Northwestern Agricultural Research Center
of the
Department of Research Centers
Montana Agricultural Experiment Station
Montana State University

ANNUAL REPORT
2017 CROP YEAR

Sixty-ninth annual report

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Jordan Penney, Farm Manager

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Brooke Bohannon, Research Associate

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Seasonal Employees

Abigail Northrup

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Intern

Scott Christensen

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Breno Bicego Almeida

Anish Sapkota

AgriMet
Cooperative Agricultural Weather Network

2016-2017 Weather Trend in Relation with the 29-year (1989-2017) Climate Data

The ambient air temperature was lower in the winter, whereas higher in the summer months than average (Fig. 1). Monthly rainfall received was consistently lower in summer than winter months in relation with the average (Fig. 2). The potential evapotranspiration demand was also steadily higher from May to July than average (Fig. 3).

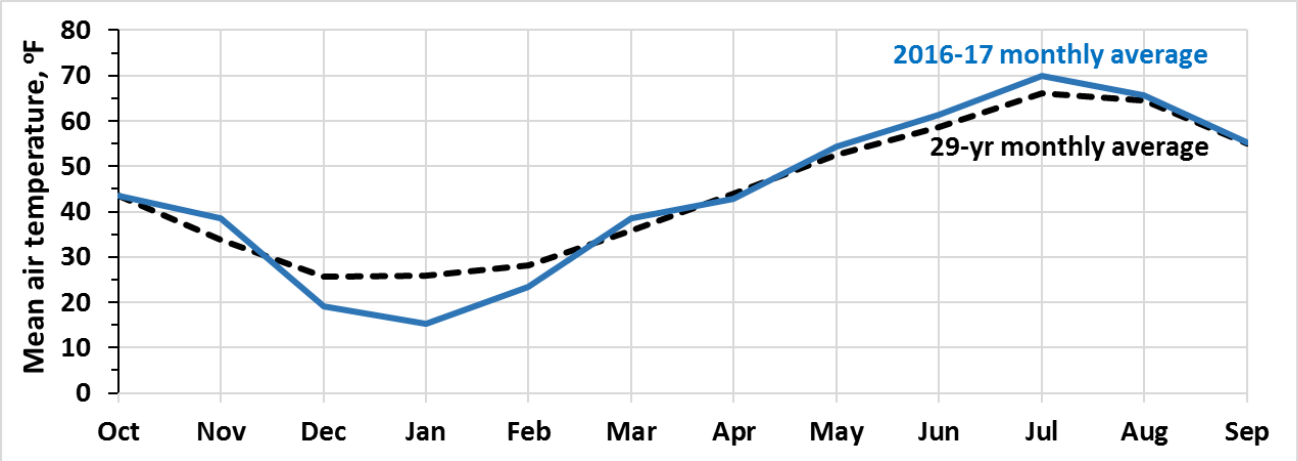


Figure 1. 2016-17 monthly mean temperature relative to the mean historical ambient temperature.

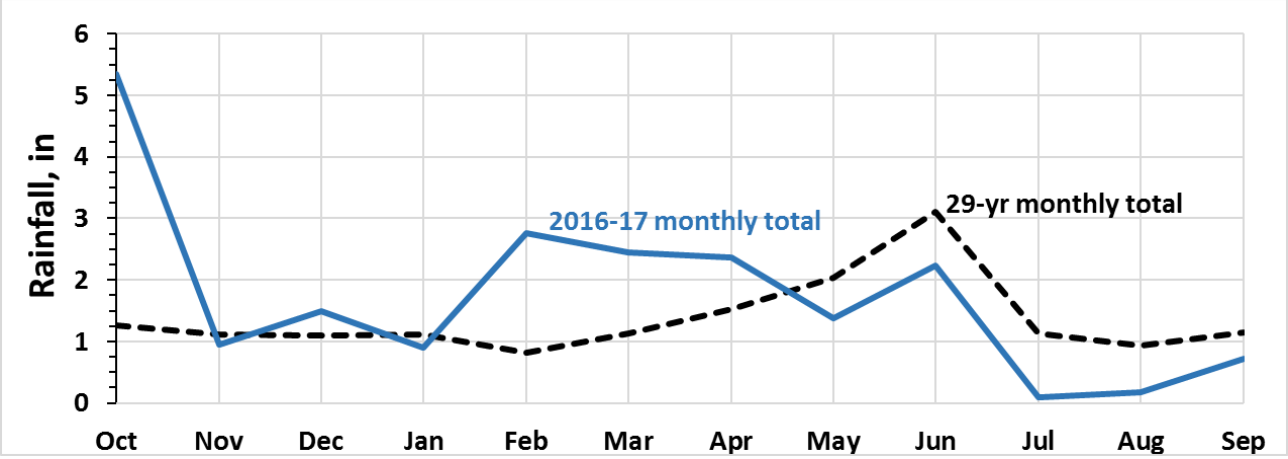


Figure 2. 2016-17 monthly total rainfall received relative to the historically expected rain.

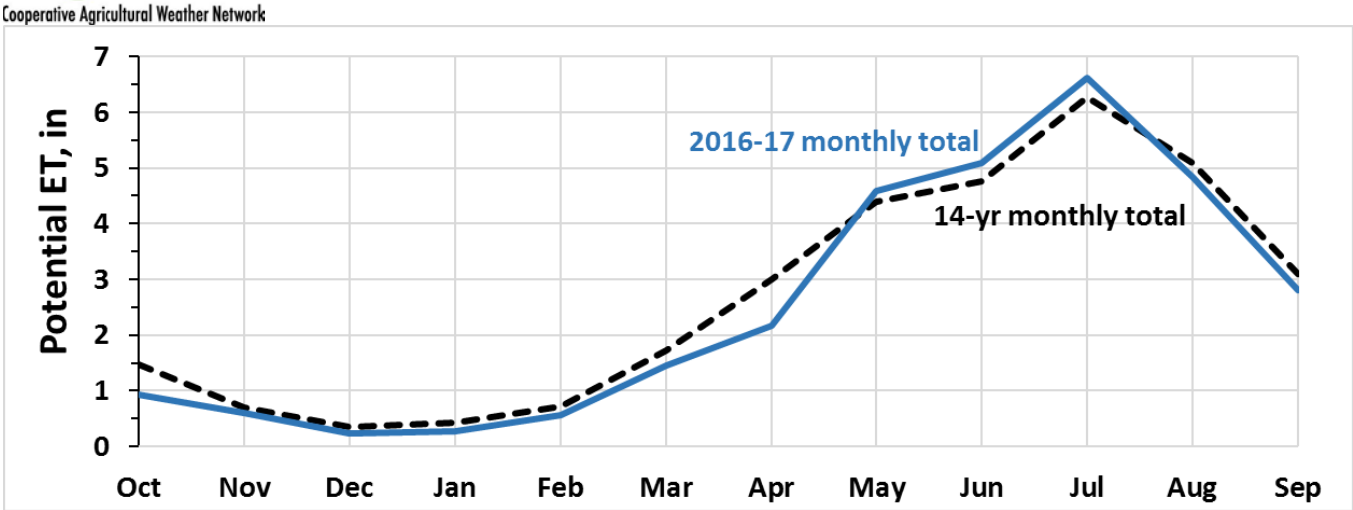


Figure 3. 2016-2017 monthly total potential evapotranspiration (ETo, grass as reference) relative to the 14-year ETo monthly total (2004-2017).

Summary of Climatic Data by Months for the 2017 Crop Year: September 2016 - August 31, 2017

	Sept. 2016	Oct. 2016	Nov. 2016	Dec. 2016	Jan. 2017	Feb. 2017	Mar. 2017	Apr. 2017	May 2017	June 2017	July 2017	Aug. 2017	
Precipitation (inches)													Total
Current Year	0.97	5.48	1.06	1.66	0.84	2.80	2.99	2.33	0.71	2.62	0.07	0.19	21.72
1981-2017	1.58	1.43	1.60	1.55	1.39	1.20	1.34	1.77	2.33	3.33	1.52	1.08	20.12
Average Temperature (F°)													Average
Current Year	52.0	43.5	38.4	17.3	12.5	22.1	35.8	40.4	52.6	59.6	68.0	64.3	42.2
1980-2017	53.8	42.4	32.5	24.1	24.3	27.1	35.0	42.8	51.4	57.9	64.5	63.5	43.3

Last killing frost[1] in spring

Spring 2017	May 19	31°
Median for 1980-2017	May 20	31°

First killing frost[1] in fall

Fall 2017	Sep 18	32°
Median for 1980-2017	Sep 16	29°

Frost Free Period

Avg. 1980-2016 122 days

Growing Degree Days April - August 2017

	April	May	June	July	Aug	Total
Base 50	28.0	238.0	349.5	539.5	506.5	1661.5
Base 40	145.0	422.5	589.5	810.5	712.0	2679.5
Base 32	292.0	638.0	827.5	1050.5	951.5	3759.5

Maximum summer temperature

Minimum winter temperature

1. In this summary 32 degrees or below is considered a killing frost.

Summary of Temperature Data at the Northwestern Agricultural Research Center
On a Crop Year Basis September 1980 - August 31, 2017
AVERAGE TEMPERATURE BY YEAR AND MONTH

In degrees Farenheit

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	MEAN
1980-81	54.1	45.3	35.8	32.2	30.1	31.3	38.5	44.5	52.5	53.8	62.8	66.4	45.6
1981-82	55.3	43.2	36.0	27.0	21.6	24.5	37.5	39.4	49.8	59.8	61.1	63.0	43.2
1982-83	53.4	41.0	29.1	25.9	30.3	33.8	37.9	42.4	51.9	57.6	59.6	65.4	44.0
1983-84	50.4	42.9	36.6	11.1	27.6	32.4	38.3	42.2	48.7	56.4	65.3	64.6	43.0
1984-85	49.5	40.0	32.6	20.6	19.2	19.0	30.8	44.8	53.7	57.6	68.3	60.2	41.4
1985-86	47.8	40.8	18.6	18.3	25.4	25.6	40.6	43.8	53.7	63.9	59.9	66.1	42.0
1986-87	50.2	43.0	30.3	24.9	22.2	27.9	35.0	47.8	55.6	61.6	62.9	59.8	43.4
1987-88	56.1	43.3	35.3	25.4	20.5	30.3	37.8	45.7	51.4	60.9	63.7	63.9	44.5
1988-89	53.4	43.4	36.3	23.3	27.5	12.4	28.8	44.2	49.6	59.8	65.4	61.9	42.2
1989-90	52.7	42.7	35.8	25.3	30.5	24.5	34.8	45.2	49.8	57.2	65.2	64.8	44.0
1990-91	59.1	41.9	36.1	16.5	18.3	34.6	32.8	42.4	50.3	55.1	64.0	65.2	43.0
1991-92	54.4	40.6	32.1	29.3	28.7	34.5	39.7	45.1	53.5	55.5	61.2	61.8	44.7
1992-93	51.1	44.7	33.1	19.4	14.7	18.4	33.7	43.6	56.0	56.5	56.6	59.7	40.6
1993-94	51.4	44.4	25.0	27.4	32.9	20.6	37.5	45.4	54.0	57.3	66.4	63.0	43.8
1994-95	56.3	42.8	29.7	27.1	23.6	33.7	33.1	42.6	51.6	56.3	63.1	59.5	43.3
1995-96	54.9	41.1	34.9	26.7	17.4	24.0	29.0	43.2	46.6	58.5	65.4	62.5	42.0
1996-97	52.3	42.1	27.3	19.8	19.8	28.0	32.3	38.3	52.3	57.8	62.8	63.8	41.4
1997-98	55.6	43.7	33.0	27.9	25.1	33.0	34.9	44.5	54.1	56.0	68.4	65.6	45.2
1998-99	59.7	42.3	37.0	27.4	30.4	32.2	37.5	41.6	48.8	55.8	60.9	65.5	44.9
1999-00	51.3	42.9	38.1	31.0	25.8	26.3	36.9	43.4	50.4	56.2	63.9	63.4	44.1
2000-01	52.0	33.5	27.5	18.4	24.0	20.6	33.6	40.5	53.4	54.8	63.1	64.6	40.5
2001-02	57.3	42.0	36.6	27.0	27.2	25.7	25.0	41.6	47.5	57.7	67.2	60.4	42.9
2002-03	54.4	37.5	32.6	30.6	28.8	28.1	33.4	44.5	50.5	60.1	69.1	66.9	44.7
2003-04	55.5	46.3	27.3	24.2	21.1	27.6	39.5	45.1	51.0	57.3	66.0	64.0	43.7
2004-05	52.3	43.4	33.8	29.4	20.6	30.6	36.1	43.9	51.8	55.3	62.6	62.8	43.6
2005-06	51.0	43.6	32.6	18.1	33.2	24.2	35.5	43.9	52.6	60.7	69.1	63.8	44.0
2006-07	53.5	44.0	32.5	24.1	22.1	28.3	37.7	42.7	52.6	59.0	72.0	62.3	44.2
2007-08	53.6	40.3	32.6	26.2	19.7	30.2	32.9	37.8	47.0	55.6	65.1	63.6	42.1
2008-09	52.4	41.7	33.3	18.0	21.5	24.5	26.2	41.8	53.3	59.2	67.1	66.1	42.1
2009-10	60.1	38.9	35.3	18.0	26.4	31.4	37.9	41.2	47.1	56.0	61.9	61.4	43.0
2010-11	51.9	43.9	29.0	23.8	24.3	19.5	34.7	38.7	48.7	53.5	61.9	64.4	41.2
2011-12	56.2	43.3	31.6	28.0	26.4	28.2	36.7	45.2	48.8	54.9	65.2	63.1	44.0
2012-13	55.4	41.9	35.8	28.5	23.9	32.6	35.3	40.4	52.4	58.5	67.2	66.0	44.8
2013-14	57.2	39.6	31.4	21.9	26.6	17.1	33.2	42.3	51.8	55.9	66.6	65.1	42.4
2014-15	54.2	48.0	28.8	25.0	22.6	32.4	38.6	43.6	52.7	63.7	65.7	64.3	45.0
2015-16	52.8	46.6	31.2	27.4	27.0	33.2	37.2	47.8	51.4	58.4	62.6	62.7	44.9
2016-17	52.0	43.5	38.4	17.3	12.5	22.1	35.8	40.4	52.6	59.6	68.0	64.3	42.2
MEAN	53.8	42.4	32.5	24.1	24.3	27.1	35.0	43.0	51.3	57.7	64.5	63.6	43.3

Mean temperature for all years = 43.3

Precipitation by Day for Crop Year September 2016- August 2017
Northwest Agriculture Research Center, Kalispell Montana

DAY	SEPT. 2016	OCT. 2016	NOV. 2016	DEC. 2016	JAN. 2017	FEB. 2017	MAR. 2017	APR. 2017	MAY 2017	JUNE 2017	JULY 2017	AUG. 2017
1	0.00	0.04	0.16	0.12	0.13	0.00	0.00	0.00	0.00	0.09	0.00	0.00
2	0.07	0.20	0.00	0.02	0.00	0.00	0.00	0.00	0.06	0.10	0.00	0.00
3	0.10	0.00	0.00	0.09	0.00	0.00	0.16	T	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.11	0.00	0.74	0.00	T	0.00	0.00	0.00	0.00
5	0.00	0.35	0.00	0.25	0.00	0.09	0.17	0.00	0.00	0.15	0.00	0.00
6	0.01	0.20	0.00	0.00	0.00	0.25	0.08	0.03	0.01	0.00	0.00	0.00
7	0.17	0.06	0.01	0.00	0.00	0.05	0.00	0.02	0.02	0.00	0.00	0.00
8	0.03	0.33	0.00	0.00	0.15	0.00	0.16	0.08	0.12	0.00	0.00	0.00
9	0.15	0.08	0.00	0.01	0.35	0.49	0.00	0.23	0.00	0.33	0.00	0.00
10	0.00	1.03	0.00	0.30	0.09	0.02	0.48	0.00	0.00	0.00	0.00	0.00
11	0.00	0.02	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.07	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.03	0.00	0.00	0.00	0.71	0.13	0.20	0.00	0.00	0.00
14	0.00	0.21	0.05	0.00	0.00	0.00	0.35	0.32	0.01	1.01	0.00	0.03
15	0.00	0.04	0.08	0.00	0.00	0.00	0.20	0.00	0.04	0.00	0.00	0.00
16	0.00	0.33	0.29	0.07	0.00	0.02	0.24	0.00	0.02	0.01	0.07	0.00
17	0.00	0.12	0.11	0.00	0.00	0.18	0.00	T	0.00	0.67	0.00	0.00
18	0.16	0.08	0.00	0.02	0.00	0.00	0.03	0.10	0.00	0.01	0.00	0.00
19	0.01	0.22	0.00	0.04	0.00	0.32	0.01	0.06	0.00	0.01	0.00	0.00
20	0.00	0.02	0.08	0.05	0.02	0.00	0.00	0.00	0.20	0.00	0.00	0.00
21	0.00	0.18	0.17	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00
22	0.15	0.18	0.00	0.00	0.00	0.30	0.29	0.00	0.00	0.00	0.00	0.00
23	0.01	0.06	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00
24	0.01	0.01	0.00	0.20	0.00	0.00	0.00	T	0.00	0.00	0.00	0.00
25	0.00	0.01	0.00	0.08	0.00	0.00	0.01	0.03	0.03	0.00	0.00	0.16
26	0.00	0.15	0.02	0.02	0.08	0.11	0.00	0.37	0.00	0.00	0.00	0.00
27	0.00	0.11	0.00	0.10	0.00	0.09	0.01	0.41	0.00	0.24	0.00	0.00
28	0.00	0.25	0.00	0.00	0.00	0.14	0.00	0.12	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	M	0.00		0.00	0.05	0.00	0.00	0.00	0.00
30	0.03	0.19	0.02	0.05	0.00		0.09	0.05	0.00	0.00	0.00	0.00
31		1.01		0.00	0.00		0.00		0.00		0.00	0.00
TOTAL	0.97	5.48	1.06	1.66	0.84	2.80	2.99	2.33	0.71	2.62	0.07	0.19

Year to date 21.72

Summary of Precipitation at the Northwestern Agricultural Research Center On a Crop Year Basis

Total Precipitation in Inches by Year and Month

YEAR	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL
1980-81	1.20	0.83	0.78	2.58	1.81	1.85	2.17	1.75	3.86	4.70	1.17	0.96	23.66
1981-82	0.77	0.56	1.49	1.91	2.38	1.48	1.16	1.60	1.25	2.41	2.06	1.17	18.24
1982-83	2.37	0.75	1.39	1.60	0.93	0.85	1.71	2.41	1.20	2.96	3.66	1.16	20.99
1983-84	1.70	1.13	1.96	2.57	0.80	2.19	1.81	1.93	2.91	2.07	0.31	0.55	19.93
1984-85	2.15	2.25	1.40	1.29	0.31	1.28	0.90	1.31	2.81	1.89	0.35	1.62	17.56
1985-86	5.35	1.55	1.61	0.51	2.39	2.33	0.50	1.34	2.92	1.83	2.09	0.81	23.23
1986-87	3.63	0.80	1.78	0.63	0.38	0.46	3.47	1.15	1.89	1.95	4.85	0.98	21.97
1987-88	0.81	0.12	0.91	1.18	0.98	1.03	0.77	1.36	3.60	1.98	1.07	0.13	13.94
1988-89	2.30	0.62	1.39	1.69	1.39	1.48	2.29	1.09	2.70	2.05	2.70	3.69	23.39
1989-90	1.50	2.29	3.75	1.92	0.96	1.00	1.76	1.63	3.74	2.68	2.34	2.44	26.01
1990-91	T	2.32	1.37	2.60	1.41	0.41	0.72	1.21	2.72	5.36	0.77	1.15	20.04
1991-92	0.80	0.75	2.26	0.58	1.17	0.61	0.83	1.18	1.65	5.34	2.24	0.94	18.35
1992-93	1.21	1.07	2.37	1.53	1.68	0.60	0.73	3.77	2.22	4.00	7.00	1.19	27.37
1993-94	1.54	0.83	1.23	1.27	1.43	1.49	0.11	2.01	1.79	2.59	0.10	0.23	14.62
1994-95	0.46	2.12	1.89	1.07	1.17	0.90	2.33	2.25	1.44	5.63	1.91	1.47	22.64
1995-96	1.21	2.75	2.33	1.91	2.22	1.18	1.19	3.32	4.58	2.05	0.95	0.80	24.49
1996-97	2.67	1.58	3.99	3.52	1.50	1.62	1.18	1.69	2.62	3.41	0.99	1.94	26.71
1997-98	2.36	0.94	0.33	0.42	0.77	0.33	2.64	1.80	5.14	4.64	1.18	0.72	21.27
1998-99	1.48	0.71	1.11	1.47	1.05	1.18	0.90	0.55	1.32	2.74	1.63	1.93	16.07
1999-00	0.36	1.72	2.33	1.08	1.46	1.81	1.30	2.21	0.89	1.80	0.84	0.35	16.15
2000-01	1.40	1.23	0.62	1.23	0.75	1.54	1.03	2.62	0.57	3.29	0.91	0.54	15.73
2001-02	0.32	1.80	1.44	0.59	1.21	1.66	1.48	0.91	2.72	2.39	1.45	1.44	17.41
2002-03	1.18	0.25	0.87	1.67	1.63	1.01	2.32	2.23	1.78	1.57	0.05	0.35	14.91
2003-04	2.56	1.29	0.59	1.04	2.02	0.42	0.57	2.23	1.97	1.31	1.24	3.60	18.84
2004-05	1.89	1.62	0.84	1.49	1.38	0.01	1.41	2.21	1.73	8.44	0.26	0.56	21.84
2005-06	2.28	2.20	1.45	1.42	3.04	1.14	0.55	2.12	2.89	5.50	0.51	0.24	23.34
2006-07	1.95	1.10	2.28	0.95	0.39	2.26	0.54	1.62	3.29	1.35	0.75	0.23	16.71
2007-08	1.28	1.11	1.02	1.13	1.31	0.76	0.61	0.90	2.33	3.65	3.80	1.15	19.05
2008-09	1.57	0.61	1.71	2.37	1.72	1.59	1.43	0.98	1.62	1.98	2.44	0.99	19.01
2009-10	0.04	1.72	0.37	2.66	1.42	0.66	0.72	3.47	2.45	5.03	1.25	1.35	21.14
2010-11	1.71	0.74	2.77	1.69	2.43	1.61	0.87	2.25	3.20	4.48	0.99	0.24	22.98
2011-12	0.91	2.46	0.46	0.40	1.08	1.15	1.16	1.35	2.11	7.11	1.41	0.56	20.16
2012-13	0.75	2.46	1.66	1.84	0.67	0.20	0.66	2.12	3.29	2.76	0.03	0.93	17.37
2013-14	2.65	0.36	2.00	0.99	1.36	1.66	2.32	0.76	1.17	6.39	0.51	1.73	21.90
2014-15	0.75	2.13	2.84	2.66	2.52	1.04	1.43	0.30	0.43	1.02	0.63	0.19	15.94
2015-16	0.96	0.79	1.00	2.16	1.42	1.01	0.97	1.50	2.78	2.07	1.55	1.11	17.32
2016-17	0.97	5.48	1.06	1.66	0.84	2.80	2.99	2.33	0.71	2.62	0.07	0.19	21.72
MEAN	1.58	1.43	1.59	1.55	1.39	1.21	1.34	1.77	2.33	3.33	1.52	1.07	20.08
	SEPT	OCT	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL

Mean monthly precipitation for all crop years = 1.67

YEAR 2017 - GROWING DEGREE DAYS JANUARY THROUGH OCTOBER
CALCULATED AT BASE 50, BASE 40, AND BASE 32
Page 1: January - May

January

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Base 40	Base 32
1	30	7	0.0	0.0	0.0
2	22	-7	0.0	0.0	0.0
3	16	-10	0.0	0.0	0.0
4	10	-26	0.0	0.0	0.0
5	4	-26	0.0	0.0	0.0
6	5	-17	0.0	0.0	0.0
7	12	-14	0.0	0.0	0.0
8	9	-13	0.0	0.0	0.0
9	16	8	0.0	0.0	0.0
10	30	16	0.0	0.0	0.0
11	28	-11	0.0	0.0	0.0
12	12	-19	0.0	0.0	0.0
13	11	-17	0.0	0.0	0.0
14	14	9	0.0	0.0	0.0
15	14	9	0.0	0.0	0.0
16	14	9	0.0	0.0	0.0
17	14	9	0.0	0.0	0.0
18	21	11	0.0	0.0	0.0
19	32	11	0.0	0.0	0.0
20	39	25	0.0	0.0	3.5
21	37	8	0.0	0.0	2.5
22	27	9	0.0	0.0	0.0
23	33	21	0.0	0.0	0.5
24	32	2	0.0	0.0	0.0
25	21	3	0.0	0.0	0.0
26	27	19	0.0	0.0	0.0
27	26	15	0.0	0.0	0.0
28	30	22	0.0	0.0	0.0
29	32	2	0.0	0.0	0.0
30	32	5	0.0	0.0	0.0
31	40	25	0.0	0.0	4.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
22.3	2.7	0.0	0.0	10.5

February

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Base 40	Base 32
1	30	-3	0.0	0.0	0.0
2	23	-9	0.0	0.0	0.0
3	17	-12	0.0	0.0	0.0
4	14	-4	0.0	0.0	0.0
5	19	13	0.0	0.0	0.0
6	38	12	0.0	0.0	3.0
7	38	7	0.0	0.0	3.0
8	20	-1	0.0	0.0	0.0
9	19	2	0.0	0.0	0.0
10	43	19	0.0	1.5	5.5
11	44	24	0.0	2.0	6.0
12	38	11	0.0	0.0	3.0
13	38	9	0.0	0.0	3.0
14	34	7	0.0	0.0	1.0
15	33	7	0.0	0.0	0.5
16	32	8	0.0	0.0	0.0
17	40	31	0.0	0.0	4.0
18	44	22	0.0	2.0	6.0
19	36	26	0.0	0.0	2.0
20	43	29	0.0	1.5	5.5
21	40	29	0.0	0.0	4.0
22	36	29	0.0	0.0	2.0
23	42	17	0.0	1.0	5.0
24	35	10	0.0	0.0	1.5
25	29	9	0.0	0.0	0.0
26	28	11	0.0	0.0	0.0
27	27	12	0.0	0.0	0.0
28	26	14	0.0	0.0	0.0
29	0	0	0.0		

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
32.4	11.8	0.0	8.0	55.0

March

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Base 40	Base 32
1	31	20	0.0	0.0	0.0
2	38	20	0.0	0.0	3.0
3	42	32	0.0	1.0	5.0
4	44	33	0.0	2.0	6.5
5	41	29	0.0	0.5	4.5
6	34	13	0.0	0.0	1.0
7	33	20	0.0	0.0	0.5
8	33	23	0.0	0.0	0.5
9	43	17	0.0	1.5	5.5
10	32	22	0.0	0.0	0.0
11	46	23	0.0	3.0	7.0
12	49	26	0.0	4.5	8.5
13	46	32	0.0	3.0	7.0
14	42	33	0.0	1.0	5.5
15	46	33	0.0	3.0	7.5
16	48	37	0.0	4.0	10.5
17	48	22	0.0	4.0	8.0
18	44	22	0.0	2.0	6.0
19	49	32	0.0	4.5	8.5
20	48	22	0.0	4.0	8.0
21	51	22	0.5	5.5	9.5
22	51	34	0.5	5.5	10.5
23	50	29	0.0	5.0	9.0
24	50	25	0.0	5.0	9.0
25	44	25	0.0	2.0	6.0
26	47	31	0.0	3.5	7.5
27	51	31	0.5	5.5	9.5
28	44	37	0.0	2.0	8.5
29	46	37	0.0	3.0	9.5
30	45	38	0.0	2.5	9.5
31	52	33	1.0	6.0	10.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
44.1	27.5	2.5	83.5	202.0

April

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Base 40	Base 32
1	56	20	3.0	8.0	12.0
2	36	24	0.0	0.0	2.0
3	38	25	0.0	0.0	3.0
4	43	20	0.0	1.5	5.5
5	48	28	0.0	4.0	8.0
6	55	33	2.5	7.5	12.0
7	59	33	4.5	9.5	14.0
8	52	35	1.0	6.0	11.5
9	51	33	0.5	5.5	10.0
10	44	24	0.0	2.0	6.0
11	42	26	0.0	1.0	5.0
12	50	30	0.0	5.0	9.0
13	48	37	0.0	4.0	10.5
14	50	34	0.0	5.0	10.0
15	51	35	0.5	5.5	11.0
16	49	20	0.0	4.5	8.5
17	54	30	2.0	7.0	11.0
18	44	37	0.0	2.0	8.5
19	53	33	1.5	6.5	11.0
20	56	30	3.0	8.0	12.0
21	54	31	2.0	7.0	11.0
22	51	26	0.5	5.5	9.5
23	60	32	5.0	10.0	14.0
24	52	39	1.0	6.0	13.5
25	50	39	0.0	5.0	12.5
26	48	38	0.0	4.0	11.0
27	47	37	0.0	3.5	10.0
28	42	36	0.0	1.0	7.0
29	49	38	0.0	4.5	11.5
30	52	35	1.0	6.0	11.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
49.5	31.3	28.0	145.0	292.0

May

Day	Temperatures MAX	Temperatures MIN	Growing Degree Days Base 50	Base 40	Base 32
1	55	34	2.5	7.5	12.5
2	53	37	1.5	6.5	13.0
3	52	32	1.0	6.0	10.0
4	61	37	5.5	10.5	17.0
5	74	41	12.0	17.5	25.5
6	75	46	12.5	20.5	28.5
7	64	43	7.0	13.5	21.5
8	49	30	0.0	4.5	8.5
9	61	34	5.5	10.5	15.5
10	65	36	7.5	12.5	18.5
11	71	41	10.5	16.0	24.0
12	81	47	15.5	24.0	32.0
13	57	39	3.5	8.5	16.0
14	50	35	0.0	5.0	10.5
15	48	31	0.0	4.0	8.0
16	57	35	3.5	8.5	14.0
17	55	40	2.5	7.5	15.5
18	62	41	6.0	11.5	19.5
19	65	44	7.5	14.5	22.5
20	68	42	9.0	15.0	23.0
21	69	39	9.5	14.5	22.0
22	70	40	10.0	15.0	23.0
23	76	44	13.0	20.0	28.0
24	80	49	15.0	24.5	32.5
25	59	40	4.5	9.5	17.5
26	63	36	6.5	11.5	17.5
27	68	37	9.0	14.0	20.5
28	75	43	12.5	19.0	27.0
29	78	46	14.0	22.0	30.0
30	80	45	15.0	22.5	30.5
31	82	50	16.0	26.0	34.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
65.3	39.8	238.0	422.5	638.0

YEAR 2017 - GROWING DEGREE DAYS JANUARY THROUGH OCTOBER
CALCULATED AT BASE 50, BASE 40, AND BASE 32
Page 2: June - October

JUNE

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	84	52	18.0	28.0	36.0
2	64	52	8.0	18.0	26.0
3	70	39	10.0	15.0	22.5
4	80	48	15.0	24.0	32.0
5	77	50	13.5	23.5	31.5
6	67	40	8.5	13.5	21.5
7	77	46	13.5	21.5	29.5
8	84	48	17.0	26.0	34.0
9	78	51	14.5	24.5	32.5
10	64	38	7.0	12.0	19.0
11	61	42	5.5	11.5	19.5
12	66	39	8.0	13.0	20.5
13	79	44	14.5	21.5	29.5
14	60	48	5.0	14.0	22.0
15	85	46	17.5	25.5	33.5
16	60	49	5.0	14.5	22.5
17	61	46	5.5	13.5	21.5
18	64	48	7.0	16.0	24.0
19	61	50	5.5	15.5	23.5
20	78	40	14.0	19.0	27.0
21	79	53	16.0	26.0	34.0
22	73	42	11.5	17.5	25.5
23	69	42	9.5	15.5	23.5
24	72	43	11.0	17.5	25.5
25	77	46	13.5	21.5	29.5
26	84	48	17.0	26.0	34.0
27	82	56	19.0	29.0	37.0
28	80	48	15.0	24.0	32.0
29	77	50	13.5	23.5	31.5
30	72	46	11.0	19.0	27.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
72.8	46.3	349.5	589.5	827.5

JULY

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	78	51	14.5	24.5	32.5
2	85	49	17.5	27.0	35.0
3	87	53	19.5	29.5	37.5
4	85	46	17.5	25.5	33.5
5	84	47	17.0	25.5	33.5
6	90	54	20.0	30.0	38.0
7	92	54	20.0	30.0	38.0
8	94	54	20.0	30.0	38.0
9	92	50	18.0	28.0	36.0
10	91	55	20.5	30.5	38.5
11	84	53	18.5	28.5	36.5
12	79	48	14.5	23.5	31.5
13	84	48	17.0	26.0	34.0
14	90	50	18.0	28.0	36.0
15	91	50	18.0	28.0	36.0
16	87	62	24.0	34.0	42.0
17	80	43	15.0	21.5	29.5
18	82	43	16.0	22.5	30.5
19	83	47	16.5	25.0	33.0
20	84	49	17.0	26.5	34.5
21	85	51	18.0	28.0	36.0
22	80	48	15.0	24.0	32.0
23	80	52	16.0	26.0	34.0
24	88	60	23.0	33.0	41.0
25	90	45	18.0	25.5	33.5
26	85	49	17.5	27.0	35.0
27	88	52	19.0	29.0	37.0
28	88	47	18.0	26.5	34.5
29	89	42	18.0	24.0	32.0
30	91	41	18.0	23.5	31.5
31	92	42	18.0	24.0	32.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
86.4	50	539.5	810.5	1050.5

AUGUST

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	92	42	21.0	24.0	32.0
2	89	47	19.5	26.5	34.5
3	82	41	16.0	21.5	29.5
4	84	42	17.0	23.0	31.0
5	88	45	19.0	25.5	33.5
6	78	40	14.0	19.0	27.0
7	82	42	16.0	22.0	30.0
8	87	48	18.5	27.0	35.0
9	84	42	17.0	23.0	31.0
10	88	44	19.0	25.0	33.0
11	83	42	16.5	22.5	30.5
12	86	52	19.0	29.0	37.0
13	86	57	21.5	31.5	39.5
14	73	52	12.5	22.5	30.5
15	75	41	12.5	18.0	26.0
16	78	43	14.0	20.5	28.5
17	82	47	16.0	24.5	32.5
18	83	49	16.5	26.0	34.0
19	86	46	18.0	26.0	34.0
20	80	44	15.0	22.0	30.0
21	76	45	13.0	20.5	28.5
22	77	46	13.5	21.5	29.5
23	85	39	17.5	22.5	30.0
24	88	44	19.0	25.0	33.0
25	88	44	19.0	25.0	33.0
26	79	41	14.5	20.0	28.0
27	80	41	15.0	20.5	28.5
28	86	42	18.0	24.0	32.0
29	86	45	18.0	25.5	33.5
30	90	51	20.5	28.5	36.5
31	89	51	20.0	28.5	36.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
83.5	45.0	506.5	712.0	951.5

SEPTEMBER

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	85	48	17.5	26.5	34.5
2	84	47	17.0	25.5	33.5
3	88	47	18.0	26.5	34.5
4	88	49	18.0	27.5	35.5
5	79	44	14.5	21.5	29.5
6	78	43	14.0	20.5	28.5
7	75	39	12.5	17.5	25.0
8	77	44	13.5	20.5	28.5
9	75	47	12.5	21.0	29.0
10	84	51	17.5	27.5	35.5
11	78	42	14.0	20.0	28.0
12	82	42	16.0	22.0	30.0
13	84	42	17.0	23.0	31.0
14	72	42	11.0	17.0	25.0
15	54	44	2.0	9.0	17.0
16	52	32	1.0	6.0	10.0
17	59	31	4.5	9.5	13.5
18	64	32	7.0	12.0	16.0
19	64	40	7.0	12.0	20.0
20	52	40	1.0	6.0	14.0
21	53	39	1.5	6.5	14.0
22	55	33	2.5	7.5	12.0
23	53	35	1.5	6.5	12.0
24	51	36	0.5	5.5	11.5
25	59	37	4.5	9.5	16.0
26	58	40	4.0	9.0	17.0
27	64	40	7.0	12.0	20.0
28	68	35	9.0	14.0	19.5
29	69	35	9.5	14.5	20.0
30	71	36	10.5	15.5	21.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
69.2	40.4	286.0	471.5	682.0

OCTOBER

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	64	40	7.0	12.0	20.0
2	52	38	1.0	6.0	13.0
3	40	31	0.0	0.0	4.0
4	49	23	0.0	4.5	8.5
5	56	26	3.0	8.0	12.0
6	57	29	3.5	8.5	12.5
7	64	28	7.0	12.0	16.0
8	54	30	2.0	7.0	11.0
9	51	26	0.5	5.5	9.5
10	56	27	3.0	8.0	12.0
11	58	27	4.0	9.0	13.0
12	49	30	0.0	4.5	8.5
13	39	31	0.0	0.0	3.5
14	40	32	0.0	0.0	4.0
15	45	33	0.0	2.5	7.0
16	63	37	6.5	11.5	18.0
17	70	30	10.0	15.0	19.0
18	56	32	3.0	8.0	12.0
19	70	40	10.0	15.0	23.0
20	46	36	0.0	3.0	9.0
21	46	37	0.0	3.0	9.5
22	57	31	3.5	8.5	12.5
23	55	30	2.5	7.5	11.5
24	54	28	2.0	7.0	11.0
25	54	26	2.0	7.0	11.0
26	58	27	4.0	9.0	13.0
27	48	25	0.0	4.0	8.0
28	50	25	0.0	5.0	9.0
29	52	23	1.0	6.0	10.0
30	47	23	0.0	3.5	7.5
31	44	22	0.0	2.0	6.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
53.0	29.8	75.5	200.5	338.5

Julian Date Calendar for Year 2017

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	32	60	91	121	152	182	213	244	274	305	335
2	2	33	61	92	122	153	183	214	245	275	306	336
3	3	34	62	93	123	154	184	215	246	276	307	337
4	4	35	63	94	124	155	185	216	247	277	308	338
5	5	36	64	95	125	156	186	217	248	278	309	339
6	6	37	65	96	126	157	187	218	249	279	310	340
7	7	38	66	97	127	158	188	219	250	280	311	341
8	8	39	67	98	128	159	189	220	251	281	312	342
9	9	40	68	99	129	160	190	221	252	282	313	343
10	10	41	69	100	130	161	191	222	253	283	314	344
11	11	42	70	101	131	162	192	223	254	284	315	345
12	12	43	71	102	132	163	193	224	255	285	316	346
13	13	44	72	103	133	164	194	225	256	286	317	347
14	14	45	73	104	134	165	195	226	257	287	318	348
15	15	46	74	105	135	166	196	227	258	288	319	349
16	16	47	75	106	136	167	197	228	259	289	320	350
17	17	48	76	107	137	168	198	229	260	290	321	351
18	18	49	77	108	138	169	199	230	261	291	322	352
19	19	50	78	109	139	170	200	231	262	292	323	353
20	20	51	79	110	140	171	201	232	263	293	324	354
21	21	52	80	111	141	172	202	233	264	294	325	355
22	22	53	81	112	142	173	203	234	265	295	326	356
23	23	54	82	113	143	174	204	235	266	296	327	357
24	24	55	83	114	144	175	205	236	267	297	328	358
25	25	56	84	115	145	176	206	237	268	298	329	359
26	26	57	85	116	146	177	207	238	269	299	330	360
27	27	58	86	117	147	178	208	239	270	300	331	361
28	28	59	87	118	148	179	209	240	271	301	332	362
29	29		88	119	149	180	210	241	272	302	333	363
30	30		89	120	150	181	211	242	273	303	334	364
31	31		90		151		212	243		304		365

CEREALS

Title: Intrastate Barley Nursery - 2017

Objective: To evaluate barley varieties and experimental lines for agronomic performance in environments representative of northwestern Montana.

Results:

High temperatures and low rainfall reduced crop height, which averaged only 21.5 inches. Height ranged from 24.3 inches for Copeland and MT124113 to a low of 18.3 inches for Genie. Heading spanned 9.7 days with an average of 178 days (June 27). MT090025 and MT090236 were the earliest at 174 days and Genie was the latest at 183.7 days. High temperatures and low rainfall also depressed yields, which only averaged 79 bu/A. Yields range from a high of 96.4 bu/A for MT124118 to a low of 66 bu/A for MT090025. At the same time, protein was high and averaged 14.05 %, ranging from a high of 15.85 % for Harrington to a low of 12.23 % for MT090025. Test weights averaged 48.2 lb/bu, with MT124134 having the heaviest grain at 51.8 lb/bu and Grower the lightest at 43.7 lb/bu.

Summary:

MT124118 was the top performer this year producing 96.4 bu/A, 13.89 % protein and a test weight of 50.2 lb/bu.

Table 1. Materials and Methods.

Seeding Date:	5/3/2017	Harvest Date:	8/17/2017
Julian Date:	123	Julian Date:	229
Seeding Rate:	80 lb/A	Soil Type:	Creston SiL
Previous Crop:	peas	Soil Test:	29-16-156
Tillage:	Conventional	Fertilizer:	150-30-30

Table 2. Intrastate Barley Nursery, Kalispell MT - 2017

Variety	HT inches	HD Julian	YLD bu/A	PRO %	TWT lb/bu
MT124118	24.0	176.3	96.4	13.89	50.2
MT124555	21.7	178.7	89.8	13.54	50.1
MT124688	22.3	179.0	88.6	13.31	50.9
Hockett	21.0	177.0	88.2	13.99	49.2
MT124243	23.0	179.0	88.2	12.77	49.0
Craft	24.0	178.7	87.1	14.38	51.0
MT090169	21.0	175.0	85.1	12.35	50.3
10WA-106.18	22.7	178.7	84.5	14.43	47.5
MT124601	21.3	178.7	84.4	14.07	48.9
11WA-107.58	22.7	179.7	84.0	14.83	50.4
MT124645	21.7	176.3	84.0	14.62	47.3
Copeland	24.3	180.3	83.5	15.28	46.2
10ARS191-3	22.7	180.3	83.5	14.82	47.0
MT124093	24.0	178.7	82.3	14.95	49.1
MT090182	22.3	181.3	81.8	13.79	48.7
MT124716	20.0	181.7	81.5	15.10	47.7
MT090236	20.0	174.0	81.2	12.70	49.1
MT124071	23.3	177.7	80.8	13.75	49.4
MT124663	20.0	175.7	80.7	13.01	51.4
Balster	20.7	180.3	80.5	14.91	46.9
MT124112	19.0	174.3	80.4	13.07	49.1
MT124127	20.3	179.3	80.4	14.59	50.0
MT124113	24.3	174.3	80.0	13.10	51.1
MT124069	21.0	180.7	79.9	14.56	47.2
MT090184	23.3	180.3	79.6	13.83	48.8
MT124673	19.7	176.3	79.6	13.01	51.7
Synergy	24.0	180.3	79.3	14.83	47.6
MT124007	21.7	179.3	78.9	14.94	47.6
MT124073	24.0	182.0	78.7	14.72	48.1
MT124128	20.7	174.3	78.6	13.00	51.8
Odyssey	19.3	180.7	78.3	13.45	31.9
MT124677	19.7	175.7	77.7	13.12	51.2
MT100120	22.7	180.3	77.3	13.76	48.8
MT124134	23.3	174.3	76.8	12.63	51.8
MT124018	22.0	180.0	76.5	14.69	48.4

HT: height, HD: heading, YLD: yield, PRO: protein, TWT: test weight

Table 2. continued

Variety	HT inches	HD Julian	YLD bu/A	PRO %	TWT lb/bu
MT090193	23.7	181.0	75.8	13.97	47.5
Metcalfe	20.7	179.7	75.7	15.76	47.2
MT124370	20.3	181.0	75.7	13.21	48.6
Harrington	21.7	179.7	75.2	15.85	47.8
Growler	21.0	180.0	74.0	15.69	43.7
2Ab08-X05M010-65	20.7	180.7	73.6	14.81	44.0
Genie	18.3	183.7	73.4	15.66	45.4
MT124164	19.7	176.0	73.4	13.80	46.1
MT124016	21.0	182.0	73.3	14.70	44.8
MT124380	19.0	181.3	71.4	14.18	47.5
MT124659	19.3	174.0	70.2	13.07	50.9
MT124664	20.3	175.7	69.8	13.39	51.2
Genesis	22.3	174.3	67.8	14.10	48.6
MT090025	19.3	174.0	66.0	12.23	45.3
Mean	**21.5**	**178.4**	**79.5**	**14.05**	**48.2**
LSD P=.05	2.226	3.229	11.76	0.72	5.26
CV	6.38	1.12	9.13	3.16	6.73
Pr>F	0.0001	0.0001	0.0019	0.0001	0.0001

HT: height, HD: heading, YLD: yield, PRO: protein, TWT: test weight

Title: Evaluation of Hull-less Barley Varieties - 2017

Personnel: Bob Stougaard, NWARC, Kalispell
Jamie Sherman, PSPP, Bozeman

Objective: To evaluate the agronomic performance of hull-less barley varieties grown in environment representative of northwestern Montana.

Results:

Stand establishment was poor with the majority of entries, but especially so for Franubet, Wanupana and Washonupana where the percent germination was zero. As a result these entries were dropped from the study. Plant height ranged from a high of 24.3 inches for Transit to a low of 18 inches for Falcon. Falcon also was the latest variety to head at 183 days (July 2), whereas X0626-T229 was the earliest at 176.7 days (June 25). X0626-T229 also was the highest yielding entry at 82.7 bu/A while Falcon had the lowest yield at 43.5 bu/A. Protein ranged from 15.6 % for X0626-T229 to 19 % for Transit. Test weights were low, ranging from a low of 47.9 for X07G30-T131 to 57.8 for Falcon. Percent plumps varied from 36.4 % with X0626-T229 to 87.7 % for MT110061.

Summary:

Most entries had poor germination which negatively impacted plant stands and yields.

Table 1. Materials and Methods.

Seeding Date:	5/1/2017	Harvest Date:	8/16/2017
Julian Date:	121	Julian Date:	228
Seeding Rate:	80 lb/A	Soil Type:	Creston SiL
Previous Crop:	peas	Soil Test:	29-16-156
Tillage:	Conventional	Fertilizer:	150-30-30

Table 2. Agronomic data from hull less barley varieties, Kalispell MT -2017

Variety	Stand %	Height inch	Heading Julian	Yield bu/A	Protein %	Test wt lb/bu	Plump %
X0626-T229	70.0	21.7	176.7	82.7	15.6	50.8	36.4
2Ab09-X06F058HL-31	73.3	19.3	179.7	77.3	16.1	52.0	38.8
MT110061	22.3	20.3	179.3	73.8	16.3	54.1	87.7
MT110065	75.0	21.0	180.0	73.1	16.5	49.3	84.9
X05013-T1	85.0	20.3	180.0	72.2	16.3	50.4	60.1
Havener	81.7	20.7	179.7	68.7	15.8	50.6	81.9
09WA-265.12	78.3	20.3	179.3	68.2	15.8	50.1	71.5
MT110066	36.7	20.0	179.0	66.7	17.4	52.1	73.2
X07G30-T131	41.7	20.7	180.3	65.1	17.1	47.9	52.9
MT110016	17.7	22.3	179.3	64.9	16.2	56.0	65.0
MT110009	21.7	22.7	180.3	61.9	17.1	52.6	51.7
Transit	66.7	24.3	179.3	59.9	19.0	54.5	61.7
Falcon	5.0	18.0	183.0	43.5	18.5	57.8	65.1
LSD P=.05	15.2	2.2	1.5	13.1	1.0	3.0	27.1
CV	21.4	6.1	0.5	11.5	3.5	3.4	25.1
Pr>F	0.0001	0.0007	0.0001	0.0008	0.0001	0.0001	0.0096

Title: Effect of Absolute Maxx and Prosaro on stripe rust control in spring wheat. 2017

Objective: Evaluate fungicides for crop tolerance and stripe rust control in spring wheat.

Materials and Methods:

Buck Pronto spring wheat was planted on May 3 in a field previously cropped to barley. A tankmix of Axial (16.4 oz/A) and Huskie (11 oz/A) was applied on June 5 to control weeds. Fungicides were applied were applied on June 19, 2017 using a CO_2 backpack sprayer equipped with TeeJet XR11002 nozzles in a volume of 20 GPA. The crop was 13 inches tall and was in the boot stage. Stripe rust infection at application was about 10 percent. The study was treated with Curtail at 2 pt/A on June 19 for the control of Canada thistle.

Results:

All treatments afforded excellent crop tolerance. Similarly, all treatments initially provided excellent control of stripe rust. That being said, hot, dry conditions prevent the disease from developing into a serious outbreak. There was essentially no infection present when the study was evaluated at 25 days after applications or at harvest. Concurrently, there were no treatment differences detected for yield, protein or test weight.

Summary:

The drought and heat stress prevented the initial stripe rust infection from increasing, which in turn, prevented an assessment of the fungicide treatments.

Table 2. Effect of Absolute Maxx and Prosaro on stripe rust control in spring wheat. Kalispell, MT 2017.

Treatment	Rate	6/26 CI %	6/26 SR %	7/14 SR %	8/16 SR %	8/16 YLD bu/A	8/16 PRO %	8/16 TWT lb/bu
Untreated		0	20.7	3.7	0	67.7	14.2	60.3
Absolute Maxx	4 fl oz/a	0	1	0	0	60.5	14.2	60.4
Induce 90 SL	0.125 % v/v							
Absolute Maxx	5 fl oz/a	0	1.3	0	0	65.3	14.3	60.4
Induce 90 SL	0.125 % v/v							
Prosaro	5 fl oz/a	0	0.3	0	0	65.5	14.3	60.5
Induce 90 SL	0.125 % v/v							
Tebuzol 3.6F	4 fl oz/a	0	0.7	0	0	63.4	14.4	60.2
Induce 90 SL	0.125 % v/v							
Mean		0.0	4.8	0.7	0.0	64.5	14.3	60.4
LSD P=.05		ns	ns	1.9	ns	ns	ns	ns
CV		0.0	240.7	140.8	0.0	8.1	1.2	0.5
Pr>F		1.0000	0.2278	0.0080	1.0000	0.5602	0.8106	0.7086

CI: Crop injury, SR: Stripe rust, YLD: Yield, PRO: Protein, TWT: Test weight,
ns: nonsignificant.

Project Title: Managing water requirement of spring wheat lines – 2017

Objective: To assess trait adjustment of wheat lines at various water regimes

Personnel: J.Torrion, L. Talbert, B. Bicego, and A. Sapkota

Methods:

This experiment was conducted on a split-plot design with four replications. The water regime was the main plot, and wheat lines (subplot) were randomly assigned to the main plot. The agronomic management information and water treatments are detailed in Table 1. The nitrogen (N) applied was only 117 lbs/A, but with 33 lbs/A (from residual soil N), the total N in the soil was 150 lbs/A.

Summary:

There was no interaction between water regimes and wheat lines for yield indicating that each wheat lines yielded following the same degree of yield response by the varying amounts of water (Figure 1). This experiment is a validation of our previous experiments that applying the final irrigation at milk stage (100ET.M) does not negatively impact yield (Figure 1A). Also, these lines tolerate moderate deficit irrigation (75ET), but not on the extreme deficit irrigation (50ET) for this year. Yield reduction is expected when the final irrigation being applied at flower (100ETF).

There was also no interaction between water regimes and wheat lines for grain protein indicating that regardless of wheat lines, the degree of response for each of the lines followed the degree of change of protein with water regimes (Figure 2). For this year, the lowest protein attained was with rainfed and with final irrigation applied at flower (100ETF) and other irrigated treatments had higher protein (Figure 2). It was also consistent that the lines with the Gpc-B1 gene (responsible for high protein), had higher protein relative to their respective counterpart line with no Gpc-B1 (Figure 2B). For the tillering alleles, despite the insignificant yield differences between the tillering alleles, the better yielding (numerically) high tiller allele had a depressed protein compared with the low-tiller allele.

Table 1. Agronomic management information

Soil Type: Flathead Fine Sandy Loam	Seed treatment: Cruiser Maxx Vibrance
Planted / Emerged: May 1st / May 10th	Herbicide @4-leaf: Huskie
Target plants: 25/ft^2	Fungicide @ Flag leaf: Tilt
Water treatments: Rainfed check = 3.0 in	Nutrient applied: K_2O = 33 lbs/A (KCl)
50ET = +3.5 in 100ET.FL = +3.0 in	P_2O_5 = 84 lbs/A (MAP)
75ET = +5.25 in 100ET.M = +5.0 in	N = 117 lbs/A (Urea 46-0-0)
100ET = +7.0 in	Harvested: Aug 11th

Footnote: ET, evapotranspiration; KCl, potassium chloride; MAP, monoammonium phosphate
FL: FLWR (based on 100ET, but with final irrigation applied at FLWR)
M: Milk stage (based on 100ET, but with final irigation appliedat milk stage)

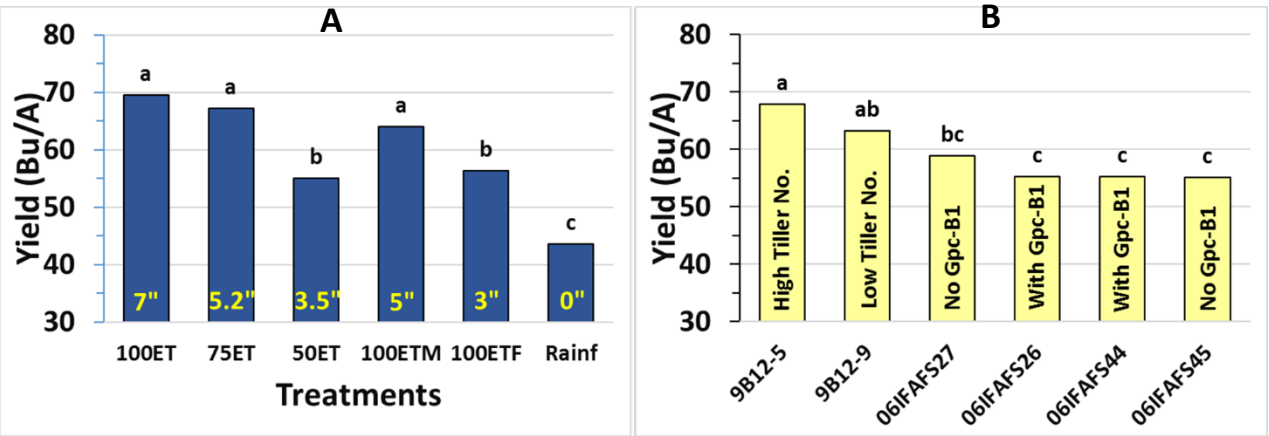


Figure 1. Yield of irrigation treatments (A), and the respective spring wheat lines (B). Same letter assignment denotes nonsignificance at α=0.05. Total irrigation amounts for each treatment are provided for each of the treatment means.

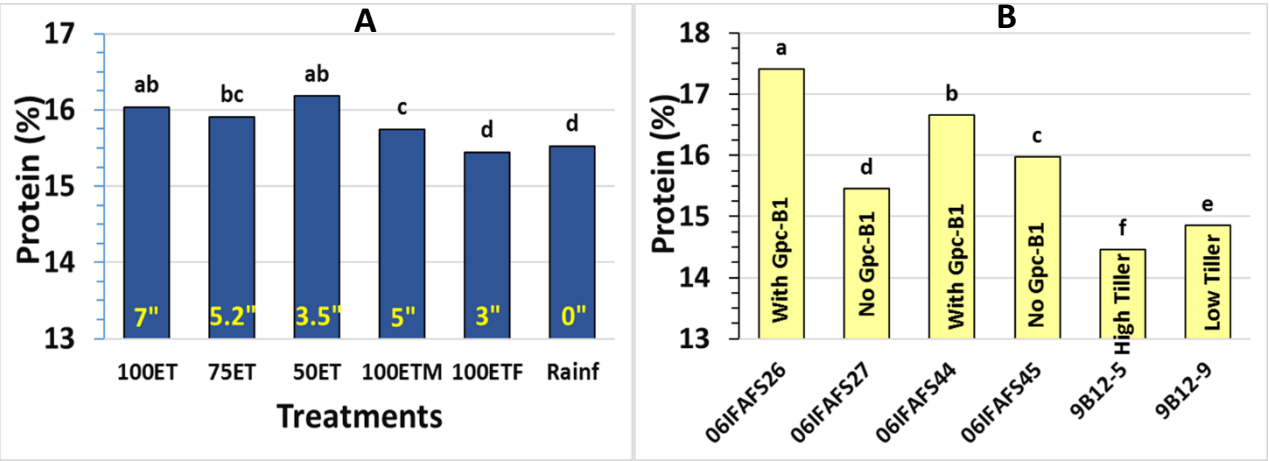


Figure 2. Grain protein of irrigation treatments (A), and the respective wheat lines (B). Same letter assignment denotes nonsignificance at α=0.05. Total irrigation amounts for each treatment are provided for each of the treatment means.

Project Title: Managing water and nitrogen of Egan spring wheat – 2017

Objective: To assess optimal nitrogen and water requirement of Egan

Personnel: J.Torrion, B. Bicego, and A. Sapkota

Methods:

Egan spring wheat was grown under four nitrogen levels and four irrigation levels as a strip-split plot with four replications, where irrigation levels represent a vertical strip plot factor, and nitrogen as a horizontal strip factor. Irrigation treatments included 50 percent evapotranspiration (ET), 75ET, 100ET, and a rainfed check. The soil had a residual N of 33 lbs N/ A. The resulting total N for the treatments were 40 (check), 150, 200, and 250 total lb of N per acre. For simplicity, treatments are referred to as Total N and not an added N. Agronomic management and the total water applied to the irrigated treatments are in Table 1.

Summary:

This year was a drought year with only 3 inches precipitation received from planting to harvest. The maximum yield response of Egan was with 100 evapotranspiration, 100ET (6 inches total irrigation). There was a yield reduction when deficit irrigation was followed (Figure 1). Possibly, this variety is much more suitable to a well-watered condition. It is because Egan was able to maintain high protein with increasing yield via irrigation for as long as 150 total N/A is available. At this N level, it showed a slight decrease in protein (Figure 1) at 100ET, but such decline remained greater than 16% protein. With the N adjusted gross income (data not shown), for this year, it seems that one can further reduce N input particularly during a drought year (lower than 150 lbs/A). For instance, under rainfed treatment, yield was not increased with increased N application and yield became more responsive to N, up to 150 lbs/A, as water supplementation was increased (Figure 1). This year, irrigation increases adjusted income (Figure 2), but the three irrigated treatments (50ET, 75ET, and 100ET) are statistically insignificant. Falling number is not presented in this report because it is not a concern for Egan variety. Egan has high falling number regardless of management and environment.

Table 1. Agronomic management information

Soil Type: Flathead Fine Sandy Loam	Seed treatment: Cruiser Maxx Vibrance
Planted / Emerged : May 3rd / May 10th	Herbicide @4-leaf: Huskie
Target plants: 25/ft^2	Fungicide @ Flag leaf: Tilt
Water treatments: Rainfed check = 3 in 50ET = +3 in 75ET = +4.5 in 100ET= +6 in	Nutrient applied: K_2O = 33 lbs/A (KCl) P_2O_5 = 84 lbs/A (MAP)
	Harvested: Aug 11th

Footnote: ET, evapotranspiration; KCl, potassium chloride; MAP, monoammonium phosphate

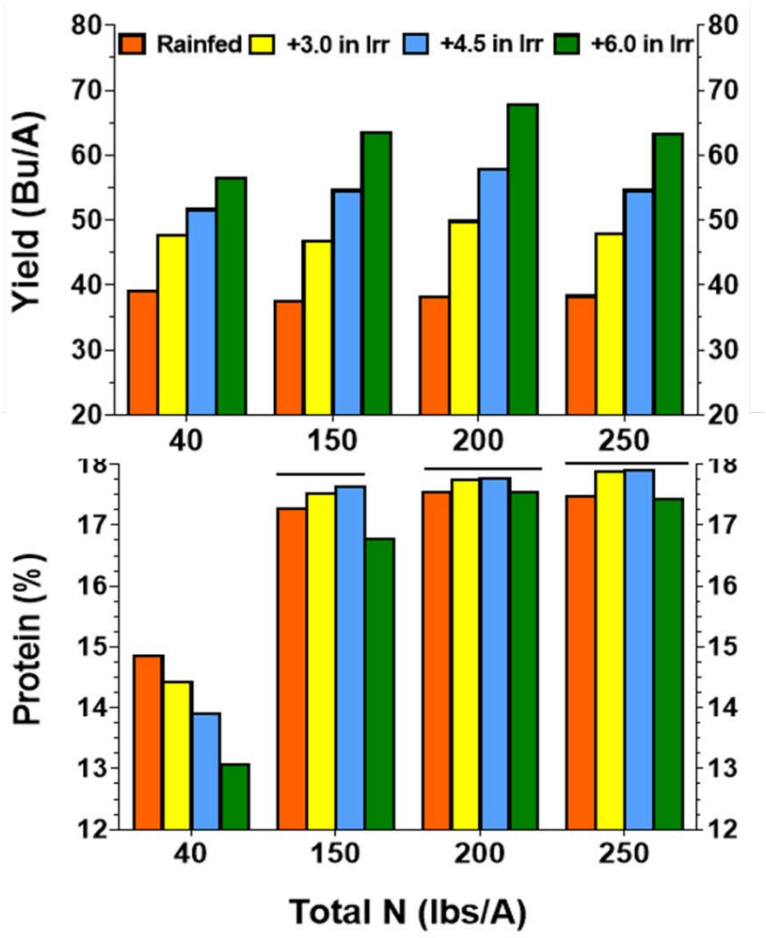


Figure 1. Yield (top) and protein (bottom) of water regime treatments when subject to various nitrogen levels. Line over the bars is nonsignificance at α =0.05.

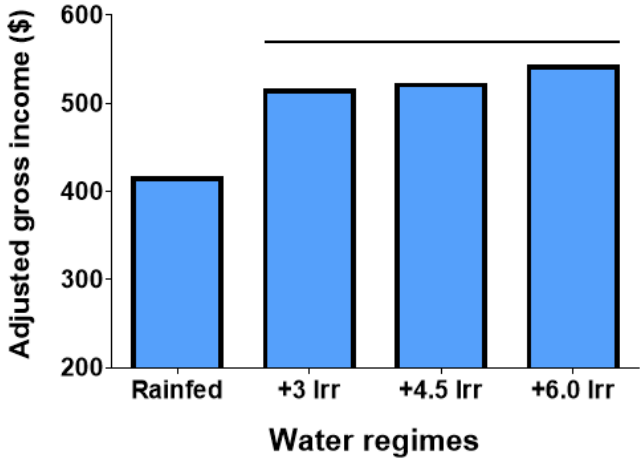


Figure 2. Adjusted gross income with irrigation.

Project Title:	Evaluation of Yield and Protein of Hard Red Spring Wheat Under Irrigated and Dryland Condition – 2017
Objective:	To evaluate nitrogen use response of hard red spring wheat varieties on yield and quality
Personnel:	B. Bicego., L. Talbert, B. Stougaard, A. Sapkota and J. Torrion

Methods:

The experiment was conducted to determine the optimal nitrogen (N) requirement of four hard red spring wheat varieties (Egan, McNeal, Solano, and Vida) under irrigated and dryland conditions. The unfertilized check treatment had 40 lbs total N per acre based on spring soil sampling, and the fertilized treatments remained the same as 2016 experiment (138, 178, 218 and 258 lbs/A of total N). Urea (46-0-0) was used as N source and applied using a 20-foot boom fertilizer spreader. The fertilizer was mixed into the soil and culti-packed before planting. The dryland environment received 3 inches of rain, and the irrigated environment received an additional 6.6 inches of water. Other management information is presented in Table 1.

Summary:

The N productivity (aka NUE) of irrigated environment diminishes as N increases (Fig. 1A). The irrigated maximum yield response was achieved at 138 lbs/A total N (Fig. 1B). Maximum protein was achieved by this N amount as well (Table 2) regardless of environment. Vida, under the irrigated condition, was the highest yielding variety, but with the lowest protein content. Regardless of the environment, there was no difference in yield between Egan, McNeal, and Solano. Egan had the highest protein content whereas both McNeal and Vida had the lowest grain protein across environments. McNeal and Egan consistently had a high falling number (FN) whereas Solano and Vida had inferior FN across environments. On the other hand, Solano and Vida consistently had high test weight compared to McNeal and Egan across environment (Table 2).

Under the rainfed condition, no N yield response was observed (Table 2). This indicates that one can further reduce N input under dryland production during drought relative to the irrigated environment.

Regarding adjusted gross income, the maximum gross income for the irrigated environment (Figure 1) was consistent with the maximum yield and protein at 138 lbs/A total N (Table 2). For the rainfed environment, further reduction of N input (i.e., lower than 138 lbs/A) is possible based on the no-yield response (Table 2) as well as the adjusted gross income (Figure 2). Egan,

Solano, and McNeal were equivalent (Table 2). Vida had the highest gross income despite its low grain protein (Table 2) regardless of environment (Figure 3).

Table 1. Agronomic management information

Soil Type: Flathead Fine Sandy Loam	Seed treatment: Cruiser Maxx Vibrance
Planted / Emerged: May 1st / May 11th	Applied herbicide @4-leaf: Huskie
Target plants: 25/ft^2	Fungicide @ Flag leaf: Tilt
Total Water: 3 in (Rain) + 6.6 in (Irrigation)	Nutrient applied: K_2O = 33 lbs/A (KCl)
Harvested: Aug 16th and 17th	P_2O_5 = 84 lbs/A (MAP)

Table 2. Means of the respective varieties, nitrogen treatments, and environment

Variety	HT in		YLD bu/A		PRO %		FN sec		TWT lb/bu	
	Irr	Dry	Irr	Dry	Irr	Dry	Irr	Dry	Irr	Dry
40 lbs/A Total Nitrogen (No added fertilizer)										
Egan	67.0	68.0	75.5	59.2	13.7	15.1	470.8	475.3	60.6	57.9
McNeal	70.6	70.5	75.8	64.6	12.1	13.4	498.3	498.0	60.5	58.0
Solano	57.1	59.2	75.7	62.0	13.7	13.5	399.5	405.0	62.3	60.1
Vida	70.1	70.0	90.7	76.1	12.2	12.4	367.8	385.0	62.1	60.8
138 lbs/A Total Nitrogen										
Egan	65.9	66.5	78.0	58.1	17.1	17.0	515.8	473.3	59.8	58.3
McNeal	70.8	66.7	84.3	56.0	15.3	15.1	546.3	507.8	60.4	58.0
Solano	56.9	59.0	83.0	58.3	15.5	15.3	398.3	404.0	61.8	59.8
Vida	68.8	68.3	104.5	68.7	15.1	14.8	369.0	380.3	61.5	60.1
178 lbs/A Total Nitrogen										
Egan	64.6	65.3	73.6	61.6	17.4	17.1	461.5	480.5	59.7	58.2
McNeal	64.8	68.2	82.3	60.4	15.5	15.3	511.3	500.8	60.3	58.1
Solano	56.9	57.5	79.1	61.2	16.1	15.5	386.3	407.3	61.9	59.9
Vida	67.9	67.6	99.6	67.1	15.4	14.7	348.8	366.0	61.6	59.6
218 lbs/A Total Nitrogen										
Egan	66.2	68.1	74.7	62.3	17.3	17.1	488.5	484.8	59.4	58.2
McNeal	69.4	67.5	85.5	61.3	15.5	15.5	501.3	488.3	60.5	58.3
Solano	57.1	59.6	76.5	58.8	15.8	15.7	402.3	402.0	61.3	59.6
Vida	72.1	70.3	97.0	76.9	15.1	14.8	367.8	385.8	61.5	60.0
258 lbs/A Total Nitrogen										
Egan	66.9	66.6	83.8	52.9	17.3	17.4	471.3	480.5	59.9	57.2
McNeal	69.8	69.5	84.5	54.3	15.8	15.8	479.0	481.8	60.8	57.6
Solano	57.6	57.6	81.8	55.8	16.0	15.9	392.8	421.8	61.8	59.7
Vida	68.85	69.6	99.2	69.8	15.3	14.9	340.8	371.8	61.4	60.0
$PR>F_{(0.05)}$ - N	0.0601		0.9576		<0.0001		0.2051		0.032	
$PR>F_{(0.05)}$ - E	0.8208		0.0048		0.6213		0.6994		<0.0001	
$PR>F_{(0.05)}$ – N x E	0.903		0.0385		0.0087		0.3327		0.1431	

HT: Height, YLD: Yield, PRO: Protein, FN: Falling Numbers, TWT: Test Weight.

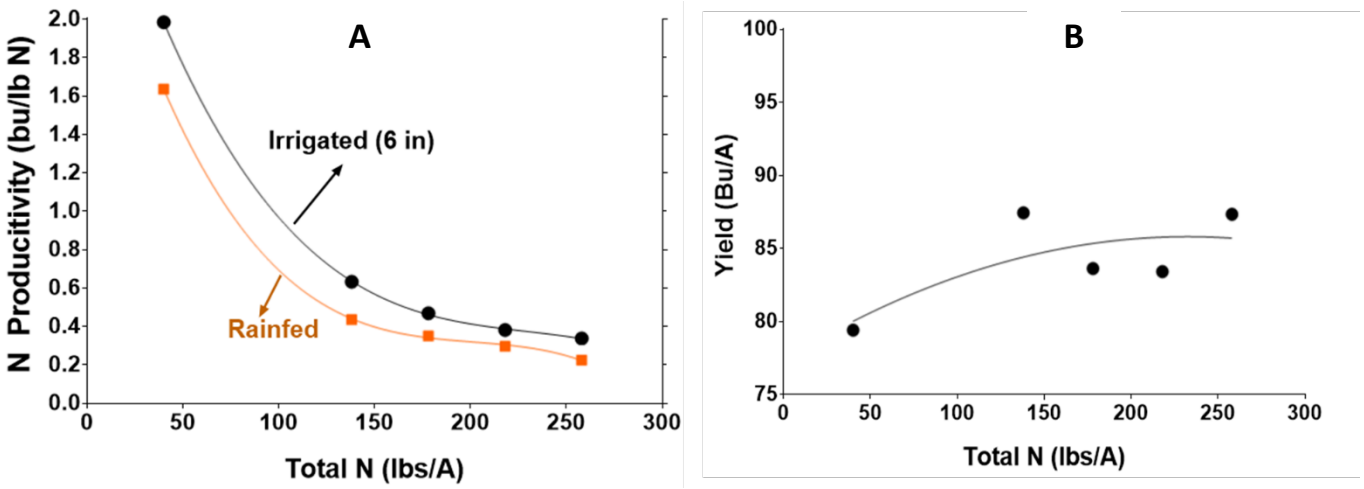


Figure 1. Nitrogen (N) productivity of irrigated and rainfed hard red spring wheat (A), and N response curve of the irrigated environment (B).

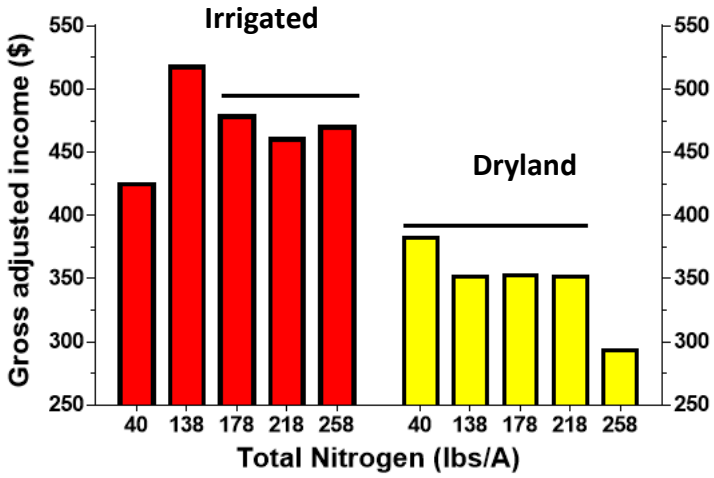
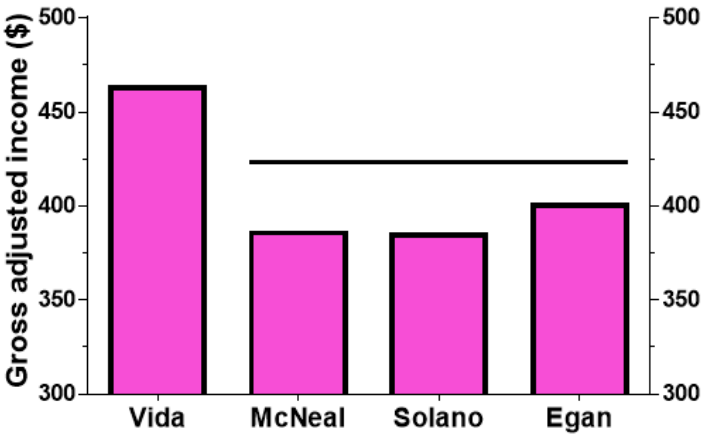


Figure 2. Adjusted gross income of applied additional N from the reference check 40 lbs/N. Lines on top of the bar charts indicate equivalency of the N treatments.

Figure 3. Adjusted gross income of when choosing varieties. Lines on top of the bar charts indicate equivalency of the varieties.



Project Title:	Evaluation of Yield and Protein of Soft White Spring Wheat Under Irrigated and Dryland Condition – 2017
Objective:	To evaluate nitrogen use response of soft white spring wheat varieties on yield and quality
Personnel:	B. Bicego., L. Talbert, B. Stougaard, A. Sapkota and J. Torrion

Methods:

The experiment was conducted to determine the optimal nitrogen (N) requirement of four soft white spring wheat varieties (Alpowa, Alturas, Penewawa, and UI-Stone) under irrigated and dryland conditions. The unfertilized check treatment had 40 lbs total N per acre based on spring soil sampling and the fertilized treatments remained the same as 2016 experiment (138, 178, 218 and 258 lbs/A of total N). Urea (46-0-0) was used as N source and applied using a 20-foot boom fertilizer spreader. The fertilizer was mixed into the soil and culti-packed before planting. The dryland environment received 3 inches of rain, and the irrigated environment received an additional 6.6 inches of water. Other management information is presented in Table 1.

Summary:

In 2017, UI-Stone and Alturas had higher yields compared with Alpowa and Penewawa under irrigated condition (Table 2, Figure 1). UI-Stone consistently had the lowest protein content which is advantageous for this market class. Dryland environment resulted in lower yields compared to the irrigated, and no significant difference was observed between UI-Stone, Alturas, and Alpowa. Higher protein contents were observed in dryland conditions. For both environments, no increase in protein was observed after applying more than 138 lbs/A of N. Ideally, 8.5 to 10.5% protein is recommended. Therefore, there is an opportunity for reduction of N input for this market class regardless of environment. Alpowa consistently had the highest falling number (FN) across environments whereas Alturas consistently had the lowest FN. Nevertheless, none of them was lower than 300 seconds (Table 2), but we suspect that further lowering of FN in Alturas is expected during wet and cold August months.

In general, dryland environment had lower adjusted gross income compared to the irrigated. Year 2017 was a hot and drought year (Table 1). UI-Stone was the most profitable variety in both environments, but in dryland, it was not significantly different than Alturas and Alpowa (Figure 1). The N treatment did not affect yield and applying 138 lbs/A of nitrogen increased the protein content to a higher level than the industry requirement resulting in price discounts. Thus, further reduction of N lower than the 138 lbs/A guarantees better gross adjusted income (Figure 2).

Table 1. Agronomic management information

Soil Type: Flathead Fine Sandy Loam	Seed treatment: Cruiser Maxx Vibrance
Planted / Emerged: May 1st / May 11th	Applied herbicide @4-leaf: Huskie
Target plants: 25/ft^2	Fungicide @ Flag leaf: Tilt
Total Water: 3 in (Rain) + 6.6 in (Irrigation)	Nutrient applied: K_2O = 33 lbs/A (KCl)
Harvested: Aug 16th and 17th	P_2O_5 = 84 lbs/A (MAP)

Table 2. Means of the respective varieties, nitrogen treatments, and environment

Variety	HT in		YLD bu/A		PRO %		FN sec		TWT lb/bu	
	Irr	Dry	Irr	Dry	Irr	Dry	Irr	Dry	Irr	Dry
40 lbs/A Total Nitrogen (No added fertilizer)										
Alpowa	64.9	68.7	88.7	70.1	10.0	11.4	376.75	405.5	62.6	60.0
Alturas	63.8	67.9	102.0	67.8	10.1	11.0	301.8	310.3	62.0	59.1
Penewawa	66.0	66.2	90.8	67.2	10.0	11.3	351.3	355.3	62.4	59.7
UI-Stone	64.7	67.6	101.1	76.3	9.6	11.3	315.0	374.3	62.1	60.4
138 lbs/A Total Nitrogen										
Alpowa	65.2	67.3	97.2	65.9	12.3	12.7	424.0	410.3	62.7	60.2
Alturas	67.2	66.0	108.7	66.2	11.5	12.3	315.3	317.8	62.5	59.8
Penewawa	67.0	64.5	95.8	58.3	12.6	12.7	376.0	357.0	62.5	59.3
UI-Stone	66.5	65.3	116.0	67.0	11.3	12.7	358.0	378.0	62.6	59.9
178 lbs/A Total Nitrogen										
Alpowa	66.6	67.7	89.5	67.4	12.7	12.5	417.0	408.0	62.6	60.5
Alturas	65.35	64.8	102.6	65.0	12.0	12.4	302.0	320.3	62.9	60.0
Penewawa	65.4	66.2	87.1	66.4	12.7	12.6	339.3	335.5	62.0	60.2
UI-Stone	64.6	96.1	101.4	68.1	11.5	12.8	343.8	375.5	62.8	60.2
218 lbs/A Total Nitrogen										
Alpowa	67.5	67.4	96.8	65.6	12.4	12.9	400.5	417.0	62.4	60.1
Alturas	66.6	68.5	104.1	70.4	11.7	12.5	303.3	333.0	62.7	59.7
Penewawa	65.7	67.4	93.1	65.4	12.8	13.0	347.0	357.0	62.3	59.2
UI-Stone	66.4	65.5	106.3	73.0	11.6	12.5	345.5	393.3	63.0	60.8
258 lbs/A Total Nitrogen										
Alpowa	64.3	66.3	90.2	67.1	12.7	12.9	379.0	401.0	62.5	60.1
Alturas	66.3	67.3	109.4	68.2	11.6	12.5	304.8	331.5	62.7	60.3
Penewawa	67.3	64.2	91.7	58.0	12.8	13.2	368.5	332.8	62.0	59.4
UI-Stone	63.8	65.4	107.6	68.1	11.6	13.1	331.8	360.5	63.0	60.1
PR>F $_{(0.05)}$ - N	0.4381		0.7169		<0.0001		0.2196		0.2613	
PR>F $_{(0.05)}$ - E	0.3527		0.0016		0.0029		0.2315		<0.0001	
PR>F $_{(0.05)}$ – N x E	0.3262		0.1134		0.0094		0.4437		0.734	

HT: Height, YLD: Yield, PRO: Protein, FN: Falling Numbers, TWT: Test Weight.

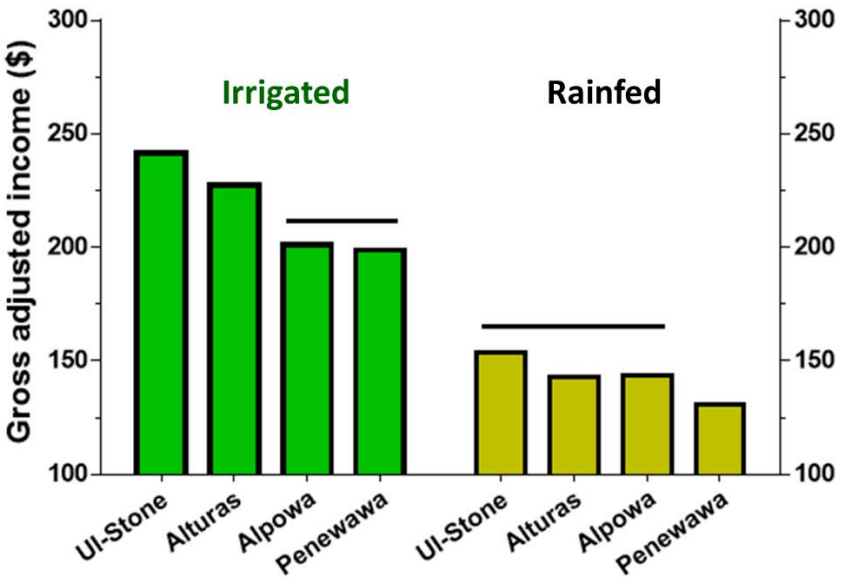


Figure 1. Adjusted gross income by variety. Lines on top of the bar charts indicate equivalency of the N treatments.

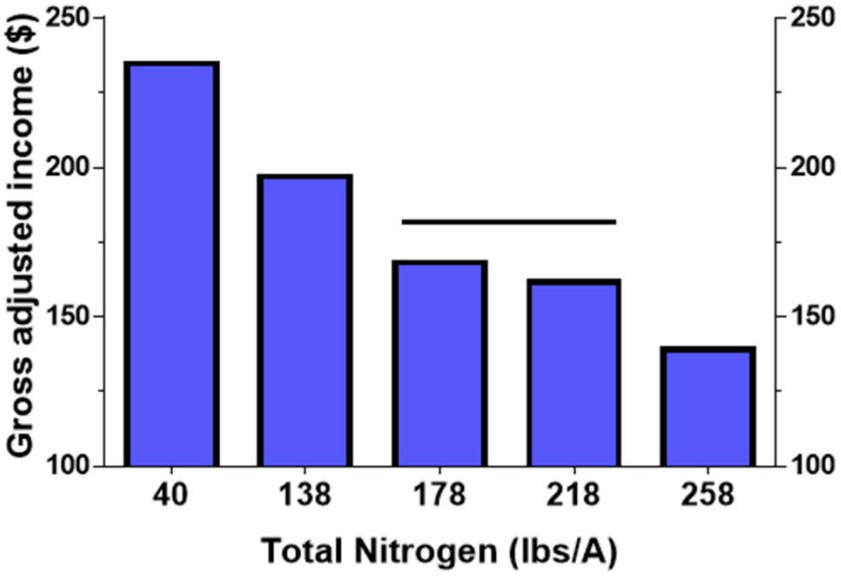


Figure 2. Adjusted gross income of applied additional N from the reference check 40 lbs/N. Lines on top of the bar charts indicate equivalency of the varieties.

Title: Spring Wheat Off-Station Trial – 2017

Personnel: Bob Stougaard, NWARC, Kalispell
Luther Talbert, Nancy Blake, Hwa Young Heo, PSPP, Bozeman

Objective: To evaluate spring wheat varieties and experimental lines for agronomic performance in environments and cropping systems representative of northwestern Montana.

Results:

This nursery was established to evaluate spring wheat varieties for yield and agronomic performance in the absence of fungicide or insecticide inputs. This year, rainfall was largely absent as well. This resulted in a shorter crop, with plant height averaging 21 inches. Fortuna was the tallest variety at 26 inches, and MT1525 was the shortest, at 19 inches. Heading spanned 8 days, with MT1570 being the earliest variety at 171 days, and NS Presser CL the latest at 179.3 days. NS Presser CL also was the highest yielding variety, producing 46.7 bu/A, whereas Brennan was the lowest yielding variety, at 25 bu/A. There were no differences among varieties for either protein or test weight. Protein averaged 14.87 % while test weight averaged 59.4 lb/bu.

Summary:

Spring wheat yields were fifty percent of the normal long term average, with NS Presser CL, LCS Pro, Vida, WB Gunnison, Alum and Lanning being the top performers.

Table 1. Materials and Methods.

Seeding Date:	5/4/2017	Harvest Date:	8/9/2017
Julian Date:	124	Julian Date:	229
Seeding Rate:	80 lb/A	Soil Type:	Kalispell vfsl
Previous Crop:	peas	Soil Test:	29-16-156
Tillage:	Conventional	Fertilizer:	150-30-30
Herbicide: Huskie 11 oz & Axial 16.4 oz			

Table 2. Agronomic data from spring wheat varieties, Kalispell, MT -2017.

Variety	Heading Julian	Height inch	Yield bu/A	Protein %	TWT lb/bu
NS Presser CL+	179.3	21.3	46.7	14.92	59.5
LCS Pro	174.0	23.0	45.2	14.80	60.3
Vida	176.3	20.5	41.7	15.20	59.7
WB Gunnison	173.0	20.8	41.3	14.58	59.4
Alum	174.7	22.7	41.0	14.20	59.2
Lanning	176.3	20.2	40.3	14.87	59.3
Oneal	177.0	21.6	36.9	15.18	60.2
MT 1525	173.0	19.0	36.9	15.09	58.8
Reeder	177.7	19.7	35.9	14.31	59.3
WB9879CLP	176.0	21.8	35.9	14.90	60.1
Duclair	171.3	22.2	35.4	14.26	59.9
SY Ingmar	173.3	21.0	35.4	15.54	57.8
MT 1543	171.7	20.9	34.1	15.23	60.2
Choteau	173.0	19.4	32.9	14.48	60.3
MT 1570	171.3	20.0	32.3	15.33	58.7
Egan	178.0	21.5	32.1	15.48	58.1
Fortuna	173.3	26.1	30.0	14.33	59.1
SY Soren	173.3	20.6	28.3	15.13	59.1
Corbin	172.0	20.7	28.0	14.89	59.3
Brennan	171.7	19.2	25.3	14.65	59.6
Mean	**174.3**	**21.1**	**35.8**	**14.87**	**59.4**
LSD P=.05	1.364	2.379	9.68	ns	ns
CV	0.47	6.82	16.38	5.19	1.98
Pr>F	0.0001	0.0003	0.0030	0.6396	0.4413

TWT: test weight, ns: nonsignificant.

Title: Spring Wheat Varietal Blend Study - 2017

Objective: To determine if agronomic difference exist among mixtures of Egan spring wheat with other varieties.

Results:

Egan was planted as a 9:1 blend with other spring wheat varieties to attain a target population of 24 plants per square foot. Stand densities were recorded on May 30. The established population was slightly lower than the target, averaging 19 plants per square foot. However, all varietal combinations had similar stand densities. High temperatures and drought conditions characterized the growing season. As a result, yields were about one-quarter of the normal long term average for this area. There were no differences noted among the variety blends for any measured variable. While the refuge system helps delay the development of resistance to the Sm1 gene, these results indicate that the varietal choice for a 9:1 blend is of little consequence with respect to agronomic performance.

Summary:

All treatments performed similarly, regardless of the varietal combination.

Table 1. Materials and Methods.

Seeding Date:	5/4/2017	Harvest Date:	8/7/2017
Julian Date:	124	Julian Date:	219
Seeding Rate:	80 lb/A	Soil Type:	Creston SiL
Previous Crop:	peas	Soil Test:	29-16-156
Tillage:	Conventional	Fertilizer:	150-30-30

Table 2. Agronomic performance of Egan blends. Kalispell, MT. 2017

Treatment	Plants per sqft	Heading Julian	Height inches	Yield bu/A	Protein %	TWT lb/bu	TKW g
Egan	19.7	176.3	20.6	23.2	16.73	56.6	30.6
Egan + Soren	17.9	177.0	20.9	25.3	16.66	56.8	29.6
Egan + Tyra	18.1	175.7	19.8	23.1	16.64	57.0	30.1
Egan + Vida	22.4	176.3	20.4	25.7	16.54	56.8	29.9
Egan + Expresso	21.0	177.7	19.6	23.4	16.49	56.8	29.7
Egan + Solano	18.3	177.7	20.4	22.8	16.75	56.8	30.1
Egan + Cabernet	18.5	176.7	20.0	21.5	16.71	56.8	29.5
Egan + WB9518	18.5	177.3	19.3	21.6	16.74	56.8	29.7
mean	19.3	176.8	20.1	23.3	16.66	56.8	29.9
LSD P=0.05	ns	ns	ns	ns	ns	ns	ns
Pr>F	0.5509	0.0891	0.9127	0.8383	0.7928	0.6397	0.6310

TWT: Test weight, TKW: 1000 kernel weight.

Title: Evaluation of spring wheat near isogenic lines (NILs) for tiller production and grain protein

Objective: To generate preliminary agronomic performance data on NILs with improved competitive traits

Results:

The 2017 growing season was characterized by high temperatures and low rainfall, which restricts the interpretation of this non-replicated trial. Within the tiller lines yields ranged from 38.21 for tiller 20 to 49.62 for tiller 15. Protein varied from a low of 14.4 for tiller 2 to a high of 16.39 for tiller 19. Test weights ranged from a high of 59.9 for tiller 15 and tiller 20 to a low of 57.2 for tiller 1. Thousand kernel weights ranged from a high of 39.3 for tiller 19 to a low of 30.2 for tiller 16. Falling numbers were high and varied from 511 for tiller 1 to 438 for tiller 16.

Within the protein lines, yields ranged from 26.5 for HGPC 14 to 39.98 for HGPC 4. Protein varied from a low of 13.83 for HGPC 13 to a high of 16.98 for HGPC 5. In contrast, test weights ranged from a low of 54.7 for HGPC 5 to a high of 60.2 for HGPC 13. Thousand kernel weight ranged from a low of 26.4 for HGPC 11 to a high of 36.1 for HGPC 3. Falling numbers ranged from a low of 383 for HGPC 5 to a high of 543 for HGPC 7.

Table 1. Agronomic performance of spring wheat NILs, Kalispell 2017

NIL		YLD	PRO	TWT	TKW	FN
		bu/A	%	lb/bu	g	sec
tiller 1	2	42.37	14.64	57.2	37.4	511
tiller 2	1	38.38	14.50	58.6	38.7	473
tiller 15	2	49.62	14.46	59.9	31.9	465
tiller 16	1	43.94	14.86	59.4	30.2	438
tiller 19	2	38.30	16.39	58.1	39.3	460
tiller 20	1	38.21	16.02	59.9	37.9	489
HGPC 1	Y	28.22	16.09	59.5	30.7	408
HGPC 2	N	32.65	16.20	59.1	30.4	404
HGPC 3	Y	34.80	14.79	57.2	36.1	481
HGPC 4	N	39.98	15.87	55.1	30.8	427
HGPC 5	Y	33.51	16.98	54.7	27.1	383
HGPC 6	N	37.63	15.12	56.5	30.0	486
HGPC 7	Y	37.18	15.48	56.6	32.4	543
HGPC 8	N	30.57	15.17	59.2	32.2	471
HGPC 9	Y	35.21	15.66	57.9	27.3	428
HGPC 10	N	32.26	14.68	59.7	30.4	428
HGPC 11	Y	36.88	15.83	57.3	26.4	423
HGPC 12	N	32.04	15.58	57.5	30.2	418
HGPC 13	N	33.27	13.83	60.2	29.7	428
HGPC 14	Y	26.51	15.34	59.4	27.7	416
HGPC 15	N	38.51	14.08	59.7	29.7	425
HGPC 16	Y	31.26	15.14	60.0	28.8	452
Mean		**35.97**	**15.30**	**58.3**	**31.6**	**448**

YLD: yield, PRO: protein, TWT: test weight, TKW: thousand kernel weight
FN: falling number

Title: Evaluation of Advanced Spring Wheat Experimental Lines -2017

Objective: To evaluate spring wheat varieties and experimental lines for agronomic performance in environments and cropping systems representative of northwestern Montana.

Results:

High temperatures and low rainfall reduced crop height, which averaged only 24 inches. Height ranged from 32.9 inches for Thatcher to a low of 21.3 inches for SY Tyra. Heading spanned 9 days with an average of 174 days. MT 1659 was the earliest at 170.3 days and WB 172 was the latest at 179.3 days. Days to physiological maturity spanned 4 days, with the average being 202.1 days (July 21). High temperatures and low rainfall also depressed yields, which only averaged 55 bu/A. Yields range from a high of 67.8 bu/A for MT 1601 to a low of 45 bu/A for Choteau. At the same time, protein was high and averaged 14.9 %, ranging from a high of 16.68 % for Egan to a low of 13.6 % for WF 162. Test weights averaged 58.8 lb/bu, with WB 173 having the heaviest grain at 61.7 lb/bu and Egan the lightest at 55.6 lb/bu. Seed size varied substantially among the entries, ranging from 42.6 g for MT 1653 to 29.1 g for Thatcher.

Summary:

MT 1601 was the top performer this year producing 67.8 bu/A, 14.86 % protein and a test weight of 59.4 ln/bu.

Table 1. Materials and Methods.

Seeding Date:	5/3/2017	Harvest Date:	8/15/2017
Julian Date:	123	Julian Date:	227
Seeding Rate:	80 lb/A	Soil Type:	Creston SiL
Previous Crop:	peas	Soil Test:	29-16-156
Tillage:	Conventional	Fertilizer:	150-30-30

Table 2. Agronomic data from advanced spring wheat lines, Kalispell MT. 2017

Cultivar	HD Julian	HT inch	PM Julian	YLD bu/A	PRO %	TWT lb/bu	TKW g
MT 1601	171.3	23.4	201.7	67.8	14.86	59.4	37.0
MT 1320	174.0	26.8	204.3	66.9	14.54	59.7	36.4
MT 1621	171.7	24.0	201.7	64.7	14.80	59.1	36.9
MT 1401	172.0	24.0	201.7	64.0	14.08	61.0	33.7
WF 162	176.0	22.0	201.7	63.9	13.60	57.7	33.0
MT 1653	176.0	25.5	205.0	62.3	14.37	59.2	42.6
SY Soren	173.0	24.5	202.3	61.3	15.23	59.3	32.3
NS Presse	179.0	25.1	204.3	60.6	14.89	56.6	32.6
MT 1624	171.3	23.1	201.7	60.3	14.89	58.7	34.4
Vida	177.3	25.1	204.3	60.2	14.53	57.7	32.1
WB 171	172.0	22.7	202.3	59.5	15.27	58.5	36.6
MT 1651	174.3	24.0	202.7	59.4	15.12	60.0	37.5
LIMAGR 17	172.7	25.5	202.7	59.3	14.80	59.9	34.6
MT 1625	172.0	25.7	201.7	59.1	14.95	58.8	33.6
MT 1451	173.7	23.5	203.0	59.0	14.13	59.4	39.6
Lanning	175.3	23.0	203.3	58.8	15.23	56.9	36.2
MT 1666	176.3	24.6	203.0	58.7	15.30	58.5	42.1
MT 1664	171.7	23.3	202.0	58.3	14.81	59.6	37.5
AGRIPR 16	176.0	23.3	201.3	58.0	14.84	58.0	35.4
MT 1348	172.3	23.9	201.7	57.9	14.65	59.1	36.9
WB 172	179.3	22.7	204.3	57.9	16.11	58.5	36.0
MT 1619	171.3	22.3	201.7	57.8	15.45	59.1	29.3
WB 173	176.0	22.2	203.3	57.0	14.43	61.7	36.3
Corbin	171.3	23.9	201.7	56.9	14.66	60.1	41.1
MT 1570	171.3	21.9	201.3	56.4	13.96	59.3	34.7
WB Gunni	174.3	22.3	202.0	56.2	13.80	59.3	38.6
SY Tyra	173.3	21.3	202.7	56.0	14.57	61.2	38.0
MT 1455	172.0	22.7	201.0	56.0	14.65	58.8	34.9
SY Ingmar	172.3	23.7	201.0	56.0	15.11	60.3	33.8
MT 1542	172.0	23.9	201.0	55.8	14.56	59.4	34.6
MT 1607	171.3	25.2	201.0	55.0	14.74	59.2	36.5
Reeder	178.7	23.5	204.3	54.9	15.18	58.0	32.1
Mean	173.9	24.0	202.1	55.6	14.91	58.8	35.1
LSD P=.05	1.82	2.29	1.43	8.68	0.58	1.47	3.96
CV	0.65	5.93	0.44	9.67	2.41	1.55	6.97
Pr>F	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

HD: heading date, HT: height, PM: physiological maturity, YLD: yield, PRO: protein
TWT: test weight, TKW: thousand kernel weight

Table 2. continued

Cultivar	HD Julian	HT inch	PM Julian	YLD bu/A	PRO %	TWT lb/bu	TKW g
Duclair	171.0	23.1	201.0	54.8	13.80	58.2	35.4
MT 1525	174.3	21.9	202.3	54.5	14.77	61.5	35.4
WF 161	173.3	23.4	202.7	54.5	15.12	58.8	35.9
MT 1543	172.0	23.4	201.7	54.4	14.77	58.4	40.6
MT 1659	170.3	23.1	201.7	54.4	14.45	59.8	32.2
SY Valda	172.3	23.5	202.0	54.3	14.04	58.9	31.5
MT 1512	172.7	25.1	201.0	54.2	14.57	59.1	38.3
MT 1627	172.7	26.1	201.0	54.2	15.18	60.1	33.0
LCS Pro	175.3	26.4	201.3	53.9	14.90	57.4	35.2
MT 1630	171.7	23.5	201.0	53.8	15.24	58.6	35.0
MT 1668	171.0	21.7	201.0	53.5	15.53	59.0	39.9
Alum	175.3	25.1	203.0	53.3	14.87	58.9	38.9
MT 1509	177.0	23.2	204.0	53.3	14.77	59.2	37.6
MT 1622	171.0	22.9	201.3	53.2	15.49	57.1	34.2
McNeal	178.0	24.5	203.3	53.1	15.05	56.5	35.1
MT 1672	173.7	23.3	201.7	52.4	15.40	58.0	35.6
MT 1617	175.3	23.6	202.0	52.1	14.62	58.0	30.6
MT 1442	173.3	24.1	202.7	52.0	14.82	59.6	36.4
WF 163	178.3	26.7	202.3	52.0	15.33	57.5	32.5
WB 9879CLP	174.7	23.9	201.0	51.9	15.24	58.7	31.2
MT 1643	172.0	23.4	201.3	51.8	15.50	59.1	31.2
MT 1635	175.0	23.0	201.7	50.9	15.74	57.9	32.5
MT 1673	172.3	23.5	201.0	50.6	15.45	56.4	31.7
Brennan	171.7	21.7	201.0	50.3	15.55	60.1	34.7
MT 1645	173.7	23.3	201.7	49.7	14.92	60.1	35.4
LCS Prime	173.3	24.0	201.0	49.7	14.01	59.1	33.9
Egan	177.3	23.7	201.0	49.0	16.68	55.6	30.9
MT 1636	174.7	23.1	201.7	48.9	15.47	59.2	29.9
Thatcher	178.0	32.9	202.7	48.6	15.35	57.0	29.1
Fortuna	174.7	30.6	201.7	48.6	14.81	59.3	40.3
MT 1514	177.3	23.5	202.7	47.3	15.66	56.4	36.4
Choteau	175.3	22.3	201.0	45.0	15.22	58.0	31.5
Mean	173.9	24.0	202.1	55.6	14.91	58.8	35.1
LSD P=.05	1.82	2.29	1.43	8.68	0.58	1.47	3.96
CV	0.65	5.93	0.44	9.67	2.41	1.55	6.97
Pr>F	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

HD: heading date, HT: height, PM: physiological maturity, YLD: yield, PRO: protein
TWT: test weight, TKW: thousand kernel weight

Title: Western Regional Hard Spring Wheat Nursery - 2017

Personnel: Bob Stougaard, NWARC, Kalispell

Objective: To evaluate experimental and commercially available hard spring wheat cultivars for agronomic performance in environments representative of northwestern Montana.

Results:

This nursery was established to evaluate hard red and hard white spring wheat varieties that are normally be targeted for use in the Pacific Northwest. This year's heat and drought resulted in a shorter crop, with plant height averaging 21 inches. WA 8259 was the tallest variety at 24 inches, and Patwin 515 was the shortest, at 17.1 inches. Heading spanned 7 days, with UI Platinum and IDO1604S being the earliest varieties at 170 days, and Patwin 515 the latest at 176.7 days. There were no statistical differences among varieties for yield. Numerically, WA 8282 was the highest yielding variety, producing 45.5 2 bu/A, whereas IDO1604S was the lowest yielding variety, at 28.1 bu/A. Egan had the highest protein at 16.11 %, and UI Platinum the lowest at 12.94 percent. Test weights were low, averaging 58.5 lb/bu. WA 8281 had the highest test weight at 60.8 lb/bu and Patwin 515HP the lowest at 54.9 lb/bu. Falling numbers were high and all entries avoided dockage this year Egan had the highest falling number at 524, while Patwin 515 had the lowest at 381 seconds.

Summary:

Statistical differences were detected for all response variables, except yield. The heat and drought resulted in shorter plants, low yields and test weights, and high proteins and falling numbers.

Table 1. Materials and Methods.

Seeding Date:	5/3/2017	Harvest Date:	8/11/2017
Julian Date:	123	Julian Date:	223
Seeding Rate:	85 lb/A	Soil Type:	Creston SiL
Previous Crop:	Peas	Soil Test:	29-16-156
Tillage:	Conventional	Fertilizer:	150-30-30

Table 2. Agronomic data from the Western Regional Hard Spring Wheat Nursery, Kalispell MT, 2017.

Cultivar	HD Julian	HT inches	YLD bu/A	PRO %	TWT lb/bu	FN sec
WA 8282	171.3	23.1	45.5	13.67	58.7	498.9
12SB0197	176.0	20.6	44.1	13.43	57.0	471.8
Vida	176.0	21.4	41.1	13.55	59.2	398.2
WA 8259	172.3	24.0	39.9	15.25	59.9	452.2
IDO1602S	171.0	21.9	39.1	13.65	59.6	519.0
WA 8281	172.0	23.5	38.5	13.89	60.8	480.0
Patwin-515HP	176.0	18.4	38.0	15.52	54.9	402.2
Glee	171.0	21.6	37.4	14.03	59.5	481.1
WB9518	175.7	20.1	37.3	15.06	58.4	424.0
UI Winchester	172.0	21.4	37.2	13.99	58.3	454.1
Jefferson	173.0	22.6	37.0	14.20	59.1	471.3
Egan	176.3	21.9	33.0	16.11	56.1	524.2
WA 8261	171.3	21.5	32.6	14.54	60.4	444.9
UI Platinum	170.0	18.8	32.3	12.94	59.3	488.0
Patwin 515	176.7	17.1	30.8	14.54	56.3	381.8
IDO1604S	170.0	19.0	28.1	13.08	58.5	429.4
Mean	**173.2**	**21.1**	**37.0**	**14.22**	**58.5**	**457.6**
LSD P=.05	2.01	2.31	12.63	0.51	0.74	75.75
CV	0.70	6.58	20.48	2.14	0.75	9.93
Pr>F	0.0001	0.0001	0.3580	0.0001	0.0001	0.0128

HD: heading date, HT: height, YLD: yield, PRO: protein, TWT: test weight, FN: falling number

Title: Western Regional Soft Spring Wheat Evaluation -2017

Personnel: Bob Stougaard, NWARC, Kalispell

Objective: To evaluate soft spring wheat varieties and experimental lines developed for the western US for agronomic performance in environments and cropping systems representative of northwestern Montana.

Results:

High temperatures and low rainfall reduced crop height, which averaged only 19.6 inches. Height ranged from 17.2 for IDO1403S to a high of 22.7 inches for Louise. Heading spanned 7 days with an average of 174 days (June 23). IDO1401S was the earliest at 170 days and Alpowa was the latest at 177.3 days. High temperatures and low rainfall also depressed yields, which only averaged 26.2 bu/A. Yields range from a high of 34.9 bu/A for WA8277 to a low of 20.8 bu/A for WB6121. Grain protein averaged 12.41 %, and ranged from a high of 13.17 for IDO1403S to a low of 11.44 % for Alturas planted at 80 lb/A. Test weights averaged 58.9 lb/bu, with WA8277 having the heaviest grain at 60.0 lb/bu and Louise the lightest at 57.2 lb/bu. Falling numbers were high, averaging 379.6 seconds. Alpowa had the highest falling number at 466.0, while the low seeding rate of Alturas had the lowest at 309.3 seconds.

Summary:

Drought and high temperatures depressed yield, which averaged 26.2 bu/A.

Table 1. Materials and Methods.

Seeding Date:	5/3/2017	Harvest Date:	8/11/2017
Julian Date:	123	Julian Date:	223
Seeding Rate:	85 lb/A	Soil Type:	Creston SiL
Previous Crop:	Peas	Soil Test:	29-16-156
Tillage:	Conventional	Fertilizer:	150-30-30

Table 2. Agronomic data from the Western Regional Soft Spring Wheat Nursery, Kalispell MT, 2017.

Cultivar	HD Julian	HT inches	YLD bu/A	PRO %	TWT lb/bu	FN sec
WA 8277	172.0	21.5	34.9	11.50	61.0	322.4
ARSDH09X122-9	176.0	20.6	30.5	13.05	59.9	345.2
14-FAC-2019	177.0	20.5	30.1	12.27	57.6	425.1
Louise	177.0	22.7	29.6	12.54	57.2	378.3
WA 8278	176.3	20.2	29.1	12.08	59.2	437.8
Treasure	176.7	19.3	28.7	12.12	58.6	426.0
Alpowa	177.3	18.9	27.8	12.97	59.1	466.0
IDO1405S	172.3	20.0	26.8	13.10	58.0	387.9
Alturas 160 lb/A	175.3	20.1	26.6	11.62	59.5	317.4
UI Stone	172.3	19.8	25.0	11.54	59.5	376.8
Alturas 80 lb/A	176.7	18.9	23.8	11.44	59.4	309.3
Penewawa 80 lb/A	174.0	19.3	23.0	12.75	58.5	353.2
IDO1401S	170.0	18.4	21.1	12.55	59.1	402.7
Penewawa 160 lb/A	174.3	18.9	20.9	12.74	58.5	362.2
IDO1403S	173.0	17.2	20.9	13.17	58.3	403.3
WB6121	170.7	17.6	20.8	13.04	59.3	359.4
Mean	**174.4**	**19.6**	**26.2**	**12.41**	**58.9**	**379.6**
LSD P=.05	1.72	2.17	6.99	0.38	0.85	11.13
CV	0.59	6.65	16	1.83	0.86	70.42
Pr>F	0.0001	0.0020	0.0046	0.0001	0.0001	0.0018

HD: heading date, HT: height, YLD: yield, PRO: protein, TWT: test weight
FN: falling number

Title: Evaluation of A21996 for wild oat control in spring wheat - 2017

Objective: Determine if there are differences in grass weed control and crop safety between A21996 and competitor products in spring wheat.

Materials and Methods:

Buck Pronto spring wheat was planted on May 3 in a field previously cropped to barley. Wild oat was planted in the center of each plot on May 15 to augment the natural weed population. Herbicides were applied to wild oat infested spring wheat on June 5, 2017 using a CO_2 backpack sprayer equipped with TeeJet XR11002 nozzles in a volume of 20 GPA. The crop was nine inches tall and had five leaves per main stem and one tiller. Wild oat was three inches tall and had two to three leaves. The study area was treated with Curtail at 2 pt/A on June 19 for the control of Canada thistle.

Results:

All treatments afforded excellent crop tolerance. Similarly, all treatments provided excellent control of wild oat. That being said, wild oat densities were low (6 plants/square foot), in spite of being seeded in each plot.

Drought and heat stress depressed spring wheat yields, which were about half of the long term average for the area. Low yields and low wild oat pressure eliminated potential yield differences among the treatments. Protein content averaged 15.17 %, with Varro having the highest protein in the study. Test weight averaged 59.7 lb/bu. The check had the lowest test weight, while the highest test weights were recorded for treatments containing A21996 and Rimfire Max.

Summary:

A21996 performed well in this experiment, demonstrating excellent crop tolerance and excellent efficacy toward wild oat.

Table 1. Materials and Methods.

Seeding Date:	5/3/2017	Harvest Date:	8/16/2017
Julian Date:	123	Julian Date:	228
Seeding Rate:	85 lb/A	Soil Type:	Creston SiL
Previous Crop:	Barley	Soil Test:	38-19-78
Tillage:	Conventional	Fertilizer:	150-30-30

Table 2. Effect of A21996 on crop tolerance and control of wild oat in spring wheat. Kalispell, MT 2017.

Treatment	Rate		6/9 CI %	6/30 CI %	7/14 CI %	7/14 AVEFA %	8/3 AVEFA %	8/16 YLD bu/A	8/16 PRO %	8/16 TWT lb/bu
Check			0	0	0	0	0	56.3	15.00	59.1
A21996	15	fl oz/a	0	0	0	98	100	55.7	14.90	60.1
Varro 10 EC	6.8	fl oz/a	0	0	0	99	100	55.6	15.60	59.4
Activator 90	0.3	% v/v								
Goldsky 0.84 SL	1	pt/a	0	0	0	99	100	54.1	15.20	59.7
Activator 90	0.3	% v/v								
Ammonium sulfate	1	lb/a	0	0	0	99	100	57.2	15.10	60.0
Everest 2.0 3.5 SC	1	fl oz/a								
Activator 90	0.3	% v/v								
Ammonium sulfate	1.5	lb/a	0	0	0	98	100	61.3	15.20	60.1
Rimfire Max 6.67 WG	3	oz/a								
Activator 90	0.3	% v/v								
Mean			**0**	**0**	**0**	**82.2**	**83.3**	**56.7**	**15.17**	**59.7**
LSD P=.05			.	.	.	2.34	.	6.1	0.38	0.72
CV			0	0	0	1.56	0	5.91	1.38	0.66
Pr>F			1	1	1	0.0001	1	0.2370	0.0457	0.0507

CI: Crop injury, AVEFA: Wild oat, YLD: Yield, PRO: Protein, TWT: Test weight.

Title: Effect of Nexicor on stripe rust control in winter wheat. 2017

Objective: Evaluate fungicides for crop tolerance and stripe rust control in winter wheat.

Materials and Methods:

Colter winter wheat was planted with a SeedMaster no-till air-drill on September 30, 2016 along with a fertilizer drill-blend of N-P-K at 0-30-70 lb/A, respectively. A supplemental fertilizer application of 75-0-40 was broadcast to the winter wheat crop on May 1, 2017. Huskie Complete was applied at 13.7 oz/A on May 9, 2017 to control weeds. Fungicide treatments were applied at the flag leaf stage on May 31 using a CO2 backpack sprayer equipped with TeeJet XR11002 nozzles in a volume of 20 GPA. Less than two percent of the crop showed signs of infection at this time.

Results:

All treatments afforded excellent crop tolerance. Similarly, all treatments provided excellent control of stripe rust. However, Priaxor plus Tilt afforded the least control of all the treatments evaluated. Drought and heat stress depressed winter wheat yields, which were about half of the long term average for the area. As such, there were no yield differences detected among the treatment. Similarly, there were no treatment effects detected for protein and test weight.

Summary:

All fungicide treatments evaluated provided excellent control of stripe rust.

Table 1. Materials and Methods.

Seeding Date:	9/30/2016	Harvest Date:	8/1/2017
Julian Date:	274	Julian Date:	213
Seeding Rate:	125 lb/A	Soil Type:	Creston SiL
Previous Crop:	100-12-172	Soil Test:	61-46-354
Tillage:	Conventional	Fertilizer:	D:0-30-70 BC: 75-0-40

Table 2. Effect of Nexicor on control of stripe rust in winter wheat. Kalispell, MT 2017.

Treatment	Rate		6/8 CI %	6/2 SR %	6/12 SR %	6/26 SR %	8/1 YLD bu/A	8/1 PRO %	8/1 TWT lb/bu
Check			0.0	1.7	3.2	78.3	55.6	10.1	59.3
Nexicor	7	oz/a	0.0	1.3	0.5	1.7	58.0	10.7	59.7
Induce	0.125	% v/v							
Nexicor	13	oz/a	0.0	1.7	0.2	4.0	55.4	10.7	59.6
Induce	0.125	% v/v							
Quilt Xcel	10.5	oz/a	0.0	2.0	0.0	3.3	56.0	10.4	59.8
Induce	0.125	% v/v							
Tilt	4	oz/a	0.0	1.3	0.2	0.7	57.9	10.6	59.8
Induce	0.125	% v/v							
Priaxor +	3	oz/a	0.0	2.0	0.5	15.0	53.2	10.6	59.2
Tilt	3	oz/a							
Induce	0.125	% v/v							
Mean			**0**	**1.7**	**0.8**	**17.2**	**56.0**	**10.5**	**59.6**
LSD P=.05			.	1.66	1.46	10.12	6.07	0.45	0.53
CV			0	54.77	106.81	32.4	5.95	2.36	0.48
Pr>F			1	0.8898	0.0054	0.0001	0.5364	0.0984	0.0867

CI: Crop injury, SR: Stripe rust, YLD: Yield, PRO: Protein, TWT: Test weight.

Title: Effect of Absolute Maxx and Prosaro on stripe rust control in winter wheat. 2017

Objective: Evaluate fungicides for crop tolerance and stripe rust control in winter wheat.

Materials and Methods:

Colter winter wheat was planted with a SeedMaster no-till air-drill on September 30, 2016 along with a fertilizer drill-blend of N-P-K at 0-30-70 lb/A, respectively. A supplemental fertilizer application of 75-0-40 was broadcast to the winter wheat crop on May 1, 2017. Huskie Complete was applied at 13.7 oz/A on May 9, 2017 to control weeds. Fungicide treatments were applied at the flag leaf stage on May 31 using a CO2 backpack sprayer equipped with TeeJet XR11002 nozzles in a volume of 20 GPA. Less than two percent of the crop showed signs of infection at this time.

Results:

All treatments afforded excellent crop tolerance. Similarly, all treatments provided excellent control of stripe rust. That being said, hot, dry conditions prevent the disease from developing into a major outbreak.

The drought and heat stress also depressed winter wheat yields, which were about half of the long term average for the area. Nevertheless, all fungicide treatments produced wheat yields greater than the nontreated check. On average, fungicide treatments increased yields by 8 bu compared to the nontreated check. The nontreated check also produced the lowest protein. However, only Absolute Maxx at 4 oz and Tebuconazole resulted in protein contents greater than the nontreated check. All fungicide treatments had higher test weights than the nontreated.

Summary:

All fungicide treatments evaluated provided excellent control of stripe rust, improving yields and test weights in the process.

Table 1. Materials and Methods.

Seeding Date:	9/30/2016	Harvest Date:	8/1/2017
Julian Date:	274	Julian Date:	213
Seeding Rate:	125 lb/A	Soil Type:	Creston SiL
Previous Crop:	100-12-172	Soil Test:	61-46-354
Tillage:	Conventional	Fertilizer:	D:0-30-70 BC: 75-0-40

Table 2. Effect of Absolute Maxx and Prosaro on stripe rust control in winter wheat. Kalispell, MT 2017.

Treatment		Rate	6/8 Cl %	6/2 SR %	6/12 SR %	6/26 SR %	8/1 YLD bu/A	8/1 PRO %	8/1 TWT lb/bu
Check			0	1.7	3.3	80	51.4	10.22	58.6
Absolute Maxx	4	fl oz/a	0	3	0.5	0	61.2	10.56	59.7
Induce 90 SL	0.125	% v/v							
Absolute Maxx	5	fl oz/a	0	1.7	0.8	0.7	57.8	10.38	59.6
Induce 90 SL	0.125	% v/v							
Prosaro	5	fl oz/a	0	1.7	0.3	0	58.2	10.28	59.4
Induce 90 SL	0.125	% v/v							
Tebuzol 3.6F	4	fl oz/a	0	1.3	1.2	5.7	60.8	10.55	59.5
Induce 90 SL	0.125	% v/v							
Mean			**0.0**	**1.9**	**1.2**	**17.3**	**57.9**	**10.40**	**59.4**
LSD P=.05			.	2.03	1.69	8.91	5.28	0.25	0.53
CV			0	57.86	72.71	27.41	4.84	1.29	0.47
Pr>F			1	0.4249	0.0197	0.0001	0.0163	0.0443	0.0106

CI: Crop injury, SR: Stripe rust, YLD: Yield, PRO: Protein, TWT: Test weight.

Title: Effect of fungicide rate, combinations and application timing on stripe rust control in winter wheat. 2017.

Objective: Evaluate fungicides for crop tolerance and stripe rust control in winter wheat.

Materials and Methods:

Colter winter wheat was planted with a SeedMaster no-till air-drill on September 30, 2016 along with a fertilizer drill-blend of N-P-K at 0-30-70 lb/A, respectively. The previous crop was a forage mix of barley, oat and pea. A supplemental fertilizer application of 75-0-40 was broadcast to the winter wheat crop on May 1, 2017. Huskie Complete was applied at 13.7 oz/A on May 9, 2017 to control weeds. Fungicide treatments were applied at herbicide timing on May 10th and at the flag leaf stage on May 31 using a CO2 backpack sprayer equipped with TeeJet XR11002 nozzles in a volume of 20 GPA. Less than two percent of the crop showed signs of infection at either application timing.

Results:

All treatments afforded excellent crop tolerance (data not presented). However, stripe rust control varied among the treatments. Treatments applied at herbicide timing failed to provide season long control, regardless of the product. However, excellent stripe rust control was obtained when treatments were applied at flag leaf, or when treatments were applied at herbicide timing followed by an application at flag leaf. The exception was Alto applied a flag leaf, which had an infection level of 27 percent. Ironically, Alto applied at flag leaf produced the highest grain yield and the highest protein content.

Summary:

Application timing had the biggest effect on stripe rust control with treatments that included flag leaf applications affording the greatest level of control. There was little difference among fungicide products or tankmix combinations.

Table 1. Materials and Methods.

Seeding Date:	9/30/2016	Harvest Date:	8/1/2017
Julian Date:	274	Julian Date:	213
Seeding Rate:	125 lb/A	Soil Type:	Creston SiL
Previous Crop:	Forage mix	Soil Test:	61-46-354
Tillage:	Conventional	Fertilizer:	0-30-70, 75-0-40

Table 2. Effect of fungicide rate and application timing on stripe rust control. Kalispell, MT 2017.

Trt	Treatment	Rate	Timing[1]	6/2 SR %	6/12 SR %	6/26 SR %	8/1 YLD bu/A	8/1 PRO %	8/1 TWT lb/bu
1	Check			2.0	3.7	95.0	56.8	10.40	59.0
2	Alto	4 fl oz/a	A	2.7	1.3	63.3	53.5	10.59	59.1
	Induce 90 SL	0.125 % v/v	A						
3	Trivapro	9.4 fl oz/a	A	1.0	1.5	65.0	60.7	10.13	59.6
	Induce 90 SL	0.125 % v/v	A						
4	Priaxor	1 fl oz/a	A	1.3	1.3	85.0	59.8	10.25	59.6
	Headline	3.5 fl oz/a	A						
	Tilt	1.5 fl oz/a	A						
	Induce 90 SL	0.125 % v/v	A						
5	Alto	4 fl oz/a	B	1.0	0.5	27.3	62.9	10.77	59.7
	Induce 90 SL	0.125 % v/v	B						
6	Trivapro	13.7 fl oz/a	B	1.0	0.2	2.3	59.7	10.71	60.1
	Induce 90 SL	0.125 % v/v	B						
7	Priaxor	1.5 fl oz/a	B	2.3	0.3	1.7	59.5	10.73	59.8
	Headline	5 fl oz/a	B						
	Tilt	2.5 fl oz/a	B						
	Induce 90 SL	0.125 % v/v	B						
8	Alto	4 fl oz/a	A	2.0	0.0	1.7	61.6	10.67	60.0
	Induce 90 SL	0.125 % v/v	A						
	Trivapro	13.7 fl oz/a	B						
	Induce 90 SL	0.125 % v/v	B						
9	Trivapro	9.4 fl oz/a	A	1.7	0.2	1.7	59.3	10.53	59.8
	Induce 90 SL	0.125 % v/v	A						
	Trivapro	13.7 fl oz/a	B						
	Induce 90 SL	0.125 % v/v	B						
10	Priaxor	1 fl oz/a	A	1.7	0.3	0.7	57.0	10.60	59.4
	Headline	3.5 fl oz/a	A						
	Tilt	1.5 fl oz/a	A						
	Induce 90 SL	0.125 % v/v	A						
	Priaxor	1.5 fl oz/a	B						
	Headline	5 fl oz/a	B						
	Tilt	2.5 fl oz/a	B						
	Induce 90 SL	0.125 % v/v	B						
11	Tebuconazole 3.6F	4 fl oz/a	A	1.0	1.2	43.7	55.6	10.34	59.0
	Activator 90	0.125 % v/v	A						
12	Tebuconazole 3.6F	4 fl oz/a	B	1.7	0.0	1.7	53.9	10.41	59.6
	Activator 90	0.125 % v/v	B						
13	Tebuconazole 3.6F	4 fl oz/a	A	1.3	0.2	0.7	56.6	10.25	59.7
	Activator 90	0.125 % v/v	A						
	Tebuconazole 3.6F	4 fl oz/a	B						
	Activator 90	0.125 % v/v	B						
14	Tebuconazole 3.6F	4 fl oz/a	B	2.0	0.5	0.0	57.3	10.50	59.7
	Mean			**1.6**	**0.8**	**27.8**	**58.1**	**10.49**	**59.6**
	LSD P=.05			1.689	0.983	21.248	5.77	0.362	0.676
	CV			62.16	73.42	45.49	5.91	2.06	0.68
	Pr>F			0.6059	0.0001	0.0001	0.0645	0.0178	0.039

SR: Stripe rust, YLD: Yield, PRO: Protein, TWT: Test weight.

A[1]: Herbicide timing, B: Flag leaf

Title: Performance of Talinor for weed control in winter wheat. Kalispell, MT - 2017

Objective: Compare Talinor to competitive products for crop tolerance and weed control.

Materials and Methods:

The previous crop was a forage mix of barley, oat and peas. The field was fertilized with 9-30-70 on September 21 and Colter winter wheat was planted on September 27, 2016 (Table 1). A supplemental fertilizer application of 75-0-40 was broadcast to the winter wheat crop on May 1, 2017. Herbicide treatments were applied on May 5, 2017 using a CO2 backpack sprayer equipped with TeeJet XR11002 nozzles in a volume of 20 GPA. Crop height averaged 10 inches and plants had a minimum of one tiller. Weeds present at application consisted of pennycress (THLAR), tumble mustard (SSYAL) and prickly lettuce (LACSE) and were five inches in height.

Results:

All treatments afforded excellent crop tolerance (Table 2). Similarly, all treatments provided excellent control of pennycress and tumble mustard, except for Widematch which failed to control pennycress. Few treatments provided acceptable control of prickly lettuce (Table 3). Talinor applied at 16 and 18.2 oz/A provided at least 90% control as did the combination of Affinity tankmix plus Widematch.

Overall, there was a linear relationship between winter wheat yield and weed biomass (Figure 1). All herbicide treatments reduced weed biomass relative to the check, but among the herbicide treatments, Widematch resulted in the greatest weed biomass. Although wheat yields were affected by the level of weed control, drought and high temperature conditions also suppressed yields, which were about one-third of normal. Wheat yields averaged 36 bu/A in this study. Grain protein averaged about 11% in the study and was unaffected by herbicide treatment. Test weights were low, averaging about 57 lb/bu. Interestingly, the highest test weights was observed with Widematch.

Summary:

Talinor treatments afforded the most complete weed control and weed control did improve as the rate of Talinor increased.

Figure 1. Relationship between weed biomass and yield

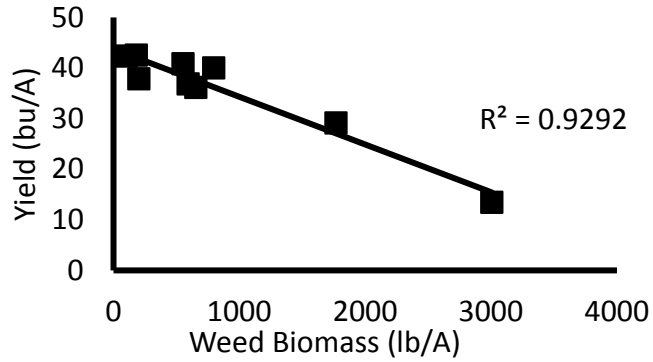


Table 1. Materials and Methods.

Seeding Date:	9/27/2016	Harvest Date:	8/7/2017
Julian Date:	271	Julian Date:	219
Seeding Rate:	125 lb/A	Soil Type:	Creston SiL
Previous Crop:	forage mix	Soil Test:	70-44-113
Tillage:	Conventional	Fertilizer:	9-30-70, 75-0-40

Table 2. Effect of Talinor on weed control in winter wheat. Kalispell, MT. 2017

Treatment	Rate	5/12 CI %	5/20 CI %	5/26 CI %	5/20 THLAR %	5/26 THLAR %	6/9 THLAR %	8/3 THLAR %	5/20 SSYAL %	5/26 SSYAL %	6/9 SSYAL %	8/3 SSYAL %
Check		0	0	0	0	0	0	0	0	0	0	0
CoAct	2.75 fl oz/a	3	0	0	96	98	98	100	97	98	98	98
Talinor	13.7 fl oz/a											
Herbimax	1 % v/v											
CoAct	3.2 fl oz/a	3	0	0	98	98	98	100	98	98	98	100
Talinor	16 fl oz/a											
Herbimax	1 % v/v											
CoAct	3.6 fl oz/a	2	2	0	97	98	98	100	98	98	98	100
Talinor	18.2 fl oz/a											
Herbimax	1 % v/v											
Huskie 2.07 EC	11 fl oz/a	3	0	0	97	98	98	100	98	98	98	100
Activator 90	0.25 % v/v											
Widematch 1.5EC	16 fl oz/a	2	0	0	57	35	15	0	66	98	97	99
Affinity Tankmix 50 SG	0.6 oz/a	3	0	0	80	92	95	97	95	98	98	100
Widematch 1.5EC	16 fl oz/a											
Activator 90	0.25 % v/v											
Affinity Tankmix 50 SG	0.6 oz/a	5	0	0	82	90	95	100	98	98	98	100
MCPA Ester 3.7 EC	12 fl oz/a											
Orion	17 fl oz/a	0	0	0	84	86	95	100	98	98	98	100
Mean		**2**	**0**	**0**	**77**	**77**	**77**	**77**	**83**	**87**	**87**	**89**
LSD P=.05		5.802	1.666	.	14.749	6.886	4.169	3.331	11.915	0.333	0.999	1.053
CV		143.66	519.62	0	11.11	5.15	3.13	2.49	8.29	0.22	0.66	0.69
Treatment Prob(F)		0.6612	0.4726	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

CI: Crop injury, THLAR: Pennycress, SSYAL: Tumble mustard.

Table 3. Effect of Talinor on weed control in winter wheat. Kalispell, MT. 2017

Treatment	Rate	5/20 LACSE %	5/26 LACSE %	6/9 LACSE %	8/3 LACSE %	7/3 Weeds lb/A	7/3 Wheat lb/A	8/7 YLD bu/A	8/7 PRO %	8/7 TWT lb/bu
Check		0	0	0	0	3005	4850	14	11.00	57.6
CoAct	2.75 fl oz/a	91	88	91	72	201	8658	38	11.38	56.4
Talinor	13.7 fl oz/a									
Herbimax	1 % v/v									
CoAct	3.2 fl oz/a	96	94	96	90	98	9768	42	11.12	57.6
Talinor	16 fl oz/a									
Herbimax	1 % v/v									
CoAct	3.6 fl oz/a	96	95	95	92	181	7692	43	11.11	57.6
Talinor	18.2 fl oz/a									
Herbimax	1 % v/v									
Huskie 2.07 EC	11 fl oz/a	96	89	93	83	551	6506	41	11.16	56.8
Activator 90	0.25 % v/v									
Widematch 1.5EC	16 fl oz/a	83	93	95	78	1767	5930	29	10.87	58.9
Affinity Tankmix 50 SG	0.6 oz/a	85	94	98	94	653	6431	36	11.21	57.8
Widematch 1.5EC	16 fl oz/a									
Activator 90	0.25 % v/v									
Affinity Tankmix 50 SG	0.6 oz/a	89	91	92	63	592	6594	37	11.15	56.9
MCPA Ester 3.7 EC	12 fl oz/a									
Orion	17 fl oz/a	86	89	91	55	796	6233	40	11.11	57.0
Mean		**80**	**81**	**83**	**70**	**872**	**6962**	**36**	**11.12**	**57.4**
LSD P=.05		8	9.485	6.826	23.035	840	2620	10.32	0.447	0.953
CV		5.75	6.73	4.73	19.11	55.7	21.74	16.78	2.32	0.95
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0001	0.0316	0.0005	0.5628	0.0029

LACSE: Prickley lettuce, YLD: Yield, PRO: Protein, TWT: Test weight.

PULSES

Project Title: Faba Variety Trial - 2017

Objective: To evaluate Faba for yield and agronomic performance in Northwestern Montana.

Results:

Significant differences were observed for faba bean yield. Mean yield was 64.0 bu/A and ranged from 51.5 bu/A to 76.2 bu/A. Flowering averaged 182 (July 1), flower as a function of days after emergence averaged 37 days. Height at pod fill averaged 44.0 inches and ranged from 33.2 inches to 47.5 inches. Test weight averaged 65.4 lb/bu and ranged from 646 to 66.3 lb/bu. Thousand kernel weights averaged 435 grams with a range from 194 (a petite type) to 496 grams. Percent protein mean value was 29.6 percent and ranged from 27.4 to 30.6 percent. No statistic differences were observed for plants density, height at flower or physiological maturity.

Summary:

The nursery was planted under rainfed condition with adequate subsurface moisture on silt loam soil. Weeds were well controlled with the pre-plant incorporated herbicide. This was our first year planting faba, which can be large seeded and irregular, thus slow planting and occasional checking of planter opener was required. Harvest was done while stems were still green as pods were crisp and prone to shatter. The combine fan speed was set to maximum. Tabular data of this nursery will not be present.

Table 1. Materials and Methods.

Seeding Date:	5/11/2017	Harvest Date:	8/19/2017
Julian Date:	131	Julian Date:	231
Seeding rate:	4 plants/sqft	Soil Test:	120-13-160
Previous Crop:	Spring Wheat	Fertilizer:	6-30-30
Tillage:	Conventional	Seed treatment:	Insecticide (Cruiser 5FS) and Fungicide (Appron Maxx RTA)
Irrigation:	None	Herbicide:	Triflurex (pre-plant incorporated)
Soil Type:	Creston silt loam	Insecticide:	Warrior II (June 7)

Project Title: Statewide Lentil Variety Trial - 2017

Objective: To evaluate Lentils for yield and agronomic performance in Northwestern Montana.

Results:

Significant difference was observed for lentil yield with a mean yield of 60.3 bu/A (Table 2) and ranged from 45.9 bu/A for CDC Imigreen to 70.9 bu/A for Avondale. Test weights averaged 62.8 lb/bu. Thousand kernel weights averaged 40.4 grams. Plant stand averaged 10.8 plants per square foot and ranged from 4.6 plnts/sqft for CDC Impala CL to 14.7 plnts/sqft for CDC Imigreen. Days to 50 percent flowering averaged 185 days (July 4). Plant height at flowering averaged 15.9 inches yet no significant difference was observed at physiological maturity.

Summary:

The nursery was planted under rainfed condition with adequate subsurface moisture on silt loam soil. Weed was well controlled this season due to the pre-plant incorporated herbicide.

Table 1. Materials and Methods.

Seeding Date:	5/11/2017	Harvest Date:	9/11/2017
Julian Date:	131	Julian Date:	254
Seeding rate:	12 plants/sqft	Soil Test:	120-13-160
Previous Crop:	Winter wheat	Fertilizer:	6-30-30
Tillage:	Conventional	Seed treatment:	Insecticide (Cruiser 5FS) and Fungicide (Appron Maxx RTA)
Irrigation:	None	Herbicide:	Triflurex (pre-plant incorporated)
Soil Type:	Creston silt loam	Insecticide:	Warrior II (June 6)

Table 2. Lentil agronomic data.

Cultivar	PLNT sqft	FLWR Julian	HT FLWR in	HT PF in	HT PM in	YLD lb/A	YLD bu/A	TWT lb/bu	TKW g
Avondale	12.4	182	15.0	21.8	20.8	4254.0	70.9	62.4	45.2
CDC Richlea	14.3	185	16.8	22.0	20.0	4169.6	69.5	61.0	47.8
CDC Maxim CL	11.5	185	14.0	21.0	22.0	3636.6	60.6	63.6	35.4
CDC Imvincible CL	7.5	187	15.8	21.3	21.0	3628.8	60.5	63.5	31.7
CDC Impala CL	4.6	188	14.8	18.8	19.3	3610.0	60.2	64.9	30.2
CDC Viceroy	8.6	187	16.8	21.0	19.5	3582.0	59.7	64.2	32.1
CDC Impress CL	12.6	185	16.3	24.0	20.0	3326.1	55.4	61.7	48.6
CDC Imigreen	14.7	185	17.8	24.5	20.7	2754.4	45.9	61.2	52.5
Mean	10.8	185	15.9	21.8	20.4	3620.2	60.3	62.8	40.4
CV	24.4	0.2	9.7	8.1	6.7	11.2	11.2	0.6	3.1
LSD	3.9	0.6	2.3	2.6	ns	596.2	9.9	0.5	1.8
Pr>F	0.0002	0.0001	0.0434	0.0053	0.1639	0.0012	0.0012	0.0001	0.0001

FLWR: 50% flower, HT FLWR: height at flowering, HT PF: height at pod fill, HT PM: height at physiological maturity, YLD: yield, TWT: test weight, TKW: thousand kernel weight, PRO: protein, ns: nonsignificant.

Project Title: Statewide Pea Variety Trial - 2017

Objective: To evaluate pea cultivars for yield and agronomic performance in Northwestern Montana.

Results:

A significant difference was observed for yellow pea yield. Mean yield was 96.7 bu/A, and ranged from 81.3 bu/A for PSO877MT632 to 107.7 bu/A for Nette 2010 (Table 2). Statistical difference was observed for flowering dates, with an average occurrence at 184 Julian days (July 3). Height averaged 32.8 inches at 50% flowering and 38.9 inches at physiological maturity. Statistical differences were observed for test weights with an average of 63.4 lb/bu. Protein averaged 22.4 percent with PSO877MT632 being highest at 23.6 percent. Plant density, height at pod fill, and thousand kernel weights were insignificant.

A significant difference was observed for green pea yield. Mean yield was 85.8 bu/A, and ranged from 98.9 bu/A for Arcadia to 63.0 bu/A for PSO877MT076 (Table 3). Days to flowering was significant with an average of 185 Julian days (July 4). Average heights were 32.7 inches at flowering, and 37.7 inches at pod fill. No significant differences were observed in height at physiological maturity. Test weights averaged 63.1 lb/bu, and plant density averaged 9.7 plants per square foot but with no significant difference observed amongst cultivars for these response variables. Thousand kernel weights averaged 200.0 grams and ranged from 180.0 grams for PSO826MT190 to 222.0 grams for PS0877NT457. Protein averaged 22.7 percent with Hampton being the highest at 24.1 percent.

Summary:

Despite the hot and dry summer, the pea trial yielded slightly higher than in 2016. In 2017, the nursery was planted on soil with subsurface water recharge. The mean yield for both market class was 7 bu/A greater in 2017 than 2016.

Table 1. Materials and Methods.

Seeding Date:	5/11/2017	Harvest Date:	8/19/2017
Julian Date:	131	Julian Date:	231
Seeding rate:	8 plants/sqft	Soil Test:	120-13-160
Previous Crop:	Winter wheat	Fertilizer:	6-30-30
Tillage:	Conventional	Herbicide:	Triflurex (pre-plant incorporated)
Irrigation:	None	Insecticide:	Warrior II (June 6)
Soil Type:	Creston silt loam		

Table 2. Yellow pea agronomic data.

Cultivar	PLNT sqft	FLWR Julian	HT FLWR in	HT PF in	HT PM in	YLD lb/A	YLD bu/A	TWT lb/bu	TKW g	PRO %
Nette 2010	9.7	184	34.0	39.2	43.2	6464.4	107.7	65.0	208.4	21.15
Jetset	10.3	185	37.8	38.3	41.2	6265.6	104.4	63.0	212.2	21.63
Navarro	9.8	na	25.0	38.1	37.9	6024.2	100.4	63.3	233.3	22.63
PSO826MT492	10.1	182	32.0	39.4	45.0	5999.4	100.0	63.6	217.5	22.53
Delta	13.8	185	33.8	32.4	39.4	5865.0	97.8	63.7	219.8	22.73
Universal Yellow	10.1	182	31.5	37.3	40.1	5828.3	97.1	63.6	209.5	22.80
DS Admiral	12.2	184	36.1	39.0	44.3	5793.3	96.6	62.6	212.3	21.63
PSO826MT460	8.3	182	30.5	30.0	17.1	5123.7	85.4	62.4	287.1	23.03
PSO877MT632	8.8	185	34.4	36.8	41.8	4875.3	81.3	63.8	210.7	23.60
Mean	10.3	184	32.8	36.7	38.9	5804.4	96.7	63.4	223.4	22.41
CV	22.08	0.45	5.1	13.3	14.3	5.6	5.6	1.0	16.5	2.16
LSD	ns	1.2	2.4	ns	8.2	470.5	7.8	1.0	ns	0.71
Pr>F	0.0640	0.0001	0.0001	0.1245	0.0001	0.0001	0.0001	0.0006	0.1175	0.0001

Table 3. Green pea agronomic data.

Cultivar	PLNT sqft	FLWR Julian	HT FLWR in	HT PF in	HT PM in	YLD lb/A	YLD bu/A	TWT lb/bu	TKW g	PRO %
Arcadia	12.3	185	30.6	34.2	36.4	5934.6	98.9	62.7	182.1	21.08
PSO877MT499	10.5	185	34.4	40.5	40.6	5493.4	91.6	63.8	210.9	21.38
Hampton	7.8	186	31.9	34.6	34.6	5364.9	89.4	63.1	208.4	24.05
Aragorn	8.9	184	31.8	37.5	39.1	5249.0	87.5	62.4	191.7	21.90
Majoret	11.7	186	35.5	36.3	38.2	5184.7	86.4	63.3	216.7	22.50
PSO826MT190	9.8	185	36.4	37.8	na	5105.8	85.1	63.3	180.1	22.60
PS0877MT457	9.0	183	32.3	43.6	35.8	5055.7	84.3	63.6	222.0	23.93
PSO877MT076	7.7	185	28.9	36.8	37.7	3781.6	63.0	62.8	188.6	23.88
Mean	9.7	185	32.7	37.7	37.5	5146.2	85.8	63.1	200.1	22.66
CV	27.5	0.5	6.1	9.5	7.4	6.1	6.1	1.1	3.5	2.22
LSD	ns	1.3	2.9	5.3	ns	460.4	7.7	ns	10.2	0.74
Pr>F	0.1926	0.0032	0.0004	0.0246	0.1392	0.0001	0.0001	0.1222	0.0001	0.0001

FLWR: 50% flower, HT FLWR: height at flowering, HT PF: height at pod fill, HT PM: height at physiological maturity, YLD: yield, TWT: test weight, TKW: thousand kernel weight, PRO: protein, ns: nonsignificant.

FORAGES

Project Title: Effects of boron fertilizer and water regimes on alfalfa yield and quality – 2017

Objective: To evaluate the effects of boron fertilizer rate and irrigation application on alfalfa yield and quality

Personnel: A. Sapkota, E.C. Meccage, R.N. Stougard, B. Bicego, J.A. Torrion

Methods:

This study was conducted to determine how much boron fertilization is needed to achieve high alfalfa yields in northwest Montana. Similarly, alfalfa is also known for its high-water use demand. So, water regimes were added to this experiment as the main plot factor – 1) rain-fed check, 2) fully irrigated (100% evapotranspiration, ET), and 3) partial irrigation (50ET, scheduled on the same date of application as 100ET but only half of its amount). The boron rates (subplot factor) are shown in Table 1, which were randomly assigned to plots within each of the water regimes. Other management information is shown in Table 2. Irrigation applied and precipitation received in 2017 is summarized in Figure 1.

Summary:

Boron fertilization did not impact alfalfa plant height or yield in either of the cuttings in 2017 (Table 3). However, the total yield of the season was barely influenced by B fertilization (P = 0.0583; Table 3). So, with the application of B, regardless of B rates, seemed to be nominally higher compared to the control treatment, but insignificant and is not worth the investment and time.

The first harvest was not irrigated due to the five inches rain early in the season (Figure 1). Effects of irrigation on alfalfa height and yield were significant for the third harvest and total yield of the season in 2017 (Table 4). The total seasonal yield showed increment in alfalfa yield with irrigation (Table 4). The lowest yield was for rainfed treatment (5.6 ton/A; Table 4). The deficit irrigation (50ET) and full irrigation (100ET) were not statistically significant (Table 4) which implies that irrigating alfalfa with 50% reduction of irrigation from the 100ET, produces competitive yield and water response (Figure 2) despite the risk associated with the imposed water stress.

Neither of the forage quality parameters of alfalfa was significantly influenced by irrigation. Effect of B on forage quality was significant only for NDF and RFV (Figure 3).

Table 1. Total boron (B) applied per treatment and application timing

Treatment	Total B (lb acre^{-1})	Description
B_0	Untreated check	None
B_1	0.50	Split: 0.25 lb acre^{-1} applied at 3-in spring growth + 0.25 lb acre^{-1} at 3-in regrowth after first cutting
B_2	1.0	Split: 0.50 lb acre^{-1} applied at 3-in spring growth + 0.50 lb acre^{-1} at 3-in regrowth after first cutting
B_3	2.0	Split: 1.0 lb acre^{-1} applied at 3-in spring growth + 1.0 lb acre^{-1} at 3-in regrowth after first cutting
B_4	2.0	2.0 lb acre^{-1} applied at 3-in spring growth

Table 2. Management information

Variety:	HybriForce-3400	Soil Test (2016):	121-21-144
Seeding date:	05/24/2017	Fertilization (2016):	44-104-240-20S
Seeding rate:	20 lb acre^{-1}	Boron fertilizer:	Liquid 10% Agri B Solution™
Previous crop:	Spring wheat	1st B application:	04/22/2017
Tillage:	Conventional	2nd B application:	06/27/2017
Irrigation:	Yes	1st harvest date:	06/15/2017
Soil type:	Sandy loam	2nd harvest date:	07/21/2017
		3rd harvest date:	09/09/2017

Table 3. Effects of boron fertilization on alfalfa plant height and yield, 2017.

	1st Harvest-June 15		2nd Harvest - July 21		3rd Harvest - Sep 9		Total Yield
	HT	YLD	HT	YLD	HT	YLD	YLD
Treatments	in	T/A	in	T/A	in	T/A	T/A
0 lb B	34.89	1.72	34.65	2.07	34.75	2.07	5.86
0.25 lb B begin + mid season	35.38	1.84	35.13	2.12	35.14	2.15	6.11
0.5 lb B begin + mid season	35.17	1.83	35.28	2.13	34.95	2.11	6.07
1 lb B begin + mid season	36.08	1.87	35.73	2.12	34.07	2.14	6.12
2 lb B begin season	36.17	1.82	35.99	2.17	34.70	2.13	6.12
$Pr>F_{(0.05)-B}$	0.5416	0.1410	0.3236	0.4395	0.6974	0.7530	0.0583

Table 4. Effects of irrigation on alfalfa plant height and yield, 2017.

	1st Harvest-June 15[†]		2nd harvest - July 21		3rd Harvest - Sep 9		Total Yield[‡]
	HT	YLD	HT	YLD	HT	YLD	YLD
Treatments	in	T/A	in	T/A	in	T/A	T/A
Rainfed	35.89	1.79	34.91	2.14	30.36[b]	1.67[b]	5.60[b]
Deficit irrigation (50ET)	35.55	1.83	35.60	2.14	36.39[a]	2.30[a]	6.28[a]
Full irrigation (100ET)	35.17	1.81	35.57	2.08	37.43[a]	2.39[a]	6.29[a]
$Pr>F_{(0.05)-ET}$	-	-	0.1090	0.3715	0.0023	0.0017	0.0123

[†] First cutting in 2017 was not irrigated.

[‡] Sum of yield from all cuttings, including the 1st cut which was not irrigated

Different letter assignment in a column are significantly different at $P < 0.05$

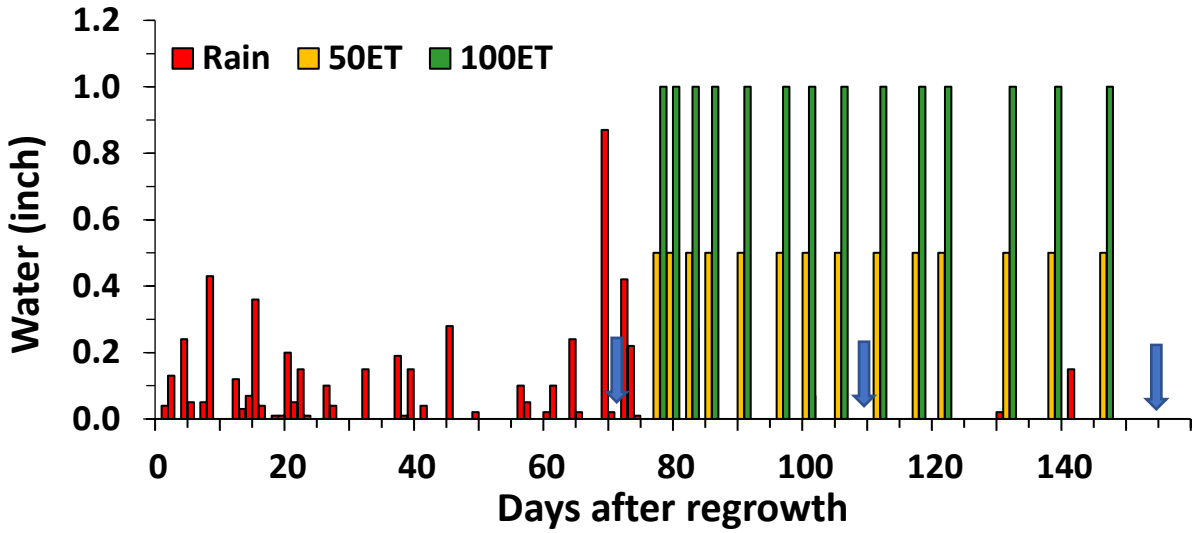


Figure 1. Rainfall received, and amount of irrigation applied in 2017. The 100 percent evapotranspiration (100ET) was irrigated with no stress and 50ET is only half of the 100ET irrigation events. Blue arrows on the X-axis shows the cutting events. Alfalfa was not irrigated before 1st cutting.

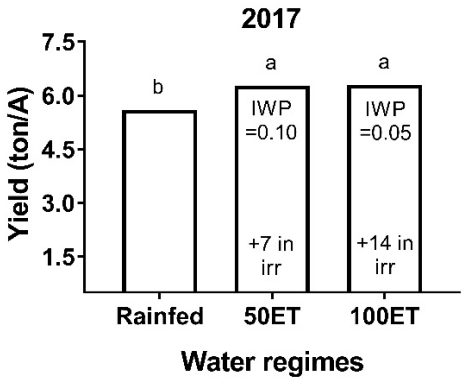


Figure 2. Effects of irrigation on alfalfa total yield, and irrigation water productivity (IWP, tons/in irrigation) in 2017.

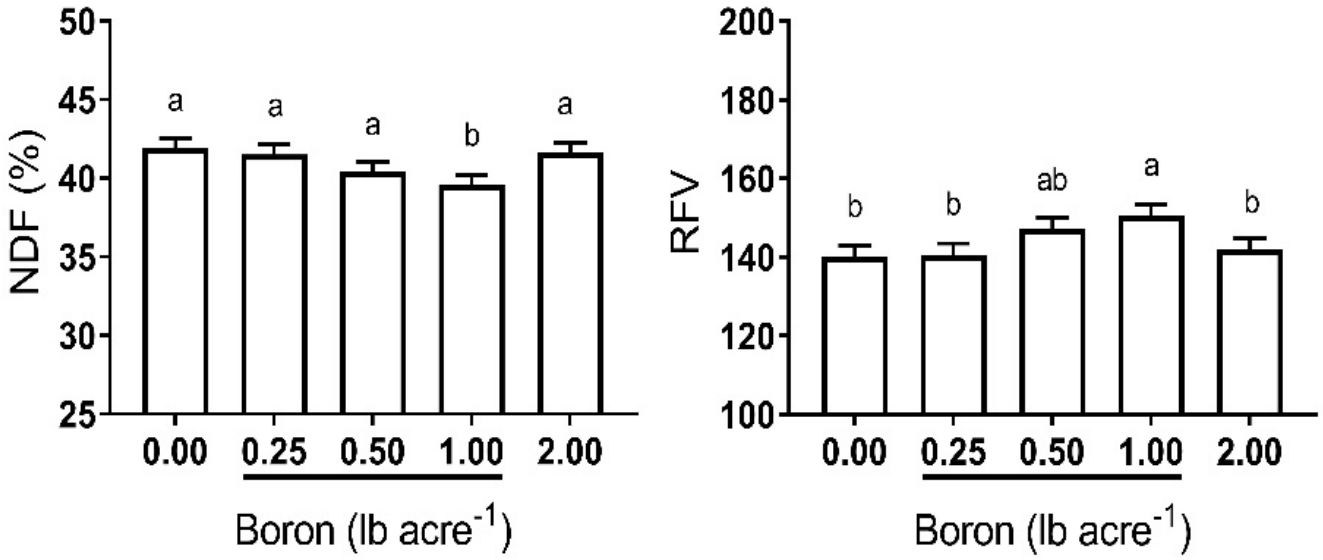


Figure 3. Effects of Boron (B) on neutral detergent fiber (NDF), and relative feed value (RFV) in 2017. Underlined B rates were re-applied after first cutting. Different letters within the graph are significantly different at $P < 0.05$. Data presented are averaged values across cuttings.