2016 ANNUAL REPORT

Central Agricultural Research Center, Moccasin, MT

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Acknowledgments

This research report is a combination of active and completed research projects at the MSU Central Agricultural Research Center (CARC). Our projects were made possible by the Montana Fertilizer Tax Fund, as well as Pulse USA, the Montana Wheat and Barley Committee, Moore Farmers Oil, First Creek Seeds, Montech, and many others. We are particularly grateful for the financial support provided by the 2015 Montana Legislature through the Montana Research and Development Initiative (MREDI) to the MSUS, a portion of which was used to conduct research at CARC in 2016.

A special thanks is extended to farmer-cooperators who provided land on their own farms for CARC-led field experiments. Many of these cooperators have provided land for several consecutive years, in spite of the inconveniences small-plot trials can create for them. We are grateful for their willingness to work with us. In 2016, cooperators included: Richard Barber (Denton), Charlie Bumgarner (Belt/Great Falls), Chuck Davis (Geraldine), Paul Dostal (Geraldine), Andy Long (Highwood), and Bruce Udelhoven (Winifred).

Lastly, we extend a sincere thank you to members of the CARC advisory board for the counsel, encouragement, and time each of them dedicates to the research center. Their ideas and suggestions are invaluable to the development and implementation of research programs at CARC. Board members include: Janelle Bergum (Garneill), Dale Cederberg (Hobson), Terry Econom (Winifred), Mike Huber (Great Falls), Rod Linhart (Moccasin), State Advisory Delegate Pam Linker (Coffee Creek), Bryan Mauws (Judith Gap), Kelly Mikkelson (Moccasin), Rex Reilly (Stanford), Lyle Shammel (Hilger), Shane Slivka (Winifred), Kent Squires (Geraldine), Toby Stahl (Roundup), and Keith Weinheimer (Moore).

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1.0 Introduction

For many years, the MSU Central Agricultural Research Center (CARC) published an annual report which provided summary data and analyses of the many field experiments and other research projects that had been completed or were on-going that year. After a several-year hiatus, we are attempting to resurrect the publishing of an annual report at CARC. The 2016 version is our first attempt to do so.

Admittedly, the 2016 CARC Annual Report is not as inclusive in summarizing the research conducted at CARC the past year as future reports will be. The department head has provided some good suggestions for formatting changes that will be included in future versions. Still, I wanted a 2016 CARC Annual Report to be completed and available, and already we are late in getting it out.

There are many people who deserve a sincere thanks for the work they did so that this report could be prepared. I can only thank a few of them here because of space limitations.

Simon Fordyce, research associate in cropping systems at CARC, is the lead author of the annual report and wrote most of what is included in it. He also created many of the tables and figures that are included and improved the readability of several others. Dr. Shabeg Briar, research associate in cereal crops and soil microbiology, generated the tables that summarize the small-grain crop variety trials at CARC and associated on-farm sites. Heather Fryer, a research assistant III at CARC, helped compile information for the report and also uploaded it onto the CARC web site. Lorrie Linhart, administrative Associate III, arranged for the printing of the annual report.

Sally Dahlhausen, research assistant III in the CARC cropping systems program, and Sherry Bishop, a research assistant III with major responsibilities in grain/seed/forage processing, contributed to the annual report through their work in the field and lab, and in compiling much of the data that were used to generate the tables and figures. Darryl Grove, CARC farm manager, and Tim Bishop, CARC farm mechanic, provided assistance to research staff on several occasions when their help was requested.

A special thanks is extended to Dr. Barry Jacobsen, Head of the Department of Research Centers and Associate Director of MAES, for his direction and support of research originating at CARC, and to Dr. Charlie Boyer, Dean of the College of Agriculture and Director of MAES, for providing overall leadership of MSU-directed research conducted at CARC and across the state.

Finally, Dave Wichman is thanked for his many years of service as CARC superintendent and research agronomist. Much of the research summarized in the 2016 CARC Annual Report was directed by Dave until his retirement in July, 2016. He will be missed!

I hope you find this report useful as a source of information for some of the research conducted at CARC during the 2015-16 growing season. Feel free to call, send an email, or let me know face-to-face what you think about it. You are always welcome at the MSU Central Agricultural Research Center!

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2.0 Useful Statistical Terms and Definitions

Observation: The measured value of a particular variable, such as grain yield, test weight, soil nitrate, daily precipitation, etc.

Variable: An attribute describing some entity (person, place, thing, idea) with values that 'vary' from one entity to the next. For instance, if variable *x* represents crops on a farm, then *x* can take on the value 'winter wheat' in one case and 'barley' in another. In experimental design, two major variable types exist: dependent and independent. The independent variable is manipulated to determine its relationship (if any) to the dependent variable.

Factor: An independent variable such as seeding date or crop variety that can be manipulated by the experimenter. Factors always have two or more levels.

Factor Levels: Different values of a factor. For example, if our factor is 'seeding date', one factor level might take on the value *September 15th* and the other *October 1st*.

Treatments: Combinations of factor levels. The table below shows *factors*, *factor levels*, and *treatments* for a hypothetical experiment which tests the effects of seeding date and variety on winter wheat performance.

Table 1. Hypothetical experiment testing effects of seeding date and variety on crop performance.

Seeding Date	**Variety**		
	Keldin	Loma	Yellowstone
September 1st	Treatment 1	Treatment 2	Treatment 3
October 1st	Treatment 4	Treatment 5	Treatment 6

In this experiment there are two factors: *seeding date* and *variety*. The *variety* factor has three levels: Keldin, Loma, and Yellowstone. The *seeding date* factor has two levels: September 1st and October 1st. Thus, the experiment has six total treatments. Treatment 1 is *Keldin seeded on September 1st*, Treatment 2 is *Loma seeded on September 1st*, and so on.

[NOTE: If we eliminate the *seeding date* factor from the above experiment, our treatment number drops from six to three—one treatment for each factor level. Because the experiment now contains a single factor with factor levels represented by individual varieties, we refer to the experiment as a *variety trial*. Variety trials are a type of single-factor experiment in which treatments are represented by the varieties themselves, i.e., the different levels of the *variety* factor.]

Replicate: Experimental groups to which each treatment is randomly assigned. Experiments led by the Central Ag Research Center typically include three or four replicates. Replication is necessary to account for variation among treatments.

Treatment Mean: Treatment observations averaged across replicates. Cell values of summary tables in this report often represent treatment means. For example, Table 21 (Pg. 22) reports grain yield treatment means for several spring lentil varieties. The reported yield of the Richlea variety, for instance, is an average of yields from three different plots seeded to Richlea in three separate treatment groups or replicates.

Grand Mean, Mean, or Average: An average of treatment means. By definition, 50% of treatment means are greater than the overall mean, and vice versa. In Table 21 (Pg. 22), a summary of spring lentil variety trial results shows that grain yield of the Richlea variety is much greater than the overall mean, (reported as 'Mean' in the lowermost section), while test weight for the same variety is much less than the (test weight) overall mean.

P-Value: A measure of statistical significance. A P-Value of 0.05 probability indicates that 19 times out of 20, the difference among treatments is real. A P-Value of 0.001 probability indicates that 999 times out of 1000, the difference among treatments is real. The table below offers guidelines for P-Value interpretation.

Table 2. Guidelines for P-Value interpretation.

P-Value	Probability of Significant Difference Between Treatments
$P \leq 0.01$	Very Strong
$0.01 < P \leq 0.05$	Strong
$0.05 < P \leq 0.1$	Low
$P > 0.1$	Very Low

Turning again to Table 21 (Pg. 22), we see that a P-Value of 0.095 probability was calculated for the variable 'Grain Yield', i.e., the probability of significant grain yield differences between treatments is *low* (Table 2). What is the P-Value for the test weight variable in Table 21? Is the probability of significant differences for test weight lower or higher than for grain yield?

Coefficient of Variation (CV): A statistic used as an indicator of variation of large and small treatment observations among replicates. Larger CVs indicate more variation and vice versa. At the Central Ag Research Center, grain yield CVs of 15% and greater are considered to be problematic. In such cases, the grain yield LSD value will be replaced by 'NS' for 'non-significant', meaning grain yield treatment differences are not likely to be real.

Least Significant Difference (LSD): A statistic used to determine whether treatment means are significantly different from one another. Turn again to Table 21 (Pg. 22) and note the LSD value for test weights. Since the test weight of the Impala variety, for instance, exceeds that of the Eagle variety by an amount *greater* than the LSD value, we may conclude that—all else constant—Impala is expected to out-perform Eagle with regard to test weight. Conversely, the test weight of the Impala variety exceeds that of the Redcoats variety by an amount *smaller* than the LSD value, so we can have little confidence that Impala will out-perform Redcoats under similar environmental conditions.

3.0 Weather

3.1 Growing Season *(April 1, 2016 – September 30, 2016)*

Total precipitation during the 2016 growing season (April 1, 2016-Sep. 30, 2016) exceeded the 107-year average despite low rainfall in June—our wettest month historically (Table 3). Roughly one quarter of the total growing season precipitation fell in the month of September, and this late-summer precipitation provided little if any benefit to the winter wheat crop. Rather, the late rains delayed harvest of the 2016 crop and delayed seeding of the 2017 crop. Figure 1 illustrates the untimeliness of these events and shows the distribution of GDDs over the 2016 growing season. A total of 4,650 Growing Degree Days (GDDs) acumulated during this 6-month period, exceeding the 3,092 GDDs necessary for maturity of hard red winter wheat. Maximum daily GDD and maximum daily precipitation were observed within the same 4-day period in early September. Peak GDD was a full month late based on the long-term average. See Table 4 for a monthly breakdown of GDDs and other meteorolgical variables.

Table 3. Observed precipitation and air temperature with long term averages, 2016 growing season

	Apr	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Total/Avg.*
Precipitation (in.)							
Current Year	1.2	4.5	1.0	1.7	1.4	3.4	13.2
1909-2016 Avg.	1.2	2.6	3.1	1.7	1.6	1.4	11.6
Temperature (°F)							
Current Year	45.3	50.4	61.7	66.0	64.3	55.4	57.2
1911-2016 Avg.	40.9	50.1	57.9	65.9	64.9	54.9	55.8

Figure 1. Daily and long-term growing degree days with daily precipitation for the 2016 growing season.

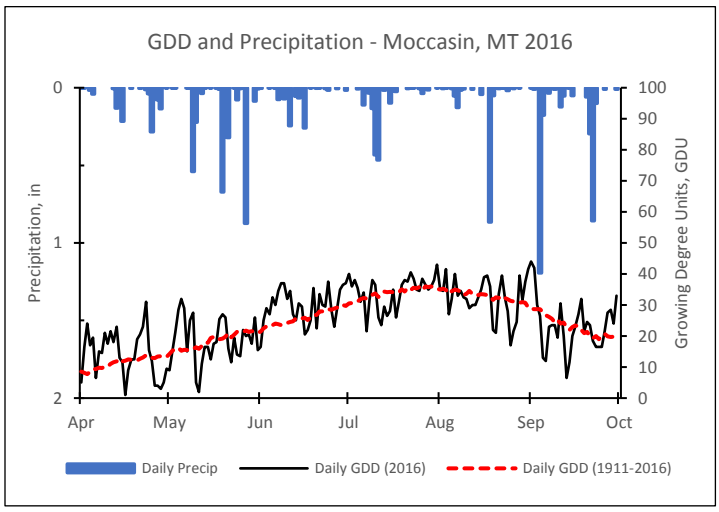


Table 4. Summary of meteorological variables by month, 2016 calendar year.

Month	Precipitation		Air Temperature		Soil Temperature				Growing Degree Days		Snow Accum.	Evap.	Wind
	inches		°F						GDD*		inches		mph
	Current Year	1909 -2016	Current Year	1911 -2016	Sod (-4 in.)	Bare (-4 in.)	Bare (-8 in.)	Bare (-20 in.)	Current Year	1909 -2016			
January	0.3	0.5	27.9	21.8	35.4	33.6	35.2	37.5	131	119	8.5	nR	5.3
February	0.3	0.4	35.8	24.7	37.5	35.6	36.4	36.9	245	123	1.5	nR	9.3
March	0.6	0.7	38.4	30.7	42.0	40.4	40.8	39.7	319	196	6.5	nR	6.6
April	1.2	1.2	45.3	40.9	49.8	47.2	47.2	44.3	425	344	4.5	3.0	6.7
May	4.5	2.6	50.4	50.1	56.5	54.4	53.9	49.5	576	573	3.0	7.1	6.0
June	1.0	3.1	61.7	57.9	67.4	68.7	66.4	57.8	892	776	0.0	10.5	6.1
July	1.7	1.7	66	65.9	73.0	73.1	71.0	63.4	1055	1047	0.0	10.8	5.4
August	1.4	1.6	64.3	64.9	71.5	71.2	70.6	64.8	1003	1017	0.0	10.3	5.3
September	3.4	1.4	55.4	54.9	59.8	58.4	59.2	58.7	700	695	0.0	5.5	5.6
October	2.8	0.9	46.3	44.9	50.5	48.3	49.9	51.4	475	459	5.0	nR	5.8
November	0.1	0.6	42.9	32.9	44.7	42.4	44.4	46.8	398	227	1.5	nR	5.7
December	0.4	0.5	15.6	24.9	35.6	32.9	35.5	39.6	56	136	12.0	nR	6.2
Total/Avg.	17.7	15.3	45.8	42.9	52.0	50.5	50.9	49.2	6272	5712	42.5	47.2	6.2

nR=not recorded due to freezing temperatures or soil too cold for sustained plant growth.

*GDD=[(Max Air Temp + Min Air Temp)/2] - Base Temperature (32°F); where Max Air Temp is capped at 95 °F and Min Air Temp is capped at 32 °F.

3.2 Crop Year *(September 1, 2015 – August 31, 2016)*

Below-average rainfall and above-average temperatures characterized the 2016 crop year (September 1, 2015-August 31, 2016). Warm and dry conditions were especially evident during winter months (Table 5). A minimum temperature of -5 °F was observed on November 26, 2015 (Table 6). Total monthly precipitation was greatest in May at 4.5 inches, followed by July at 1.7 inches, followed by August at 1.4 inches. Together the year's three wettest months received 7.6 inches, or 50% of the long-term annual mean.

Table 5. Observed precipitation and air temperature by month with long-term averages, 2016 crop year.

	Sept 2015	*Oct* 2015	*Nov* 2015	*Dec* 2015	*Jan* 2016	*Feb* 2016	*Mar* 2016	*Apr* 2016	*May* 2016	*Jun* 2016	*Jul* 2016	*Aug* 2016	*Total/Avg.*
Precipitation (in.)													
Current Year	0.8	0.6	0.5	0.4	0.3	0.3	0.6	1.2	4.5	1.0	1.7	1.4	13.3
1909-2016 Avg.	1.4	0.9	0.6	0.5	0.5	0.4	0.7	1.2	2.6	3.1	1.7	1.6	15.3
Temperature (°F)													
Current Year	57.6	48.4	31.8	27.6	27.9	35.8	38.4	45.3	50.4	61.7	66.0	64.3	46.3
1911-2016 Avg.	54.9	44.9	32.9	24.9	21.8	24.7	30.7	40.9	50.1	57.9	65.9	64.9	42.9

Table 6. Frost and min\max temperature summary, 2016 crop year.

Last killing frost* in Spring	
2016	May 14 (32 °F)
1911-2016 Avg.	May 27
First killing frost* in Fall	
2016	Sep 13 (31 °F)
1911-2016 Avg.	Sep 15
Frost-free period	
2016	122 days
1911-2016 Avg.	111 days
Max summer temp.	98 °F - Sep 1, 2016
Min winter temp.	-5 °F - Nov 26, 2015

*In this summary 32°F is considered a killing frost

3.3 Calendar Year *(January 1, 2016 – December 31, 2016)*

Mean annual temperature of the 2016 calendar year (January 1, 2016 – December 31, 2016), like that of 2016 crop year, was warmer-than-average. However, total precipitation during the calendar year far exceeded total precipitation during the crop year (Tables 5 & 7). The calendar year accrued 17.7 inches, or 115% of the long-term annual mean, while the crop year received just 13.3 inches, or 87% of the long-term annual mean. The large discrepancy between the 2016 crop and calendar years can be explained by unusually wet conditions in September and October of 2016 (months excluded from the 2016 crop year). Monthly precipitation was greatest in May at 4.5 inches, followed by October at 3.4 inches, followed by September at 2.8 inches. Together the calendar year's three wettest months received 10.7 inches of precipitation, or 70% of the long-term annual mean.

Table 7. Observed precipitation and air temperature by month with long term averages, 2016 calendar year.

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total/Avg.*
Precipitation (in.)													
Current Year	0.3	0.3	0.6	1.2	4.5	1.0	1.7	1.4	3.4	2.8	0.1	0.4	17.7
1909-2016 Avg.	0.5	0.4	0.7	1.2	2.6	3.1	1.7	1.6	1.4	0.9	0.6	0.5	15.3
Temperature (°F)													
Current Year	27.9	35.8	38.4	45.3	50.4	61.7	66.0	64.3	55.4	46.3	42.9	15.6	45.8
1911-2016 Avg.	21.8	24.7	30.7	40.9	50.1	57.9	65.9	64.9	54.9	44.9	32.9	24.9	42.9

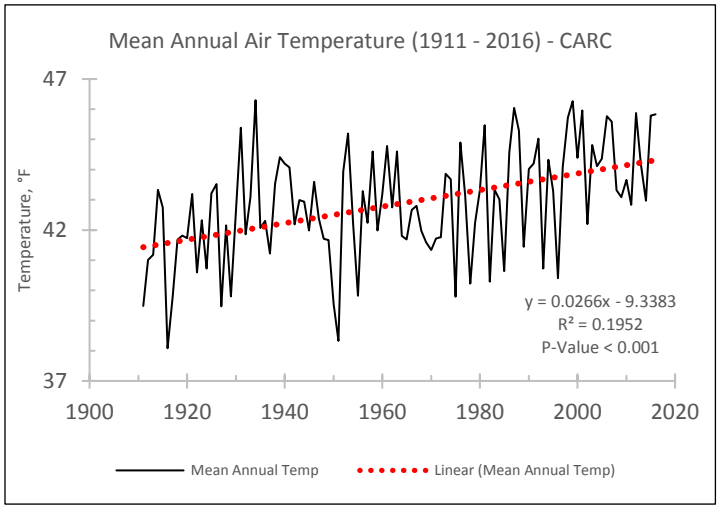
4.0 Climate

4.1 Long-Term Air Temperature *(1911-2016)*

A simple statistical analysis was performed on air temperature data collected over the period 1911-2016 at the Central Agricultural Research Center. While the results of our analysis identified large variability in air temperature over the 105-year period, some clear trends did emerge—most notably, a steady upward trend in mean annual temperature (Figure 2). Significance of this trend was verified by both Mann-Kendall and linear regression analyses.

IMPORTANT: THESE DATA ARE NOT GLOBAL OR REGIONAL, BUT **LOCAL**; THEY ARE NOT REPRESENTATIVE OF CLIMATIC TRENDS AT LOCATIONS OTHER THAN THOSE IN THE IMMEDIATE VICINITY OF THE CENTRAL AGRICULTURAL RESEARCH CENTER, MOCCASIN, MT.

Figure 2. 1911-2016 mean annual temperature and linear model, CARC, Moccasin, MT.



Special Thanks: This dataset embodies the efforts of hundreds of researchers over multiple generations. These devoted professionals collected meteorological data every day, rain or shine, for over century. The result was an extremely valuable dataset. Montana State University and the Central Ag Research Center would like to extend a warm Thank You to these researchers for their dedication to the CARC mission.

5.0 Variety Trial Results

5.1 Cereals

5.1.1 Winter Wheat

Table 8. Winter wheat variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)		Test Weight (lb/bu)	Protein (%)	Gross Return* ($/ac)
			2016	2015-16	2016		
Bearpaw	2011	MAES	38.1	38.5	57.3	14.1	167.6
Broadview	2009	Meridian Seeds LLC, ALB	32.1	33.4	55.4	14.5	145.2
CDC Falcon	1999	WPB/SK	35.8	38.7	56.8	13.7	153.1
Colter	2013	MAES	**49.7**	43.4	59.3	13.5	**209.6**
+ Cowboy	2012	CO/WY	45.1	…	58.0	13.3	187.5
Decade	2010	MAES/NDSU	38.2	41.6	57.7	13.7	163.4
Jerry	2001	NDSU	36.7	37.3	55.9	14.4	164.8
Judee	2011	MAES	32.6	31.7	57.9	13.9	141.5
+ Keldin	2011	Seed Linc./Wesbred LLC	47.4	…	57.6	13.1	194.4
Loma	2016	MAES	41.5	41.8	58.9	13.5	175.2
Northern	2015	MAES	39.3	38.6	**59.4**	13.5	165.8
Rampart	1996	MAES	35.0	28.7	59.0	14.5	158.1
SY Clearstone 2CL	2012	Syngenta	44.4	42.6	57.6	13.6	188.6
SY Wolf	2010	AgriPro/Syngenta	40.6	40.9	56.8	13.7	173.5
Warhorse	2013	MAES	39.3	40.1	56.1	14.1	173.1
WB3768	2013	WestBred LLC	42.3	42.3	**59.4**	14.3	188.8
WB-Quake	2011	WestBred LLC	30.1	32.7	55.9	**15.0**	140.7
Yellowstone	2005	MAES	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

*Gross returns calculated based on protein premiums\dockages as of September 2016, United Grains Elevator, Moccasin, MT.

Note: Study averages include experimental lines not listed here. Trial seeded 9/23/2015 and harvested 8/2/2016.

Table 9. Winter wheat variety trial, Geraldine, Montana, 2016.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)		Test Weight (lb/bu)	Protein (%)	Gross Return* ($/ac)
			2016	2015-16	2016		
Bearpaw	2011	MAES	76.9	78.7	61.4	9.6	219.9
Broadview	2009	Meridian Seeds LLC, ALB	78.1	72.1	61.7	9.5	220.1
CDC Falcon	1999	WPB/SK	77.5	75.4	62.1	10.1	237.0
Colter	2013	MAES	82.1	81.6	62.1	10.0	248.0
+ Cowboy	2012	CO/WY	98.8	…	62.6	8.5	239.1
Decade	2010	MAES/NDSU	71.8	73.4	63.0	9.0	188.0
Jerry	2001	NDSU	74.1	74.5	61.0	9.6	211.9
Judee	2011	MAES	71.6	74.7	64.0	9.8	210.5
+ Keldin	2011	Seed Linc./Wesbred LLC	**101.1**	…	63.8	9.1	**268.7**
Loma	2016	MAES	77.3	77.3	62.0	9.8	227.2
Northern	2015	MAES	90.1	83.0	62.2	9.6	257.6
Rampart	1996	MAES	72.5	68.1	63.0	**10.4**	230.5
SY Clearstone 2CL	2012	Syngenta	92.7	82.8	62.3	9.2	250.3
SY Wolf	2010	AgriPro/Syngenta	94.0	88.1	**64.6**	9.3	257.5
Warhorse	2013	MAES	80.6	76.2	62.7	**10.4**	256.1
WB3768	2013	WestBred LLC	94.4	87.0	63.4	8.8	239.8
WB-Quake	2011	WestBred LLC	73.7	74.3	62.5	10.1	225.3
Yellowstone	2005	MAES	89.8	**88.3**	62.7	9.2	242.5
Average			85.4	79.8	62.6	9.5	240.1
LSD (0.05)			6.0	…	0.5	…	…
C.V. (%)			3.8	…	0.4	…	…

+ = new for 2016

*Gross returns calculated based on protein premiums\dockages as of September 2016, United Grains Elevator, Moccasin, MT.

Note: Study averages include experimental lines not listed here. Trial seeded 9/22/2015 and harvested 7/26/2016.

Table 10. Winter wheat variety trial, Highwood, MT, 2016.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)	Protein (%)	Gross Return* ($/ac)
Bearpaw	2011	MAES	48.1	10.6	156.7
Broadview	2009	Meridian Seeds LLC, ALB	57.3	9.9	170.6
CDC Falcon	1999	WPB/SK	58.5	11.1	202.5
Colter	2013	MAES	54.0	12.3	208.5
+ Cowboy	2012	CO/WY	60.7	9.9	181.0
Decade	2010	MAES/NDSU	55.0	11.0	188.2
Jerry	2001	NDSU	41.6	9.9	123.8
Judee	2011	MAES	66.0	12.0	248.9
+ Keldin	2011	Seed Linc./Wesbred LLC	58.3	11.6	212.6
Loma	2016	MAES	55.4	11.9	207.0
MT1138	NA	MAES	61.7	11.7	226.9
Northern	2015	MAES	58.5	**12.5**	229.2
Rampart	1996	MAES	46.3	11.3	164.0
SY Clearstone 2CL	2012	Syngenta	**68.5**	11.8	**254.0**
SY Wolf	2010	AgriPro/Syngenta	43.1	11.1	149.1
Warhorse	2013	MAES	68.3	12.2	261.5
WB3768	2013	WestBred LLC	51.3	10.5	165.1
WB-Quake	2011	WestBred LLC	51.6	12.1	196.2
Yellowstone	2005	MAES	51.2	11.4	183.3
Average			56.1	11.2	196.7
LSD (0.05)			8.7	…	…
C.V. (%)			8.7	…	…
P-value			<0.0001	…	…

+ = new for 2016

*Gross returns calculated based on protein premiums\dockages as of September 2016, United Grains Elevator, Moccasin, MT.

Note: Study averages include experimental lines not listed here. Trial seeded 9/26/2015 and harvested 7/29/2016.

Table 11. Winter wheat variety trial, Winifred, MT, 2016.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)		Test Weight (lb/bu)	Protein (%)	Gross Return* ($/ac)
			2016	2015-16	2016		
Bearpaw	2011	MAES	79.7	65.1	61.6	9.5	224.7
Broadview	2009	Meridian Seeds LLC, ALB	77.7	59.7	61.9	10.2	240.9
CDC Falcon	1999	WPB/SK	76.5	66.2	62.1	10.1	234.0
Colter	2013	MAES	82.7	69.2	62.4	9.5	233.1
+ Cowboy	2012	CO/WY	98.5	…	62.0	8.8	250.2
Decade	2010	MAES/NDSU	75.5	67.4	62.1	9.5	212.8
Jerry	2001	NDSU	73.3	60.7	60.7	10.1	224.1
Judee	2011	MAES	88.4	67.0	63.8	10.0	266.8
+ Keldin	2011	Seed Linc./Wesbred LLC	**105.7**	…	63.0	9.1	281.1
Loma	2016	MAES	92.4	**78.6**	62.6	10.5	**297.5**
Northern	2015	MAES	91.3	72.3	62.1	9.6	261.1
Rampart	1996	MAES	71.2	55.3	61.2	**11.5**	257.7
SY Clearstone 2CL	2012	Syngenta	89.7	64.1	62.2	9.1	238.5
SY Wolf	2010	AgriPro/Syngenta	101.5	77.9	**63.9**	9.7	294.4
Warhorse	2013	MAES	84.2	66.8	62.5	10.3	264.3
WB3768	2013	WestBred LLC	87.5	67.8	63.0	9.0	229.2
WB-Quake	2011	WestBred LLC	81.2	67.3	62.6	9.3	222.4
Yellowstone	2005	MAES	92.5	76.0	62.5	9.9	275.5
Average			86.4	67.8	62.3	9.7	249.8
LSD (0.05)			8.38	ns	0.70	…	…
C.V. (%)			5.22	9.10	0.50	…	…

+ = new for 2016

*Gross returns calculated based on protein premiums\dockages as of September 2016, United Grains Elevator, Moccasin, MT.

Note: Study averages include experimental lines not listed here. Trial seeded: 9/22/2015 and harvested 8/2/2016.

5.1.2 Spring Wheat

Table 12. Spring wheat variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)			Test Weight (lb/bu)	Protein (%)	Gross Return* ($/ac)
			2016	2015-16	2014-16	2016		
Alum	2014	WSU	**37.5**	…	…	61.1	13.6	173.2
Brennan	2009	Syngenta/AgriPro	31.1	29.6	29.8	**62.0**	14.7	150.2
Choteau	2003	MAES	35.9	31.8	30.9	59.9	14.3	170.9
Corbin	2006	Westbred, LLC	30.3	29.1	31.0	59.8	14.5	145.3
Duclair	2011	MAES	35.4	33.1	33.8	59.1	13.3	161.1
Egan	2013	Westbred, LLC	37.4	33.7	33.8	59.3	14.5	**179.4**
Fortuna	1966	MAES/NDSU	35.1	32.8	32.2	59.6	14.0	165.0
HRS3100	--	Croplan	35.3	…	…	60.5	14.0	165.6
HRS3504	--	Croplan	35.2	…	…	60.0	13.9	164.6
HRS3530	--	Croplan	32.2	…	…	59.4	14.7	155.9
HRS3361	--	Croplan	29.3	…	…	60.4	15.0	143.3
McNeal	1995	MAES	31.0	29.1	28.7	60.2	14.0	145.6
Mott	2009	NDSU	27.9	26.3	27.2	60.9	15.1	137.1
Oneal	2008	WestBred, LLC	33.1	33.3	32.0	60.8	13.8	154.3
Prestige	2015	Pulse USA	31.4	30.0	31.4	60.4	14.7	151.8
Redstone	2014	Pulse USA	29.0	26.6	28.1	57.0	14.2	137.5
Reeder	1999	NDSU	36.3	31.7	31.0	60.1	14.5	174.1
SY Soren	2011	Syngenta/AgriPro	32.4	28.5	…	60.5	**15.8**	164.0
SY Tyra	2011	MAES/Syngenta/AgriPro	36.2	30.9	29.0	61.1	12.9	161.9
Vida	2005	MAES	33.5	32.2	34.0	60.2	14.0	157.5
WB Gunnison	--	Westbred, LLC	33.2	32.0	32.2	60.3	13.4	152.1
WB9879CLP	--	MAES	33.8	30.8	47.1	61.3	14.5	162.2
Average			33.9	30.7	32.0	60.2	14.2	160.5
LSD (0.05)			8.10	…	…	1.61	…	…
C.V. (%)			14.50	…	…	1.30	…	…

*Gross returns calculated based on protein premiums\dockages as of September 2016, United Grains Elevator, Moccasin, MT.

Note: Trial seeded 4/16/16 and harvested 8/17/2016. Fertilizer applied at 10+15+10+5 w/seed + 90 lbs N top urea.

Table 13. Spring wheat variety trial, Geraldine, MT, 2016.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/ac)			Test Weight (lb/bu)	Protein (%)	Gross Return* ($/ac)
			2016	2015-16	2014-16	2016		
Alum	2014	WSU	**42.0**	…	…	**62.2**	11.4	174.4
Brennan	2009	Syngenta/AgriPro	35.6	**40.1**	37.6	61.7	**13.0**	160.2
Choteau	2003	MAES	39.9	36.7	36.2	60.5	11.9	170.4
Corbin	2006	Westbred, LLC	36.9	35.8	35.3	61.2	11.2	150.4
Duclair	2011	MAES	41.2	38.2	37.7	59.7	10.9	162.8
Egan	2013	Westbred, LLC	40.8	39.8	38.0	59.8	12.7	**181.1**
Fortuna	1966	MAES/NDSU	34.4	35.1	33.9	60.8	12.4	150.4
HRS3100	--	Croplan	29.5	…	…	57.0	11.6	124.4
HRS3504	--	Croplan	34.8	…	…	58.6	10.4	130.8
HRS3530	--	Croplan	30.0	…	…	59.3	11.6	127.2
HRS3361	--	Croplan	26.7	…	…	58.6	12.0	114.8
McNeal	1995	MAES	36.5	37.7	35.2	58.6	11.7	154.7
Mott	2009	NDSU	32.8	36.9	34.5	59.2	12.5	144.2
Oneal	2008	WestBred, LLC	36.0	37.6	35.0	58.7	11.2	146.7
Prestige	2015	Pulse USA	32.0	37.2	35.0	59.5	11.6	134.9
Redstone	2014	Pulse USA	38.2	33.0	33.2	59.4	11.8	162.6
Reeder	1999	NDSU	38.6	38.7	37.1	61.6	11.4	160.4
SY Soren	2011	Syngenta/AgriPro	36.0	…	…	59.8	12.3	156.9
SY Tyra	2011	MAES/Syngenta/AgriPro	29.2	36.0	34.2	56.7	12.1	126.2
Vida	2005	MAES	37.4	39.8	38.1	60.2	11.2	152.3
WB Gunnison	--	Westbred, LLC	34.9	36.3	35.0	61.4	11.0	139.4
WB9879CLP	--	MAES	37.2	39.5	**39.6**	60.7	11.7	159.2
Average			35.2	37.4	36.0	59.9	11.5	146.3
LSD (0.05)			5.74	…	…	1.58	…	…
C.V. (%)			9.94	…	…	1.28	…	…

*Gross returns calculated based on protein premiums\dockages as of September 2016, United Grains Elevator, Moccasin, MT.

Note: Trial seeded 4/22/2016 and harvested 8/18/2016. Fertilizer applied at 10+15+10+5 w/seed + 60 lbs N top urea.

Table 14. Spring wheat variety trial, acidic soils, Highwood, MT, 2016.

Variety/Pedigree	Year of Release	Source	Grain Yield (bu/a)	Test Weight (lb/bu)	Protein (%)	Gross Return ($/ac)
Alum	2014	WSU	**46.4**	**62.7**	13.2	**210.3**
Brennan	2009	Syngenta/AgriPro	27.6	59.8	15.4	137.2
Choteau	2003	MAES	35.1	58.8	13.0	157.8
Corbin	2006	Westbred, LLC	35.0	60.6	13.1	157.9
Duclair	2011	MAES	37.2	59.7	12.5	163.4
Egan	2013	Westbred, LLC	42.2	60.3	14.5	202.2
Fortuna	1966	MAES/NDSU	28.7	60.3	13.0	129.0
HRS3100	--	Croplan	31.7	58.7	11.1	127.8
HRS3504	--	Croplan	33.9	59.5	12.1	146.3
HRS3530	--	Croplan	30.7	57.0	12.8	136.9
HRS3361	--	Croplan	23.8	58.4	12.4	104.1
McNeal	1995	MAES	29.9	58.1	12.2	129.8
Mott	2009	NDSU	30.9	58.5	14.5	148.0
Oneal	2008	WestBred, LLC	30.4	58.1	12.1	131.0
Prestige	2015	Pulse USA	22.1	57.4	12.2	95.8
Redstone	2014	Pulse USA	39.1	59.3	12.3	170.3
Reeder	1999	NDSU	37.8	59.9	13.6	174.5
SY Soren	2011	Syngenta/AgriPro	29.3	60.4	**14.8**	142.1
SY Tyra	2011	MAES/Syngenta/AgriPro	23.0	57.6	13.3	104.9
Vida	2005	MAES	33.9	59.4	11.5	142.2
WB Gunnison	--	Westbred, LLC	29.5	61.3	11.5	123.6
WB9879CLP	--	MAES	35.9	59.8	13.3	163.4
Average			32.4	59.4	12.9	145.2
LSD (0.05)			4.94	2.53	…	…
C.V. (%)			9.31	2.07	…	…

*Gross returns calculated based on protein premiums\dockages as of September 2016, United Grains Elevator, Moccasin, MT.

Note: Trial seeded 4/11/2016 and harvest 8/17/16. Fertilizer applied at 10+15+10+5 w/seed + 60 lbs N top urea.

5.1.3 Barley

Table 15. Barley variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Year of Release	Source	Type	Grain Yield (bu/ac)			Protein (%)	Test Weight (lb/bu)	Plump (%)
				2016	2015-16	2014-16	2016		
Champion	2007	WestBred, LLC	F	57.6	54.4	49.7	14.4	55.3	85.1
Conlon	1996	NDSU	M/F	41.5	…	…	15.2	53.2	76.8
Conrad	2007	MAES	M/F	46.5	46.6	47.0	16.3	54.2	65.3
Craft	--	--	M/F	40.5	43.7	43.2	14.9	56.3	75.9
Eslick	2003	MAES	F	**70.9**	…	…	13.4	55.8	90.6
Genesis	2015	NDSU	M/F	42.2	…	…	13.3	54.7	84.4
Harrington	1981	Canada	M/F	46.8	44.8	46.7	15.3	53.7	40.8
Haxby	2003	MAES	F	60.0	**55.3**	**54.9**	13.6	**56.5**	87.6
Haybet	1989	MAES/USDA	Forage	36.7	39.7	…	16.4	52.3	30.2
Hays	2003	MAES	Forage	53.4	…	…	15.9	53.9	74.8
Hockett	2008	MAES	M/F	59.3	52.4	50.0	13.8	56.1	32.3
Lavina	1989	MAES/USDA	Forage	59.8	54.5	…	14.3	53.0	21.0
Merit	--	--	--	52.2	47.6	….	**16.5**	53.7	43.3
Metcalfe	--	Canada	M/F	48.4	44.9	47.8	15.3	55.4	89.2
Moravian115	--	--	--	39.1	38.8		15.4	52.7	73.4
Overture	--	Britain	--	58.8	…	…	13.2	55.2	86.9
Pinnacle	2006	NDSU	M/F	48.9	…	…	13.6	55.7	**96.5**
Rawson	2005	NDSU	F	49.5	…	…	13.3	56.3	94.3
Stepford	--	--	Forage	45.8	…	…	13.8	49.2	89.7
Stockford	--	--	Forage	64.1	54.4		13.1	54.7	93.0
Average				51.38	48.1	48.5	14.3	54.6	73.0
C.V. (%)				19.22	…	…	8.33	2.39	30.19
LSD (0.05)				21.63	…	…	…	3.66	…

Note: Trial seeded 4/4/2016 and harvested 8/8/2016. Fertilizer applied at 10+15+10+5 w/seed + 30 N topdress urea.

Table 16. Barley variety trial, Geraldine, MT, 2016.

Variety/Pedigree	Year of Release	Source	Type	Grain Yield (bu/ac)		Protein (%)	Test Weight (lb/bu)	Plump (%)
				2016	2015-16	2016		
Champion	2007	WestBred, LLC	F	87.7	73.6	10.1	57.4	91.4
Conlon	1996	NDSU	M/F	67.7	…	11.9	54.9	94.7
Conrad	2007	MAES	M/F	86.9	70.9	11.9	55.0	94.2
Craft	--	--	M/F	64.3	58.7	**12.1**	56.3	92.7
Eslick	2003	MAES	F	**106.0**	…	11.2	55.6	88.7
Genesis	2015	NDSU	M/F	75.8	…	10.4	55.9	90.0
Harrington	1981	Canada	M/F	78.2	66.6	11.6	56.5	92.0
Haxby	2003	MAES	F	79.3	70.5	10.9	57.1	91.7
Haybet	1989	MAES/USDA	Forage	58.1	52.5	**12.1**	54.7	69.7
Hays	2003	MAES	Forage	89.1	…	10.9	54.1	87.2
Hockett	2008	MAES	M/F	84.1	67.8	10.5	**58.3**	**95.1**
Lavina	1989	MAES/USDA	Forage	87.0	68.7	10.9	53.4	76.7
Merit	--	--	--	84.1	**74.0**	11.2	56.2	87.9
Metcalfe	--	Canada	M/F	79.1	67.0	11.7	56.1	91.9
Moravian115	--	--	--	91.5	67.8	10.8	55.9	92.2
Overture	--	Britain	--	90.9	…	11.4	57.3	93.5
Pinnacle	2006	NDSU	M/F	75.8	…	10.8	56.1	94.0
Rawson	2005	NDSU	F	63.5	…	12	56.6	89.0
Stepford	--	--	Forage	69.6	…	11.7	50.7	93.1
Stockford	--	--	Forage	84.1	65.7	10.9	54.0	93.7
Average				80.35	67.0	11.07	55.6	90.1
C.V. (%)				8.09	…	6.14	1.19	6.14
LSD (0.05)				14.23	…	…	1.85	…

Note: Trial seeded 4/11/2016 and harvested 8/15/2016. Fertilizer applied at 10+15+10+5 w/seed + 30 N topdress urea.

Table 17. Barley variety trial, acidic soils, Highwood, MT, 2016.

Variety/Pedigree	Year of Release	Source	Type	Grain Yield (bu/ac)	Protein (%)	Test Weight (lb/bu)	Plump (%)
Champion	2007	WestBred, LLC	F	38.5	8.4	55.5	89.0
Conlon	1996	NDSU	M/F	26.4	11.1	52.0	76.8
Conrad	2007	MAES	M/F	36.3	10.2	54.8	86.2
Craft	--	--	M/F	39.1	10.2	56.2	90.1
Harrington	1981	Canada	M/F	**46.1**	9.7	**56.3**	89.1
Haxby	2003	MAES	F	38.6	10.1	56.0	90.1
Haybet	1989	MAES/USDA	Forage	32.3	11.8	54.2	69.1
Hays	2003	MAES	Forage	40.9	9.9	54.2	78.7
Hockett	2008	MAES	M/F	42.1	10.6	**56.3**	94.0
Lavina	1989	MAES/USDA	Forage	37.6	9.7	54.7	70.0
Merit 57	--	--	--	42.9	8.9	55.8	86.3
Metcalfe	--	Canada	M/F	31.0	9.5	55.7	90.3
Moravian	--	--	--	31.7	9.3	54.8	**95.2**
Stockford	--	--	Forage	18.6	**12.3**	50.3	93.6
Average				34.64	10.48	54.5	86.3
C.V. (%)				16.57	12.54	2.0	8.1
LSD (0.05)				12.92	…	3.2	…

Note: Trial seeded 4/11/2016 and harvested 8/17/2016. Fertilizer applied at 10+15+10+5 w/seed + 30 N topdress urea.

5.2 Pulses

5.2.1 Spring Pea

Table 18. Spring pea variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Plant Count	Days to Flower	Days to Maturity	Canopy Height	Lodging Score*	Grain Yield	Test Weight	Seeds per Pound
	(plants/ft²)	(days)		(inches)	(0-9)	(bu/ac)	(lb/bu)	(seeds/lb)
Yellow Cotyl. Type								
AAC Carver	6.0	74	108	19	1	24.2	67.0	1813
AAC Lacombe	7.2	75	112	18	2	25.6	65.6	1617
Abarth	7.0	72	108	16	3	22.0	66.2	1680
AC Earlystar	8.2	73	109	17	2	21.2	66.8	1929
Agassiz	7.7	75	108	16	1	25.5	66.1	1891
Bridger	7.8	71	108	16	2	21.0	67.4	1950
CDC Amarillo	7.0	75	110	17	1	28.3	66.3	1870
CDC Saffron	8.8	75	108	16	2	25.9	66.4	1861
CDC Treasure	7.9	72	107	18	2	21.3	67.3	1983
Delta	7.4	72	107	14	3	23.2	67.1	1982
DS Admiral	7.8	74	108	16	2	23.6	66.5	1861
Durwood	7.8	74	110	19	1	30.0	67.2	1848
Gunner	8.5	74	110	17	2	25.0	66.6	1802
Hyline	7.2	75	108	18	1	22.1	66.3	1802
Jet Set	7.9	74	109	17	1	23.4	66.8	1925
Korando	6.6	69	109	16	3	21.5	66.3	1656
Majestic	7.6	75	109	17	1	26.3	66.4	1771
Navarro	7.9	70	110	15	3	21.1	66.1	1589
Nette 2010	7.5	72	108	16	2	24.2	67.6	1856
Pro 093-7410	7.5	71	108	17	2	23.5	66.9	1945
Salamanca	6.5	74	108	16	2	24.3	67.1	1762
Spider	8.3	74	111	17	2	23.0	66.0	1758
Green Cotyl. Type								
Aragon	8.7	72	107	14	3	19.9	65.1	2040
Arcadia	8.3	74	108	14	3	19.6	66.9	2104
Banner	7.3	69	108	16	2	21.6	66.7	2036
CDC Patrick	7.8	74	110	16	2	23.0	66.6	2263
CDC Raezer	7.7	72	110	17	2	22.0	66.1	1926
Cruiser	7.1	73	107	15	3	19.1	65.2	2182
Ginny	7.9	72	108	15	2	21.3	66.7	2090
Greenwood	8.3	72	108	14	3	22.5	66.5	2109
Hampton	8.0	74	109	14	2	23.8	65.5	1885
LN 1123	8.8	75	109	15	2	22.6	67.2	1923
Majoret	8.0	74	109	16	3	20.9	66.8	1901
Viper	8.1	71	109	17	2	21.3	66.6	1795
All								
P-Value	0.989	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mean	7.7	73	109	16.2	1.9	23.1	66.5	1894.4
CV%	24.2	1.4	0.9	9.6	33.1	10.5	0.8	2.6
LSD (0.05)	NS	1.4	1.3	2.2	0.9	3.4	0.8	68.0

*Lodging score: 0=All plants upright; 9=All plants prostrate

Note: Trial seeded 4/8/2016 and harvested 8/1/2016.

5.2.2 Winter Pea

Table 19. Winter pea variety trial #1, Moccasin, MT, 2016.

Variety/Pedigree	Days to Flower*	Grain Yield	Test Weight	Seeds per Pound
	(days)	(bu/ac)	(lb/bu)	(seeds/lb)
MTWP97097	67	22.8	66.5	3090
MTWP980961	66	21.0	67.4	3598
MTWP980962	67	19.2	66.4	2427
MTWP980963G	69	12.7	66.2	2994
MTWP980963Y	67	18.1	66.1	2865
MTWP981032BE	66	18.4	66.7	3141
MTWP98106BE	67	18.1	67.3	3429
PS0017018	67	20.6	66.2	3111
PS0230F092	68	9.8	65.0	3167
PS03101150	67	15.3	66.1	2864
PS03101160W	65	14.5	66.3	2334
PS05300180W	66	13.2	66.3	3146
PS05300225	66	17.9	65.8	2662
PS0530069	66	18.2	66.0	2391
PS0530078	66	15.8	65.9	2190
PS0530083	65	14.7	66.4	2628
PS9830F011	66	21.1	66.7	3076
P-Value	< 0.001	< 0.001	< 0.001	< 0.001
Mean	66	17.1	66.3	2889
CV%	1.3	16	0.6	5.7
LSD (0.05)	1.2	NS**	0.5	234.2

*April 1, 2016 to date of first flowering

**LSD considered non-significant when grain yield CV% > 15

Note: Trial seeded 9/22/2015 and harvested 7/26/2016.

Table 20. Winter pea variety trial #2, Moccasin, MT, 2016.

Variety/Pedigree	Days to Flower*	Grain Yield	Test Weight	Seeds per Pound
	(days)	(bu/ac)	(lb/bu)	(seeds/lb)
1234-271-1	66	16.2	66.7	2883
1234-271-2	66	14.8	66.7	2610
1234-273-0	66	12.6	67.1	3135
12WIL01-0	66	10.5	65.5	2691
12WIL02-0	66	17.1	68.1	2748
12WIL04-0	66	13.2	66.3	2984
12WIL07-0	66	12.9	67.2	3228
12WIL10-0	67	16.0	66.5	3039
12WIL11-0	66	11.5	67.3	2839
12WIL17-0	66	14.1	66.4	2782
X09MP012-0-1-W-MT	66	12.7	66.5	2736
X09MP020-0-1-W-MT	67	13.3	66.8	2811
X09MP021-0-1-W-MT	66	11.8	66.9	2894
X09RP040-0-1-1-MT	66	14.3	66.8	2986
X09RP040-0-7-1-MT	66	14.2	67.2	2476
P-Value	0.409	0.370	< 0.001	< 0.001
Mean	66	13.7	66.8	2862
CV%	0.8	26	0.5	6.6
LSD (0.05)	NS	NS	0.5	271.6

*April 1, 2016 to date of first flowering

Note: Trial seeded 9/22/2015 and harvested 7/27/2016.

5.2.3 Spring Lentil

Table 21. Spring lentil variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Plant Count	Days to Flower	Days to Maturity	Canopy Height	Vine Length	Lodging Score*	Grain Yield	Test Weight
	(plants/ft²)	(days)		(inches)		(0-9)	(lb/ac)	(lb/bu)
Avondale	14.5	72	112	11	13	1.3	1430	62.9
CDC Imigreen	13.3	74	114	12	14	1.0	1142	62.0
CDC Impala CL	13.0	75	111	12	12	1.0	1299	65.4
CDC Redcoats	15.8	75	111	11	12	1.0	1235	64.9
CDC Richlea	14.9	73	112	12	13	1.3	1497	62.7
CDC Viceroy	14.6	76	112	11	12	0.8	1311	65.1
Eagle	12.9	72	112	11	12	1.3	1243	64.3
Imvincible	12.8	76	112	11	12	1.0	1340	64.7
P-Value	0.060	< 0.001	< 0.001	0.439	0.028	0.689	0.095	< 0.001
Mean	14.0	74.1	111.8	11.5	12.4	1.1	1312	64.0
CV%	10.5	0.8	0.4	8.7	6.5	40.4	12.0	0.8
LSD (0.05)	NS	NS	0.64	NS	1.2	NS	NS	0.76

*Lodging score: 0=All plants upright; 9=All plants prostrate

Note: Trial seeded 4/8/2016 and harvested 8/4/2016.

5.2.4 Winter Lentil

Table 22. Winter lentil variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Days to Flower*	Flower Duration	Grain Yield	Test Weight
	(days)		(bu/ac)	(lb/bu)
LC99709065	69	20	18.9	66.6
LC9976079	67	23	13.3	66.1
LC9977019	66	24	17.8	66.3
LC9977116	66	23	13.5	66.3
LC99780571	66	23	12.4	66.6
LC9978094	67	24	12.8	66.3
LC9979016	70	22	18.3	66.4
LC9979120	69	21	18.5	66.6
WA8649090	66	24	15.3	66.8
P-Value	0.012	0.078	0.005	< 0.001
Mean	67	23	15.6	66.4
CV%	2.3	8.5	17.9	0.3
LSD (0.05)	2.3	NS	NS**	0.3

*April 1, 2016 to date of first flowering

**LSD considered non-significant when grain yield CV% > 15

Note: Trial seeded 9/22/2015 and harvested 8/2/2016.

5.3 Other

5.3.1 Safflower

Table 23. Spineless safflower variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Grain Yield	Test Weight	Oil
	(lb/ac)	(lb/bu)	(%)
Baldy	628.7	46.2	27.1
Cardinal	669.0	42.0	35.8
Finch	632.3	43.7	33.0
Rubis Red	663.9	46.0	28.7
11 C 21	800.1	44.3	30.9
11Saff01	687.0	43.8	29.2
11Saff17	701.8	45.3	28.8
11Saff18	770.4	45.2	28.7
132 Saff 02 SaffD17	811.6	44.0	29.9
132Saff01 Saff D12	624.9	45.3	29.2
132Saff19	647.3	44.8	27.9
C14 red 3SC14	602.7	44.0	28.3
C15	609.6	42.3	26.6
C18 short 6SC18	700.9	45.9	29.0
C21SE3 H	576.5	45.7	28.4
D13	716.6	45.4	28.6
D20	793.5	44.3	28.5
D23	882.5	45.5	27.4
Saff D11	649.0	45.5	28.4
Saff D14	753.1	45.0	28.3
Average	696.1	44.7	29.1
LSD (0.05)	NS	1.62	1.26
C.V. (%)	22.10	1.73	0.77
P- Value	NS	< 0.001	< 0.001

Table 24. Spineless safflower variety trial, Geraldine, MT, 2016.

Variety/Pedigree	Grain Yield	Test Weight	Oil
	(lb/ac)	(lb/bu)	(%)
Baldy	1189	43.4	26.7
Cardinal	1712	42.7	34.7
Finch	1692	43.5	31.3
Rubis Red	1763	46.1	30.3
11 C 21	1859	44.4	30.4
11Saff01	2001	44.1	26.6
11Saff17	1667	45.5	27.6
11Saff18	1886	44.6	28.0
132 Saff 02 SaffD17	1849	44.8	27.6
132Saff01 Saff D12	1744	44.7	27.7
132Saff19	1496	44.0	27.5
C14 red 3SC14	1833	46.7	30.2
C15	1344	42.2	28.1
C18 short 6SC18	1819	46.3	29.1
C21SE3 H	1853	46.6	30.4
D13	1863	45.8	27.5
D20	1867	44.4	27.8
D23	1974	45.1	27.4
Saff D11	1694	44.8	31.1
Saff D14	2052	45.1	27.3
Average	1758	44.7	28.9
LSD (0.05)	311	1.43	1.53
C.V. (%)	12.4	1.53	2.54
P- Value	< 0.001	< 0.001	< 0.001

Table 25. Safflower statewide variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Grain Yield	Test Weight	Oil
	(lb/ac)	(lb/bu)	(%)
10B6015	461.3	40.6	36.5
Baldy	717.4	45.3	27.4
Cardinal	767.5	41.9	35.6
Finch	616.5	43.1	35.7
Hybrid 1601	871.1	40.1	37.1
Hybrid 200	707.6	41.3	34.3
Hybrid 300	842.9	42.4	33.6
Hybrid 446	753.8	43.5	32.6
Hybrid 621	887.1	36.8	43.4
MonDak	617.5	42.5	35.3
Montola 2003	638.0	41.7	36.1
NutraSaff	508.9	37.1	48.2
Rubis Red	756.5	45.2	28.6
STI 1201	667.9	35.7	43.5
Average	701.0	41.2	36.3
LSD (0.05)	NS*	1.17	1.41
C.V. (%)	22.02	1.31	1.79
P- Value	0.008	< 0.001	< 0.001

*LSD considered non-significant when grain yield CV% > 15

Table 26. Safflower statewide variety trial, Geraldine, MT, 2016.

Variety/Pedigree	Grain Yield	Test Weight	Oil
	(lb/ac)	(lb/bu)	(%)
10B6015	1493.8	40.4	35.0
Baldy	1403.9	43.9	27.3
Cardinal	1985.6	42.2	32.6
Finch	1703.4	42.5	33.7
Hybrid 1601	2326.9	39.5	36.3
Hybrid 200	1998.4	41.9	30.8
Hybrid 300	2404.6	42.6	31.3
Hybrid 446	2396.7	43.9	30.0
Hybrid 621	1686.6	35.5	41.1
MonDak	2254.2	41.7	34.6
Montola 2003	1854.6	41.8	36.5
NutraSaff	1555.9	37.7	46.0
Rubis Red	1815.9	45.5	29.7
STI 1201	1620.6	35.6	43.9
Average	1892.9	41.0	34.9
LSD (0.05)	288.3	1.64	1.25
C.V. (%)	10.60	1.73	1.66
P- Value	< 0.001	< 0.001	< 0.001

5.3.2 Sorghum

Table 27. Sorghum variety trial, Moccasin, MT, 2016.

Variety/Pedigree	Grain Yield* (lb/ac)
13 Sorg23	177.6
13NW6-119	171.6
13Sorg12	154.8
13Sorg12D red	223.6
13Sorg12NirrWhite	109.0
13Sorg17-14Nirr	184.4
13Sorg19	99.8
13Sorg22-17Nirr whiteseed	102.7
13sorg25	231.7
13Sorg25Nirr	162.6
13Sorg29	177.4
13Sorg29 NIrr	148.0
13Sorg29drkhd	136.2
13Sorg29Nirrwhite	71.2
13Sorg37	96.2
13Sorg44-35Nirr	140.4
13Sorg45	45.8
13SorgNW6-109	287.2
Bag 2 13Sorg12 Ndry	50.1
DK18C	138.1
P-Value	< 0.001
Mean	2.6
CV%	32.1
LSD (0.05)	NS**

*Up to 80% harvest loss due to poor threshing

**LSD considered non-significant when grain yield CV% > 15

Note: Trial seeded 6/1/2016 and harvested 10/21/2016.

6.0 Cover Crop Trial Results

Table 28. Cover crop comparison study, Moccasin, MT, 2016.

	Cover Crop or Cocktail Name	Harvest Date	Plant Count	Dry Matter Yield	AUMs per Acre
		(m/d)	(plants/ft²)	(lb/ac)	(AUM/ac)
Seeded 5/5	*Alsike Clover*	8/10	4.4	713	0.27
	*Alternative Cool**	7/22	5.2	601	0.23
	Canola	7/5	11.0	725	0.28
	*Cool Season Cool***	7/13	8.7	1126	0.43
	Diversity Early⁺*	7/13	8.7	1034	0.40
	Flax	7/5	16.2	619	0.24
	Oat	7/13	26.1	1548	0.59
	Purple Top Turnip Cool	8/10	25.9	751	0.29
	Radish Cool	7/1	5.0	716	0.27
	Safflower	8/10	3.1	2008	0.77
	Spring Pea	7/13	4.4	944	0.36
	Triticale	7/5	15.1	1294	0.50
	Vetch	7/29	5.4	1678	0.64
	Warm Season Cool⁺⁺*	7/5	4.8	492	0.19
Seeded 5/26	*Alternative Warm**	8/10	3.2	1802	0.69
	Berseem Clover	7/22	10.5	271	0.10
	Black Bean	8/10	2.0	1214	0.46
	Chickpea	7/13	2.4	584	0.22
	*Cool Season Warm***	7/22	12.1	1786	0.68
	Diversity Late⁺*	7/22	11.0	1697	0.65
	Fababean	7/22	3.8	754	0.29
	German Millet	8/10	10.7	2205	0.84
	Indian Corn	8/10	1.0	2853	1.09
	Purple Top Turnip Warm	8/10	8.3	234	0.09
	Radish Warm	8/10	3.5	181	0.07
	Sorghum	8/10	15.0	1901	0.73
	Soybean	8/10	1.6	1187	0.45
	Sunflower	8/10	0.2	1835	0.70
	Warm Season Warm⁺⁺*	7/29	3.0	1284	0.49
	P-Value	-	< 0.001	< 0.001	< 0.001
	Mean	-	8.0	1174	0.45
	CV%	-	40.2	34.2	34.2
	LSD (0.05)	-	4.5	564	0.22

Note: AUM per acre = (lbs per acre dry forage) * (35% grazing efficiency) / (915 lbs per AUM)

*Radish, purple top turnip, faba bean, black bean, teff, Indian corn, sorghum

**Radish, spring pea, canola, spineless safflower, oat

⁺Radish, purple top turnip, spring pea, faba bean, chickpea, canola, spineless safflower, oat, sorghum

⁺⁺Radish, purple top turnip, chickpea, faba bean, sunflower, sorghum

Table 29. 2014 and 2016 cover crop performance with winter wheat and barley responses, Moccasin, MT, 2016.

Crop	*2014 Cover Crop*		*2016 Cover Crop*		*2014 & 2016 Avg.*		*2015 Winter Wheat*		*2016 Barley*	
	Canopy Height	Dry Matter Yield	Canopy Height	Dry Matter Yield	Canopy Height	Dry Matter Yield	Grain Yield	Test Weight	Grain Yield	Test Weight
	(inches)	(lb/ac)	(inches	(lb/ac)	(inches	(lb/ac)	(lb/ac)	(lb/bu)	(bu/ac)	(lb/bu)
*Cocktail**	52.5	921.0	41.0	531.5	46.8	726.3	51.9	56.6	35.1	50.9
Flax	57.8	1283.4	49.8	684.7	53.8	984.0	44.3	56.0	26.8	49.9
No Crop	-	-	-	-	-	-	46.4	55.0	33.9	50.4
Radish	79.8	1339.0	65.3	396.6	72.5	867.8	50.0	56.7	29.7	50.5
Safflower	69.8	1442.4	51.8	520.5	60.8	981.5	43.4	55.8	35.4	49.9
Sweet Clover	34.0	974.6	18.3	329.3	26.1	651.9	52.4	55.1	28.9	51.1
Turnip	14.3	431.6	9.5	404.9	11.9	418.3	43.3	55.8	37.5	50.8
Yellow Mustard	75.0	2010.0	52.5	508.8	63.8	1259.4	49.7	56.4	35.4	50.3
P-Value	< 0.001	< 0.001	< 0.001	0.018	-	-	0.101	0.235	0.215	0.780
Mean	54.7	1200.3	41.1	482.3	-	-	47.6	55.9	32.8	50.5
CV%	9.4	4.4	10.0	26.0	-	-	11.3	1.9	16.0	2.1
LSD (0.05)	7.1	14.3	6.1	186.5	-	-	NS	NS	NS	NS

*Safflower, clover, flax, turnip, radish

Note: Winter wheat in 2015 was planted into plots following cover crop treatments in 2014; barley in 2016 was planted into plots planted to winter wheat in 2015 and cover crops in 2014; a second field experiment was initiated in 2016 establishing the same cover crop treatments as those planted in 2014.

Table 30. Cover crop sequence study, Moccasin, MT, 2016.

Crop or Cocktail Name	*Cover Crop*			*Forage*			*Grain*	
	Plant Count	Dry Matter Yield	AUM per Acre	Plant Count	Dry Matter Yield	AUM per Acre	Plant Count	Grain Yield[#]
	(plants/ft²)	(lb/ac)	(AUM/ac)[‡]	(plants/ft²)	(lb/ac)	(AUM/ac)[‡]	(plants/ft²)	(lb/ac)
Browntop Millet	2.8	95	0.0	3.8	537	0.1	-	-
Buckwheat	19.8	2328	0.6	22.2	2368	0.6	22.3	119
Bush Cowpea	1.6	467	0.1	1.8	1167	0.3	-	-
Corn	1.3	1773	0.5	1.3	3797	1.0	1.3	621
Corn+Pinto	1.2	1661	0.5	1.2	2981	0.8	1.5	567
* *CS Cocktail*	14.5	1818	0.5	14.7	2112	0.6	15.1	1322
Forage Sorghum	11.7	1699	0.5	14.3	2713	0.7	-	-
German Millet	32.1	1193	0.3	27.6	2315	0.6	-	-
Grain Sorghum	8.1	1762	0.5	10.6	1992	0.5	8.4	170
Hungarian Millet	35.3	1980	0.5	35.8	2520	0.7	41.8	576
† *Mung Bean*	2.0	759	0.2	1.8	1606	0.4	2.2	13
† *Navy Bean*	2.0	1218	0.3	2.6	1290	0.4	2.8	96
Pearl Millet	4.7	869	0.2	4.6	1733	0.5	-	-
† *Pinto Bean*	1.8	1296	0.4	1.2	1736	0.5	1.6	154
Proso Millet	20.3	2488	0.7	24.2	3090	0.8	22.6	73
Proso+Pinto	4.3	1324	0.4	5.1	1978	0.5	4.9	99
SorghumXSudan	21.8	1684	0.5	22.4	2450	0.7	-	-
† *Soybean*	3.3	1419	0.4	3.8	2182	0.6	3.4	168
Spring Pea	7.2	1316	0.4	7.7	1570	0.4	7.8	1008
Spring Wheat	20.9	1463	0.4	22.3	1567	0.4	23.6	1492
Sudangrass	29.1	1728	0.5	23.1	2840	0.8	-	-
Sunflower	0.7	3114	0.9	0.8	2904	0.8	0.8	755
Viney Cowpea	2.0	705	0.2	2.0	1237	0.3	-	-
** *WS Cocktail*	3.8	1925	0.5	3.6	3124	0.9	-	-
P-Value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mean	10.5	1503.5	0.4	10.8	2158.8	0.6	10.7	482.2
CV%	49.3	29.2	29.2	47.7	27.2	27.2	35.3	40.2
LSD (0.05)	7.3	619.9	0.2	7.3	829.6	0.2	5.4	NS[††]

*Wheat, barley, pea, lentil

** Corn, sorghum-sudangrass hybrid, pinto bean, cowpea

[†]Up to 85% grain harvest loss

[††]LSD considered non-significant when grain yield CV% > 15

[‡]AUM per acre = (lbs per acre dry forage) * (35% grazing efficiency) / (915 lbs per AUM)

[#]Grain/seed shattering was severe for some treatments (e.g., soybean) while others were planted late (e.g., corn), resulting in measured yields that were considerably lower than potential yields.

Note: Plots belonging to the 'Cover Crop' treatment were terminated at heading for small grains and at flowering for broadleafs. Those in the 'Forage' treatment were terminated prior to seed fill stage and significant leaf loss. Lastly, plots belonging to the 'Grain' treatment were harvested at full seed maturity.

7.0 Cereal Forage Trial Results

Table 31. Winter cereal forage performance in conventional-and no-till systems, Moccasin, MT, 2016.

Crop	*Conventional-Till*			*No-Till*		
	Plant Height	Dry Matter Yield	AUM per Acre	Plant Height	Dry Matter Yield	AUM per Acre
	(inches)	(lb/ac)	(AUM/ac)	(inches)	(lb/ac)	(AUM/ac)
Experimental Triticale Line #1	52.2	6129	2.34	43.2	4361	1.67
" *#2*	55.3	5767	2.21	42.7	3524	1.35
" *#3*	51.4	5619	2.15	44.0	4985	1.91
" *#4*	54.8	5651	2.16	41.1	3323	1.27
" *#5*	54.4	5767	2.21	39.6	3281	1.26
" *#6*	51.6	6138	2.35	39.3	2617	1.00
" *#7*	51.8	5977	2.29	38.5	4596	1.76
" *#8*	55.9	6502	2.49	43.5	3105	1.19
" *#9*	54.3	6676	2.55	42.6	3518	1.35
" *#10*	53.3	6217	2.38	40.4	4394	1.68
" *#11*	53.8	5962	2.28	42.3	4432	1.70
" *#12*	53.0	6582	2.52	41.9	3463	1.32
" *#13*	52.1	6025	2.30	45.1	5094	1.95
" *#14*	56.4	5982	2.29	42.7	5309	2.03
" *#15*	56.2	6253	2.39	41.9	4519	1.73
" *#16*	46.3	6550	2.51	41.3	2809	1.07
Trical Triticale	50.3	5641	2.16	33.7	2957	1.13
Willow Creek Winter Wheat	38.6	3285	1.26	21.2	1963	0.75
P-Value	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mean	52.3	5929	2.27	40.3	3792	1.45
CV%	7.8	11.0	11.0	6.9	13.1	13.1
LSD (0.05)	6.8	1079	0.41	4.6	827	0.32

Note: AUM per acre = (lbs per acre dry forage) * (35% grazing efficiency) / (915 lbs per AUM)

Table 32. Spring cereal forage performance, Moccasin, MT, 2016.

Variety/Pedigree	Crop*	Heading Date	Canopy Height	Dry Matter Yield	Grain Yield	Test Weight
		(m/d)	(inches)	(lb/ac)	(bu/ac)	(lb/bu)
		(n=3)				(n=2)
Experimental Line #1	(B)	7/18	19.8	2591	19.2	48.1
" *#2*	(B)	7/15	16.1	2688	9.8	41.1
" *#3*	(B)	7/16	16.0	3096	9.8	43.1
" *#4*	(B)	7/14	17.6	2630	19.7	47.7
" *#5*	(B)	7/18	22.3	1480	7.7	48.5
" *#6*	(B)	7/14	19.3	2203	16.7	51.2
Haxby	(B)	7/13	18.5	2319	26.5	56.9
Haybet	(B)	7/14	18.1	2882	15.4	55.0
Haymaker	(B)	7/18	16.8	2707	19.7	51.1
Hays	(B)	7/13	18.0	2610	23.3	50.2
Horsford	(B)	6/30	23.5	2222	24.2	47.4
Lavina	(B)	7/14	17.8	3212	20.1	52.0
Otana	(O)	7/7	24.8	2474	32.8	40.0
Pronghorn	(T)	6/30	22.6	2494	14.8	47.7
Stampede	(O)	7/15	20.9	3309	25.9	32.0
P-Value		-	0.159	0.379	< 0.001	< 0.001
Mean		-	19	2595	19.0	47.4
CV%		-	19.7	28.5	25.1	4.0
LSD (0.05)		-	6.4	1238	NS**	4.1

*(B)=Barley; (O)=Oats; (T)=Triticale

**LSD considered non-significant when grain yield CV% > 15

8.0 Application Trial Results

8.1 Fertilizer

Table 33. Responses of three barley varieties to varied rates of nitrogen and sulfur fertilizers Moccasin, MT, 2016.

Var./Ped.	N+S	Plant Density	Grain Yield	Test Weight	Seeds per Pound	Plumps	Thins
	(lb/ac)	(plants/ft²)	(bu/ac)	(lb/bu)	(seeds/lb)	(%)	
Exp. #1	68+0	10.5	30.2	47.6	11,142	79.8	4.8
	68+10	12.6	29.9	50.3	10,885	84.2	3.2
	91+0	11.1	33.6	48.2	11,011	79.5	5.1
	91+10	13.0	34.6	48.7	10,440	86.6	2.8
	114+0	13.9	31.2	48.5	11,027	78.3	4.3
	114+10	13.1	39.9	49.2	10,627	83.0	3.9
	137+0	12.2	32.9	48.4	10,961	75.8	6.3
	137+10	13.4	41.2	49.6	10,434	83.6	3.9
Odyssey	68+0	12.7	30.5	50.6	10,152	89.6	2.9
	68+10	12.1	31.8	51.3	9,930	92.1	2.3
	91+0	13.3	43.5	51.1	9,982	91.2	2.5
	91+10	10.6	38.3	50.6	10,147	92.9	2.1
	114+0	10.8	36.1	50.3	10,377	85.3	4.3
	114+10	11.1	38.0	50.8	10,157	90.3	2.9
	137+0	13.9	38.0	49.8	10,429	87.6	3.4
	137+10	11.9	41.9	50.5	9,868	91.1	2.8
Voyager	68+0	8.6	30.6	48.1	10,516	89.7	2.6
	68+10	8.8	30.3	49.8	10,617	89.8	2.2
	91+0	8.8	31.4	48.7	10,674	89.9	2.8
	91+10	8.4	30.2	49.3	10,680	90.0	2.6
	114+0	10.0	35.5	48.8	10,627	90.1	2.8
	114+10	8.9	34.8	49.7	10,492	88.3	3.2
	137+0	8.2	33.3	47.5	10,434	90.7	2.4
	137+10	10.0	39.2	48.5	10,434	89.6	2.7
P-Value	-	0.507	< 0.001	0.148	0.173	< 0.001	< 0.001
Mean	-	11.2	34.9	49.4	10,502	87.0	3.3
CV%	-	18.7	12.4	2.4	3.4	3.0	28.2
LSD (0.05)	-	NS	6.1	NS	NS	3.7	1.3

Note: Trial seeded 5/3/2016 and harvested 8/29/2016.

Table 34. Alfalfa responses to 15 fertilizer treatments, Moccasin, MT, 2016.

Treatment	N+P+K+S+Zn+B	Dry Matter Yield	Canopy Height	ADF	NDF	Protein	P	K	S	Mg	Zn	Mn	Cu	Mo
	(lb/ac)	(ton/ac)	(inches)	(%)							(ppm)			
No Fertilizer	0+0+0	0.3	12	23	28	22	0.36	2.56	0.14	0.38	25.4	39.0	9.7	6.9
Urea	46+0+0	0.4	15	22	27	26	0.41	2.31	0.14	0.38	24.8	39.0	10.0	5.4
Check (standard NPS)	22+20+0+20	1.2	19	25	27	25	0.32	2.86	0.26	0.28	19.4	44.7	7.9	2.2
Check minus P	22+0+0+20	1.2	20	26	28	25	0.31	2.89	0.30	0.29	19.6	48.0	8.2	1.3
Check minus S	22+20+0+0	0.4	14	26	30	22	0.36	2.66	0.13	0.35	24.2	32.7	9.2	5.0
Check plus B	22+20+0+20+0+1	1.2	19	27	30	24	0.31	2.65	0.32	0.27	20.5	45.7	7.2	1.3
Check plus K	22+20+20+20	1.2	19	24	26	25	0.31	2.60	0.32	0.32	19.2	52.3	7.6	1.3
Check w/Gypsum	22+20+0+20	1.0	19	26	29	24	0.31	2.76	0.21	0.29	18.6	39.3	8.1	2.0
Check w/Dissolving S	22+20+0+23	0.5	15	26	30	22	0.36	2.58	0.14	0.33	24.7	38.7	9.8	5.7
Check w/Elemental S	22+20+0+20	0.5	14	24	28	23	0.36	2.68	0.14	0.36	26.5	42.3	9.3	5.8
Simplot 40 Rock	22+20+0+20+0+1	1.1	18	25	28	24	0.31	2.69	0.27	0.31	19.9	49.0	7.5	2.0
MosaicSZ (P)	22+80+0+35+2	1.1	18	24	27	25	0.31	2.68	0.28	0.32	19.2	47.3	7.0	1.1
MosaicSZ	22+20+0+20+1	1.2	19	23	26	26	0.32	2.58	0.35	0.31	18.6	50.3	6.6	2.7
ELX Lvstck Mnrl	22+20+0+20+0+0	1.1	18	28	31	23	0.32	2.80	0.22	0.30	20.7	42.3	8.6	2.5
Simplot 16-20-0-S13	25+31+0+20	1.2	20	26	29	24	0.32	2.79	0.30	0.29	21.2	48.3	7.8	1.2
Simplot " w/NutriSphere	25+31+0+20	1.2	18	24	27	25	0.32	2.71	0.31	0.30	18.5	47.0	7.4	1.3
P-Value	-	< 0.001	< 0.001	0.148	0.888	0.053	< 0.001	0.049	< 0.001	0.024	< 0.001	0.025	0.002	< 0.001
Mean	-	0.93	17.2	24.9	28.2	24.1	0.33	2.67	0.24	0.32	21.3	44.1	8.23	3.0
CV%	-	9.9	9.0	14.0	14.0	7.7	6.65	6.30	15.16	12.35	9.3	13.8	12.14	38.5
LSD (0.05)	-	0.15	2.6	NS	NS	NS	0.04	0.28	0.06	0.07	3.3	10.1	1.67	1.9

8.2 Inoculant

Table 35. Spring pea inoculant trial, Moccasin, MT, 2016.

Treatment	Plant Density	Node Count	Nodule Count	Nodule Weight	Grain Yield	Test Weight	Seeds per Pound
	(plants/ft²)	(#/plant)		(g/plant)	(bu/ac)	(lb/bu)	(seeds/lb)
Check	5.2	13	39	0.32	28.5	65.3	1635
Exceed Granular	4.8	13	37	0.34	28.2	65.4	1624
Exceed Granular+Chitosan	4.9	14	49	0.41	28.7	65.8	1646
Exceed Stic	5.6	13	33	0.32	31.5	65.4	1630
Standard Peat	5.6	14	38	0.26	26.9	65.7	1670
P-Value	0.54	0.93	0.06	0.21	0.33	0.38	0.35
Mean	5.2	13.3	39.3	0.33	28.8	65.5	1641
CV%	16.0	11.4	17.4	25.8	10.3	0.6	2.0
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS

Note: Trial seeded 4/18/2016 and harvested 8/2/2016.

Table 36. Spring lentil inoculant trial, Moccasin, MT, 2016.

Treatment	Plant Density	Node Count	Nodule Count	Nodule Weight	Grain Yield	Test Weight	Seeds/lb
	(plants/ft²)	(#/plant)		(g/plant)	(bu/ac)	(lb/bu)	(seeds/lb)
Check	11.3	14	29	0.09	23.0	61.5	8323
Exceed granular	9.8	12	26	0.07	23.2	61.4	8248
Exceed granular + chitosan	10.2	14	27	0.12	19.7	61.5	8213
Exceed Stic	10.1	13	23	0.07	22.7	61.2	8210
Peat	10.9	13	30	0.08	22.7	61.5	8288
P-Value	0.38	0.79	0.75	0.37	0.08	0.95	0.78
Mean	10.4	13.1	26.8	0.09	22.3	61.4	8257
CV%	11.0	13.0	32.3	40.0	8.0	0.8	1.8
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS

Note: Trial seeded 4/18/2016 and harvested 8/4/2016.

8.3 Herbicide

Table 37. Spring pea, spring lentil, and spring chickpea responses to varied rates of 8 different herbicide treatments applied in spring, Moccasin, MT, 2016.

Treatment	Rate	*Pea*		*Lentil*		*Chickpea*	
		Grain Yield	Test Weight	Grain Yield	Test Weight	Grain Yield	Test Weight
		(bu/ac)	(lb/bu)	(bu/ac)	(lb/bu)	(bu/ac)	(lb/bu)
ANTHEM MAXX	*8.25 floz/ac*	29.1	65.7	16.7	62.3	12.1	62.1
ANTHEM MAXX	*16.5 floz/ac*	24.3	65.8	17.8	62.2	12.8	62.2
AUTHORITY MTZ	*8 oz/ac*	35.5	65.9	21.0	62.4	9.7	62.5
AUTHORITY MTZ	*16 oz/ac*	26.6	65.9	5.5	61.8	14.0	62.7
CORVUS	*4 oz/ac*	28.6	64.7	12.3	61.9	9.3	62.3
CORVUS	*8 oz/ac*	26.1	65.3	10.0	61.4	10.4	62.4
CORVUS+METRIBUZIN	*3,8 oz/ac*	29.5	65.4	20.2	62.3	14.6	62.3
CORVUS+METRIBUZIN	*6,16 oz/ac*	28.8	66.1	12.4	61.6	13.8	62.9
METRIBUZIN 75 DF	*8 oz/ac*	28.1	65.4	17.2	62.4	7.9	62.4
METRIBUZIN 75 DF	*16 oz/ac*	25.3	65.5	18.3	63.0	10.1	62.7
PROWL H2O+Outlook	*16,18 floz/ac*	30.8	65.8	23.1	62.4	10.0	62.7
PROWL H2O+Outlook	*32,36 floz/ac*	27.5	65.8	23.0	62.5	10.2	62.8
SPARTAN 4L	*5 oz/ac*	27.7	66.0	8.5	62.4	12.1	62.8
SPARTAN 4L	*10 oz/ac*	28.6	65.9	8.3	61.9	9.6	62.3
VALOR SX	*3 oz/ac*	30.3	65.4	21.5	62.6	14.4	62.7
VALOR SX	*6 oz/ac*	30.6	65.6	17.9	62.6	9.5	62.2
NO TREATMENT	*NA*	27.6	65.4	21.9	62.4	9.7	62.1
P-Value	-	0.721	0.444	< 0.001	< 0.001	0.34	0.22
Mean	-	28.5	65.6	16.2	62.2	11.2	62.5
CV%	-	17.8	0.9	25.9	0.5	29.8	0.6
LSD (0.05)	-	NS	NS	NS*	0.5	NS	NS

*LSD considered non-significant when grain yield CV% > 15