

Project Title: Off-Station winter wheat variety performance trials in Central Montana – CARC

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Objectives:

Identify top performing winter wheat cultivars in central Montana.

Methods:

On-farm winter wheat performance trials were established at Moccasin, Denton, Belt, Highwood, and Geraldine. Varieties were compared for height, propensity to lodge, heading date, yield, test weight, and protein. Each variety was planted in three 5 x 15 ft plots in a randomized experimental design to determine differences between varieties. Seeding dates were 27 October 2018 at Moccasin, 9 October at Highwood and Belt, and 25 October at Denton and Geraldine. Planting depth was 1 inch at a rate of 20 seeds/ft². Starter fertilizer, 20-30-20-10 NPKS, was applied at seeding at a rate of 50 lb/ac. An additional 180 lb/ac of urea was broadcast applied at the CARC location on 16 May. Broadleaf and grass weeds were controlled with a burndown of glyphosate at 1.25 pt/ac prior to planting. Trials at Moccasin were also sprayed 23 May with Vendetta at 24 oz/ac for broadleaf control. Plots were harvested with a small-plot harvester on 14 August at Moccasin, 16 August at Belt and Highwood, 28 August at Geraldine, and 4 September at Denton.

Results:

Above-average precipitation and cool temperatures occurring in fall 2018 planting of some 2019 winter crops. December of 2018 and January of 2019 were characterized by relatively warm and dry conditions, though this pattern ended in early February. A high of 53°F on 2 February was followed by a high of -5°F on 3 February, after which cold and wet conditions persisted through the month of May. An average air temperature of 3.3°F in the month of February made it the second coldest on record, behind February of 1936 (-2.9°F). From February through May, the Central Agricultural Research Center (CARC) received 7.42 inches of precipitation (2.39 inches above normal) and 972 growing degree days (264 below normal). Heavy frosts occurring in late April and early May also disproportionately set back winter crops, particularly early-seeded winter wheat. The CARC received 5.58 inches of precipitation in April and May alone, or 1.72 inches above normal. In June, air temperatures were consistent with long-term averages and rainfall was slightly below average. Light hail was observed at the CARC on 27 June, though damage to field crops was minimal. After a brief reprieve in June, cooler- and wetter-than-normal conditions persisted through the months of July and August, delaying maturity and seed fill of cereals, pulses, and oilseeds. Some of these crops were still in the field when snow arrived in late September. The 2019 average annual air temperature (41°F) was 1.8°F below the 108-yr average and 3.1°F below the 30-yr average. Annual precipitation (18.45 in) was 3.1 inches over the 110-yr average and 3.85 inches over the 30-yr average. Air temperatures maxed out at 92°F on 23 July and 3 August, two of only three days in the 2019 crop year when temperatures surpassed 90°F. The coldest day of the 2019 crop year was 2 March at -33°F. It has been colder than this only once in the last 30 years: -35°F on 20 December, 1990.

Table 1 shows average heading date, yield, test weight, and protein for all named varieties tested. Winter wheat yields are reported at a moisture content of 13.5%. Average yield for all winter wheat trials (including experimental lines) at Moccasin in 2019 was 71.2 bu/ac. Top yielding varieties at Moccasin included LCS Jet (86.0 bu/ac), SY Clearstone (80.9 bu/ac), and Northern (79.4 bu/ac). Average protein was 10.1%. The top varieties for protein were Brawl CLP (10.9%), Decade (10.4%), and Warhorse (10.3%). Average heading date was 19 June which was 5 days later than last year, and Brawl had the earliest heading date on 14 June. No lodging was observed with any of the varieties. Gross returns per acre were also calculated for each variety and location based on prices and protein premiums and discounts obtained from United Grain Corporation on 19 November 2019. Average gross return at Moccasin was \$312.34 per acre. Numerically, the highest gross return was obtained with LCS Jet (\$380.90/ac). Note that this calculated return does not account for any expenses but does account for dockage and premiums associated with the test weight and protein.

Average yield at the Belt, MT location was 70.8 bu/ac. Top yielding varieties were Byrd CL Plus, a new entry for 2019, (89.6 bu/ac), SY Monument (76.2 bu/ac), and Loma (74.3 bu/ac). Average test weight was 63.0 lb/bu and average protein was 9.5%. No statistically significant difference in protein was observed between any of the varieties. Substantial sawfly damage was observed with many of the varieties at Belt this year (Table 2). Average gross return was \$321.20/ac and differences in gross return were not statistically significant between varieties. At Geraldine, average yield was 77.2 bu/ac. Top performers for yield included Bryd CL Plus (85.7 bu/ac) and Northern (85.0 bu/ac). Differences in yield was not significant among the top 10 performers (Table 3). Average protein at Geraldine was 11.5% and the variety with the highest protein was Brawl CLP (13.0%). Average gross return at Geraldine was \$339.80 per acre. Numerically, the highest gross return was obtained with Brawl CLP (\$391.90/ac). Average yield at Denton, MT was 62.3 bu/ac (Table 4) and differences in yield were not significant among the top 6 varieties. Protein averaged 11.8% at Denton and differences in protein were not significant among the top 11 varieties. Average gross return at Denton was \$282.00 per acre. Numerically, the highest gross return was obtained with Keldin (\$332.90/ac). At Highwood, the average yield was 51.5 bu/ac (Table 5). Top performing varieties included a new entry for 2019, AAC Wildfire, (61.9 bu/ac) and SY Monument (60.6 bu/ac). Differences in yield was not significant among the top 7 performers. Average protein was 11.5% and differences in protein were not significant between the top 14 varieties. Average gross return at Highwood was \$228.00/ac and differences in gross return were not statistically significant between varieties.

Summary:

Cooler and wetter conditions contributed to high average yields but resulted in a later than usual harvest. Average yield for the winter wheat trial at Moccasin in 2019 was 71.2 bu/ac, 70.8 bu/ac at Belt, 77.2 bu/ac at Geraldine, 62.3 bu/ac at Denton, and 51.5 bu/ac at Highwood.

Funding Summary:

An expenditure summary will be provided by OSP. No additional grant support was provided for this project.

MWBC FY 2020 Grant Submission Plans:

A request for continuing this project was submitted for funding consideration for the next fiscal year. Funding was awarded. Thank you!

Table 1: 2018-2019 Winter Wheat Trial, Moccasin, MT

Variety/Pedigree	Year of Release	Source	Heading Date		Height (in)	Test Weight (lb/bu)	Protein (%)	Gross Return (\$/ac)	Grain Yield (bu/ac)			
			cal	jul					2017	2018	2019	3 yr Avg
+ AAC Wildfire	2015	Alberta: SECAN	26-Jun	177	34.7	61.3	9.7	349.40			77.9	
Brawl CL Plus	2011	Colorado Research Foundation	14-Jun	<u>165</u>	28.9	<u>65.0</u>	<u>10.9</u>	266.39	61.4	59.1	63.1	61.2
+ Byrd CL Plus	2018	Plainsgold/Col. Wheat Res Fdn	17-Jun	169	32.2	61.0	9.0	367.47			76.2	
Decade	2010	Montana/North Dakota	18-Jun	169	33.0	63.8	10.4	296.12	58.2	59.3	72.0	63.2
FourOsix	2018	Montana (MT1465)	20-Jun	171	30.5	63.1	9.5	337.09		70.0	76.3	
Judee	2011	Montana	19-Jun	170	31.3	64.5	10.1	300.98	59.7	57.9	69.6	62.4
Keldin	2011	Westbred	23-Jun	174	31.6	63.5	9.6	331.74	<u>71.5</u>	<u>66.3</u>	<u>73.0</u>	<u>70.3</u>
LCS Jet	2015	Limagrain Cereal Seeds	19-Jun	170	29.0	59.9	8.8	<u>380.90</u>	-	<u>70.7</u>	<u>86.0</u>	
Loma	2016	Montana	20-Jun	171	30.5	63.0	9.6	340.04	55.7	68.0	71.6	65.1
MT1564 (Flathead)	2019	Montana	16-Jun	167	30.6	64.0	10.1	280.49			64.4	
MIS1588 (Bobcat)	2019	Montana	20-Jun	171	29.9	63.7	9.8	348.82			71.4	
Northern	2015	Montana	22-Jun	174	31.9	63.1	9.8	329.61	60.5	66.5	79.4	68.8
Ray	2018	Montana (MTF1432)	24-Jun	175	36.4	61.4	9.0	259.69	-	<u>78.9</u>	56.7	
SY Clearstone 2CL	2012	Montana/Syngenta	20-Jun	171	34.7	62.6	9.3	347.32	68.5	67.8	80.6	72.3
SY Monument	2015	Syngenta	18-Jun	169	29.6	63.4	9.6	354.49	61.6	71.5	77.6	70.2
Warhorse	1013	Montana	19-Jun	170	30.4	63.6	10.3	278.09	57.8	60.6	66.0	61.5
Yellowstone	2005	Montana	20-Jun	171	33.9	62.9	9.6	321.07	63.1	68.7	71.9	67.9
Average			19-Jun	170	30.5	63.2	10.1	312.34	60.3	65.5	71.2	
LSD (0.05)			2.5	2.5	2.3	1.7	0.6	50.5	10.0	10.4	9.4	
CV (%)			0.9	0.9	4.4	1.6	3.8	10.0	9.9	11.1	7.6	
P-value			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	#####	0.0006	<0.0001	

+ = New for 2019

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant

Table 2: 2018-2019 Winter Wheat Trial, Belt, MT

Variety/Pedigree	Year of Release	Source	Height (in)	Sawfly cutting (%)	Test Weight (lb/bu)	Protein (%)	Gross Return (\$/ac)	Grain Yield (bu/ac)			
								2017	2018	2019	3 yr avg
+ AAC Wildfire	2011	Montana	29.7	3.3	63.2	9.5	331.3			72.9	
Brawl CLP	2012	Montana/Syngenta	26.1	10.0	62.5	9.4	288.8	60.0	57.4	62.2	59.9
+ Byrd CL Plus	2015	Alberta: SECAN	29.6	13.3	62.7	9.6	421.2			89.6	
Decade	2019	Montana	29.9	3.3	63.2	9.6	308.2	49.5	73.5	68.2	63.7
FourOsix	2015	Montana	26.5	20.0	62.8	9.3	310.5		71.4	64.0	
Judee	2011	Westbred	28.4	3.3	64.0	9.5	313.9	47.0	70.2	70.9	62.7
Keldin	2005	Montana	27.2	20.0	62.6	9.5	269.5	50.6	72.7	57.7	60.3
LCS Jet	2016	Montana	23.6	16.7	59.6	9.5	322.9		69.6	68.7	
Loma	2010	Montana/North Dakota	26.6	3.3	63.8	9.6	329.9	45.4	80.3	74.3	66.7
MT1564 (Flathead)	2015	Syngenta	28.5	20.0	63.0	9.7	273.0			62.2	
MTS1588 (Bobcat)	2018	Plainsgold/Col. Wheat Res Fdn	27.4	0.0	63.6	9.5	339.5			75.3	
Northern	2018	Montana (MT1465)	27.9	20.0	63.8	9.5	327.0	51.6	70.3	73.1	65.0
Ray	2018	Montana (MTF1432)	32.8	33.3	62.4	9.2	281.8		65.6	62.6	
SY Clearstone 2CL	2019	Montana	29.9	30.0	62.2	9.5	301.7	56.4	73.5	64.5	64.8
SY Monument	2011	Colorado Research Foundation	25.7	10.0	62.1	9.4	352.7	50.5	79.1	76.2	68.6
Warhorse	1013	Montana	26.8	0.0	63.9	9.4	282.6	45.0	73.4	61.8	60.1
Yellowstone	2015	Limagrain Cereal Seeds	29.6	26.7	62.6	9.7	308.8	53.7	68.7	68.8	63.7
Average			28.1	13.3	63.0	9.5	321.2	51.1	70.9	70.8	
LSD (0.05)			2.7	9.0	1.0	0.6	87.4	N.S.	6.9	15.3	
CV (%)			5.4	41.2	0.9	3.5	16.6	55.0	9.0	12.3	
P-value			<0.0001	<0.0001	<0.0001	0.7050	0.1980	0.0840	0.0015	0.0239	

+ = New for 2019

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant

Table 3: 2018-2019 Winter wheat variety trial at Geraldine, MT.

Variety/Pedigree	Year of Release	Source	Height (in)	Test Weight (lb/bu)	Protein (%)	Gross Return (\$/ac)	Grain Yield (bu/ac)			
							2017	2018	2019	3 yr avg
+ AAC Wildfire	2015	Alberta: SECAN	31.4	61.4	11.4	346.6			79.5	
Brawl CLP	2011	Colorado Research Foundation	27.6	62.3	<u>13.0</u>	<u>391.9</u>	83.8	75.5	80.9	80.1
+ Byrd CL Plus	2018	Plainsgold/Col. Wheat Res Fdn	29.2	61.1	11.0	367.6			<u>85.4</u>	
Decade	2010	Montana/North Dakota	33.1	61.4	11.6	347.3	82.9	79.7	78.1	80.2
FourOsix	2018	Montana (MT1465)	29.2	61.2	11.5	311.6		70.0	69.9	70.0
Judee	2011	Montana	28.5	62.4	11.6	321.9	71.1	78.9	72.4	74.1
Keldin	2011	Westbred	29.9	61.6	11.3	357.0	<u>90.4</u>	<u>85.7</u>	82.8	86.3
LCS Jet	2015	Limagrain Cereal Seeds	26.7	58.3	11.0	313.2		82.9	73.4	78.2
Loma	2016	Montana	28.2	61.4	11.3	335.0	75.0	80.0	77.6	77.5
MT1564 (Flathead)	2019	Montana	29.2	61.9	11.4	312.2			71.5	
MTS1588 (Bobcat)	2019	Montana	27.3	61.2	11.7	316.2			70.5	
Northern	2015	Montana	31.6	61.6	11.5	379.1	84.0	78.7	85.0	82.6
Ray	2018	Montana (MTF1432)	36.1	60.1	11.6	277.7		76.2	61.7	
SY Clearstone 2CL	2012	Montana/Syngenta	34.0	60.3	11.5	366.5	82.2	81.1	84.1	82.5
SY Monument	2015	Syngenta	29.3	60.3	10.8	356.3	88.1	78.4	84.8	83.8
Warhorse	1013	Montana	29.4	61.1	11.9	329.2	72.0	74.3	73.1	73.1
Yellowstone	2005	Montana	31.2	60.9	11.1	331.0	85.1	74.3	77.7	79.0
Average			29.8	61.3	11.5	339.8	82.1	76.9	77.2	
LSD (0.05)			2.1	0.7	0.6	40.1	7.6	5.2	8.5	
CV (%)			4.1	0.6	3.4	7.2	5.6	6.6	6.7	
P-value			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0004	

+ = New for 2019

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant

Table 4: 2018-2019 Winter wheat variety trial at Denton, MT.

Variety/Pedigree	Year of Release	Source	Height (in)	Test Weight (lb/bu)	Protein (%)	Gross Return (\$/ac)	Grain Yield (bu/ac)			
							2017	2018	2019	3 yr avg
+ AAC Wildfire	2015	Alberta: SECAN	32.2	58.5	13.0	279.0			59.4	
Brawl CLP	2011	Colorado Research Foundation	25.2	61.8	13.0	276.1	<u>49.0</u>	54.7	56.1	53.3
+ Byrd CL Plus	2018	Plainsgold/Col. Wheat Res Fdn	30.5	59.6	11.7	307.8			65.9	
Decade	2010	Montana/North Dakota	31.1	59.7	12.9	320.9	41.9	58.2	67.4	55.8
FourOsix	2018	Montana (MT1465)	27.7	59.0	12.4	326.1		50.6	69.1	
Judee	2011	Montana	29.4	60.1	<u>13.1</u>	286.7	37.3	51.6	56.5	48.5
Keldin	2011	Westbred	30.2	60.4	12.8	332.9	46.0	30.4	<u>70.1</u>	48.8
LCS Jet	2015	Limagrain Cereal Seeds	26.7	57.1	11.2	284.9		58.9	66.5	
Loma	2016	Montana	26.9	60.0	10.6	242.0	22.1	56.2	61.6	46.6
MT1564 (Flathead)	2019	Montana	27.9	60.6	11.7	249.4			54.2	
MTS1588 (Bobcat)	2019	Montana	26.4	60.9	11.1	256.5			60.8	
Northern	2015	Montana	28.7	61.0	11.1	269.3	37.3	53.0	67.2	52.5
Ray	2018	Montana (MTF1432)	35.6	58.8	11.6	261.4		48.6	58.2	
SY Clearstone 2CL	2012	Montana/Syngenta	32.9	59.2	11.9	280.8	40.3	61.2	59.7	53.7
SY Monument	2015	Syngenta	27.6	59.6	11.1	265.2	36.1	53.3	60.1	49.8
Warhorse	1013	Montana	27.9	60.5	11.7	276.0	34.3	54.8	61.8	50.3
Yellowstone	2005	Montana	31.4	60.2	10.5	227.3	40.3	51.8	59.4	50.5
Average			29.2	60.1	11.8	282.0	39.2	53.7	62.3	
LSD (0.05)			1.6	1.3	1.6	57.8	8.2	22.5	7.5	
CV (%)			2.9	1.2	8.3	12.5	12.8	19.8	6.6	
P-value			<0.0001	<0.0001	0.0300	0.0270	<0.0001	0.5000	0.0062	

+ = New for 2019

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant

Table 5: 2018-2019 Winter wheat variety trial at Highwood, MT.

Variety/Pedigree	Year of Release	Source	Height (in)	Test Weight (lb/bu)	Protein (%)	Gross Return (\$/bu)	Grain Yield (bu/ac)			
							2017	2018	2019	3 yr avg
+ AAC Wildfire	2015	Alberta: SECAN	29.8	62.4	11.3	268.5			61.9	
Brawl CLP	2011	Colorado Research Foundation	23.0	62.4	<u>12.1</u>	178.7	35.6	21.5	38.5	31.9
+ Byrd CL Plus	2018	Plainsgold/Col. Wheat Res Fdn	27.3	61.9	10.6	249.7			58.8	
Decade	2010	Montana/North Dakota	29.1	61.4	11.5	247.8	64.2	45.2	57.5	55.6
FourOsix	2018	Montana (MT1465)	26.7	61.6	11.1	240.6		38.9	53.3	
Judee	2011	Montana	25.1	63.0	11.7	221.3	56.5	50.8	49.7	52.3
Keldin	2011	Westbred	26.8	60.9	11.7	215.8	55.4	32.6	44.4	44.1
LCS Jet	2015	Limagrain Cereal Seeds	22.4	59.4	11.0	189.5		39.4	49.0	
Loma	2016	Montana	24.9	61.5	11.8	272.1	60.9	36.6	55.2	50.9
MT1564 (Flathead)	2019	Montana	26.9	62.0	<u>12.1</u>	199.6			42.1	
MTS1588 (Bobcat)	2019	Montana	25.0	59.4	11.9	209.9			44.7	
Northern	2015	Montana	26.8	61.7	11.1	245.6	60.5	33.8	58.3	50.9
Ray	2018	Montana (MTF1432)	32.3	60.5	12.0	210.4		31.1	42.1	
SY Clearstone 2CL	2012	Montana/Syngenta	29.9	61.1	10.8	233.5	67.6	45.9	55.7	56.4
SY Monument	2015	Syngenta	26.9	60.9	10.9	239.3	65.0	46.4	60.6	57.3
Warhorse	1013	Montana	26.5	61.4	<u>12.1</u>	234.7	51.2	43.3	47.9	47.5
Yellowstone	2005	Montana	29.3	61.4	10.6	249.4	53.2	35.2	54.2	47.5
Average			26.7	61.5	11.5	228.0	57.2	36.4	51.5	
LSD (0.05)			2.1	1.2	1.3	55.1	8.9	8.79	8.6	
CV (%)			4.4	1.2	6.8	14.7	8.4	13.3	9.1	
P-value			<0.0001	<0.0001	0.0280	0.0730	<0.0001	<0.0001	<0.0001	

+ = New for 2019

Bolded and underlined values are the highest mean. Bolded values are not different from the highest value based on the Least Significant Difference (LSD) test

Note: Study averages include experimental lines not listed here.

N.S. = Not Significant