

Project Title: Off-station winter wheat cultivar evaluations for the Western Golden Triangle area of Montana

Principle Investigator: Gadi V.P. Reddy, Superintendent and Associate Professor of Entomology/Insect Ecology, Western Triangle Ag Research Center

Personnel: John H. Miller, Research Associate and Julie Prewett, Research Assistant WTARC, Conrad, MT, and Phil Bruckner and Jim Berg, MSU Plant Science Dept., Bozeman, MT.

Cooperators: Bradley Farms, north of Cut Bank, MT
Brian Aklestad, north of Devon, MT
Aaron Killion, east of Brady, MT
Inbody Farms, northeast of Choteau, MT

Objectives: There are diverse cropping environments within the area served by Western Triangle Agricultural Research Center. Each off station location has its own unique environment and soils. Producers in the various locations are interested in variety performance in the local area. To this end the objective is to evaluate winter wheat varieties under the local conditions with respect to yield, test weight, plant height, and seed protein. The environmental conditions at the off station nurseries can vary greatly from those at WTARC. The research center strives to provide growers of the western triangle area unbiased information of various winter wheat varieties.

Methods: Off station winter wheat nurseries consist of 25 entries replicated three times, seeded with a four row plot seeder on one foot spacing. All plots were planted on no-till chemical fallow. Plots were trimmed, measured for length, and then harvested with a Hege 140 plot combine. Winter wheat seed was cleaned prior to collecting data. Orange wheat blossom midge pheromone traps were installed at each off station plot.

Results: Most off station winter wheat plots began growing this spring in February as the soil and air temperatures were warmer than normal. Off station plots were harvested at Choteau, Cut Bank, Devon, and the 'Knees'. The data are presented in Tables 1 thru 8. Soil test data is shown in Table 9.

At the research center, this years' overall crop year temperatures were slightly higher than the 30 year average at the research center, being 1.2 degrees warmer than normal. With November being 0.9 degrees warmer than the 30 year average. December and January average temperatures were very close to the long term average. February was exceptionally warmer, with the temperature being 11.4 degrees warmer than the 30 year average. March and April were also warmer by 4.6 and 2.4 degrees above the 30 year average. May temperatures were cooler than the average by 1.6 degrees. June was also above average by 1.9 degrees. With July and August being slightly cooler than normal by 2.1 and 2.7 degrees.

Precipitation at the research center was surprising with 5.18 inches more moisture than the 30 year average. We received above average moisture the fall of 2015, resulting in good soil

moisture at planting. September was 1.82 inches above the 30 year average. October through December were 0.5 inches of precipitation above normal. January was ahead of the average with 2.1 inches more than the normal precipitation. February was exceedingly dry reporting no moisture for the month. With March close behind only receiving 0.2 of inch. April brought some much needed moisture with about an inch above the 30 year average, while May was only slightly above the 30 year average. June precipitation was 2.3 inches below normal. July received 1.4 inches over the 30 year average for precipitation. The chemical fallowed soils generally had good moisture while seeding winter wheat during the fall of 2015. Precipitation in September and October was above the 30 average, with a cooler September and a warmer October, and November was slightly cooler than normal.

Grain yields and test weights at Choteau were about 4 bu/ac higher and 2 lb/bu higher than the four year average. Seed protein at Choteau was 0.7 percent lower than the four year average. The top yielding varieties at Choteau include Cowboy, the Montana State University experimental line MT1348, and Keldin at 88.0, 82.5, and 82.5 bu/ac (Table 1 and 2). Grain yields and test weights at Cut Bank were 15.7 bu/ac higher and 1 lb/bu higher than the three year average. Seed protein at Cut Bank was 0.5 percent higher than the three year average. At Cut Bank, the top yielding wheat's were Keldin, SY Wolf, and WB3768 with yields of 95.1, 91.5, and 90.0 bu/ac (Table 3 and 4).

Grain yields and test weights at Devon were a little more than 20 bu/ac higher and 1 lb/bu higher than the four year average. Seed protein at Devon was about 2 percent lower than the four year average. Top yielders at Devon include Cowboy, Keldin, and the Montana State University experimental line MT1332 at 94.0, 91.3, and 90.8 bu/ac (Table 5 and 6). Grain yields and test weights at the 'Knees' were a little more than 23 bu/ac higher and 2 lb/bu lower than the five year average. Seed protein at the 'Knees' was 0.4 percent lower than the five year average. The top yielding varieties at the 'Knees' include Montana State University experimental line Keldin, Judee, and SY Clearstone 2CL at 121.9, 117.2, and 114.2 bu/ac (Table 7 and 8).

No insect incidence (wheat stem sawfly or wireworms) was noticed in any of the winter wheat varieties at Devon or Cut Bank. The plots at Choteau and the 'Knees' had sawfly cutting, and the plot at the 'Knees' had some stripe and tan rust. Because of the high number of parasitoids of the wheat stem sawfly at the research center very little cutting was observed. Insignificant amount of adult of orange wheat blossom midge were found at the off station locations.

Summary: The data from the off station plots is supported by the local producers and advisory committee as well as the seed industry. It is planned to continue the off station variety plots at the same locations as the environmental conditions at each location is unique to the western triangle area.

These data should be used for comparative purposes rather than using absolute numbers. Statistics are used to indicate that treatment or variety differences are really different and are not different due to chance or error. The least significant difference (LSD) and coefficient of variability (CV) values are useful in comparing treatment or variety differences. The LSD value represents the smallest difference between two treatments at a given probably level. The LSD at $p=0.05$ or 5 % probability level is usually the statistic reported, and it means that the odds are 19

to 1 that treatment differences by the amount of the LSD are truly different. The CV value measures the variability of the experiment or variety trial, and a CV greater than 15 % indicates a high degree of variability and less accuracy.

Funding Summary: Office of Special Projects will provide expenditure information. No other grants support this project.

MWBC FY2017 Grant Submission Plans: A similar project will be proposed for FY 2017. The continuation of on and off-station variety trials help elucidate researchers and farmers which varieties are better suited for that particular region in Montana.

Table 1. Off-station Winter Wheat variety trial located near the Choteau. Teton County. Western Triangle Ag. Research Center. 2016.

Variety or ID	Yield bu/ac	Test Wt lb/bu	Height inch	Lodging %	Protein %
Cowboy	88.0	60.2	31.0	6.4	14.0
MT1348	82.5	61.2	32.7	19.7	14.3
Keldin	82.5	62.0	33.0	22.6	13.6
MT1254	82.0	60.0	33.0	8.1	14.1
SY WOLF	79.8	62.7	30.3	13.1	14.1
MT1265	79.2	59.6	34.0	7.8	14.4
MT1257	78.4	60.7	32.3	10.1	13.8
Yellowstone	78.2	60.2	34.0	13.6	14.3
MT1332	77.9	59.9	33.0	13.6	14.3
Colter	77.1	59.4	33.3	7.9	14.5
Loma	77.1	60.0	32.0	7.1	14.8
Judee	76.2	62.4	31.3	8.8	14.9
Northern	75.9	60.4	31.7	1.3	14.2
SY Clearstone 2CL	75.7	59.7	32.0	9.8	14.9
WB3768	75.7	60.3	34.3	21.7	14.5
MT1138	75.6	60.4	34.0	20.3	14.5
Mt1356	72.1	59.0	33.0	6.7	14.8
Decade	71.5	60.9	32.0	6.9	15.0
Warhorse	71.5	60.7	30.0	0.0	14.7
CDC Falcon	69.5	59.9	31.3	13.7	14.3
Jerry	65.1	59.6	35.0	13.5	14.1
Broadview	64.7	59.8	34.0	21.7	14.1
Rampart	64.1	61.3	33.7	6.3	15.2
Bearpaw	63.1	61.2	30.3	7.8	14.6
WB Quake	62.6	61.5	30.0	8.8	14.0
Mean	74.6	60.5	32.5	11.1	14.4
LSD (.05)	8.6	1.5	2.9	8.2	0.8
C.V. (%)	6.2	1.4	5.4	43.4	3.0
P-Value	<0.0001	<.00007	0.0235	<0.0001	0.0201

Cooperator and Location: Inbody Farms western Chouteau County.

Planted on 9/20/2015 on chemical fallow durum stubble. Harvested on 8/6/16.

Fertilizer, actual lbs/ac: 11-22-0 with seed at planting, 40-0-20 broadcast while planting. Spring top dressing took place on 3/5/15 with 96-0-0. For fertilizer rates a yield goal of 70 bu/ac was used.

Herbicide: Pre-plant sprayed with RT3 @ 16 oz/ac on 9/20/2015. Plots were sprayed on 6/13/16 with Axiel XL @ 16 oz/ac and Vendetta @ 2 pints per acre.

Conducted by MSU Western Triangle Ag. Research Center.

** = Solid stem sawfly-resistant (solid stem score of 19 or higher). * = Less preferred by sawfly (behavioral preference) in small plots. Conducted by MSU Western Triangle Ag. Research Center.

Table 2. Four-year means, Winter Wheat varieties, Choteau area, Teton County.
2012-2014 and 2016.

Variety Or ID	**	4-Year Mean			
		Yield bu/ac	Test weight lbs/bu	Height inch	Protein %
Yellowstone	-	62.7	58.5	32.1	14.9
Colter	-	59.0	58.1	31.8	15.3
SY Clearstone 2CL	-	58.5	58.4	31.9	15.1
Judee	-	58.2	57.3	29.6	15.2
Northern (MT0978)	-	57.7	58.2	30.1	15.5
CDC Falcon	-	57.2	58.2	29.3	14.8
Decade	-	56.8	59.5	30.0	15.3
Bearpaw	**	56.0	59.8	29.7	14.9
Warhorse	**	54.8	58.6	29.0	14.9
WB-Quake	**	51.7	59.0	29.0	15.1
Rampart	**	50.0	59.6	32.8	15.7
Mean		56.6	58.6	30.5	15.1

** = Solid stem sawfly-resistant (solid stem score of 19 or higher).

Cooperator and Location: Inbody Farms, Teton County.

Conducted by MSU Western Triangle Ag. Research Center.

Table 3. Off-station Winter Wheat variety trial located north of Cut Bank, MT.
Glacier County. Western Triangle Ag. Research Center. 2016.

Variety or ID	Yield bu/ac	Test Wt lb/bu	Height inch	Protein %
Keldin	95.1	59.5	32.1	13.6
SY Wolf	91.5	59.3	30.9	13.8
WB3768	90.0	60.3	33.9	14.3
MT1356	89.8	60.2	31.7	13.8
Cowboy	87.2	58.6	29.3	12.9
MT1138	85.0	59.2	32.9	14.1
Loma	84.3	59.2	29.6	14.1
Colter	83.9	58.9	31.3	15.0
MT1354	82.9	59.6	31.8	14.0
MT1332	82.8	59.2	30.9	14.1
MT1257	82.3	59.1	31.5	13.9
MT1348	81.2	58.7	30.5	13.4
Yellowstone	80.7	59.3	32.0	14.2
Northern	80.6	59.2	30.6	14.5
CDC Falcon	79.6	57.2	30.2	14.2
MT1265	78.1	59.1	32.3	14.3
SY Clearstone 2CL	77.5	58.7	33.1	13.9
Broadview	76.0	58.4	30.2	14.1
Judee	74.9	59.1	30.3	14.3
Decade	74.0	57.7	30.4	13.9
WB-Quake	71.2	58.5	31.5	14.4
Bearpaw	66.3	56.5	29.9	14.7
Rampart	65.3	58.3	35.6	15.5
Warhorse	64.6	58.4	29.1	15.0
Jerry	62.5	58.1	35.3	14.2
Mean	79.5	58.8	31.5	14.2
LSD (.05)	13.4	1.4	3.1	0.8
C.V. (%)	9.5	1.3	5.7	3.0
P-Value	<0.0001	0.0004	0.0044	0.0001

Cooperator and Location: Bradley Farms, northern Glacier County.

Planted on 9/24/2015 on chem-fallow. Harvested on 8/31/2016.

Fertilizer, actual lbs/ac: 11-22.5-0 with seed at planting, topdressed with 100-0-20 on 3/11/2016. For fertilizer rates a yield goal of 70 bu/ac was used.

Herbicide: Sprayed with Huskie @ 11 oz/ac and Axial XL at 16.4 oz/ac on 5/2/2016.

** = Solid stem sawfly-resistant (solid stem score of 19 or higher). * = Less preferred by sawfly (behavioral preference) in small plots.

Conducted by MSU Western Triangle Ag. Research Center.

Table 4. Three-year means, Winter Wheat varieties, Cut Bank area, northern Glacier County. 2014-2016.

Variety Or ID	**	3-Year Mean			
		Yield bu/ac	Test weight lbs/bu	Height inch	Protein %
Yellowstone	-	70.6	57.6	32.1	13.5
Northern (MT0978)	-	68.5	58.2	30.7	13.8
Colter	-	68.4	58.1	31.1	13.7
Judee	-	66.3	58.6	29.4	13.5
CDC Falcon	-	65.8	56.0	29.3	13.6
Decade	-	64.6	57.2	29.6	13.4
Bearpaw	**	64.6	56.3	30.2	13.6
SY Clearstone 2CL	-	63.9	57.5	32.1	13.5
WB-Quake	**	57.7	57.9	30.5	13.4
Rampart	**	56.7	57.8	32.4	14.5
Warhorse	**	54.3	57.7	29.0	14.0
Mean		63.8	57.5	30.6	13.7

** = Solid stem sawfly-resistant (solid stem score of 19 or higher).

Cooperator and Location: Bradley Farms, Glacier County.

Conducted by MSU Western Triangle Ag. Research Center.

Table 5. Off-station Winter Wheat variety trial located near the Devon. Toole County. Western Triangle Ag. Research Center. 2016.

Variety or ID	Yield bu/ac	Test Wt lb/bu	Height inch	Protein %
Cowboy	94.0	61.2	60.5	10.3
Keldin	91.3	63.0	32.1	9.9
MT1332	90.8	61.5	33.0	10.1
Yellowstone	90.3	61.2	31.9	10.2
MT1354	89.9	62.2	31.7	9.8
MT1257	88.4	61.4	32.3	10.1
MT1356	88.2	61.7	31.9	10.4
MT1348	88.0	61.8	32.1	10.3
Northern	87.0	61.1	29.9	10.3
MT1138	86.7	61.3	32.2	10.0
SY Wolf	86.6	62.8	30.5	10.4
Loma	84.2	60.7	29.2	10.4
WB3768	84.2	61.2	32.9	11.5
Decade	83.9	61.2	31.0	10.5
Colter	83.4	61.1	30.7	11.0
Broadview	81.6	61.3	30.4	11.1
CDC Falcon	81.0	60.8	28.1	10.8
SY Clearstone 2CL	80.3	61.0	32.2	10.3
Rampart	78.7	60.9	33.1	11.3
Judee	78.6	61.7	30.2	11.3
Bearpaw	76.6	60.4	29.7	10.9
MT1265	76.3	60.4	32.3	10.8
Warhorse	74.3	61.8	29.7	11.4
WB Quake	72.7	60.6	28.8	11.4
Jerry	70.5	59.4	31.7	10.5
Mean	83.5	61.3	31.1	10.6
LSD (.05)	11.2	1.4	1.7	ns
C.V. (%)	7.3	1.3	3.0	7.3
P-Value	0.0002	0.0059	<0.0001	0.4090

Cooperator and Location: Brian Akelstad, Toole County.

Planted on September 17, 2015 on chem-fallow. Harvested on 7/28/2016.

Fertilizer, actual lbs/ac: 11-22-0 with seed at planting, 40-0-20 broadcast while planting. Spring topdressing took place on 3/10/16 with 77-0-0. For fertilizer rates a yield goal of 70 bu/ac was used.

Herbicide: Pre-plant sprayed with and RT3 @ 16 oz/ac on 9/17/2015. Sprayed with Huskie @ 11 oz/ac and Axial XL @ 16.4 oz/ac on 5/1/16.

** = Solid stem sawfly-resistant (solid stem score of 19 or higher). * = Less preferred by sawfly (behavioral preference) in small plots.

Conducted by MSU Western Triangle Ag. Research Center.

Table 6. Four-year means, Winter Wheat varieties, Devon area, Toole County.
2012-2014 and 2016.

Variety Or ID	**	4-Year Mean			
		Yield bu/ac	Test weight lbs/bu	Height inch	Protein %
Northern (MT0978)	-	67.5	60.3	27.0	12.0
Yellowstone	-	66.9	59.8	29.6	12.0
Decade	-	65.6	61.1	28.3	12.1
Colter	-	64.3	60.3	29.5	12.4
CDC Falcon	-	62.1	59.7	26.5	12.3
SY Clearstone 2CL	-	61.8	59.8	29.6	11.9
WB-Quake	**	61.1	60.1	27.5	12.2
Bearpaw	**	61.0	60.0	26.5	12.8
Warhorse	**	58.7	60.4	27.3	12.4
Judee	**	58.2	60.7	26.6	12.9
Rampart	**	58.1	60.7	30.4	12.7
Mean		62.2	60.2	28.1	12.3

** = Solid stem sawfly-resistant (solid stem score of 19 or higher).

Cooperator and Location: Aklestad farms, Toole County.

Conducted by MSU Western Triangle Ag. Research Center.

Table 7. Off-station Winter Wheat variety trial located near the Knees, Chouteau County, Western Triangle Ag. Research Center, 2016.

Variety or ID	Yield bu/ac	Test Wt. lb/bu	Height inch	Lodging %	Protein %
Keldin	121.9	59.4	35.3	83.1	8.7
Judee	117.2	61.2	34.7	46.0	12.9
SY Clearstone 2CL	114.2	58.7	39.3	75.6	12.2
SY Wolf	104.2	59.3	33.9	52.7	11.9
MT1348	101.1	59.6	38.8	94.5	12.3
Yellowstone	99.5	56.9	37.1	80.7	11.9
MT1138	93.8	58.3	38.4	64.0	11.6
MT1332	93.2	57.3	37.0	97.0	13.0
MT1265	92.2	57.8	38.9	82.3	11.3
Broadview	92.1	57.6	36.9	57.3	12.3
Northern	90.2	56.8	37.7	37.1	12.3
Cowboy	89.2	57.9	35.2	95.7	12.4
MT1356	88.5	57.7	37.5	57.6	11.9
CDC Falcon	88.1	58.2	33.9	91.3	12.8
MT1257	87.3	57.9	36.5	88.4	13.0
Colter	86.0	58.0	36.8	97.6	13.0
WB-Quake	85.6	58.4	36.4	42.1	13.4
WB3768	85.0	57.3	39.9	97.7	12.0
Decade	83.5	58.1	33.1	51.1	12.5
Loma	83.1	55.9	35.2	23.8	13.6
Warhorse	81.4	58.2	35.2	0.0	13.2
MT1354	80.6	58.3	37.2	57.7	13.1
Jerry	68.4	57.8	41.9	92.4	12.0
Rampart	66.6	56.4	36.1	36.4	14.4
Bearpaw	66.1	56.0	35.7	11.5	12.5
Mean	90.3	58.0	36.7	64.5	12.4
LSD (.05)	20.5	ns	2.4	33.8	2.1
C.V. (%)	13.8	2.6	3.7	29.8	9.6
P-Value	0.0002	0.1287	<0.0001	<0.0001	0.0221

Cooperator and Location: Aaron Killion, western Chouteau County.

Planted on 9/10/15 on chem-fallow. Harvested on 8/1/16.

Fertilizer, actual lbs/ac: 11-22-0 with seed at planting, 40-0-20 broadcast while planting. Spring topdressing took place on 3/15/2016 with 121-0-0. For fertilizer rates a yield goal of 70 bu/ac was used.

Herbicide: Pre-plant sprayed with Olympus @ 0.6 oz/ac and RT3 @ 16 oz/ac on 9/10/2015. The plots were sprayed on 4/23/16 with Huskie @ 11 oz/ac and Axial XL @ 16.4 oz/ac.

Conducted by MSU Western Triangle Ag. Research Center.

Table 8. Five-year means, Winter Wheat varieties, Knees area, western Chouteau County.
2012-2016.

Variety Or ID	**	5-Year Mean			
		Yield bu/ac	Test weight lbs/bu	Height inch	Protein %
SY Clearstone 2CL	-	75.3	59.1	32.7	12.8
Yellowstone	-	72.9	59.2	31.2	12.5
Northern (MT0978)	-	72.2	59.7	30.2	12.6
Judee	**	70.8	61.3	29.4	13.1
Colter	-	70.0	59.8	30.8	12.5
Decade	-	69.6	60.7	29.8	12.8
Warhorse	**	66.4	60.4	28.9	12.6
CDC Falcon	-	64.8	60.1	27.4	12.9
WB-Quake	**	62.8	60.3	29.1	12.9
Bearpaw	**	56.0	59.4	28.6	12.9
Rampart	**	53.7	59.9	30.2	13.5
Mean		66.7	60.0	29.9	12.8

** = Solid stem sawfly-resistant (solid stem score of 19 or higher).

Cooperator and Location: Aaron Killion, western Chouteau County.

Conducted by MSU Western Triangle Ag. Research Center.

Table 9. Soil test values for off-station and on-station plots, 2016.

Location	N (lbs/ac) ¹	Olsen-P (ppm)	K (ppm)	pH	OM (%)	EC (mmhos/cm)
Cut Bank	39.6	17	385	7.5	2.7	0.39
Devon	12.1	14	221	7.2	0.8	0.15
Knees	21.1	28	482	6.9	2.4	0.55
Choteau	44.5	7	412	8.1	2.3	0.82
WTARC	15.6	20	318	7.8	2.4	0.56

¹Nitrogen soil samples were to a depth of four feet in one foot increments. All other soil tests were for zero to six inches in depth.

WTARC- Western Triangle Ag. Research Center