

FY10 Program Descriptions and Research Priorities/Objectives

Barley Coordinated Project (BAR-CP)

Project Description:

Minimizing the impact of Fusarium head blight (FHB) on barley production in the U.S. requires a multi-dimensional, yet focused and coordinated research effort. The Barley Coordinated Project (CP) seeks to combine existing lines of productive research with new avenues of investigation to develop a set of tools and disease management strategies that will minimize disease risk to producers and end-users of barley (Figure 1 - http://scabusa.org/pdfs/bar-cp_flow-chart.pdf). This toolbox will consist of: 1) varieties with enhanced levels of resistance to FHB, lower levels of deoxynivalenol (DON), superior agronomic performance, and good end-use quality; 2) chemical formulations, application procedures, and a disease forecasting model, that maximize fungicide efficacy; 3) residue management strategies that reduce the potential of pathogen inoculum to contribute to disease epidemics; and 4) a set of best management practices that incorporate our current understanding of the tools available to combat this disease.

Research Objectives:

The Barley CP is organized around four of the Research Areas (RA) outlined in the USWBSI Action Plan. A set of 10 objectives are established within these four RA.

I. Variety Development and Host Resistance (VDHR)

- Objective 1. Screen available *Hordeum* germplasm for novel sources of resistance.
- Objective 2. Map novel QTL for resistance to FHB in barley.
- Objective 3. Validate and fine map FHB resistance QTL.
- Objective 4. Develop new barley varieties with enhanced resistance to FHB and lower DON.

II. Gene Discovery and Engineering Resistance (GDER)

- Objective 5. Identify barley genes differentially regulated in the barley-*Fusarium* interaction.
- Objective 6. Evaluate promising transgenes in adapted genetic backgrounds in regional nurseries.

III. Pathogen Biology and Genetics (PBG)

- Objective 7. Investigate host genotype x pathogen interaction for infection, spread, disease development, and accumulation of DON.

IV. FHB Management (MGMT)

- Objective 8. Elucidate the epidemiology of colonization and survival of *Fusarium graminearum* on host tissue, disease development, and toxin accumulation.
- Objective 9. Develop and evaluate chemical/biological management strategies that reduce FHB and/or DON in barley.
- Objective 10. Develop and promote best management strategies through integrated disease management.

DURUM COORDINATED PROJECT (DUR-CP)

Project Description:

Fusarium head blight (FHB) caused by the fungus *Fusarium graminearum* Schwabe (telomorph *Gibberella zeae* (Schwein.) Petch. has been seriously attacking durum wheat (*Triticum turgidum* L. var. *durum*) in North Dakota and the surrounding states. There is continuous decline in harvested durum acreage and production in the durum producing area in the United States because of FHB. Fungicides may reduce the disease but the most environmentally safe and economical way to control the disease is with genetic resistance. A durum Coordinated Project (CP) has been created under the direction of the USWBSI to accomplish the initiative action plans. The CP's main objective is to develop FHB resistant durum wheat germplasm (lines/cultivars) with low DON levels, good agronomic traits, and good quality traits that will serve the producers, the domestic pasta industry, and the international export market. Reducing the impact of FHB requires a multidisciplinary effort and therefore the CP includes plant breeders, pathologists, geneticists, and researchers working in the area of disease management. The CP also includes stakeholders such as millers and pasta manufactures.

Research Objectives for FY10:

1. Search for novel sources of resistance to FHB in durum and its tetraploid relatives.
2. Identify, map, and validate FHB resistance QTL in the newly identified sources of resistance and develop user-friendly molecular markers to assist selection in durum breeding and germplasm development.
3. Incorporate FHB resistance QTL from tetraploid and hexaploid wheat accessions into adapted durum backgrounds and develop elite durum germplasm with the assistance of molecular markers in selection.
4. Develop durum varieties with enhanced level of FHB resistance and reduced DON accumulation.
5. Investigate host genotype x pathogen chemotype/genotype interaction for FHB and DON.
6. Evaluate chemical management strategies that reduce FHB and/or DON in durum.
7. Develop and promote best management strategies through integrated disease management.

HARD WINTER WHEAT COORDINATED PROJECT (HWW-CP)

Project Description:

The HWW-CP is a scientifically lean coordinated project that will measure its success by one goal: 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 our grain is exported and the majority of the grain shipped to the EU is sourced from the scab prone regions of the HWW region (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. Based upon the timelines expected for success in reducing DON, we include predominantly plant breeders, pathologists, geneticists and those that support these activities. We work closely with those in disease management as we feel improved cultivars with improved management have the greatest potential for success within our timelines. Our germplasm, information, and all other activities are freely available to other researchers in other Research Areas. We fully support their efforts, but remain focused on reducing DON as quickly as possible. The membership of the HWW-CP includes: all researchers currently funded within the CP, individuals designated as representatives from other Research Areas, all interested FHB researchers who may or may not be funded by the Initiative, our stakeholders committee representing members from groups that fund us (e.g. the KS, NE, SD, and ND Wheat Commissions), and lastly, members of groups that are key to our industry, but do not fund us monetarily. These are the “independent” stakeholders and would include the major mills and bakeries, private wheat breeders, and chemical company representatives.

Research Objectives for FY10:

The HWW-CP is organized around one of the Research Areas (VDHR) as outlined in the USWBSI Action Plan. A set of four objectives are established within this CP. In addition, we intend to work closely with the other Research Areas (RA) as they provide information applicable to our stated goal of reducing DON to the level of required by the EU. Specifically we will work most closely with research coming from the FHB Management RA.

I. Variety Development and Host Resistance (VDHR)

- Objective 1. Increase acreage planted to varieties exhibiting improved FHB resistance.
- Objective 2. Increase efficiency of individual breeding programs to develop and release FHB resistant varieties.
- Objective 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.
- Objective 4. Expand the testing and evaluation of regional germplasm to include breeding lines from public and private breeding programs and to include irrigated field nurseries representative of all FHB environments throughout the region.

Related Research to the HWWCP of Immediate Importance:

II. FHB Management (MGMT)

- Objective 5. Characterize genotype x fungicide treatment responses for enhancing FHB resistance and the reduction of DON.
- Objective 6. Develop a full understanding of specific environmental and biological factors influencing infection and toxin accumulation.
- Objective 7. Enhance communication and end user education/outreach.

VARIETY DEVELOPMENT AND HOST RESISTANCE (VDHR)

FY10 Program Description:

The VDHR research area will be Uniform Nursery based in the case of soft winter wheat and spring wheat. States will be aligned with the uniform nurseries as follows: Uniform Regional Scab Nursery for Spring Wheat Parents (MN, ND, SD, MT); Uniform Northern Soft Winter Wheat FHB Screening Nursery (NY, MI, OH, IN, IL, MO, KY); Uniform Southern Soft Winter Wheat FHB Screening Nursery (NC, MD, VA, AR, GA, LA). VDHR research will be commodity-based in the case of barley, durum and hard winter wheat coordinated projects.

Each Uniform nursery will be coordinated by a regional committee, chaired by existing nursery coordinators. Nurseries will be conducted in collaboration with a pathologist wherever possible and a subset of promising entries may be grown at multiple locations in Integrated Management Trials. The nurseries will also be evaluated for milling and baking quality, and haplotyped at the USDA regional genotyping labs. The most promising lines may be entered in the nurseries for a second year of testing at the lines originator's request. Collaborators will submit candidate parents for crossing, and pre-breeding populations derived from these crosses/populations will be made available to all collaborators. Mapping of new resistance sources will be accomplished through joint phenotyping of populations. All collaborators must screen varieties planted commercially (>5% of wheat acreage) in their state for FHB resistance and provide this information to growers.

FY10 Research Priorities Derived from Action Plan Goals:

1. Increase acreage planted with varieties with improved FHB resistance to reduce DON in the US grain supply.
2. Increase efficiency of coordinated project breeding programs to develop and release FHB resistant varieties.
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.