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

Project Leader: D.M. Wichman (pre-July 8) and P.M. Carr (post-July 8)

Project Personnel:

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Objectives:
Identify top performing winter wheat cultivars in central Montana.

Results:
The 2015-16 growing season at CARC was drier (13.1 inches) than the long-term average (15.3 inches; Table 1). Less-than-average amounts of precipitation occurred each month from September through March, but timely precipitation in April along with greater than average amounts of precipitation in May (4.5 vs. 2.6 inches) created favorable conditions for winter wheat growth during the mid-spring period. Dry conditions developed again in June (1 inch vs. a long-term average of 3.1 inches) and into early July, during the critical grain-fill period. The relatively dry conditions, when combined with warmer-than-average temperatures during June (62^{o} vs. 58^{o}F) and near-normal average temperatures during July, resulted in relatively light test weights across cultivars included in the trial at Moccasin. Test weight averaged less 58 lb/bu across the commercial cultivars included in the trial (Table 2). In contrast, grain test weight averaged greater than 62 lb/bu across cultivars at both Geraldine and Winifred (Tables 3 and 4), reflecting the more favorable growing conditions at both locations. Growing conditions favored excellent yields at both Belt and Denton locations, but an infestation of jointed goat grass forced abandonment of the trial at Belt while hail destroyed the trial at Denton. Low soil-pH levels (<5) and other factors resulted in less-than-ideal growing conditions for cultivars at the Highwood location.

Average grain yield across the 18 cultivars presented in Tables 2 through 5 ranged from 41 bu/ac at Moccasin to 86 bu/ac at Winifred. Colter was among the highest-yielding cultivars at Moccasin but was not among the top performing cultivars for yield at other locations. Conversely, Cowboy produced grain yields that were equal or greater than those produced by other cultivars at each of the four locations harvested in 2015-16. Similarly, Keldin was among the highest-yielding cultivars at Moccasin, Geraldine, and Winifred. Only the cultivars SY Clearstone 2CL and Warhorse produced more grain than Keldin at Highwood, but these two cultivars produced less grain than Keldin at Geraldine and Winifred. Both Cowboy and Keldin produced low-protein grain compared with several other cultivars at each of the four locations. The 'gross return' column integrated yield and protein premiums/discounts as a separate ranking criterion. The mean value for gross returns was highest for Colter at Moccasin, Keldin at Geraldine, Warhorse at Highwood, and Loma at Winifred. Readers are warned that gross return comparisons were not analyzed statistically and so comparisons should be made cautiously.

Yields for the 2014-15 and 2015-16 growing seasons were combined for all cultivars at Moccasin, Geraldine, and Winifred locations. Yellowstone was at or near the top for mean grain yield at all three locations. Others cultivars ranking in the top 50% for mean grain yield across the three locations included Colter, SY Clearstone, WB3768, Loma, and SY Wolf. Comparisons of cultivar performance across multiple growing seasons and locations should be limited since multi-locational statistical analyses were not conducted.

Summary:

Less than average precipitation was received during the 2015-16 growing season at Moccasin, while more favorable growing conditions occurred at Geraldine and Winifred. This was reflected in the relatively high yields of cultivars at both Geraldine and Winifred compared with Moccasin. Acidic soils (pH < 5) likely limited the yield potential of cultivars at Highwood. Cowboy and Keldin were among the highest-yielding cultivars across all locations in central Montana during 2016. It is important to evaluate performance in subsequent years to determine how well adapted these two new cultivars are relative to other cultivars presently grown in the region.

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

MWBC FY 2017 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 2015-16 growing season and the long-term average at the Central Ag. Research Center in Moccasin, MT.

Month	Year	Precipitation, in		Air Temperature, °F	
		Current Year	*1909-2016*	*Current Year*	*1911-2016*
Sep	*2015*	0.8	1.4	57.8	54.9
Oct	"	0.6	0.9	48.7	44.9
Nov	"	0.5	0.6	33.4	32.8
Dec	"	0.4	0.5	27.2	25.0
Jan	*2016*	0.3	0.5	27.9	21.8
Feb	"	0.3	0.4	35.8	24.7
Mar	"	0.6	0.7	38.4	30.6
Apr	"	1.2	1.2	45.3	40.8
May	"	4.5	2.6	50.4	50.1
Jun	"	1.0	3.1	61.7	57.9
Jul	"	1.7	1.7	66.0	65.9
Aug	"	1.4	1.6	64.3	64.9
Total\Average		13.3	15.3	46.4	42.9

Table 2. 2014-2016 Off-Station Winter Wheat Test, Moccasin, Montana.

Cultivar/Line	Grain Yield (bu/a)			Test Weight (lb/bu)	Protein (%)	Gross returns /ac ($)
	2016	2015-16		2016	2016	2016
Bearpaw	38.1	38.5	2014, no	57.3	14.1	167.6
Broadview	32.1	33.4	harvest	55.4	14.5	145.2
CDC Falcon	35.8	38.7	cheat-	56.8	13.7	153.1
Colter	49.7	43.4	grass	59.3	13.5	209.6
+ Cowboy	45.1		infest-	58.0	13.3	187.5
Decade	38.2	41.6	ation	57.7	13.7	163.4
Jerry	36.7	37.3		55.9	14.4	164.8
Judee	32.6	31.7		57.9	13.9	141.5
+ Keldin	47.4			57.6	13.1	194.4
Loma	41.5	41.8		58.9	13.5	175.2
Northern	39.3	38.6		59.4	13.5	165.8
Rampart	35.0	28.7		59.0	14.5	158.1
SY Clearstone 2CL	44.4	42.6		57.6	13.6	188.6
SY Wolf	40.6	40.9		56.8	13.7	173.5
Warhorse	39.3	40.1		56.1	14.1	173.1
WB3768	42.3	42.3		59.4	14.3	188.8
WB-Quake	30.1	32.7		55.9	15.0	140.7
Yellowstone	42.0	44.1		57.6	13.8	180.9
Average	40.5	39.7		57.8	13.9	174.9
LSD (0.05)	8.1	7.8		2.9		
C.V. (%)	10.8	9.4		2.5		

+ = new for 2016

*: Prices are calculated based on protein premiums and discounts as of September 2016, United Grains Elevator.

Note: Averages provided include experimental lines which are not listed here along with the named varieties which are.

Table 3: 2014-2016 Off-Station Winter Wheat Test Geraldine (CARC), Montana.

Cultivar/Line	Grain Yield (bu/a)			Test Weight (lb/bu)	Protein (%)	Gross returns / ac ($)
	2016	2015-16	2014-16	2016	2016	2016
Bearpaw	76.9	78.7	72.3	61.4	9.6	219.9
Broadview	78.1	72.1		61.7	9.5	220.1
CDC Falcon	77.5	75.4	71.5	62.1	10.1	237.0
Colter	82.1	81.6	78.0	62.1	10.0	248.0
+ Cowboy	98.8			62.6	8.5	239.1
Decade	71.8	73.4	68.8	63.0	9.0	188.0
Jerry	74.1	74.5	67.5	61.0	9.6	211.9
Judee	71.6	74.7	72.5	64.0	9.8	210.5
+ Keldin	101.1			63.8	9.1	268.7
Loma	77.3	77.3		62.0	9.8	227.2
Northern	90.1	83.0	78.1	62.2	9.6	257.6
Rampart	72.5	68.1	67.3	63.0	10.4	230.5
SY Clearstone 2CL	92.7	82.8	78.4	62.3	9.2	250.3
SY Wolf	94.0	88.1		64.6	9.3	257.5
Warhorse	80.6	76.2	70.8	62.7	10.4	256.1
WB3768	94.4	87.0	79.4	63.4	8.8	239.8
WB-Quake	73.7	74.3	71.0	62.5	10.1	225.3
Yellowstone	89.8	88.3	82.5	62.7	9.2	242.5
Average	85.4	79.8	74.4	62.6	9.5	240.1
LSD (0.05)	6.0			0.5		
C.V. (%)	3.8			0.4		

+ = new for 2016

*: Prices are calculated based on protein premiums and discounts as of September 2016, United Grains Elevator.

Note: Averages provided include experimental lines which are not listed here along with the named varieties which are.

Table 4. 2016 Off-Station Winter Wheat Test (Exp. 3876): Highwood (CARC)

	Cultivar/Line	Grain Yield bu/ac	Protein %	Gross returns / ac ($) 2016
	Bearpaw	48.08	10.6	156.7
	Broadview	57.25	9.9	170.6
	CDC Falcon	58.53	11.1	202.5
	Colter	54.02	12.3	208.5
+	Cowboy	60.7	9.9	181.0
	Decade	55.0	11.0	188.2
	Jerry	41.6	9.9	123.8
	Judee	66.0	12.0	248.9
+	Keldin	58.26	11.6	212.6
	Loma	55.37	11.9	207.0
	MT1138	61.66	11.7	226.9
	Northern	58.49	12.5	229.2
	Rampart	46.34	11.3	164.0
	SY Clearstone 2CL	68.49	11.8	254.0
	SY Wolf	43.1	11.1	149.1
	Warhorse	68.3	12.2	261.5
	WB3768	51.3	10.5	165.1
	WB-Quake	51.6	12.1	196.2
	Yellowstone	51.2	11.4	183.3
	Average	56.1	11.2	196.7
	LSD (0.05)	8.7		
	C.V. (%)	8.7		
	P-value (Varieties)	<.0001		

+ = new for 2016

*: Prices are calculated based on protein premiums and discounts as of September 2016, United Grains Elevator.

Note: Averages provided include experimental lines which are not listed here along with the named varieties which are.

Table 5. 2014-2016 Off-Station Winter Wheat Test Winifred (CARC).

Cultivar/Line	Grain Yield (bu/a)				Test Weight (lb/bu)	Protein (%)	Gross returns / ac ($)
	2016	2015-16	2014-16	2013-16	2016	2016	2016
Bearpaw	79.7	65.1	56.8	58.5	61.6	9.5	224.7
Broadview	77.7	59.7			61.9	10.2	240.9
CDC Falcon	76.5	66.2	59.3	59.3	62.1	10.1	234.0
Colter	82.7	69.2	60.6	58.4	62.4	9.5	233.1
+ Cowboy	98.5				62.0	8.8	250.2
Decade	75.5	67.4	59.9	63.6	62.1	9.5	212.8
Jerry	73.3	60.7	52.9	53.2	60.7	10.1	224.1
Judee	88.4	67.0	58.0	58.3	63.8	10.0	266.8
+ Keldin	105.7				63.0	9.1	281.1
Loma	92.4	78.6			62.6	10.5	297.5
Northern	91.3	72.3	63.8	66.2	62.1	9.6	261.1
Rampart	71.2	55.3	50.7	49.7	61.2	11.5	257.7
SY Clearstone 2CL	89.7	64.1	55.7	55.4	62.2	9.1	238.5
SY Wolf	101.5	77.9			63.9	9.7	294.4
Warhorse	84.2	66.8	58.7	57.2	62.5	10.3	264.3
WB3768	87.5	67.8	59.7	60.6	63.0	9.0	229.2
WB-Quake	81.2	67.3	58.2	57.4	62.6	9.3	222.4
Yellowstone	92.5	76.0	64.4	63.7	62.5	9.9	275.5
Average	**86.4**	**67.8**	**58.6**	**58.6**	**62.3**	**9.7**	249.8
LSD (0.05)	**8.38**	**ns**	**ns**	**7.90**	**0.70**		
C.V. (%)	**5.22**	**9.10**	**9.40**	**9.40**	**0.50**		

+ = new for 2016

*: Prices are calculated based on protein premiums and discounts as of September 2016, United Grains Elevator.

Note: Averages provided include experimental lines which are not listed here along with the named varieties which are.