercial release for the Southern US.

Increased collaboration across breeding programs in mapping FHB resistance and development of germplasm with enhanced FHB resistance.

Comprehensive testing of breeding lines and commercial varieties and posting of results online.

**2. As we enter into year 5 of the Action Plan, what ‘Outputs’ have been produced?**

Several germplasm lines and commercial varieties have been released with enhanced FHB resistance, such as ‘Jamestown’, ‘SS 5205’, and ‘SW049029104’, ‘Tribute’, ‘MD01W233-06-1’, and ‘VA04-90’.

Posting of results online of FHB evaluations of current commercial varieties and breeding lines.

**3. What does your RA/CP realistically expect to accomplish during the next two year-funding cycle?**

Most of the currently funded projects started in the previous cycle and are mostly just getting started. These will continue in the next 2-year cycle to reach completion. For example, the evaluation of scab resistance in MD01W233-06-1 and the association mapping study of Roane and Jamestown populations in the Southern CP. These evaluations are being done cooperatively across several programs in the region (VA, MD, NC, GA, LA). Additionally, initiate the development of regional wheat breeding populations segregating for FHB resistance QTL. Generate doubled haploid lines and distribute them to all participating breeding programs.

**4. What changes (in funding, structure, other factors) would allow your RA/CP to reach its goals more quickly?**

Ability to generate doubled haploids and carry out more comprehensive DNA marker evaluation for the development of regional wheat breeding populations segregating for FHB resistance QTL would be helpful in speeding up variety development.

**Additional Comments:**