

**US Wheat and Barley Scab Initiative**  
**Report of the Barley Coordinated Project Planning Meeting**  
**April 21, 2017**

**491 Borlaug Hall**  
**1991 Upper Buford Circle, St. Paul MN 55108**

**Participants:** Phil Bregitzer, Wynse Brooks (by phone), Robert Brueggeman (by phone), Mike Davis, Rich Horsley, Gongshe Hu, Doyle Lenz, Jolanta Menert (for Joshua Butler), Ali Moghimi (guest presenter), Gary Muehlbauer, Kevin Smith, Mark Sorrells (by phone), Paul Sadosky, Brian Steffenson, Frances Trail (by phone), and Marv Zutz.

**Purpose:** In the fall of 2017, the Barley Coordinated Project (CP) will submit a two-year proposal of coordinated research. The two major objectives of this meeting were to: 1) discuss CP research progress in the FY16-17 funding cycle; 2) discuss draft letters of intent (DLOIs), and 3) begin to formulate the new CP proposal for FY18-19. All DLOIs were distributed to members of the CP prior to the meeting.

Brian Steffenson opened the meeting and outlined the agenda for the day. Mike Davis briefed the group on the current status of funding for the USWBSI in Congress. The following is a general summary of the discussion points from the meeting.

**New Initiatives.** Patrick Hayes is a new member of the Barley CP. While Pat has worked on FHB in the past, this disease is currently not regarded as a major problem in Oregon at this time. Pat has ably served the barley community for many years by production of doubled haploid (DH) populations for various investigators. Private support for Pat's DH service recently ended. He is seeking to assist barley researchers through the production of DH populations with USWBSI funding. Some discussion was made about the needs of breeders for doubled haploid populations and how many lines could be generated by Pat's group per year.

**Breeding program updates.** Mark Sorrells (northeast region) gave an update on his FHB resistance breeding in New York. Progress is being made in the selection of FHB-resistant malting types that are adapted to New York. He outlined his plan for an expanded number of crosses in the coming season. He also extended his gratitude to all established FHB researchers who have shared germplasm and knowledge with him. Wynse Brooks (Mid-Atlantic region) indicated that FHB continues to be a major disease threat to barley production in the region. Native sources of FHB resistance have been detected in Virginia germplasm: e.g. in cultivars Nomini and Eve. However, other resistance sources are being used namely: Chevron, Fredrickson, Atahualpa, Island, AC Alberte, and elite genotypes including MN-Brite, Quest (M122), BC4-2459-1 and FEG4-98. Each year approximately 100 new FHB crosses are made, and 100 to 150 segregating populations are evaluated in an inoculated, mist-irrigated scab nursery. Marker assisted selection is being used to transfer resistance QTL in the Virginia germplasm. Interstate screening nurseries in KY, NC and VA have greatly aided the phenotyping efforts in the region. From the west region, Gongshe Hu summarized his progress in developing two-rowed barley for FHB resistance. Surprisingly, several lines from the Aberdeen program have native FHB resistance and one in American Malting Barley Association

(AMBA) plant scale testing showed lower levels of DON. Juliet Marshall, who works closely with breeders in the west, updated the group on the current status of FHB in her region and some of the problems encountered in obtaining reliable disease infection in screening nurseries. She is working out the methodology to obtain reliable screening nurseries for western breeding programs. From the Midwest, Rich Horsley and Kevin Smith gave updates on their progress in FHB resistance breeding. Rich indicated that all of the 6- and 2-rowed crosses made in the fall 2017 greenhouse have a least one adapted parent with improved FHB resistance and lower DON accumulation. The release of the cultivars 'Quest' (UM) and 'ND Genesis' (NDSU) have provided alternatives to popular cultivars, providing more production of barley with lower DON levels. ND Genesis accumulates about 22% less DON than Pinnacle and was added to the AMBA list of recommended varieties in 2016. It is expected that ND Genesis will be the most widely grown two-rowed variety in North Dakota in 2017. Kevin stated that current breeding lines in the Minnesota program exhibit modest levels of resistance to mycotoxin accumulation: ~50% (or less) DON accumulation compared to Robust. These lines trace back to multiple exotic sources of resistance and crossing among them should provide continued improvement in disease resistance. He is using genomic selection to select lines in early generations (F<sub>3</sub>) based on predictions for DON, yield, and some quality parameters. Initial indications of success in spring six-row breeding are encouraging and will be expanded to include the two-row breeding program. In FY18-19, Kevin and Shiaoman Chao will submit a separate project on introgressing favorable genomic regions from elite six-row breeding lines into two-row barley. Frankie Crutcher and Jamie Sherman were not able to join us by teleconference due to field planting.

**Molecular approaches to developing FHB resistant barley.** Gary Muehlbauer updated the group on the transgenic barley overexpressing a barley UDP-glucosyltransferase (*HvUGT13248*) transgene that exhibited high levels of resistance to DON in a root assay. He plans to examine the host response in these transgenics to DON inoculation and also for FHB resistance in the greenhouse and field. Guo-qing Song at Michigan State University's Plant Biotechnology Resource and Outreach Center is proposing to develop transgenic resistance to *Fusarium graminearum* in barley. The specific strategy involves small interference RNAs. Frances Trail discussed her work on using genes from the *Fusarium* pathogen to reduce inoculum and mycotoxin contamination. Specifically, spray-induced gene silencing can be an effective disease control with dsRNA molecules that target genes in the ergosterol biosynthesis pathway. She is investigating the use of five gene knock-out required for perithecia development. Some post-meeting discussions about the acceptance of GMO barley were made via email by Phil Bregitzer and Frances Trail.

**NABSEN/screening efforts.** Bob Brueggeman continues to organize the North American Barley Scab Evaluation Nursery and collating data for all breeders submitting entries. This nursery provides valuable data and will be continued in the next FY.

**Germplasm Screening.** Brian Steffenson indicated that there are still several germplasm collections that may be worth evaluation in the coming FY. The first is a collection of landraces from the IPK genebank in Germany and the second would be unique material not previously screened from the ICARDA collection. The latter collection is now accessible after the rescue of germplasm from the civil war in Syria.

**Mapping QTL for resistance to FHB and mycotoxin accumulation.** Robert Brueggeman is investigating the genetics of a Turkish line that may be a useful and unique source of FHB resistance. Introgression into ND Genesis and Conlon is in progress. Brian Steffenson will begin the phenotypic evaluations of the PI 350725/Quest advanced backcross population in 2017 and 2018. PI 350725 is a two-rowed accession from the Tirol in Austria with a resistance level comparable to Chevron. Both doubled haploid and recombinant inbred line populations have been developed for this population (n=498). An important aspect of this work has been that additional USWBSI funding for DH population development has accelerated progress in the development of these populations. Phil Bregitzer and colleagues propose developing mapping populations to characterize QTL for FHB resistance in western barley germplasm. The populations would involve crossing 95SR316A (good malt quality, stripe rust resistance) and/or 2Ab07-X031098-31 (excellent quality, currently in pilot malting testing) with ND-Genesis (to assess similarity/dissimilarity) and a Canadian line that is more susceptible but which will bring in resistance to scald.

**Genomic selection.** More breeding programs are adopting genomic selection as part of their standard methodology. Kevin Smith and colleagues are proposing another stand-alone project to develop and test methods to use genome-wide markers to optimize prediction accuracy and select effective parent combinations for resistance to FHB and DON accumulation in barley. Genomic selection can increase the efficiency of breeding, enabling shorter breeding cycle times.

**Special presentation.** Assessing the severity of FHB in field nurseries is laborious, time-consuming, expensive, and fraught with subjectivity. High-throughput phenotyping with both RGB and hyperspectral imaging holds great promise for increasing the accuracy and efficiency of screening both barley and wheat for FHB resistance. Ali Moghimi, a Ph.D. candidate in the Department of Bioproducts and Biosystems Engineering, gave a presentation on “Development of a high throughput phenotyping platform for assessing FHB severity in wheat and barley using RGB/hyper-spectral imaging.” This presentation was well-received by the group, and many questions were asked about the technology and when it could be deployed in practical use.