

Summary of the plans on oat quality research for Fargo, ND labs – based on feedback from the Oat Strategy Meeting (October 2019)

The Oat strategy meeting, which was co-hosted by the Oat Global and POGA, was held on October 29th-30th at the Continuing Education & Conference Center, St. Paul Campus of the University of Minnesota. The meeting was very valuable as it provided a chance to discuss important issues that will help develop future research plans in oat quality and oat genotyping.

Oat Quality Phenotyping: For high throughput analysis of oat quality traits, the application of near infrared (NIR) spectroscopy will be explored. The NIRS has been widely used for quality evaluation of cereal grains. Research will be performed to improve the prediction of important oat biochemical components such as protein, oil, and beta-glucan using NIRS. Currently, an old dispersive NIRS system is used for oat quality analysis. The maintenance service for this system is not available. We plan to replace the old system with the Fourier Transformation (FT)-NIR system as soon as we develop reliable or improved calibration models. For this, an FT-NIR system (MPA-II, Bruker Scientific, LLC) was recently purchased. We also plan to test new computer algorithms such as machine learning procedures for calibration of prediction models. In the future, further research will be performed to test infrared (FT-IR) spectroscopy for improvement of the evaluation of oat quality traits such as protein, oil, and beta-glucan.

The Single Kernel Characterization System (SKCS) that provides data of hardness index, weight, and size for single kernel samples will be tested for oat groat characterization. The SKCS parameter will be investigated for the associations with quality traits such as groat yield, groat breakage, etc. For the future, application of NIR/IR imaging analysis system will be researched for rapid characterization of oat physical traits such as groat shape and plumpness, dehulling efficiency and groat percent in oat.

Rancidity is the most important off-flavor of oat. Rancidity is generally caused by free fatty acids which are produced by lipase activity and is of particular concern for the hullless (naked) oat. A preliminary experiment is being planned to compare rancidity between hullless and covered oat varieties. Briefly, changes in free fatty acids will be compared between hullless and covered oat varieties during storage at high temperature (35 °C).

Quality evaluation of oat varieties is a priority in this laboratory. We have been analyzing protein, oil, and beta-glucan for the Spring Oat Uniform Nursery samples. We also support the NDSU oat breeding program for analyses of protein, oil, and beta-glucan. We plan to expand quality evaluation of oat varieties. Specifically, we plan to work on quality evaluation of Advanced Yield Trial Samples (approximately 100 samples per individual program) for state spring oat breeding programs (MN, ND, SD, and WI) beginning with the 2020 harvest samples, upon request. We also plan to evaluate the International Oat Nursery samples as soon as the program resumes. For quality traits, we currently focus on analyses of biochemical components such as protein, oil, and beta-glucan. We plan to add more quality traits such as groat shape and plumpness, groat yield, and groat breakage and processing quality traits such as flaking

characteristics. It was also indicated at the meeting that other traits such as micronutrients, iron, copper, selenium, and folate would be of interest and could be measured in variety evaluations. Dr. Michael Grusak (USDA-ARS ETS Agricultural Research Center, Fargo, ND) will provide analyses of mineral composition for Spring Uniform samples. The quality data obtained in this laboratory will be available to the public through uploading to T3 etc.

We plan to provide quality data for genotyping samples upon request. Specifically, we will provide quality data of Spring Uniform Nursery samples to Dr. Jason Fiedler (USDA-ARS ETS Agricultural Research Center, Genotyping Lab. Fargo, ND).

Oat Genotyping: The North Central Small Grains Genotyping Laboratory in Fargo provides genotyping services to small grains researchers and breeders. Currently, the only genotyping assay run for oats has been the Illumina Infinium 6K genotyping array. This provides usable information but underserves the community in two ways: 1) The marker density is too low for proper association and linkage mapping, and 2) The price and marker positions are not ideal for genomic selection purposes. To overcome these issues, we will be investing in a new genotyping array that combines multiple species together to drive the per-sample price down to a suitable level for breeders. The goal is to have this working by the end of 2020. Alternatively, a higher density oat genotyping array has been developed by PepsiCo. The Genotyping Lab will be available to run this, but it does come with a higher cost.

The more economical way to provide high-density genotypes is to use next-generation sequencing methods to identify molecular markers. For this technique to work, a reference genome is needed to align to. As part of a global Pangenome project in Oat, the USDA will submit a few lines to be sequenced that represent US germplasm.

Finally, only a few loci are known to be associated with oat traits. To support marker-assisted selection efforts, the Genotyping Lab will genotype several mapping populations already developed and initiate new populations to maximally investigate as many breeder-relevant traits as possible. The Spring Oat Uniform Nursery samples that go to the Fargo Quality Lab will also be genotyped. Trait mapping will identify novel loci that influence traits. High-throughput marker assays will be developed for all these loci, which will be validated in orthologous germplasm. A postdoc was hired to develop new mapping populations and initiate genotyping. A new permanent scientist will be hired soon to manage these efforts and develop new genotyping protocols that meet the oat community's needs.