Project FY22-BA-024: Coordination of the NABSEN and Screening US Barley Germplasm

Note: Report must cover the *entire* duration of the project period of performance, May 1, 2022-July 30, 2026.

1. **What are the major goals and objectives of the research project?**
   The project goals were to coordinate the North American Barley Scab Evaluation Nursery (NABSEN), evaluate elite barley germplasm for Fusarium head blight (FHB) resistance and reduced deoxynivalenol (DON) accumulation across environments, and provide comparative results that support barley breeding and selection. Common reference checks connect annual trials and help identify material for further evaluation while maintaining resistance alongside malting quality and agronomic performance.

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

   What were the major activities?
   Spring nursery evaluations generated entry means for DON, FHB severity, FHB incidence, and heading time across cooperating environments. The 2022–2025 records include 164 annual entry listings, 22 analyzed environment-years, and 2,764 observed trait values. Annual entry listings include checks and repeated lines across years; they are not counts of distinct genotypes or independent field replicates.

Year	Entries	Analyzed environments	Trait values
2022	44	4	572
2023	40	6	720
2024	35	6	662
2025	45	6	810

Table 1. Spring nursery coverage during 2022–2025. In 2022, coordinators reported seven nursery environments, but four have data in the analyzed report. Trait values count available measurements across traits.

   What were the significant results?

   Multi-environment screening revealed substantial variation in DON pressure. In 2025, mean DON among misted sites ranged from 3.34 ppm at Brandon to 65.81 ppm at Crookston (Figure 1). Fargo and Langdon each averaged approximately 21.3 ppm. These differences support continued evaluation across sites; mist irrigation does not remove environmental variation.

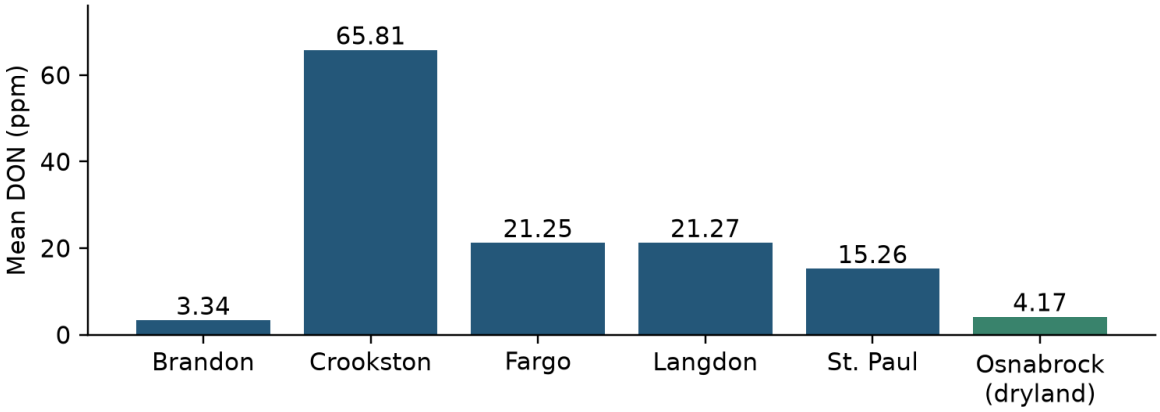


Figure 1. Mean DON concentration among entries in the six 2025 spring environments. Five sites were misted; Osnabrock was dryland. Bars summarize entry means, not independent plot replicates. Differences do not isolate the causal effect of misting. Source: NABSEN analysis, Table 2.

Long-running reference checks consistently accumulated less DON than Stander in matched misted environments. Across 2012–2025, pooled geometric DON ratios were 0.245 for Chevron, 0.309 for Conlon, and 0.470 for Quest, equivalent to approximately 76%, 69%, and 53% lower DON (Figure 2). The direction persisted in sensitivity analyses, although the magnitude varied among environments.

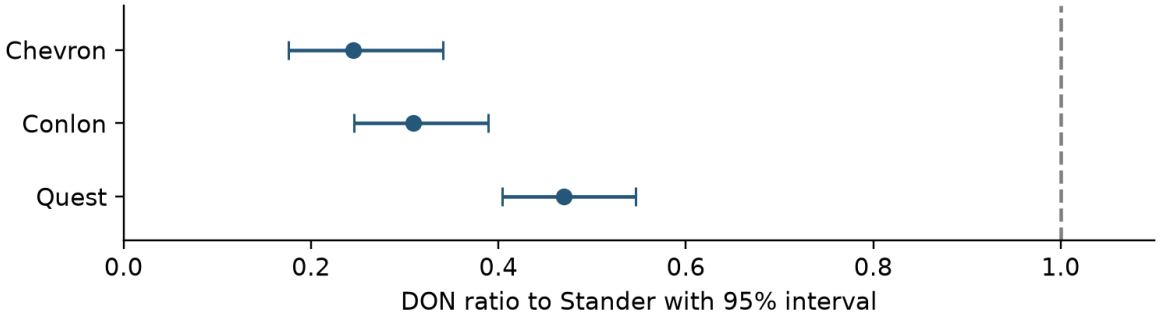


Figure 2. Historical DON contrasts with Stander across 14 annual effects, 2012–2025. Intervals use REML and modified Hartung–Knapp inference. Annual variances reflect differences among sites, not field-replicate error; comparisons share Stander. The dashed line indicates equality. Source: NABSEN analysis, Table 3.

Resistance trends and candidate germplasm

The nursery retained substantial resistance relative to Stander, but the historical comparisons do not establish sustained improvement. During 2022–2025, mean breeding-entry DON reduction was 58.5%, 44.7%, 54.3%, and 44.6%, respectively; the five best entries averaged reductions of 78.7%, 59.7%, 69.3%, and 68.6% (Figure 3). Across all 14 years, the average-entry and top-five trend intervals included zero. These are changing annual cohorts, so the trends are not estimates of genetic gain.

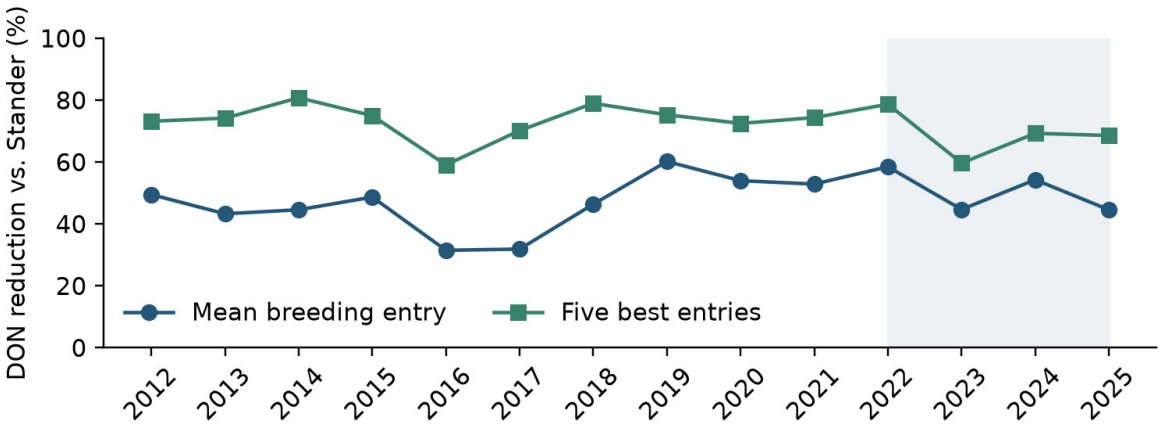


Figure 3. Annual DON reduction relative to Stander, excluding checks. Each line's within-site ratios are averaged equally across included misted sites, followed by averaging across eligible lines or the five best lines. Shading marks 2022–2025. Top-five membership changes annually. Source: NABSEN analysis, Table 11; values rounded to one decimal.

S2M208 and S2M211 were the only 2025 non-check entries with geometric mean DON ratios below Conlon across five misted sites (Figure 4). Their mean DON concentrations were 12.44 and 13.48 ppm; they were below Conlon at three and four of five sites, respectively. These lines warrant repeat testing and evaluation of agronomic and malting quality. Published entry means do not support a replicate-based test of superiority.

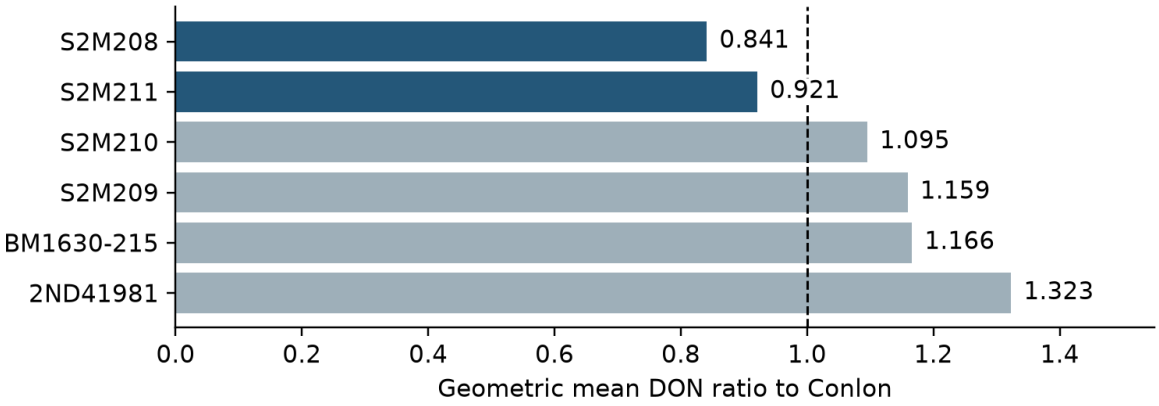


Figure 4. Selected 2025 breeding entries ranked by geometric mean DON ratio to Conlon across five matched misted sites. The dashed line indicates equality. Ratios are descriptive and have no plot-level confidence intervals.

List key outcomes or other achievements.

1. Maintained a comparative screening resource. The 2022–2025 spring records provide multi-environment measurements for breeding decisions, supported by shared checks and a longer historical baseline.

2. Identified candidates for follow-up. S2M208 and S2M211 combined favorable DON ratios with advantages in several 2025 spring environments. In the winter supplement, VA15H-73 had the lowest average within-site DON rank among 55 entries in 2023–24. MTWF7_4-2 and 2MW18_4462-011 were the highest-ranked non-check entries; their six-site mean DON concentrations were 4.00 and 3.92 ppm. These rankings identify testing priorities rather than release recommendations.

3. Clarified the need to measure toxin directly. The historical median within-environment Spearman correlation between FHB severity and DON was 0.420, showing that visible symptoms and toxin accumulation provide related but distinct information. Among non-check entries, heading–DON correlations changed direction across environments. Selection should retain DON measurements alongside symptoms, maturity, and end-use traits.

4. Defined improvements for future nursery data. Priorities include retaining original replicate-level DON results, consistent plot and line identifiers, laboratory and management records, and plant height measurements. Published means cannot recover within-environment sampling error or support additive heritability estimates. Height was not measured in the analyzed spring records, and malting-quality gains were not quantified.

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

The project employed student workers and trained them to score FHB, manage field plots, and set up a mist irrigation system. This work provided hands-on experience in disease assessment and management of field screening nurseries.

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

Annual NABSEN reports are available through the U.S. Wheat and Barley Scab Initiative report repository (https://scabusa.org/reports). These reports provide entry-level disease, DON, and related trait results for use by participating breeding programs and the barley research community.

Representatives from AB InBev, Rahr Malting, and the American Malting Barley Association (AMBA) were invited to visit the nursery. The 2025 NABSEN report was posted through USWBSI on March 10, 2026, making the results publicly available to breeding programs, researchers, and industry stakeholders.

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

Not applicable, this is the final report for the agreement.