



**On-Farm Cereal Variety and Advanced Breeding Line
Testing across Montana for Environment Specific
Cultivar Recommendations:**



Winter Wheat Off-Station Variety Performance, Loma, MT

Principal Investigator:

Peggy Lamb, Research Scientist, Northern Ag Research Center, Havre

Project Personnel:

Sue Mondal, Breeder/Geneticist, Winter Wheat, Bozeman

Eleri Haney, Research Associate, Havre

Tracy Runner, Research Assistant II, Havre

Tyler Lane, Chouteau County Extension

Cooperators:

Lyle McKeever, Terry McKeever and Kendrick McKeever, Landowners, Loma

Objectives:

Commercially available winter wheat varieties and advanced breeding lines were evaluated for agronomic performance and fit at on-farm locations across the state of Montana. Sites chosen for the research considered the environment, growing conditions and soil types, and represent the major land areas for producers in those regions served by Northern Agricultural Research Center. The Chouteau County location, between Big Sandy and Loma, has been used for various trials since 1998.

Methods:

The uniform off-station winter wheat variety performance trial was seeded into chemical fallow ground during 2023. The trial consisted of 25 entries seeded in replicated, three-row, 22-foot plots on a 12-inch row spacing, utilizing a self-propelled cone seeder with Atom Jet paired row openers. All plots were trimmed to a harvest length of approximately 17 feet with a three-point rototiller. Plant height was measured from the soil surface to the top of the head, excluding awns, and percent sawfly cutting was visually estimated for each plot immediately prior to harvest. A 'Wintersteiger' small plot combine, funded in part by the Montana Wheat and Barley Committee, was used to harvest each three-row plot. Prior to measuring plot weight for yield determination, seed was either cleaned or weighed in-dirt as per protocols. Protein, test weight and moisture content were determined on a clean sample using a Foss Infratec 1241 near infrared analyzer. Falling number was determined using a Perten FN1700 according to the FGIS Directive 9180.38. Other variables specific to each individual trial are listed with the current year data tables.

Please note that research trial seed yield results recorded under wheat stem sawfly pressure are likely much higher than a producer should expect. Small plot variety trials are managed to assess maximum yield potential and are harvested in such a way that all stems and heads are picked up by the combine, regardless of lodging or cutting due to wheat stem sawfly. Pickup guards coupled with an extremely slow ground speed and an exceptionally low cutting height help researchers collect all heads in order to assess seed yield potential. If you are a producer in a wheat stem sawfly environment, although hollow stemmed varieties may be high yielding in research trials in your area, we strongly recommend against

growing those hollow stemmed varieties. Please be aware that if you seed hollow stemmed varieties with wheat stem sawfly present, you are only creating a breeding ground for future generations of sawfly in your area and not helping combat the pest population.

Results:

This report contains both single-year and long-term data summaries limited to the most recent ten years. It should be noted that the 2023 data table in this report represents varietal performance for a single crop year at a single location, therefore cannot be considered representative of performance expected when differing conditions due to location, year and management are imposed. By itself, 2023 data shall not constitute in any form a recommendation for or against any variety or breeding line included.

At the Loma winter wheat site, seed yields averaged just over 80 bu/ac (Table 1). The Montana State University release 'Northern' was the highest yielding entry at just over 88 bu/ac. 'MT WarCat', 'Loma', 'Bridger CL Plus', 'StandClear CLP', 'Yellowstone' and six MSU breeding lined produced yields statistically equal to that of Northern. Test weights of all entries averaged just under 60 lb/bu with 'Brawl CL Plus' and breeding line 'MTCS20158' producing test weights of 62 lb/bu or greater. Wheat stem sawfly cutting was severe in the winter wheat entries lacking tolerance and/or solid stems, averaging over 43 percent cut and lodged. However, entries with more solidness and/or tolerance to sawfly averaged less than five percent cut. There were eight entries exhibiting less than 10 percent cutting, including 'Bobcat' and 'Warhorse', plus six MSU breeding lines. Yield, test weight, protein, falling number, plant height and sawfly cutting data for the 2023 Loma dryland winter wheat trial are summarized in Table 1.

Comparable averages are calculated using a standard check variety when not all entries are present in a specific trial for all years. Variety means are adjusted by multiplying the actual check mean by the ratio of the individual variety mean compared to the check mean for the same years as tested. All varieties are then directly comparable to each other when in the same nursery. A minimum of three years of data is necessary to be included in the comparable average calculation. Ten-year comparable averages for seed yield and test weight at Loma are summarized in Table 2, while ten-year comparable averages for protein content and sawfly cutting are summarized in Table 3. Based on the comparable average calculations, Bobcat is the highest yielding variety at the Loma site and also has the least amount of wheat stem sawfly cutting across the years.

Summary:

Overall, the growing season started out drier than average, with many later fall-seeded crops not emerging until early in 2023. Following snow cover that persisted into early April, the Loma site had the best stand uniformity of all winter wheat sites in northcentral Montana. With timely and above average precipitation throughout the growing season, the Loma winter wheat variety trial produced its highest seed yield in the past ten years.

This work has been strongly supported by producers in the Loma-Big Sandy area, and by the Northern Agricultural Research Center Advisory Board. With budget and other resources allowing, it is planned to continue off-station winter wheat variety and breeding line testing in this area. The Chouteau County location between Loma and Big Sandy has been hosting various trials for 26 years, beginning in 1998.

Recognition:

This research would not have been possible without the assistance of the following seasonal employees: Clara Haslem, Brady Kueffler, Cleta Lamb, Teresa Miller, and Nevaeh Phillips.

TABLE 1. Dryland Fallow Winter Wheat Cultivar Evaluation Nursery Grown Off-Station at McKeever Farm & Seed, Inc., Loma. Northern Agricultural Research Center. Havre, Montana. 2023. (Exp# 23-3853-WW)

ID	ORIGIN or PEDIGREE	1/	2/	3/	4/		
		YIELD bu/ac	TEST WT lb/bu	PROTEIN %	FN seconds	PLNT HT inches	SAWFLY %
AAC Wildfire	Alberta: SECAN, 2015	78.2	58.4	11.8	427	<u>35.1</u>	36.7
Bobcat	Montana, 2019	74.8	60.7	12.3	462	29.1	2.3
Brawl CL Plus	Colorado Res. Foundation, 2011	75.8	<u>62.7</u>	12.1	435	29.0	55.0
Bridger CL Plus	Montana/Circle S, 2023 (MTCL19151)	82.9	60.0	11.4	490	27.8	88.3
Flathead	Montana, 2019	78.1	60.5	11.6	463	28.2	73.3
FourOsix	Montana, 2018	74.9	58.8	11.8	441	29.1	66.7
Keldin	Westbred, 2011	77.4	59.8	12.0	476	31.9	41.7
Loma	Montana, 2016	85.8	58.5	11.7	430	30.9	35.0
MT WarCat	Montana, 2022	88.0	58.7	<u>12.5</u>	438	30.2	31.7
Northern	Montana, 2015	88.3	60.5	11.1	499	30.8	70.0
StandClear CLP	Montana/Nutrien, 2020	80.8	60.5	12.3	478	30.3	58.3
SY Monument	Syngenta, 2015	76.1	59.4	11.3	429	27.9	40.0
Warhorse	Montana, 2013	73.6	58.7	12.4	487	33.6	2.3
Yellowstone	Montana, 2005	84.6	58.5	11.5	476	30.8	73.3
MTS2068	potential release, 2024	83.8	59.4	12.1	467	31.9	3.7
MT2019	MT10114/MT10128//MTW1251	87.8	58.3	11.5	498	28.7	81.7
MTAX21187	FourOsix*2/Crescent AX	77.9	59.2	11.6	444	29.0	85.0
MTCL2010	MT0871/(06X445B1-2, SY Clearston	83.1	60.0	11.5	488	28.7	80.0
MTCS20151	Loma//(Bobcat sib, MTS1589)/Stan	86.8	61.3	11.4	436	31.9	3.7
MTCS20156	Bobcat//(Bobcat sib, MTS1589)/Sta	75.7	61.1	12.0	475	30.8	8.3
MTCS20158	Bobcat//(Bobcat sib, MTS1589)/Sta	85.9	62.0	12.2	464	27.8	2.3
MTFH20170	09x257cD9-2/DecadeFhb1-DH7	77.3	61.2	11.6	488	31.3	66.7
MTS1908	(Judee sib, MTS0819)//08X350-A6/	72.2	59.5	11.6	428	33.0	6.7
MTS2197	Bobcat//LCS Jet/MTS1703	72.9	59.8	12.2	486	25.5	8.3
MTV2164	MT1265*2/Joe	79.4	59.6	10.8	478	30.5	70.0
EXPERIMENTAL MEANS		80.1	59.9	11.8	463.4	30.2	43.6
LSD (0.05)		9.4	1.2	0.8	21.7	2.0	28.8
C.V.%		7.2	1.2	4.1	2.8	4.0	40.2
P-VALUE (Varieties)		0.0043	<.0001	0.0057	<.0001	<.0001	<.0001

1/ Volumetric yields are based on plot weights adjusted to uniform 13 percent grain moisture and 60 lbs/bu as the standard test weight for wheat.

2/ Protein values are adjusted to 13 percent grain moisture.

3/ FN is the falling number value reported in seconds adjusted to 14 percent flour moisture.

4/ Sawfly rating is reported as the percentage of cut stems.

Bold indicates the highest or lowest value within a column (whichever is most desirable for the specific characteristic).

Underlined indicates values equal to the underlined value within a column based on Fisher's protected LSD (P=0.05).

Management Information (23-3853-WW)

Seeding Date:	October 12, 2022
Harvest Date:	August 9, 2023
Fertility:	89-14-7-7 side banded
System:	No Till
Herbicide:	none
Insecticide:	none
Previous Crop:	Chemical Fallow - Spring Wheat
Precipitation:	8.43" April 1 to harvest maturity

TABLE 2. Ten-Year Yield and Test Weight Summary on Selected Entries from Dryland Fallow Winter Wheat Variety Nurseries Grown Off-Station at McKeever Farm & Seed, Inc., Loma. Northern Agricultural Research Center. Havre, Montana. 2014-2023. (Exp# 3853-WW)

2/ VARIETY or SELECTION	3/ No. of YEARS TESTED	1/ YIELD (Bushels Per Acre)					TEST WEIGHT (Pounds Per Bushel)										
		2019	2020	2021	2022	2023	3/ AVE. for YEARS TESTED	4/ % of CHECK YIELD	5/ 10-YR COMP. AVE. YIELD	2019	2020	2021	2022	2023	3/ AVE. for YEARS TESTED	4/ % of CHECK TEST WT	5/ 10-YR COMP. AVE. TEST WT
MTS1588 BOBCAT (++) (sawfly tol)	7	73.9	59.2	31.8	41.5	74.8	56.8	108.5	54.5	61.8	60.4	54.3	56.7	60.7	59.4	102.8	59.3
MT0978 NORTHERN (+)	10	60.7	67.8	28.1	34.7	88.3	52.8	105.0	52.8	60.3	60.0	52.8	55.1	60.5	58.0	100.6	58.0
COResFdn,20 BRAWL CLP (++) (CL)	7	61.0	62.1	36.3	36.1	75.8	54.5	104.1	52.4	61.6	61.5	55.2	59.1	62.7	60.5	104.7	60.4
Syngenta, 2015 SY Monument (P+)	7	74.2	59.4	26.7	34.0	76.1	53.4	102.0	51.3	60.4	58.9	52.2	58.7	59.4	58.6	101.3	58.4
ACSS5017 KELDIN (P+)	8	63.6	58.4	27.2	35.9	77.4	51.9	101.2	50.9	60.7	59.5	53.5	55.3	59.8	58.2	101.4	58.5
MTCL1077 SY CLEARSTONE 2CL (P+) (CL)	9	55.4	66.2	24.3	37.9		46.5	100.1	50.3	59.4	59.2	53.9	57.1		57.8	100.4	57.9
MT00159 YELLOWSTONE (+)	10	53.2	59.6	27.5	40.2	84.6	50.3	100.0	50.3	59.2	59.8	52.5	56.0	58.5	57.7	100.0	57.7
MTF1432 RAY (++)	6	61.6	58.7	26.0	34.7		46.9	99.9	50.2	59.6	59.2	53.2	56.3		57.4	99.4	57.4
MTS18149 MT WARCAT (++)	4		57.3	26.9	39.2	88.0	52.8	99.7	50.1		59.9	52.7	56.4	58.7	56.9	100.5	58.0
MT1465 FOUROSIX (++)	7	61.3	56.4	29.9	32.4	74.9	51.1	97.7	49.1	60.5	59.6	51.9	57.6	58.8	58.4	101.0	58.3
MTS1224 LOMA (++)	9	60.0	61.7	30.5	36.5	85.8	49.5	97.6	49.1	60.7	59.8	53.0	56.4	58.5	57.4	100.2	57.8
MTS0713 JUDEE (+) (sawfly tol)	9	62.0	55.8	23.6	33.8		44.9	96.5	48.5	62.4	59.8	54.7	57.7		58.8	102.0	58.9
MTCS1601 STANDCLEAR CLP	6	50.5	56.1	29.1	40.1	80.8	51.9	96.1	48.3	60.9	61.2	54.5	58.0	60.5	59.3	103.2	59.5
MT1564 FLATHEAD (++)	6	54.5	61.0	29.3	31.4	78.1	51.5	95.4	48.0	60.9	59.7	54.4	58.7	60.5	59.3	103.1	59.5
SECAN, 2015 AAC WILDFIRE (++)	5	60.0	56.3	22.5	35.6	78.2	50.5	95.3	47.9	59.9	58.6	51.4	56.1	58.4	56.9	99.5	57.4
LCS, 2015 LCS JET (P+)	5	58.3	46.8	25.3	33.9		43.1	90.2	45.3	57.8	57.3	50.9	54.4		55.4	96.8	55.8
MTS0808 WARHORSE (+) (sawfly tol)	10	44.5	52.4	28.1	27.7	73.6	43.7	86.9	43.7	61.4	59.8	52.2	56.8	58.7	58.4	101.3	58.4
MEANS (For Entries Listed)		59.7	58.5	27.8	35.6	79.7			49.6	60.5	59.7	53.1	56.8	59.7			58.3
6/ Growing Season Precipitation (in.)		n/a	n/a	n/a	1.60	8.43	6.01										
Soil PAW (in.) to SD @ Planting		8.19	7.35	7.94	7.12	n/a	7.59										
Total Plant Available Water (in.)		n/a	n/a	n/a	8.72	n/a	13.94										
Soil NO3 (lbs.) to SD at Planting		100	115	97	299	n/a	145										
SD (Sampling Depth in Inches)		48	48	45	48	n/a	48										
Fertilizer Applied																	
	(# N)	125	125	125	125	89	109										
	(# P ₂ O ₅)	20	20	20	20	14	19										
	(# K ₂ O)	10	10	10	10	7	10										
	(# S)	10	10	10	10	7	6										

Check Variety is Yellowstone.

1/ See MCES Bulletin 1098 or the Plant Sciences & Plant Pathology website at <http://plantsciences.montana.edu/> for evaluation of other important variety performance characteristics to include protein, quality, winter hardiness, disease resistance, etc. before making cultivar selection decisions.

2/ P = Private Variety, + = Protected Variety, ++ = PVP Title 5 Pending, CL = Clearfield Line, HW = Hard White.

3/ Only the most recent 5 years shown, but summary calculations include all years noted.

4/ Percent of Yellowstone yield or test weight for the same data years as those in which a given entry was tested.

5/ 10-Yr Comparable Average = (x/y) * z where x = average yield or test weight of a given entry for years tested, y = average yield or test weight for Yellowstone for the same years, and z = 10-Yr average yield or test weight for the check variety Yellowstone.

6/ April 1 to 14 days prior to harvest.

TABLE 3. Ten-Year Protein and Sawfly Summary on Selected Entries from Dryland Fallow Winter Wheat Variety Nurseries Grown Off-Station at McKeever Farm & Seed, Inc., Loma. Northern Agricultural Research Center. Havre, Montana. 2014-2023. (Exp# 3853-WW)

2/ VARIETY or SELECTION	3/ No. of YEARS TESTED	1/ PROTEIN % (Adjusted to 13% Grain Moisture)					SAWFLY RATING (% of Cut and Lodged Stems)										
		2019	2020	2021	2022	2023	3/ AVE. for YEARS	4/ % of CHECK	5/ 10-YR COMP. AVE.	3/ AVE. for YEARS	4/ % of CHECK	5/ 10-YR COMP. AVE.					
							TESTED	PROTEIN	PROTEIN	TESTED	SAWFLY	SAWFLY					
MTS1588 BOBCAT (++) (sawfly tol)	7	11.8	13.5	14.8	15.0	12.3	13.8	99.1	14.1	6.3	4.3	15.9	1.0	2.3	8.7	15.9	6.5
MTS0808 WARHORSE (+) (sawfly tol)	10	14.1	13.9	15.1	15.1	12.4	14.7	103.3	14.7	16.6	3.9	16.9	7.0	2.3	7.9	19.3	7.9
MTS18149 MT WARCAT (++)	4		14.2	15.3	14.9	12.5	14.2	104.5	14.9		6.0	52.5	8.3	31.7	24.6	51.4	21.0
MTS1224 LOMA (++)	9	13.3	13.8	15.1	15.1	11.7	14.5	101.9	14.5	22.3	13.1	68.0	13.3	35.0	26.6	59.4	24.2
MTCS1601 STANDCLEAR CLP	6	12.8	13.7	14.5	14.5	12.3	13.6	99.9	14.3	45.0	11.6	57.5	16.7	58.3	39.6	66.8	27.3
MTS0713 JUDEE (+) (sawfly tol)	9	12.1	14.3	15.7	15.6		15.1	103.8	14.8	41.0	4.2	61.3	13.3		25.8	69.3	28.3
SECAN, 2015 AAC WILDFIRE (++)	5	12.9	13.9	15.2	14.6	11.8	13.7	101.2	14.4	20.3	10.9	79.4	58.3	36.7	41.1	76.0	31.0
MT1564 FLATHEAD (++)	6	13.3	13.5	15.0	14.7	11.6	13.6	99.9	14.3	55.7	6.1	62.6	11.7	73.3	45.8	77.4	31.6
COResFdn, 20' Brawl CLP (++) (CL)	7	13.3	13.0	14.7	14.6	12.1	13.9	100.3	14.3	39.3	2.4	61.1	45.0	55.0	44.0	79.8	32.6
Syngenta, 2015 SY Monument (P+)	7	12.0	12.3	13.6	14.1	11.3	12.8	92.5	13.2	38.2	3.4	74.8	51.7	40.0	46.8	84.9	34.6
MTF1432 RAY (++)	6	11.9	13.5	14.2	14.9		14.0	98.4	14.0	31.9	11.7	74.8	41.7		46.3	88.9	36.3
MT0978 NORTHERN (+)	10	13.1	13.9	15.5	15.5	11.1	14.8	103.4	14.8	50.5	4.7	57.9	65.0	70.0	37.6	92.2	37.6
LCS, 2015 LCS JET (P+)	5	11.6	13.1	14.5	14.5		13.5	96.2	13.7	52.8	14.9	46.9	65.0		53.9	95.6	39.0
MT00159 YELLOWSTONE (+)	10	13.3	13.5	14.6	14.8	11.5	14.3	100.0	14.3	53.5	5.5	81.4	56.7	73.3	40.8	100.0	40.8
MTCL1077 SY CLEARSTONE 2CL (P+) (CL)	9	12.4	13.7	15.0	15.1		14.7	100.6	14.4	62.2	10.3	64.6	50.0		37.6	101.0	41.2
ACS55017 KELDIN (+)	8	12.5	13.4	14.3	15.4	12.0	14.1	99.2	14.2	48.9	14.6	76.8	73.3	41.7	52.6	108.3	44.2
MT1465 FOUROSIX (++)	7	12.1	13.9	14.9	14.8	11.8	13.8	99.3	14.2	65.5	17.4	84.1	53.3	66.7	59.9	108.7	44.4
MEANS (For Entries Listed)		12.7	13.6	14.8	14.9	11.9			14.3	40.6	8.5	61.0	37.1	45.1			31.1
6/ Growing Season Precipitation (in.)		n/a	n/a	n/a	1.60	8.43	6.01										
Soil PAW (in.) to SD @ Planting		8.19	7.35	7.94	7.12	n/a	7.59										
Total Plant Available Water (in.)		n/a	n/a	n/a	8.72	n/a	13.94										
Soil NO3 (lbs.) to SD at Planting		100	115	97	299	n/a	145										
SD (Sampling Depth in Inches)		48	48	45	48	n/a	48										
Fertilizer Applied																	
	(# N)	125	125	125	125	89	109										
	(# P ₂ O ₅)	20	20	20	20	14	19										
	(# K ₂ O)	10	10	10	10	7	10										
	(# S)	10	10	10	10	7	6										

Check Variety is Yellowstone.

1/ See MCES Bulletin 1098 or the Plant Sciences & Plant Pathology website at <http://plantsciences.montana.edu/> for evaluation of other important variety performance characteristics to include protein, quality, winter hardiness, disease resistance, etc. before making cultivar selection decisions.

2/ P = Private Variety, + = Protected Variety, ++ = PVP Title 5 Pending, CL = Clearfield Line, HW = Hard White.

3/ Only the most recent 5 years shown, but summary calculations include all years noted.

4/ Percent of Yellowstone protein or sawfly for the same data years as those in which a given entry was tested.

5/ 10-Yr Comparable Average = (x/y) * z where x = average protein or sawfly rating of a given entry for years tested, y = average protein or sawfly rating for Yellowstone for the same years, and z = 10-Yr average protein or sawfly rating for the check variety Yellowstone.

6/ April 1 to 14 days prior to harvest.