CHEMICAL, BIOLOGICAL AND CULTURAL CONTROL (CBCC)

FY06 Program Description:

The Chemical, Biological and Cultural Control (CBCC) research area supports research to develop effective and economical disease management practices that reduce FHB severity and the level of DON in harvested grain to meet the immediate and long-term needs of wheat and barley growers for managing FHB. Practical outcomes of research in this area include: 1) The advancement of chemical and biological agents capable of suppressing or controlling Fusarium head blight on wheat (all classes) and barley; 2) Development of BCAs to prove efficacy against Fusarium head blight; 3) Formulated BCAs ready to market to producers; 4) Improved ground and aerial application technologies that enhance the efficacy of fungicides against FHB compared with standard commercial application practices; 5) Integrated disease management programs that enhance disease suppression over any one method of disease control.

This research area involves tillage practices, crop sequences, and other cultural practices; fungicides, biological control agents, and application techniques for those chemical and biological agents. Cultural control studies might include studies examining the influence of residue on disease development or other studies integrating disease management strategies. Fungicide efforts are focused on uniform field tests of the most promising fungicides on wheat, barley, and durum across multiple environments. The biological control aspect includes greenhouse and field testing of biological control agents (BCAs) that have been shown to be effective against FHB in preliminary tests, uniform field tests of the most promising BCAs in uniform tests across multiple environments, and formulation of BCAs that have commercial potential. The application portion involves comparison and modification of ground and aerial application equipment to determine the most effective methods for applying fungicides and BCAs and research on timing of applications, adjuvants, etc., that may enhance the efficacy of fungicides and BCAs.

ETIOLOGY, EPIDEMIOLOGY AND DISEASE FORECASTING (EEDF)

FY06 Program Description:

The Etiology, Epidemiology and Disease Forecasting research area supports studies on the relationship of causal organisms with the host at the cellular, tissue, whole organism (the plant), and population levels. Practical outcomes of research in this area are disease management decision tools and advanced knowledge pertaining to disease development.

Research at the cellular, tissue and whole organism level will address host pathogen interactions that elucidate the cause and progress of disease in the host and factors that condition the resistance/susceptibility response.

In addition, research at the whole plant level will focus on an understanding of the biology and development of the pathogens in relation to the host plants and may include studies of the physical, structural and chemical (including mycotoxin) components of disease development; and of host, pathogen and environment interactions.

At the population level research will address an understanding of epidemic development through examination of pathogen biology and environmental influences. The RA also supports studies on the refinement and deployment of disease simulation and forecasting models.

FOOD SAFETY, TOXICOLOGY AND UTILIZATION OF MYCOTOXIN-CONTAMINATED GRAIN (FSTU)

FY06 Program Description:

The Food Safety, Toxicology and Utilization of Mycotoxin-contaminated Grain (FSTU) research area supports research on food safety and food processing issues related to the presence of *Fusarium* spp. mycotoxins in wheat and barley grain. Practical outcomes of research in this area include: 1) improved toxicological data to assure that current guidelines are providing the appropriate safety factors for the consumer; 2) analytical tools that can be used by small grain producers, elevators, millers, and processors, to rapidly and reliably identify mycotoxin-contaminated grain; 3) develop appropriate strategies to deal with contaminated grain; and 4) diagnostic data on *Fusarium* spp. mycotoxins required for development of FHB resistant/tolerant varieties of wheat and barley.

This research area supports ongoing centralized *Fusarium* spp. toxins diagnostic services for all USWBSI research projects.

GENETIC ENGINEERING AND TRANSFORMATION (GET)

FY06 Program Description:

The Genetic Engineering and Transformation (GET) research area (RA) will focus primarily on development of transgenic wheat and barley with resistance to FHB. Practical outcomes of research in this area are FHB resistant transgenic plants and technologies for rapid deployment of the engineered resistance gene(s) by breeders.

Genetic transformation will be for the purpose of rapidly producing FHB resistant, commercially viable cultivars. Therefore, proposals should address success limiting issues; examples include the use of elite cultivars or breeding lines, adequate testing of transgene expression, gene stability and copy number, the rationale of defense strategy (e.g., DON- or *Fusarium*-tolerant plants vs. plants resistant to infection) and robust testing for FHB resistance. Science and affiliated technologies will focus on host plant resistance and will involve the introduction of non-host genes, altered/enhanced expression of host resistance genes, gene silencing and pyramiding of resistance genes. Antifungal genes shown to be effective in wheat, barley or other systems or genes identified by other disciplines, such as map-based cloning or epidemiology studies will be utilized.

HOST GENETICS AND GENOMICS (HGG)

FY06 Program Description:

The Host Genetics and Genomics (HGG) research area (RA) will focus on understanding the genetic/molecular basis of native host plant resistance. Practical outcomes of research in this area are science and technologies which inform and accelerate pre-breeding and breeding, and novel candidate genes for transformation leading to commercial, FHB resistant varieties.

This research area includes all elements of the former Biotechnology research area except those related to genetic engineering and transformation. This area also includes genetic studies of host resistance (except allelism testing), and marker validation studies previously covered in other areas.

Research in this area includes: 1) genetic (classical or molecular), genomic (structural, functional, or comparative), or proteomic studies leading to discovery and/or identification of diagnostic markers for, and/or the nucleotide sequence of genes conferring native host plant resistance; 2) studies of mechanisms of resistance/susceptibility with the aim of facilitating efforts to map and manipulate relevant genes, or identification of candidates for transgenic approaches to resistance, and 3) adaptive research which leads to novel 'breeder-friendly' (low cost, high throughput, etc.) diagnostic markers.

Research activities employing transformation should be submitted to the Genetic Engineering and Transformation (GET) research area (RA) as stand alone proposals.

HOST GENETIC RESOURCES (HGR)

FY06 Program Description:

The Host Genetic Resources (HGR) research area (RA) will focus on the assembly of all useful native host plant resistant genes in parent stocks of sufficient adaptation so that they can and will be successfully exploited by breeders. Practical outcomes of research in this area include the identification and characterization of novel sources of host plant resistance, and breeding parents having requisite agronomic and quality characteristics with one to several FHB resistance genes/QTL.

The predecessor to this research area (Germplasm Introduction and Enhancement) focused on discovery of novel host plant resistance through screening of germplasm collections. Pro-active, systematic screening of world genetic resources for genes with diverse and complementary effects remains a critical objective, particularly in barley and durum wheat. On the other hand, the Initiative's fundamental objective of practical solutions demands aggressive pursuit of proof of novelty and pre-breeding in those cases where multiple sources of resistance are already identified (e.g., common wheat).

Accordingly, this research area seeks projects targeting 1) discovery, 2) test of novelty (e.g., allelism testing), or 3) pre-breeding deployment of native host (or related species) genes which

confer resistance to FHB. Specific priorities depend on the state of progress in each of the targeted crop species. Employment and/or development of contemporary strategies and technologies (i.e., molecular markers) are considered critical to either tests of novelty or pre-breeding. Note that mapping or genomic oriented studies of new resistance sources will be conducted through the Host Genetics and Genomics Research Area.

The Initiative, through the HGR research area, also wishes to foster development of cutting edge strategies for aggressive application of molecular markers to accelerate variety development in our target crops. Accordingly, the Initiative specifically seeks competitive proposals involving the USDA-ARS Regional Cereal Genotyping centers and one or more plant breeding programs. These projects should be truly collaborative and multi-disciplinary, with high resolution, innovative strategies inclusive of clear milestones with timelines and specifically defined outcomes. Target outcomes can range from finished varieties to high value breeding parents containing one or more FHB resistance genes. A practical outcome of collaborative research among breeders and genotyping centers also will be to accelerate incorporation and pyramiding of diverse FHB resistance genes into potential varieties as well as improved parental lines.

PATHOGEN GENETICS AND GENOMICS (PGG)

FY06 Project Description:

The Pathogen Genetics and Genomics (PGG) research area (RA) supports studies on the genetics (classical, molecular, or population), genomics (structural, functional, or comparative), or proteomics of the causal organisms. Practical outcomes of research in this area include: 1) greater understanding of pathogen diversity and taxonomy which may inform grain crop breeding strategies and phytosanitary issues; and 2) increased understanding of pathogen biology that could lead to identification of innovative control strategies. These strategies could be implemented through novel types of resistant varieties, transgenic varieties, fungicides, biological controls, or cultural practices.

Research in this area includes studies that address pathogen diversity, taxonomy, life cycle functions, mycotoxin biosynthesis, and host/parasite interactions at the molecular level. Research should improve our fundamental understanding of the evolution, ecology, reproductive biology, pathogenicity and aggressiveness, and mycotoxin production of the pathogens. Basic information on pathogen gene regulation, developmental or metabolic pathways, or virulence mechanisms may be useful for developing novel control strategies. This research area also supports studies of the effects of host resistance mechanisms on the pathogen at the molecular level.

VARIETY DEVELOPMENT AND UNIFORM NURSERIES (VDUN)

FY06 Program Description:

The Variety Development and Uniform Nurseries (VDUN) research area (RA) will focus on wheat and barley plant breeding programs in FHB-threatened states. Commercially viable varieties which minimize economic loss from FHB are recognized by the USWBSI as an essential and critical research objective. Practical outcomes of research in this area are new, FHB resistant varieties.

Research in this area includes classical and emerging breeding technologies such as use of markers to confirm the presence of specific FHB resistance genes in advanced breeding lines on track for variety release. Projects should be multi-disciplinary, with high resolution, innovative strategies inclusive of clear milestones and timelines from which progress can subsequently be judged. Projects should also demonstrate awareness of developments in complementary research areas of the Initiative. Regional uniform testing nurseries will be conducted to verify putative resistance in multiple environments and promote access to diverse germplasm that is essential for efficient variety development. Projects are expected to participate in their regional uniform testing program.