

Project Title: Evaluation of winter wheat cultivar performance under continuous crop and crop-fallow systems in central Montana

Project Leader: P.M. Carr (pre-March 6) and J.O. Eberly (post-March 6)

Project Personnel:

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Objectives:

Identify top performing winter wheat cultivars in central Montana.

Methods:

Standard winter wheat variety performance trials were conducted on chemical fallow or minimal tillage during 2017 at Moccasin (CARC) and on farms near Denton and Highwood. Trials consisted of 14 named varieties of winter wheat and additional experimental lines. Each variety was seeded in three 5 row, 16 foot plots in a randomized experimental design. Seeding dates were September 27, 2016 at Denton, September 28, 2016, at Highwood and Belt, September 30, 2016, at Moccasin, and October 25 at Geraldine. All plots were trimmed to a harvest length of approximately 12 feet and harvested with a small plot combine. Plots were harvested on July 26 at Moccasin and Denton, July 31 at Belt, August 1 at Geraldine, and August 4 at Highwood.

Results:

The 2017 growing season at CARC started out with good recharge soil moisture and above average precipitation through June 14, followed by exceptionally dry conditions. Total annual precipitation was above the 108-year average, despite exceptionally low rainfall in the months of June (55% of average), July (40% of average), and August (20% of average). This created favorable conditions for winter wheat growth during the mid-spring period. The 2017 crop year was characterized by above-average temperatures. Average annual temperature was 1.7°F higher than the 106-year mean, with individual monthly averages exceeding long-term averages by greater than 6°F in the months of November and March. July was by far the hottest month with an average monthly temperature of 71.4°F (5.4°F above normal), and a total of 14 days above 90°F. By August, central Montana was considered to be in a severe drought based on the Palmer Drought Severity Index monitoring by the National Oceanic and Atmospheric Administration (NOAA).

Dry conditions existed in June (1.7 inches vs. a long-term average of 3.1 inches) and July (0.7 inch vs. a long-term average of 1.65 inches), during the critical grain-fill period. The dry conditions, when combined with warmer-than-average temperatures during June (60°F vs. 58°F) and July (71°F vs. 66°F), resulted in relatively light test weights across cultivars included in the trial at Moccasin. Test weight averaged 58.6 lb/bu across the commercial cultivars included in the trial (Table 2). In contrast, grain test weight averaged 62 lb/bu or greater for trials at Denton, Geraldine, Belt, and Highwood (Tables 3-6).

Average grain yield across the 14 cultivars presented in Tables 2 through 6 ranged from 39.2 bu/ac at Denton to 82.1 bu/ac at Geraldine. Keldin was among the highest-yielding cultivars at Moccasin, Denton, and Geraldine. In contrast, SY Clearstone 2CL was one of the top performing cultivars at Highwood and Brawl CLP, a new entry for 2017, was the top performer at Belt. Average protein at Belt was very low at only 8.9% compared to averages of 11.4-13.9% at the other locations. Northern and Loma were among the top performers for protein at Moccasin and Belt while Brawl CLP had the highest protein content at

Highwood. Bearpaw and Loma both had protein levels at 14% or greater at Denton while Warhorse was among the highest protein varieties at Geraldine. Gross return calculations integrated yield and protein premiums/discounts as a separate ranking criterion. The mean value for gross returns was highest for SY Clearstone CL at Moccasin, SY Wolf at Denton and Geraldine, Decade at Highwood, and Brawl CLP at Belt. Note that gross return calculations do not take into account any expenses.

Summary:

A wet spring combined with drier and warmer conditions through June and July at Moccasin led to lower yields and test weights. While average annual rainfall was slightly above the historic average during the 2016-2017 growing season, lower than average precipitation during June and July negatively impacted overall performance. Brawl CLP was among the best performing cultivars at many of the locations in central Montana during 2017. It is important to evaluate performance in subsequent years to determine how well adapted this new cultivar is relative to other cultivars presently grown in the region. This work has been strongly supported by producers at the off station locations and by the Central Agricultural Research Center Advisory Council. With budget and other resources allowing, plans are in place to continue off-station cereal variety investigation throughout the central Montana region.

Funding Summary:

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

MWBC FY 2018 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: Monthly precipitation and temperature data during the 2016-17 growing season and the long-term average at the Central Ag. Research Center in Moccasin, MT.

Month/Year	Temperature			Growing Degree Days			Precipitation		
	2017	2012-2017	Δ	2017	2012-2017	Δ	2017	2010-2017	Δ
	----- F -----			----- GDD ₃₂ -----			----- in -----		
September 2016	55.4	54.9	0.5	700	695	5	3.37	1.42	1.95
October 2016	46.3	44.9	1.4	475	459	16	2.76	0.93	1.83
November 2016	42.9	32.9	10.0	398	227	170	0.14	0.56	-0.42
December 2016	15.6	24.9	-9.3	56	136	-80	0.43	0.54	-0.11
January 2017	19.1	21.8	-2.7	105	119	-14	0.23	0.54	-0.31
February 2017	26.9	24.8	2.1	172	125	48	0.39	0.44	-0.05
March 2017	37.2	30.6	6.6	307	196	111	0.37	0.70	-0.33
April 2017	42.2	40.9	1.3	352	344	8	2.20	1.22	0.98
May 2017	52.4	50.1	2.3	636	574	61	2.93	2.62	0.31
June 2017	60.0	57.9	2.1	840	777	63	1.68	3.06	-1.38
July 2017	71.4	66.0	5.4	1220	1051	169	0.66	1.65	-0.99
August 2017	65.9	65.0	0.9	1052	1019	33	0.31	1.59	-1.28
Average/Total	44.6	42.9	1.7	526	477	49	15.47	15.27	0.20

Table 2: 2016-2017 Winter Wheat Trial, Moccasin, MT

Variety/Pedigree	Year of Release	Source	Heading Date		Grain Yield (bu/ac)		Test Weight	Protein	Gross Return
			cal	jul	2017	2016	(lb/bu)	(%)	(\$/ac)
Bearpaw	2011	MAES	8-Jun	159	56.6	38.1	58.5	14.2	293.30
+ Brawl CLP	2017	Colorado Research Foundation, 2011	<u>2-Jun</u>	<u>153</u>	61.4	-	<u>61.1</u>	12.9	286.60
CDC Falcon	1999	WPB/SK	11-Jun	162	56.1	35.8	57.7	13.7	276.70
Decade	2010	MAES/NDSU	8-Jun	159	56.5	38.2	58.2	14.1	290.30
Judee	2011	MAES	8-Jun	159	57.0	32.6	60.4	14.3	300.00
Keldin	2011	Seed Linc./Westbred LLC	10-Jun	162	71.5	<u>47.4</u>	59.7	13.5	351.20
Loma	2016	MAES	12-Jun	163	55.7	41.5	57.5	14.6	295.80
Northern	2015	MAES	14-Jun	165	60.5	39.3	58.4	<u>15.0</u>	333.20
SY Clearstone 2CL	2012	Syngenta	10-Jun	161	68.5	44.4	58.3	13.7	340.90
+ SY Monument	2017	Syngenta, 2015	7-Jun	158	61.6	-	58.4	12.4	273.80
SY Wolf	2010	AgriPro/Syngenta	7-Jun	158	63.3	40.6	60.6	13.3	307.40
Warhorse	2013	MAES	8-Jun	160	57.8	39.3	58.2	14.3	302.50
WB-Quake	2011	WestBred LLC	12-Jun	163	51.5	30.1	57.7	14.6	273.20
Yellowstone	2005	MAES	11-Jun	162	63.1	42.0	57.5	14.5	333.00
Average			10-Jun	161	60.3	39.1	58.6	13.9	313.95
CV%			0.003	0.9	10	9.4	1.1	1.9	9.7
LSD (0.05)			2.3	2.3	N.S.	8.1	1.1	0.4	N.S.
P-value			<0.0001	<0.0001	0.1119		<0.0001	<0.0001	0.078

+ = New for 2017

*Gross returns calculated based on protein premiums/dockages as of September 2017, United Grains Elevator, Moccasin, MT.

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.

Note: Yellowstone plots, for 2017, were planted with varying amounts of 'Warhorse' seed depending on location.

N.S. = Not Significant

Table 3: 2016-2017 Winter Wheat Trial, Denton, MT

Variety/Pedigree	Year of Release	Source	Grain Yield	Test Weight	Protein	Gross Return
			(bu/ac)	(lb/bu)	(%)	(\$/ac)
Bearpaw	2011	MAES	22.1	62.8	14.0	116.36
+ Brawl CLP	2017	Colorado Research Foundation, 2011	49.0	64.4	12.7	231.55
CDC Falcon	1999	WPB/SK	44.3	61.5	13.9	227.81
Decade	2010	MAES/NDSU	41.9	62.4	13.2	206.70
Judee	2011	MAES	37.3	63.2	13.8	190.60
Keldin	2011	Seed Linc./Westbred LLC	46.0	63.0	13.2	226.30
Loma	2016	MAES	22.1	61.7	14.4	120.71
Northern	2015	MAES	37.3	61.4	14.3	201.53
SY Clearstone 2CL	2012	Syngenta	40.3	61.0	13.3	201.28
+ SY Monument	2017	Syngenta, 2015	36.1	60.9	12.7	169.63
SY Wolf	2010	AgriPro/Syngenta	50.5	63.5	12.7	238.46
Warhorse	2013	MAES	34.3	62.6	13.8	176.30
WB-Quake	2011	WestBred LLC	26.6	62.7	13.8	136.39
Yellowstone	2005	MAES	40.3	61.4	13.8	209.83
Average			39.2	62.1	13.5	197.52
CV%			12.8	0.72	2.5	11.7
LSD (0.05)			8.2	0.73	0.56	N.S.
P-value			<0.0001	<0.0001	<0.0001	<0.0001

+ = New for 2017

*Gross returns calculated based on protein premiums/dockages as of September 2017, United Grains Elevator, Moccasin, MT.

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.

Note: Yellowstone plots, for 2017, were planted with varying amounts of 'Warhorse' seed depending on location.

Note: No trial performed at this site in 2016.

N.S. = Not Significant

Table 4: Winter wheat variety trial at Geraldine, MT.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)		Test Weight	Protein	Gross Return
			2017	2016	(lb/bu)	(%)	(\$/ac)
Bearpaw	2011	MAES	83.0	76.9	63.6	10.8	350.50
+ Brawl CLP	2017	Colorado Research Foundation, 2011	83.8	-	64.7	12.3	373.20
CDC Falcon	1999	WPB/SK	78.1	77.5	62.0	12.2	342.60
Decade	2010	MAES/NDSU	82.9	71.8	63.4	11.8	350.00
Judee	2011	MAES	71.1	71.6	62.2	11.6	301.70
Keldin	2011	Seed Linc./Westbred LLC	90.4	101.1	63.2	10.4	372.90
Loma	2016	MAES	75.0	77.3	62.2	11.3	315.90
Northern	2015	MAES	84.0	90.1	62.6	11.7	354.00
SY Clearstone 2CL	2012	Syngenta	82.2	92.7	61.3	10.9	343.10
+ SY Monument	2017	Syngenta, 2015	88.1	-	62.0	10.5	362.10
SY Wolf	2010	AgriPro/Syngenta	93.6	94.0	64.2	11.2	384.70
Warhorse	2013	MAES	72.0	80.6	62.7	12.4	323.00
WB-Quake	2011	WestBred LLC	73.0	73.7	63.2	11.0	302.90
Yellowstone	2005	MAES	85.1	89.8	61.9	11.2	359.40
Average			82.1	85.4	62.6	11.4	328.60
C.V. (%)			5.6	3.8	1.0	4.2	9.5
LSD (0.05)			7.6	6.0	1.1	0.8	N.S.
P-value			<0.0001	-	<0.0001	<0.0001	<0.001

+ = New for 2017

*Gross returns calculated based on protein premiums/dockages as of September 2017, United Grains Elevator, Moccasin, MT.

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. Trial seeded 9/30/16 and harvested 7/26/17.

Note: Yellowstone plots, for 2017, were planted with varying amounts of 'Warhorse' seed depending on location.

N.S. = Not Significant

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

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)		Test Weight	Protein	Gross Return
			2017	2016	(lb/bu)	(%)	(\$/ac)
Bearpaw	2011	MAES	54.4	48.1	61.8	12.9	253.30
+ Brawl CLP	2017	Colorado Research Foundation, 2011	35.1	-	63.4	14.7	188.00
CDC Falcon	1999	WPB/SK	53.2	58.5	61.9	12.6	241.60
Decade	2010	MAES/NDSU	67.5	55.0	63.3	12.0	290.10
Judee	2011	MAES	52.9	66.0	62.5	13.1	252.80
Keldin	2011	Seed Linc./Westbred LLC	57.0	58.3	61.6	12.4	254.00
Loma	2016	MAES	59.5	55.4	61.9	12.4	264.40
Northern	2015	MAES	58.2	58.5	62.3	12.6	262.60
SY Clearstone 2CL	2012	Syngenta	68.0	68.5	61.2	11.6	284.20
+ SY Monument	2017	Syngenta, 2015	65.0	-	62.3	11.2	267.30
SY Wolf	2010	AgriPro/Syngenta	62.1	43.1	63.9	12.1	268.70
Warhorse	2013	MAES	54.5	68.3	60.7	13.3	264.90
WB-Quake	2011	WestBred LLC	39.1	51.6	62.4	13.0	183.70
Yellowstone	2005	MAES	50.0	51.2	61.8	13.3	241.20
Average			56.7	56.1	62.0	12.4	255.68
CV%			14.6	8.7	0.6	4.5	10.2
LSD (0.05)			5.5	8.7	0.6	0.9	N.S.
P-value			0.035	<0.0001	<0.0001	<0.0001	<0.0001

+ = New for 2017

*Gross returns calculated based on protein premiums/dockages as of September 2017, United Grains Elevator, Moccasin, MT.

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.

Note: Yellowstone plots, for 2017, were planted with varying amounts of 'Warhorse' seed depending on location.

N.S. = Not Significant

Table 6: Winter wheat variety trial at Belt, MT.

Variety/Pedigree	Year of Release	Source	Grain Yield	Test Weight	Protein	Gross Return
			(bu/ac)	(lb/bu)	(%)	(\$/ac)
Bearpaw	2011	MAES	41.0	62.8	8.6	100.75
+ Brawl CLP	2017	Colorado Research Foundation, 2011	60.0	<u>64.4</u>	9.7	178.71
CDC Falcon	1999	WPB/SK	50.5	61.5	9.3	144.17
Decade	2010	MAES/NDSU	49.5	62.4	9.6	148.57
Judee	2011	MAES	47.0	63.2	8.7	119.00
Keldin	2011	Seed Linc./Westbred LLC	50.6	63.0	8.3	119.97
Loma	2016	MAES	45.4	61.7	9.1	124.73
Northern	2015	MAES	51.6	61.4	9.1	143.35
SY Clearstone 2CL	2012	Syngenta	56.4	61.0	8.6	148.55
+ SY Monument	2017	Syngenta, 2015	50.5	60.9	7.9	110.23
SY Wolf	2010	AgriPro/Syngenta	52.7	63.5	8.3	123.21
Warhorse	2013	MAES	45.0	62.6	8.9	120.10
WB-Quake	2011	WestBred LLC	44.6	62.7	8.3	104.56
Yellowstone	2005	MAES	53.7	61.4	8.3	126.51
Average			51.1	62.1	8.9	129.46
C.V.(%)			5.5	0.7	7.8	9.8
LSD (0.05)			N.S.	0.7	1.1	N.S.
P-value			0.084	<0.0001	<0.0001	0.019

+ = New for 2017

*Gross returns calculated based on protein premiums/dockages as of September 2017, United Grains Elevator, Moccasin, MT.

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.

Note: Yellowstone plots, for 2017, were planted with varying amounts of 'Warhorse' seed depending on location.

Note: No trial performed at this site in 2016.

N.S. = Not Significant