

Developing Soft Winter Wheat Varieties for Michigan, 2024

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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. 2024 Results

A. Commercial Yield Trials

The 2024 commercial wheat yield trial was comprised of 104 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. Data were reported through the Wheat Wisdom newsletter, Michigan Farm News and at <https://varietytrials.msu.edu/wheat/>.

Five soft red winter wheat lines from the MSU breeding program were tested including MI16R0906, MI20R0012, MI20R0013, MI20R0096, MI20R0210, MI21R0051, MI21R0054, MI21R0058, MI21R0089 and two soft whiter winter wheat lines and MI21W0040 and MI20W0120.

B. 2024 Advanced Yield Trials

A set of 42 experimental lines and 2 checks were evaluated at 28 locations across IL, IN, KY, MO, OH, MI and Canada (Table 1). A set of eight soft 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.

C. 2024 Preliminary Yield Trials

Preliminary yield trials (PYT) of 250 soft red and white wheat experimental genotypes and commercial checks were conducted at two locations, the Mason breeding location 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.

Table 1. Advanced yield testing grain yield results from 28 locations in 2024.

Line	Yield, bu/ac	Group
MI22W213	92	a
MI22R057	92	ab
MI22W212	90	abc
MI21W0040	90	abcd
MI20R0210	90	abcd
MI22R097	90	abcd
P25R40	90	bcd
MI20R0096	90	bcde
MI22R136	89	cdef
MI22R145	89	cdef
MI20W0120	89	cdef
SY 100	89	defg
MI22R144	89	defgh
MI22R135	89	defgh
MI21R0058	88	defghi
MI22R142	88	efghij
MI22R112	88	fghijk
MI22R238	88	fghijkl
MI20R0012	88	fghijkl
MI22R182	87	fghijklm
MI22R207	87	ghijklmn
MI22R075	87	ghijklmno
MI22R110	87	hijklmno
MI22R090	87	hijklmno
MI20R0013	87	ijklmnop
MI21R0051	87	jklmnop
MI22R109	86	klmnopq
MI22W191	86	klmnopq
MI22R026	86	klmnopq
MI22R173	86	klmnopq
MI22W193	86	klmnopq
MI22R227	86	lmnopqr
MI22R225	86	lmnopqr
MI22R236	86	lmnopqr
MI22R115	86	mnopqrs
MI22R098	85	nopqrs

MI22W181	85	opqrs
MI22R134	85	pqrs
MI21R0089	85	qrs
MI21R0054	85	qrst
MI22W196	85	qrst
MI22R187	85	qrst
MI22R033	84	rst
MI22R224	84	st
MI22R154	83	t

D. 2024 Early Generation Nursery

A set of 2,300 F4:5 lines derived from MSU21 populations were evaluated in a single plot observation nursery in 2023. Plots were two rows spaced at 7.5" and 10' in length. F4-derived lines were selected as single plants in 2023. GEBVs could not be developed due to changes in sample processing for sequencing at the MSU genomics core. New lab protocols for sequencing library quantification had to be established and new lab equipment was purchased to accommodate the changes. Sequencing did not take place until May, 2024. Lines not selected were mowed by hand prior to harvest. Approximately 3lb. of seed was harvested from 351 selected lines advanced based on canopy leaf retention in response to disease at Mason as well as GEBVs for DON and grain yield. Selected lines will be planted in yield trials in two replicates at two locations in 2025.

E. Early Generation Selection

Single plant selections were made in 449 F4 plots at Mason. A total of 2,300 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.

F. 2024 Crossing Program

A total of 436 unique crosses were made in fall 2023 and spring 2024 to develop segregating breeding populations. All crosses included at least one FHB-resistant parent and 262 included *Fhb1* from at least one parent and 69 populations included *Fhb1* from more than one parent. Leaf rust susceptible individuals were culled from the F₂ and F₃ generations as populations are advanced in the greenhouse using the Minibulk system. The F₄ seed will be planted in the field in bulk plots in fall, 2024. Marker assisted selection will be used to identify F_{4:5} lines carrying *Fhb1*.