**Developing Soft Winter Wheat Varieties for Michigan, 2023**

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**Principal Investigator**

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**I. Mission Statement**  
Michigan State University Wheat Breeding and Genetics develops high yielding soft winter wheat varieties with improved quality and disease resistance that meet the demands of wheat growers and the Michigan flour milling industry. The MSU wheat breeding program sustains a pipeline of elite soft white and soft red winter wheat varieties by combining accelerated generation advancement and enrichment of genetic diversity. As a service to the wheat industry of Michigan, statewide testing of wheat varieties and experimental lines is conducted annually.

**II. 2023 Results**

**A. Commercial Yield Trials**

In 2023, 8 soft white winter and 14 soft red wheat lines were tested in the Michigan commercial yield trial <https://varietytrials.msu.edu/wheat/>. The commercial yield trial was comprised of 102 soft red and white winter wheat varieties and experimental lines and tested at seven locations across Michigan. Combine harvest collected data on grain yield and test weight. Other important traits evaluated include plant height, flowering date and FHB resistance. Additionally, data on milling and baking quality is provided by the USDA-Soft Wheat Quality Lab in Wooster, OH.

Seven soft red winter wheat lines were advanced including MI20R0012, MI20R0013, MI20R0210, MI21R0051, MI21R0054, MI21R0058, MI21R0089 and two soft white winter wheat lines including MI21W0040 and MI20W0120 were advanced to a second year of commercial testing in 2024.

**B. 2023 Advanced Yield Trials**

Advanced yield trials (AYT) was comprised of 35 soft red winter wheat entries and five commercial checks. The AYT was tested in 30 locations across IL, IN, KY, MI, MO and OH (Table 1). A set of seven soft red winter wheat lines were advanced to commercial testing in 2024.

Intensive management practices are applied to the AYT including an early fungicide application, additional nitrogen and a fungicide at flowering. Intensive management enables a more accurate assessment of yield potential and comparison with commercial check varieties. Data were collected on a suite of traits and disease resistance. Flowering date was measured at Mason. Plant height was measured at Mason and SVREC sites. Three replications of each line were evaluated in the misted and inoculated FHB nursery. All lines in the AYT were screened for resistance to leaf rust in the greenhouse.

Table 1. Advanced yield testing grain yield results from 30 locations in 2023

|  |  |  |
| --- | --- | --- |
| Line | Yield  Bu/ac | Group |
| MI20R0013 | 116 | a |
| MI20R0012 | 116 | a |
| SY 100 | 115 | a |
| P25R40 | 115 | ab |
| AgriMAXX 505 | 114 | abc |
| MI21R0058 | 114 | abc |
| MI16R0720 | 114 | abc |
| MI21R0051 | 113 | bcd |
| MI20R0210 | 113 | cde |
| MI20R0096 | 113 | cdef |
| MI20R0143 | 113 | cdef |
| MI20R0011 | 112 | cdefg |
| MI21R0054 | 111 | defgh |
| MI20R0120 | 111 | defghi |
| MI21R0001 | 111 | efghij |
| MI20R0051 | 111 | fghijk |
| MI21M0121 | 110 | ghijkl |
| MI21R0250 | 110 | ghijkl |
| MI21R0089 | 110 | hijkl |
| MI21R0050 | 109 | hijklm |
| MI21R0118 | 109 | hijklm |
| MI21R0123 | 109 | ijklm |
| MI21R0195 | 109 | ijklmn |
| MI21R0137 | 109 | jklmn |
| MI21R0002 | 109 | jklmn |
| MI21R0025 | 109 | klmno |
| MI21R0249 | 108 | lmnop |
| MI21R0154 | 107 | mnopq |
| MI21R0202 | 107 | nopqr |
| MI21R0197 | 106 | opqr |
| MI21R0129 | 106 | pqrs |
| MI21R0240 | 106 | qrs |
| MI21R0028 | 106 | qrs |
| MI21R0144 | 105 | rst |
| MI21R0052 | 104 | st |
| MI21R0179 | 104 | t |
| MI21R0135 | 101 | u |

**C. 2023 Preliminary Yield Trials**

Preliminary yield trials (PYT) of 353 soft red and white wheat experimental genotypes and commercial checks were conducted at four locations, the Mason breeding location, Huron count, Sanilac county and the Saginaw Valley Research and Extension Center (SVREC) in Richville, MI. All lines were evaluated for grain yield, test weight, plant height and flowering date in two replicates at each location. Additionally, lines were tested in three replicates in the FHB nursery and screened in the greenhouse for resistance to leaf rust. DON data were also available as a selection criteria.

A set of 27 soft red winter and six soft white winter wheat lines were advanced to a second year of testing at 30 locations across Michigan and the Eastern soft wheat region.

**D. 2023 early generation nursery**

The 2023 early generation nursery was comprised of 500 F4 derived lines advanced in 2022 genome-estimated breeding values for high grain yield, low DON mycotoxin and low preharvest sprouting. Flowering date canopy architecture and agronomic data were collected in spring and summer 2023. Fusarium head blight resistance was evaluated in the FHB nursery.

Lines not selected were mowed by hand prior to harvest. Selected lines were combine harvested and seed was cleaned for planting. FHB resistance, agronomic type and resistance to rusts was used to advance a set of 250 new lines to replicated yield testing in 2023.

**E. Early Generation Selection**

Single plant selections were made in 456 F4 plots at Mason. A total of 2,280 single plants were selected, harvested and threshed individually. Tissue was collected in all selected plants, DNA was isolated and SNP genotyping was carried out. Marker data and phenotypic data on the program training population were used to develop GEBVs for grain yield, FHB resistance and resistance to preharvest sprouting. All single plants were planted in two-row plots for observation and selection in 2024.

**F. 2023 Crossing Program**

A total of 445 unique crosses were made in fall 2022 and spring 2023 to develop segregating breeding populations. All crosses have at least one FHB-resistant parent and 176 crosses involve at least one parent with Fhb1. A total of 34 crosses were made between Fhb1 donor lines to generate fixed populations. Leaf rust susceptible individuals have been culled from the F2 and subsequently the F3 as populations were advanced in the greenhouse using the minibulk system. The F4 seed will be planted in the field in bulk plots in fall, 2023. Marker assisted selection will be used to select F4:5 lines carrying Fhb1.