

Durum Wheat Coordinated Project Planning Meeting Report

Fargo, ND

3-26-2015

The 2015 Durum CP Planning meeting was held in Walster Hall (Plant Pathology Department) on the North Dakota State University Campus, Fargo, ND on March 26, 2015. The meeting was announced through the USWBSI FHB Listserv, and both durum wheat stakeholders/growers and researchers were invited to attend. There were nine attendees present, including Elias Elias (NDSU), Xiwen Cai (NDSU), Joel Ransom (NDSU), Shahryar Kianian (USDA-ARS), Steven Xu (USDA-ARS), Shaobin Zhong (NDSU), Joe Mullins (NDSU), Luis Kuster (ND durum wheat grower) and Randy Marten (Miller Milling Company).

The meeting started with research progress updates presented by the individual PIs:

Xiwen Cai updated the progress on introgression of FHB resistance from hexaploid wheat to durum:

- Developed 78 advanced durum introgression lines with improved FHB resistance and various agronomic characteristics;
- Developed 55 LDN durum lines that contain 1-2 different D-genome chromosomes from LDN-*Aegilops tauschii* amphiploid and evaluated their resistance to FHB.
- Developed new FHB-resistant recombinant lines that contain *Qfhs.ndsu-3AS* on reduced *T. dicoccoides* chromosomal segment. This has reduced linkage drag and made this resistance QTL more usable in durum breeding.
- Developed PCR-based molecular markers for *Qfhs.ndsu-3AS*.

Elias Elias reported the progress in developing FHB-tolerant durum cultivars and germplasm:

- Three new durum cultivars (Tioga, Carpio, and Joppa) with tolerance or moderate resistance to FHB have been released since 2010. The newly released 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.
- Advanced breeding lines with FHB resistance from hexaploid cultivar Sumai 3 and Tunisian durum lines are upcoming in the release pipelines. Some will be released as cultivars or improved germplasm soon.
- Adapted durum germplasm is being used in the durum breeding program, including those 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, additional durum accessions from ICARDA were screened in China and some accessions were selected for evaluation on the second time.

Shahryar Kianian updated the research progress on FHB resistance by epigenetic modification of durum cultivars:

- FHB resistance QTL on chromosome 5AL, 5BL, and 2BL identified in Tunisian lines are being pyramided into durum cultivar.
- The epigenetic changes of FHB resistant durum cultivars produced by altering the DNA methylation pattern have been characterized.
- Durum lines derived from popular durum cultivars missing portions of chromosome 2A region containing the FHB suppressor locus were developed.

Joe Ransom reported the experiments on the value of genetic resistance and fungicides on the control of FHB in durum in North Dakota:

- Five durum cultivars (Divide, Alkabo, Carpio, Joppa and Mountrail) were planted in the FHB nursery in 2005 summer and the effect of resistance and fungicide on FHB management was evaluated.
- The first year trial experiment showed that fungicides significantly reduced FHB and DON in durum regardless of levels of resistance.

Steven Xu updated his research on mapping and introgression of scab resistance from emmer wheat to durum wheat:

- Developed 30 durum lines with improved FHB resistance derived derived from *T. dicoccum*, *T. carthlicum* and the hexaploid wheat line PI 277012 and several lines are being using in durum wheat breeding.
- Constructed a SNP-based genetic map for the mapping population derived from the cross between Ben and *T. dicoccum* PI 41025.
- Identified three major QTL on chromosome 2A, 3A, and 5A, respectively, from the the mapping population derived from the cross between Ben and *T. dicoccum* PI 41025.

Shaobin Zhong reported the progress on identification and mapping of novel QTL for FHB resistance introduced into durum wheat:

- A mapping population consisting of 241 recombinant inbred lines (RILs) (F2:7) from the cross between 10Ae564 and Joppa has been developed. 10Ae564 is a BC1F8 durum wheat line, derived from cross and backcross of the durum wheat cultivar Lebsock to PI 277012, a hexaploid wheat line with major FHB resistance QTL on 5A (Chu et al. 2012). Joppa is a newly released durum wheat cultivar with the least susceptibility to FHB and lowest DON accumulation in grains among durum wheat cultivars currently grown in ND.
- A total of 182 RILs (F2:6) were evaluated in three FHB nurseries located at Fargo and Langdon, ND for FHB reactions in the summer of 2014. Three replicates were used for each line and the whole population was grown in a randomized complete block design. Grain samples were harvested from one FHB nursery and will be used for DON testing.
- The RIL population is being raised to F2:8 generation for DNA extraction and genotyping with the 90K wheat chips.

The members then discussed research plans and expected accomplishments for the next 2-year cycle of funding.

- 1) Develop and release 1-2 new durum cultivars with increased FHB resistance and excellent yield potential and overall quality (PI: Elias)
- 2) Finish screening of a new set of 2,000 durum accessions from ICARDA (PI: Elias) and a set of 150 tetraploid wheat (*T. durum*, *T. dicoccoides*, *T. dicoccum*, *T. cathlicum*) accessions and their newly-derived 200 synthetic hexaploid wheat lines for FHB resistance (PI: Xu).
- 3) Identify, map, and validate FHB resistance QTL in the newly identified sources of resistance and develop user-friendly molecular markers.
 - a) Complete association mapping of FHB resistance derived from domesticated emmer (*T. dicoccum*). A panel of 181 *T. dicoccum* accessions were recently genotyped with the wheat 9000-SNP array and 2,356 polymorphic SNPs were identified. To fully utilize these SNP marker data, the 181 *T. dicoccum* accessions will be evaluated for Type II resistance in three greenhouse seasons. The phenotypic data will be used for association mapping (PI: Xu)
 - b) Accomplish association analysis of novel sources of FHB resistance from Tunisian durum lines (PI: Kianian)
 - c) Validate molecular markers flanking the FHB resistance QTL that have been transferred to durum wheat and identify alien chromatin containing FHB resistance genes that have been integrated into the durum wheat genome (PI: Cai)
 - d) Identify and map QTL for FHB resistance in durum wheat cultivar 'Joppa' and a durum wheat line derived from a cross between Divide and PI 277012 (PIs: Zhong and Xu)
- 4) Incorporate FHB resistance QTL from tetraploid and hexaploid wheat accessions into adapted durum backgrounds and develop elite durum germplasm
 - a) Continue introgression of FHB resistance from emmer wheat (*T. dicoccum*) and timopheevi into durum wheat using marker-assisted selection (PIs: Zhong and Xu)
 - b) Transferring FHB resistance from hexaploid wheat and wild species to durum (PI: Cai)
 - c) Introgress FHB resistant QTL from Tunisian sources into newer durum cultivars (PI: Kianian)
- 5) Further characterize the role of individual durum chromosomes and D-genome chromosomes in the expression of FHB resistance in durum (PI: Cai)
- 6) Characterize deletion mutants generated for chromosome 2A, which carries the gene for suppression of FHB resistance (PI: Kianian)
- 7) Develop an understanding of the possible mechanism of epigenetic silencing of resistance in durum cultivars by analysis of lines developed through removal of GC methylation (PI: Kianian)
- 8) Establish new FHB screening nursery in Fargo, ND.

The members finally discussed challenges in DUR-CP, possible future collaborations between projects, and prioritized research items for the next funding cycle.