

Project FY22-BA-014: Developing Two-rowed Malting Barley Cultivars with Reduced FHB and DON

1. What are the major goals and objectives of the research project?

This project aims to develop two-rowed malting barley cultivars with enhanced resistance to FHB and reduced DON accumulation. Our goals for this project were: 1) continued development and screening of two-rowed barley lines in our breeding program for reduced FHB and DON, 2) growing the North American Barley Scab Evaluation Nursery (NABSEN) at our Osnabrock, ND research site, and 3) collect FHB and DON data on cultivars and advanced breeding lines that growers can use for making decisions on what cultivar(s) to grow.

2. What was accomplished under these goals or objectives? (For each major goal/objective, address these three items below.)

What were the major activities?

Objective 1

Commercial barley cultivars, new cultivars, and promising advanced selections were sown at up to six locations across ND. Foliar disease and FHB were minimal at all locations. All lines and cultivars entered in yield trials were grown in mist-irrigated and inoculated FHB nurseries at the Langdon Research Extension Center and our Osnabrock, ND, research site. All experimental lines from the NDSU breeding program have at least one parent with FHB resistance and DON accumulation, like the moderately resistant cultivar ND Genesis.

Four hundred twenty-two-rowed experimental lines were evaluated for the first time in the Preliminary Yield Trial (PYT) at our Fargo, Casselton, and Osnabrock research sites; 66 two-rowed lines were grown and harvested in the Intermediate Yield Trial at five locations across ND; and 33 two-rowed entries were grown in the Advanced Yield Trial or Variety Yield trial at up to six locations in their third or more years of yield trial evaluation. Selected lines from all trials were evaluated for malt quality by the USDA-ARS-CCRU and for net blotch and spot blotch resistance in the greenhouse by Dr. Tom Baldwin. Five lines from the Variety Yield Trial were submitted to the American Malting Barley Association's (AMBA) Pilot Scale Evaluation Program.

About 12,200 F3 or F4 head rows were grown at the Osnabrock research site. Nearly 4,000 two-rowed spikes from these head rows were selected and sown in October as head rows in Yuma, AZ, to increase seed for 2024 yield trials. Rows with acceptable straw strength, maturity, uniformity, predicted beta-glucan, heading date, and yield as determined using genomic selection (GS) were harvested and advanced to the Preliminary Yield Trial. A new GS model for low DON accumulation is being validated.

In the summer of 2023, 40 two-rowed F2 populations originating from crosses made in the fall 2022 greenhouse were grown in Fargo. About 600 spikes were harvested from each population, threshed in bulk, sized, and sent to the off-season nursery in New Zealand. Thirty-eight crosses were made in the 2024 spring greenhouse. F1 seed from these crosses was grown in the 2023 summer greenhouse, and the F2 generation from each cross was sown in October in the New Zealand off-season nursery. Selected F3 and F4 spikes from the New Zealand nursery were advanced to the 2024 headrow nursery. All crosses aim to combine

favorable agronomic characteristics, disease resistance, and malt quality traits. All crosses made use of at least one parent with FHB resistance.

Objective 2

The 2023 NABSEN trial was grown at our Osnabrock research site. Each row was harvested and provided to Dr. Baldwin's project for cleaning and submission to Dr. Zhou Jin's lab for DON testing.

Objective 3

The goals of objective three were accomplished under the work done for objective 1.

What were the significant results?

The two-rowed line 2ND39010 was found satisfactory in its second year of evaluation, so it is eligible for Plant Scale evaluation. Lines found satisfactory in two years of Pilot Scale evaluation are eligible for Plant Scale evaluation. The lines 2ND39881, 2ND40316, 2ND40324, and 2ND40363 were sown for their first year of AMBA Pilot Scale evaluation. All four lines were rated satisfactory. DON levels of all lines were less than that of AAC Synergy, one of ND's most widely grown cultivars.

List key outcomes or other achievements.

The two-rowed line 2ND36638 was sown for its second year of Plant Scale evaluation by Rahr Malting in 2024. Cultivars found satisfactory in this final stage of industry evaluation are eligible for addition to the AMBA Recommended list of Malting Varieties. DON accumulation of 2ND36638 is intermediate to AAC Synergy and ND Genesis.

3. What opportunities for training and professional development has the project provided?

Cameron Mathews, a PhD student from Indiana, is researching to update our genomic selection model for DON accumulation.

4. How have the results been disseminated to communities of interest?

Results are disseminated via peer-reviewed journals and popular press articles, field day presentations, and presentations to stakeholder groups at local and regional meetings.

5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

Breeding barley lines with improved FHB resistance and reduced DON accumulation is an annual process. Our breeding pipeline represents every stage of the breeding program. We evaluate annually how we can improve our work to increase efficiency in advancing lines to varietal release.