USWBSI Durum CP Planning Meeting Report

Fargo, ND
May 8, 2013

The 2013 Durum CP Planning meeting was held in Loftsgard Hall on the North Dakota State University Campus, Fargo, ND on May 8, 2013. The meeting was announced through the USWBSI FHB Listserv, both durum wheat stakeholders/growers and researchers were invited to attend. There were seven attendees present, including Elias Elias (NDSU), Xiwen Cai (NDSU), Shiaoman Chao (USDA-ARS), Joel Ransom (NDSU), Jason Axtman (NDSU), Steven Xu (USDA-ARS), and Shaobin Zhong (NDSU). Durum growers Louis Kuster (ND) and Bruce Freitag were unable to attend due to field planting. Shahryar Kianian (USDA-ARS) was unable to attend due to a scheduling conflict.

The meeting started with research progress updates presented by the individual PIs. Elias Elias's durum breeding program has made good progress in developing FHB-tolerant durum cultivars using native resistance sources. Since 2007, six new durum cultivars with tolerance or moderate resistance to FHB, including Divide, Alkabo, Grenora, Tioga, Carpio, and Joppa, have been developed and released. The new cultivar Joppa has the highest level of resistance with high yield and excellent quality. These cultivars have rapidly replaced the highly susceptible cultivars such as Mountrail and Lebsock. The upcoming cultivars in the release pipelines include advanced breeding lines with FHB resistance from hexaploid cultivar Sumai 3 and Tunisian durum lines. Adapted durum germplasm that is being used in breeding include lines derived from domesticated emmer, wild emmer, Tunisian lines, and durum accessions from Steven Xu, Xiwen Cai, Shahryar Kianian, and Elias Elias, respectively. For identifying sources of FHB resistance in durum wheat, 1,000 durum accessions were screened in China and 327 accessions selected and were evaluated for the second time.

Xiwen Cai updated the progress in transferring FHB resistance from hexaploid wheat to durum. Over 30 new hybrids have been made from crosses of four durum varieties with eight hexaploid FHB resistance sources. A total of 271 durum lines derived from different durum-hexaploid wheat crosses were evaluated for FHB resistance in the greenhouse and FHB nursery in Fargo, ND during the summer of 2012 in collaboration with Shaobin Zhong. The inheritance of the FHB resistance genes derived from hexaploid wheat in the durum backgrounds have been characterized with the use of molecular markers in collaboration with Shiaoman Chao. His group evaluated the FHB reaction of a complete set of Langdon (LDN) durum D-genome disomic substitution lines and found that FHB severity of LDN 5D(5A) was significantly lower than LDN and other substitution lines. Because LDN 5D(5A) had long and slim spikes due to the absence of the *Q* gene on chromosome 5A, it was suggested that the modified spike structure might contribute to the improvement of FHB resistance in LDN 5D(5A).

Shahryar Kianian sent his progress update by e-mail. Steven Xu made the presentation on behalf of Shahryar Kianian. His group has completed the analysis of a Tunisian 108 × Ben population and are nearing the completion of the Tun 108 × Lebsock lines for FHB resistance as well as FDK and DON phenotypic measures. They have identified a QTL in this material that explains a large portion of the phenotypic/genotypic variation. They already finished the analysis of the

other Tunisian lines which was published in Genes, Genome and Genetics last year. In the next year, they will wrap things up with regard to the Tunisian lines and convert the markers most closely associated with the important QTL regions to those that can easily be used by Elias' breeding program. They treated several durum cultivars with a chemical that removes CG methylation and found a large number of lines showing improved resistance, some being much better than the check lines that included Sumai3.

For the introgression of scab resistance from emmer and timopheevii wheat into durum wheat, Steven Xu's group evaluated 30 BC_1-derived advanced lines (BC_1F_{7-10}) and double haploid lines with improved FHB resistance, derived from crosses of adapted cultivars/experimental lines with *T. dicoccum*, *T. carthlicum*, and the hexaploid wheat line PI 277012, in the greenhouse and at three FHB nurseries in the summer of 2012 in collaboration with Elias Elias and Shaobin Zhong. Seven BC_1-derived advanced (BC_1F_{7-10}) lines and a DH line have been backcrossed with Tioga, Carpio, and Joppa. The BC_1F_2 progeny from 170 BC_1F_1 plants were evaluated in the greenhouse and in FHB field nurseries grown at three locations in North Dakota in the summer of 2012. Over 3,000 heads were selected from the three locations based on the disease evaluation and agronomic performance. In addition about 30 BC_1F_2 plants with improved FHB resistance were selected based on evaluations in the greenhouse. In order to transfer the 5A QTL derived from *T. timopheevii* PI 343447 into ND durum cultivars, the spring wheat germplasm TC67 carrying the 5A QTL from PI 343447 has been crossed and backcrossed with Divide, Tioga, Carpio, and Joppa.

Shaobin Zhong has evaluated all the *T. timopheevii* accessions. He identified several accessions with moderate level of resistance. He continues to provide FHB innoculum to several durum research groups at NDSU, including but not limited to the research groups of Xiwen Cai, Elias Elias, Steven Xu, and Sharyar Kianian.

The members then discussed research plans for the next 2-year cycle of funding. Elias Elias program will continue to identify new sources for resistance and to develop durum varieties with increased FHB resistance and excellent yield potential and overall quality. His program in addition to the native resistance will use all the best resistant germplasm lines developed by Xiwen Cai, Steven Xu, and Shahryar Kianian. In addition to FHB, the program is also targeting development of durum cultivars with low cadmium due to the new requirement. Xiwen Cai will continue to transfer FHB resistance from hexaploid wheat and wild species to durum. He will also characterize performance and inheritance of FHB resistance QTL in the durum genetic backgrounds and determine the effect of D-genome chromosomes on FHB resistance in durum. Shahryar Kianian will investigate what genes were turned on by the removal of CG methylation to improve resistance by RNAseq and methyl DNA sequencing analysis. He will cross the lines to parental cultivars to see if they will maintain the resistance and provide them to Elias's group for further introgression into advanced breeding lines.. Steven Xu will continue the introgression of FHB resistance from emmer and timopheevi wheat into durum and map the FHB resistance derived from emmer wheat using 9K SNP platform in Shiaoman Chao's lab. Shaobin Zhong will transfer FHB resistance from timopheevi to durum. He also plans to map and validate the FHB resistance in durum derived from hexaploid wheat PI 277012 from Steven Xu and native resistance from Joppa durum developed by Elias Elias. Using the new durum cultivars, Joel

Ransom plans to investigate fungicide by variety in order to establish the best fungicide application practice for durum growers.

The members also discussed budget issues and possible consequences, possible future collaborations between projects, and reviewed currently-available germplasm and genomic resources that could be further utilized for the improvement of FHB resistance in U.S. durum wheat. Through this meeting, we prioritized research items for the next funding cycle to strengthen collaboration and avoid possible duplication of efforts.