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

ANNUAL REPORT
2022 CROP YEAR

Seventy-fourth annual report

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2022 Northwestern Agricultural Research Center Staff

Full Time Staff Members

Jessica Torrion, Superintendent – Associate Professor of Crop Physiology

Clint Beiermann – Assistant Professor – Cropping Systems Agronomist

Charlene Kazmier, Administrative Associate III

Jordan Penney, Farm Manager

Ashley Goodman, Assistant Farm Operations Manager

Daniel Porter, Research Associate

Jessica Pavelka, Research Associate

Ray Volin, Research Assistant III

Seasonal Employees

Ben Cluka

Natalie Bruno

Jane Spain

Natalie Gilford

Dave Davis

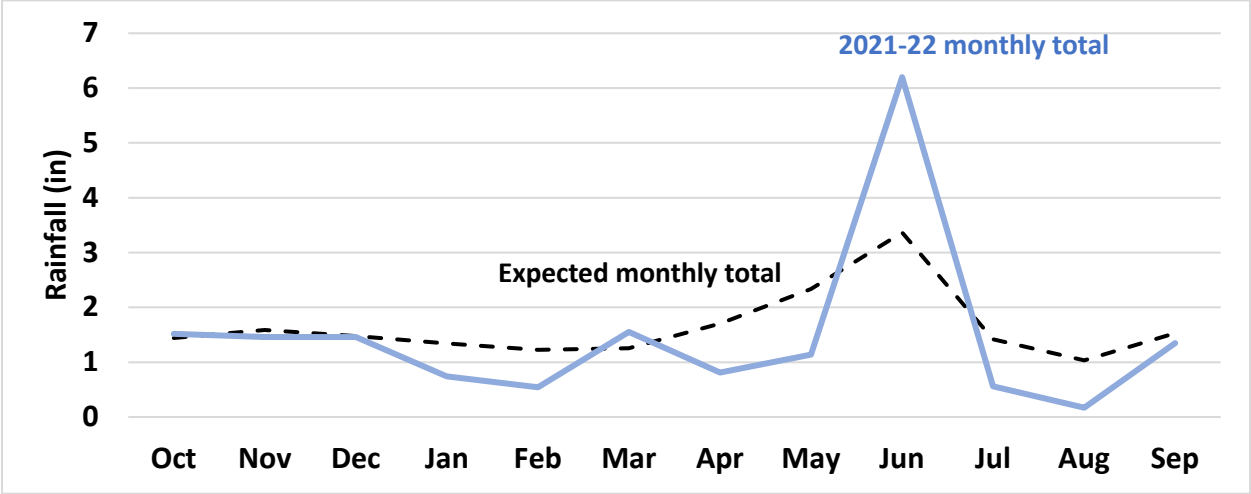
Reece Whitehead

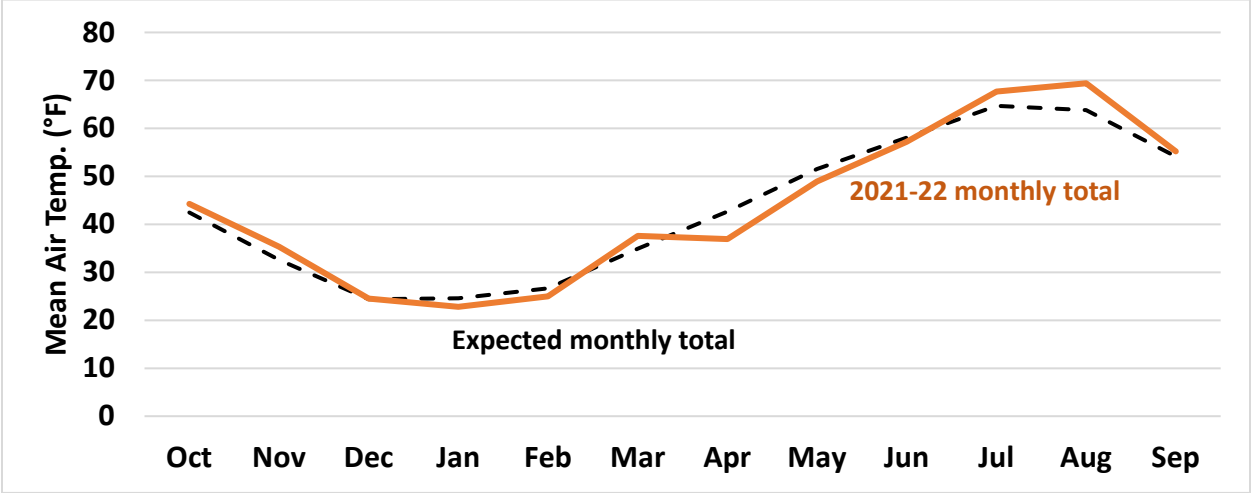
Cerria Swagger

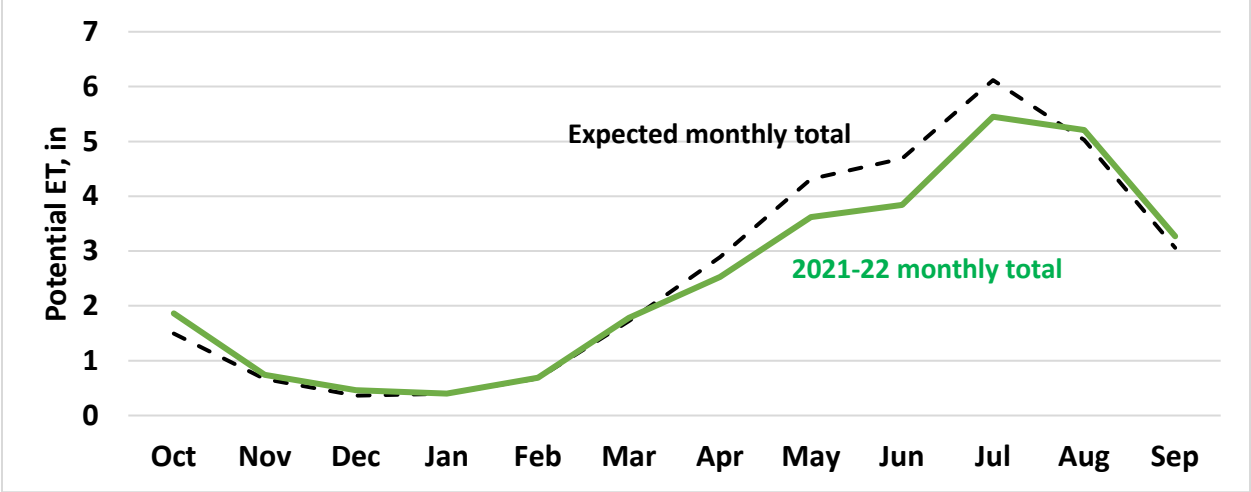
CLIMATOLOGY

Weather information as recorded at the
Northwestern Agricultural Research Center, Kalispell, Mont ana.

2020-21 monthly (solid lines) and historical expected monthly (dashed lines) rainfall, temperature, potential evapotranspiration (ET, grass referenced)







Summary of Climatic Data by Months for the 2022 Crop Year: September 2021- August 31, 2022
and Averages for the Years 1980-2021 at the
Northwestern Agricultural Research Center, Kalispell, Montana

Month Year	Sept. 2021	Oct. 2021	Nov. 2021	Dec. 2021	Jan. 2022	Feb. 2022	Mar. 2022	Apr. 2022	May 2022	June 2022	July 2022	Aug. 2022	
Precipitation (inches)													**Total**
Current Year	1.01	1.52	1.46	1.46	0.74	0.54	1.55	0.81	1.14	6.2	0.56	0.17	17.16
1981-2021	1.54	1.45	1.58	1.51	1.37	1.24	1.25	1.73	2.36	3.30	1.44	1.04	19.81
Difference	-0.53	0.07	-0.12	-0.05	-0.63	-0.70	0.30	-0.92	-1.22	2.90	-0.88	-0.87	-2.65
Average Temperature (F°)													**Average**
Current Year	55.2	44.3	35.3	24.5	22.8	25.0	37.6	36.9	48.9	57.2	67.7	69.4	43.7
1980-2021	54.0	42.3	32.7	24.6	24.8	26.6	34.9	43.0	51.5	57.9	64.7	63.7	43.4
Difference	1.20	1.95	2.60	-0.10	-2.00	-1.60	2.70	-6.10	-2.60	-0.70	3.00	5.70	0.34

Last killing frost in spring*

Spring, 2022: May 22 (26°)

Average (1980 – 2019): May 19th (31°)

First killing frost in fall*

Fall, 2021: September 30 (31°F)

Average (1980-2019): September 19 (30°F)

Frost-free period

2022: 122 days

Average (1980-2021): 124 days

Maximum summer temperature: 97°F Aug. 1st, 2022)

Minimum winter temperature: -10°F (February 23rd & 24th, 2022)

Growing degree days (base 50)

Jan 1st – October 31st, 2022: 2,226 GDD

Average (2018-2021): 2027.50 GDD

*32 °F is considered a killing frost

Summary of Temperature Records at the Northwestern Agricultural Research Center
January 1980 - December 2022
AVERAGE TEMPERATURE BY MONTH AND YEAR - DEGREES FAHRENHEIT

DATE	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	MEAN
1980	16.3	29.0	32.6	47.1	54.8	56.9	63.5	58.6	54.1	45.3	35.8	32.2	43.9
1981	30.1	31.3	38.5	44.5	52.5	53.8	62.8	66.4	55.3	43.2	36.0	27.0	45.1
1982	21.6	24.5	37.5	39.4	49.8	59.8	61.1	63.0	53.4	41.0	29.1	25.9	42.2
1983	30.3	33.8	37.9	42.4	51.9	57.6	59.6	65.4	50.4	42.9	36.6	11.1	43.3
1984	27.6	32.4	38.3	42.2	48.7	56.4	65.3	64.6	49.5	40.0	32.6	20.6	43.2
1985	19.2	19.0	30.8	44.8	53.7	57.6	68.3	60.2	47.8	40.8	18.6	18.3	39.9
1986	25.4	25.6	40.6	43.8	53.7	63.9	59.9	66.1	50.2	43.0	30.3	24.9	44.0
1987	22.2	27.9	35.0	47.8	55.6	61.6	62.9	59.8	56.1	43.2	35.3	25.4	44.4
1988	20.5	30.3	37.8	45.7	51.4	60.9	63.7	63.9	53.8	47.5	36.3	23.3	44.6
1989	27.5	12.4	28.8	44.2	49.6	59.8	65.4	61.9	52.7	42.7	35.8	25.3	42.2
1990	30.5	24.5	34.8	45.2	49.8	57.2	65.2	64.8	59.2	41.9	36.1	16.5	43.8
1991	18.3	34.6	32.8	42.4	50.3	55.1	64.0	65.2	54.4	40.6	32.1	29.3	43.3
1992	28.7	34.5	39.7	45.1	53.5	55.5	61.2	61.8	51.1	44.7	33.1	19.4	44.0
1993	14.7	18.4	33.7	43.6	56.0	56.5	56.6	59.7	51.4	44.4	25.0	25.4	40.5
1994	32.9	20.6	37.5	45.4	54.0	57.3	66.4	66.6	56.3	43.3	32.5	27.1	45.0
1995	23.6	33.7	33.1	42.6	51.6	56.3	63.1	59.5	54.9	41.1	34.9	26.7	43.4
1996	17.4	24.0	29.0	43.2	46.6	58.5	65.4	62.5	52.3	42.1	27.3	19.8	40.7
1997	19.8	28.0	32.3	38.3	52.3	57.8	62.8	63.8	55.6	43.7	33.0	27.9	42.9
1998	25.1	33.0	34.9	44.5	54.1	56.0	68.4	65.6	59.7	42.3	37.0	27.4	45.7
1999	30.4	32.2	37.5	41.6	48.8	55.8	60.9	65.5	51.3	42.9	38.1	31.0	44.7
2000	25.8	26.3	36.9	43.4	50.4	56.2	63.9	63.4	52.0	33.5	27.5	18.4	41.5
2001	24.0	20.6	33.6	40.5	53.4	54.8	63.1	64.6	57.3	42.0	36.6	27.0	43.1
2002	27.2	25.7	25.0	41.6	47.5	57.7	67.2	60.4	54.4	32.6	30.6	28.8	41.6
2003	28.8	28.1	33.4	44.5	50.5	60.1	69.1	66.9	55.5	46.3	27.3	24.2	44.6
2004	21.1	27.6	39.5	45.1	51.0	57.3	66.0	64.0	52.3	43.4	33.8	29.4	44.2
2005	20.6	30.6	36.1	43.9	51.8	55.3	62.6	62.8	51.0	43.6	32.6	18.1	42.4
2006	33.2	24.2	35.5	43.9	52.6	60.7	69.1	63.8	53.5	44.0	32.5	24.1	44.8
2007	22.1	28.3	37.7	42.7	52.6	59.0	72.0	62.3	53.6	40.3	32.6	26.2	44.1
2008	19.4	30.2	32.9	37.8	47.0	65.1	65.1	63.6	52.4	41.7	33.3	18.0	42.2
2009	21.5	24.5	26.2	41.8	53.3	59.2	67.1	66.1	60.1	38.9	35.3	18.0	42.7
2010	26.4	31.4	37.9	30.0	47.1	56.0	61.9	61.4	51.9	43.9	29.0	23.8	41.7
2011	24.3	19.5	34.7	38.7	48.7	53.5	61.9	64.4	56.2	43.3	31.6	28.0	42.0
2012	26.4	28.2	36.7	45.2	48.8	54.9	65.2	63.1	55.4	41.9	35.8	28.5	44.2
2013	23.9	32.6	35.3	40.4	52.4	58.5	67.2	66.0	57.2	39.6	31.4	21.9	43.9
2014	26.6	17.1	33.2	42.3	51.8	55.9	66.6	65.1	54.2	48.0	28.8	25.0	42.9
2015	22.6	32.4	38.6	43.6	52.7	63.7	65.7	64.3	52.8	46.6	31.2	27.4	45.1
2016	27.0	33.2	37.2	47.8	51.4	58.4	62.6	62.7	52.0	43.5	38.4	17.3	44.3
2017	12.5	22.1	35.8	40.4	52.6	59.6	68.0	64.3	54.0	41.4	35.4	28.9	42.9
2018	33.8	26.6	37.0	43.6	58.4	59.7	66.3	65.5	55.5	44.7	37.3	29.0	46.5
2019	25.6	11.3	25.5	43.9	53.5	59.4	63.4	64.8	56.1	37.4	30.8	31.2	41.9
2020	28.8	30.4	34.3	40.6	50.5	57.8	63.3	65.5	55.9	41.0	34.1	28.1	44.2
2021	29.5	19.7	36.6	42.4	50.0	62.4	70.5	64.8	55.2	44.3	35.3	24.5	44.6
2022	22.8	25.0	37.6	36.9	48.9	57.2	67.7	69.4	58.5	48.2	24.5	18.2	42.9
MEAN	24.6	26.6	34.9	42.7	51.5	58.1	64.7	63.8	54.1	42.5	32.6	24.4	43.4

Precipitation by Day for Crop Year September 2021- August 2022
Northwest Agriculture Research Center, Kalispell Montana

DAY	SEPT 2021	OCT 2021	NOV 2021	DEC 2021	JAN 2022	FEB 2022	MAR 2022	APR 2022	MAY 2022	JUNE 2022	JULY 2022	AUG 2022	Total
1	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
2	0.00	0.00	0.00	0.00	0.00	0.18	0.13	0.00	0.00	0.00	0.00	0.00	0.31
3	0.00	0.00	0.00	0.01	0.00	0.07	0.35	0.11	0.00	0.00	0.00	0.00	0.54
4	0.00	0.00	0.00	0.18	0.00	0.00	0.24	0.00	0.00	0.20	0.13	0.00	0.75
5	0.00	0.00	0.10	0.22	0.01	0.00	0.00	0.05	0.00	0.21	0.02	0.00	0.61
6	0.00	0.00	0.03	0.00	0.17	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.23
7	0.00	0.00	0.00	0.04	0.34	0.00	0.00	0.00	0.00	0.34	0.09	0.00	0.81
8	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.12	0.00	0.14
9	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.11
10	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.05
11	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.15	0.00	0.00	0.90
12	0.04	0.00	0.04	0.04	0.09	0.00	0.00	0.00	0.00	0.26	0.00	0.02	0.49
13	0.02	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.04	0.00	0.76
14	0.00	0.00	0.46	0.24	0.00	0.00	0.00	0.00	0.11	0.97	0.00	0.00	1.78
15	0.03	0.00	0.03	0.10	0.00	0.01	0.10	0.00	0.00	1.82	0.00	0.04	2.13
16	0.00	0.00	0.00	0.00	0.00	0.06	0.15	0.00	0.01	0.00	0.02	0.00	0.24
17	0.00	0.00	0.00	0.06	0.00	0.00	0.03	0.07	0.00	0.00	0.00	0.00	0.16
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.03	0.00	0.00	0.10
19	0.00	0.00	0.10	0.02	0.00	0.00	0.00	0.03	0.05	0.15	0.14	0.00	0.49
20	0.35	0.00	0.00	0.00	0.05	0.04	0.00	0.00	0.28	0.55	0.00	0.00	1.27
21	0.00	0.00	0.00	0.20	0.08	0.05	0.00	0.00	0.00	1.01	0.00	0.00	1.34
22	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.12	0.00	0.02	0.00	0.01	0.17
23	0.00	0.98	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01
24	0.00	0.00	0.33	0.02	0.00	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.42
25	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.09	0.35
26	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.09
27	0.00	0.03	0.01	0.11	0.00	0.00	0.00	0.07	0.32	0.00	0.00	0.00	0.54
28	0.11	0.00	0.03	0.02	0.00	0.10	0.00	0.00	0.05	0.00	0.00	0.00	0.31
29	0.00	0.00	0.00	0.02	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.02
30	0.00	0.29	0.07	0.07	0.00		0.00	0.00	0.05	0.00	0.00	0.00	0.48
31		0.00		0.06	0.00		0.00		0.00		0.00	0.00	0.06
TOTAL	1.01	1.52	1.46	1.46	0.74	0.54	1.55	0.81	1.14	6.20	0.56	0.17	17.16

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
2017-18	0.99	1.28	1.69	2.98	1.17	2.14	0.42	1.54	1.78	2.63	0.30	0.22	17.14
2018-19	0.59	1.17	1.52	0.46	1.37	1.79	0.98	1.19	1.63	1.96	1.12	0.65	14.43
2019-20	2.50	1.12	0.90	0.48	1.59	0.61	0.10	1.53	3.44	5.39	1.22	0.41	19.29
2020-21	0.36	2.73	1.84	0.85	0.77	1.76	0.19	1.04	3.68	2.12	0.19	1.82	17.35
2021-22	1.01	1.52	1.46	1.46	0.74	0.54	1.55	0.81	1.14	6.20	0.56	0.17	17.16
MEAN	1.52	1.45	1.57	1.51	1.36	1.22	1.26	1.70	2.33	3.37	1.42	1.02	19.70
	SEPT	OCT	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	TOTAL

Mean monthly precipitation for all crop years = 1.64

YEAR 2022 - GROWING DEGREE DAYS JANUARY THROUGH OCTOBER
CALCULATED AT BASE 50, BASE 40, AND BASE 32

Page 1: January - May

January

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	11	-5	0.0	0.0	0.0
2	13	-2	0.0	0.0	0.0
3	18	4	0.0	0.0	0.0
4	33	13	0.0	0.0	0.5
5	33	4	0.0	0.0	0.5
6	12	5	0.0	0.0	0.0
7	17	7	0.0	0.0	0.0
8	40	17	0.0	0.0	4.0
9	33	12	0.0	0.0	0.5
10	38	6	0.0	0.0	3.0
11	30	6	0.0	0.0	0.0
12	40	26	0.0	0.0	4.0
13	42	28	0.0	1.0	5.0
14	42	20	0.0	1.0	5.0
15	32	20	0.0	0.0	0.0
16	34	22	0.0	0.0	1.0
17	34	17	0.0	0.0	1.0
18	42	20	0.0	1.0	5.0
19	38	18	0.0	0.0	3.0
20	32	20	0.0	0.0	0.0
21	37	26	0.0	0.0	2.5
22	41	22	0.0	0.5	4.5
23	38	18	0.0	0.0	3.0
24	29	17	0.0	0.0	0.0
25	32	16	0.0	0.0	0.0
26	30	13	0.0	0.0	0.0
27	29	10	0.0	0.0	0.0
28	27	16	0.0	0.0	0.0
29	23	16	0.0	0.0	0.0
30	25	18	0.0	0.0	0.0
31	39	21	0.0	0.0	3.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
31.1	14.5	0.0	3.5	46.0

February

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	33	14	0.0	0.0	0.5
2	29	-7	0.0	0.0	0.0
3	8	-2	0.0	0.0	0.0
4	21	6	0.0	0.0	0.0
5	34	21	0.0	0.0	1.0
6	40	21	0.0	0.0	4.0
7	43	15	0.0	1.5	5.5
8	51	15	0.5	5.5	9.5
9	42	33	0.0	1.0	5.5
10	43	31	0.0	1.5	5.5
11	54	22	2.0	7.0	11.0
12	46	18	0.0	3.0	7.0
13	42	20	0.0	1.0	5.0
14	42	24	0.0	1.0	5.0
15	36	24	0.0	0.0	2.0
16	35	27	0.0	0.0	1.5
17	38	27	0.0	0.0	3.0
18	39	32	0.0	0.0	3.5
19	44	34	0.0	2.0	7.0
20	45	14	0.0	2.5	6.5
21	39	4	0.0	0.0	3.5
22	15	2	0.0	0.0	0.0
23	11	-10	0.0	0.0	0.0
24	12	-10	0.0	0.0	0.0
25	20	7	0.0	0.0	0.0
26	35	12	0.0	0.0	1.5
27	37	15	0.0	0.0	2.5
28	37	18	0.0	0.0	2.5
29	0	0	0.0	0.0	0.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
34.7	15.3	2.5	26.0	93.0

March

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	43	37	0.0	1.5	8.0
2	50	35	0.0	5.0	10.5
3	44	34	0.0	2.0	7.0
4	41	34	0.0	0.5	5.5
5	45	22	0.0	2.5	6.5
6	40	24	0.0	0.0	4.0
7	39	26	0.0	0.0	3.5
8	41	24	0.0	0.5	4.5
9	26	5	0.0	0.0	0.0
10	25	7	0.0	0.0	0.0
11	32	10	0.0	0.0	0.0
12	37	24	0.0	0.0	2.5
13	51	32	0.5	5.5	9.5
14	42	36	0.0	1.0	7.0
15	47	39	0.0	3.5	11.0
16	52	32	1.0	6.0	10.0
17	46	32	0.0	3.0	7.0
18	50	33	0.0	5.0	9.5
19	48	27	0.0	4.0	8.0
20	46	29	0.0	3.0	7.0
21	45	32	0.0	2.5	6.5
22	42	32	0.0	1.0	5.0
23	53	33	1.5	6.5	11.0
24	63	35	6.5	11.5	17.0
25	55	27	2.5	7.5	11.5
26	58	28	4.0	9.0	13.0
27	57	28	3.5	8.5	12.5
28	66	30	8.0	13.0	17.0
29	65	35	7.5	12.5	18.0
30	57	25	3.5	8.5	12.5
31	55	25	2.5	7.5	11.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
47.1	28.1	41.0	131.0	256.5

April

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	49	28	0.0	4.5	8.5
2	48	28	0.0	4.0	8.0
3	45	26	0.0	2.5	6.5
4	52	24	1.0	6.0	10.0
5	48	30	0.0	4.0	8.0
6	46	33	0.0	3.0	7.5
7	53	23	1.5	6.5	10.5
8	59	24	4.5	9.5	13.5
9	59	28	4.5	9.5	13.5
10	42	29	0.0	1.0	5.0
11	41	24	0.0	0.5	4.5
12	34	21	0.0	0.0	1.0
13	32	19	0.0	0.0	0.0
14	35	13	0.0	0.0	1.5
15	37	16	0.0	0.0	2.5
16	38	14	0.0	0.0	3.0
17	39	23	0.0	0.0	3.5
18	41	20	0.0	0.5	4.5
19	47	24	0.0	3.5	7.5
20	50	25	0.0	5.0	9.0
21	51	32	0.5	5.5	9.5
22	57	30	3.5	8.5	12.5
23	53	33	1.5	6.5	11.0
24	54	27	2.0	7.0	11.0
25	60	28	5.0	10.0	14.0
26	66	33	8.0	13.0	17.5
27	53	28	1.5	6.5	10.5
28	51	27	0.5	5.5	9.5
29	53	28	1.5	6.5	10.5
30	55	26	2.5	7.5	11.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
48.3	25.5	38.0	136.5	245.5

May

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	57	26	3.5	8.5	12.5
2	63	38	6.5	11.5	18.5
3	68	40	9.0	14.0	22.0
4	68	45	9.0	16.5	24.5
5	67	41	8.5	14.0	22.0
6	70	45	10.0	17.5	25.5
7	70	42	10.0	16.0	24.0
8	57	38	3.5	8.5	15.5
9	52	34	1.0	6.0	11.0
10	46	33	0.0	3.0	7.5
11	56	26	3.0	8.0	12.0
12	61	33	5.5	10.5	15.0
13	62	35	6.0	11.0	16.5
14	52	27	1.0	6.0	10.0
15	53	33	1.5	6.5	11.0
16	65	41	7.5	13.0	21.0
17	68	44	9.0	16.0	24.0
18	66	37	8.0	13.0	19.5
19	54	35	2.0	7.0	12.5
20	45	35	0.0	2.5	8.0
21	51	36	0.5	5.5	11.5
22	56	26	3.0	8.0	12.0
23	62	35	6.0	11.0	16.5
24	63	40	6.5	11.5	19.5
25	63	48	6.5	15.5	23.5
26	51	35	0.5	5.5	11.0
27	71	43	10.5	17.0	25.0
28	66	46	8.0	16.0	24.0
29	59	39	4.5	9.5	17.0
30	62	45	6.0	13.5	21.5
31	64	38	7.0	12.0	19.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
60.3	37.4	163.5	334.0	533.0

YEAR 2022 - 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	67	40	8.5	13.5	21.5
2	72	44	11.0	18.0	26.0
3	74	47	12.0	20.5	28.5
4	69	45	9.5	17.0	25.0
5	62	49	6.0	15.5	23.5
6	60	44	5.0	12.0	20.0
7	63	51	7.0	17.0	25.0
8	64	43	7.0	13.5	21.5
9	65	42	7.5	13.5	21.5
10	71	51	11.0	21.0	29.0
11	71	54	12.5	22.5	30.5
12	63	49	6.5	16.0	24.0
13	64	46	7.0	15.0	23.0
14	52	41	1.0	6.5	14.5
15	46	41	0.0	3.5	11.5
16	62	40	6.0	11.0	19.0
17	80	48	15.0	24.0	32.0
18	85	54	19.5	29.5	37.5
19	71	52	11.5	21.5	29.5
20	62	48	6.0	15.0	23.0
21	54	48	2.0	11.0	19.0
22	68	48	9.0	18.0	26.0
23	78	52	15.0	25.0	33.0
24	73	39	11.5	16.5	24.0
25	66	36	8.0	13.0	19.0
26	72	39	11.0	16.0	23.5
27	78	44	14.0	21.0	29.0
28	84	49	17.0	26.5	34.5
29	86	53	19.5	29.5	37.5
30	69	43	9.5	16.0	24.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
68.4	46.0	286.0	518.5	755.5

JULY

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	75	45	12.5	20.0	28.0
2	83	47	16.5	25.0	33.0
3	85	56	20.5	30.5	38.5
4	75	50	12.5	22.5	30.5
5	73	43	11.5	18.0	26.0
6	78	46	14.0	22.0	30.0
7	78	54	16.0	26.0	34.0
8	81	58	19.5	29.5	37.5
9	83	52	17.5	27.5	35.5
10	83	55	19.0	29.0	37.0
11	77	50	13.5	23.5	31.5
12	80	48	15.0	24.0	32.0
13	86	49	18.0	27.5	35.5
14	78	48	14.0	23.0	31.0
15	88	49	18.0	27.5	35.5
16	83	52	17.5	27.5	35.5
17	92	59	22.5	32.5	40.5
18	90	50	18.0	28.0	36.0
19	72	51	11.5	21.5	29.5
20	80	50	15.0	25.0	33.0
21	89	50	18.0	28.0	36.0
22	88	52	19.0	29.0	37.0
23	85	46	17.5	25.5	33.5
24	87	48	18.0	27.0	35.0
25	85	55	20.0	30.0	38.0
26	86	54	20.0	30.0	38.0
27	88	54	20.0	30.0	38.0
28	93	58	22.0	32.0	40.0
29	94	59	22.5	32.5	40.5
30	96	53	19.5	29.5	37.5
31	94	53	19.5	29.5	37.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
84.0	51	519.0	803.5	1043.5

AUGUST

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	97	49	23.0	27.5	35.5
2	95	59	27.0	32.5	40.5
3	86	59	22.5	32.5	40.5
4	88	58	23.0	32.0	40.0
5	85	44	17.5	24.5	32.5
6	80	48	15.0	24.0	32.0
7	81	49	15.5	25.0	33.0
8	86	48	18.0	27.0	35.0
9	90	48	20.0	27.0	35.0
10	95	61	28.0	33.5	41.5
11	84	55	19.5	29.5	37.5
12	91	55	23.0	30.5	38.5
13	88	54	21.0	30.0	38.0
14	88	46	19.0	26.0	34.0
15	85	45	17.5	25.0	33.0
16	88	47	19.0	26.5	34.5
17	90	48	20.0	27.0	35.0
18	93	53	23.0	29.5	37.5
19	95	53	24.0	29.5	37.5
20	96	57	26.5	31.5	39.5
21	92	58	25.0	32.0	40.0
22	88	53	20.5	29.5	37.5
23	89	50	19.5	28.0	36.0
24	89	55	22.0	30.5	38.5
25	88	54	21.0	30.0	38.0
26	75	58	16.5	26.5	34.5
27	82	56	19.0	29.0	37.0
28	78	39	14.0	19.0	26.5
29	75	42	12.5	18.5	26.5
30	81	45	15.5	23.0	31.0
31	88	50	19.0	28.0	36.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
87.3	51.5	607.5	836.5	1076.0

SEPTEMBER

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	91	46	18.0	26.0	34.0
2	91	48	18.0	27.0	35.0
3	91	46	18.0	26.0	34.0
4	93	47	18.0	26.5	34.5
5	85	45	17.5	25.0	33.0
6	87	41	18.0	23.5	31.5
7	85	43	17.5	24.0	32.0
8	88	46	18.0	26.0	34.0
9	74	33	12.0	17.0	21.5
10	67	33	8.5	13.5	18.0
11	75	38	12.5	17.5	24.5
12	72	39	11.0	16.0	23.5
13	72	43	11.0	17.5	25.5
14	76	43	13.0	19.5	27.5
15	72	42	11.0	17.0	25.0
16	74	48	12.0	21.0	29.0
17	73	39	11.5	16.5	24.0
18	72	36	11.0	16.0	22.0
19	71	41	10.5	16.0	24.0
20	76	42	13.0	19.0	27.0
21	66	30	8.0	13.0	17.0
22	73	35	11.5	16.5	22.0
23	51	38	0.5	5.5	12.5
24	63	40	6.5	11.5	19.5
25	70	38	10.0	15.0	22.0
26	72	40	11.0	16.0	24.0
27	77	40	13.5	18.5	26.5
28	77	41	13.5	19.0	27.0
29	81	46	15.5	23.5	31.5
30	64	40	7.0	12.0	20.0

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
76.0	40.9	377.0	561.0	781.5

OCTOBER

Day	Temperatures		Growing Degree Days		
	MAX	MIN	Base 50	Base 40	Base 32
1	65	45	7.5	15.0	23.0
2	71	49	10.5	20.0	28.0
3	65	38	7.5	12.5	19.5
4	70	39	10.0	15.0	22.5
5	72	38	11.0	16.0	23.0
6	73	39	11.5	16.5	24.0
7	74	37	12.0	17.0	23.5
8	71	35	10.5	15.5	21.0
9	66	33	8.0	13.0	17.5
10	66	34	8.0	13.0	18.0
11	70	36	10.0	15.0	21.0
12	68	36	9.0	14.0	20.0
13	70	33	10.0	15.0	19.5
14	65	30	7.5	12.5	16.5
15	65	33	7.5	12.5	17.0
16	69	30	9.5	14.5	18.5
17	65	27	7.5	12.5	16.5
18	63	27	6.5	11.5	15.5
19	63	28	6.5	11.5	15.5
20	61	26	5.5	10.5	14.5
21	61	29	5.5	10.5	14.5
22	59	37	4.5	9.5	16.0
23	55	32	2.5	7.5	11.5
24	40	31	0.0	0.0	4.0
25	46	34	0.0	3.0	8.0
26	41	35	0.0	0.5	6.0
27	45	35	0.0	2.5	8.0
28	50	37	0.0	5.0	11.5
29	51	36	0.5	5.5	11.5
30	55	37	2.5	7.5	14.0
31	52	43	1.0	7.5	15.5

AV MAX	AV MIN	Total Base 50	Total Base 40	Total Base 32
61.5	34.8	191.5	334.5	499.5

Julian Date Calendar for Year 2022

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

Project Title: 2022 Forage Barley EYT

Objective: To evaluate the agronomic performance of experimental forage barley lines grown in northwestern Montana.

Personnel: Clint Beiermann, Jamie Sherman, Jessica Pavelka**,** Gregory Lutgen

Summary:

Thirty-six developmental barley lines were planted on April 29th, 2022 and harvested on August 19th, 2022 (Table 1). They were managed under rainfed conditions and received 8.1 inches of rainfall throughout the growing period (Apr-Aug).

Average yield for the study was 83.66 bu/A, with the highest yield at 103.1 bu/A for MT20_F109_08 to the lowest at 58.2 bu/A for MT20_F108_12. The highest ADF content was 40.76% for MT20_F098_01 while the lowest was 34.38% for MT20_F097_07. The average NDF content across the trial was 63.08% with MT20_F098_01 being the highest at 66.79% and MT20_F097_07 the lowest at 59.46%. The average dry matter was 90.77%, the highest at 91.16% for MT20_F098_03 and the lowest at 90.45% for MT20_F110_07.

Table 1. Management information

Seeding date:	4/29/2022	**Field Location:**	Y5
Julian date:	119	**Harvest date:**	8/19/2022
Seeding rate:	NA	**Julian date:**	231
Previous crop:	Spring Wheat	**Soil type:**	Silty Clay Loam
Herbicide:	CleansweepM 1pt/A + Axial Bold 15oz/A	**Tillage:**	Conventional
Insecticide:	None	**Soil residual nutrient (NO_3^{-1}, P, K lb/A):**	108-10-248
Fungicide:	None	**Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):**	50-40-50

Table 2. Agronomic performance of barley

Variety/Line	HD (julian)	HT (cm)	DM Forage Biomass (tons/A)	ADF (%)	NDF (%)	TWT (lb/bu)	DM (%)	YLD (bu/A)
MT20_F109_08	**187**	95.7	5.3	37.7	63.7	49.2	90.6	**103.1**
MT20_F108_13	**187**	90.6	4.7	37.7	63.1	50.0	**90.9**	**101.9**
MT20_F110_17	185	**103.2**	5.8	37.2	63.0	**52.1**	90.6	**101.7**
Hays	**187**	90.3	4.8	36.9	62.4	49.5	90.6	**98.5**
MT20_F097_07	**187**	65.9	4.4	34.4	59.5	46.3	90.6	**96.7**
MT20_F109_22	**186**	89.2	4.8	38.0	63.2	48.7	**90.8**	**96.1**
MT20_F098_01	185	99.7	5.5	**40.8**	**66.8**	46.7	**91.1**	**94.8**
MT20_F109_04	**186**	**100.7**	5.0	37.6	63.4	49.1	90.6	**94.8**
Haymaker	**187**	98.2	4.7	37.9	62.7	49.4	90.7	**92.2**
MT20_F098_05	**186**	96.6	5.2	**38.9**	**64.6**	49.1	**91.0**	**91.6**
MT20_F109_10	186	**102.0**	5.3	37.0	62.4	49.3	90.6	**88.4**
MT20_F099_02	**187**	96.4	4.0	36.0	61.3	49.9	90.5	**88.3**
MT20_F110_10	**186**	**104.0**	4.8	37.9	63.4	50.7	90.7	**88.3**
MT20_F099_05	186	94.1	4.3	38.1	63.5	50.6	**91.0**	**88.1**
MT20_F098_03	186	85.9	4.1	37.5	63.5	47.3	**91.2**	**85.8**
MT20_F098_08	**186**	84.5	4.4	38.7	**64.2**	48.5	**90.8**	**85.6**
MT20_F110_04	**187**	88.2	4.8	37.2	63.3	49.6	**90.8**	**85.5**
MT20_F097_01	**187**	98.6	4.8	37.5	63.3	49.5	90.7	84.0
MT20_F098_24	**186**	92.8	4.6	37.2	62.1	48.4	90.6	83.9
MT20_F097_20	185	**104.8**	3.9	38.0	63.1	49.2	90.7	83.8
MT20_F098_28	**187**	82.6	4.1	37.8	**64.0**	47.6	**90.8**	82.4
MT20_F099_10	**187**	82.6	4.0	38.5	**64.1**	48.0	**91.0**	81.6
MT20_F109_18	**186**	97.0	4.2	37.2	62.0	47.6	90.7	81.5
MT20_F099_14	186	95.8	4.8	**38.8**	**65.3**	49.6	**91.1**	79.5
MT20_F111_10	**187**	**103.4**	4.5	37.7	63.0	48.5	**90.8**	79.2
MT20_F110_12	**186**	93.4	5.4	35.9	59.6	48.4	90.6	78.8
MT20_F110_07	**187**	97.1	4.7	36.6	60.8	49.7	90.5	78.5
MT Cowgirl	185	**103.1**	4.9	38.7	63.9	47.4	**90.9**	77.5
MT20_F110_19	**186**	96.7	5.0	37.8	62.9	47.6	90.7	73.9
MT20_F111_15	186	98.9	5.5	37.7	63.1	47.2	**90.9**	72.0
MT20_F111_21	**186**	**109.2**	5.4	36.9	61.4	49.5	90.7	71.8
MT20_F099_04	**186**	98.7	5.2	**39.0**	**65.4**	48.7	**90.9**	71.4
Lavina	**186**	87.6	4.4	38.1	**65.3**	47.5	**90.8**	69.5
MT20_F111_25	186	**109.1**	5.8	**39.3**	**64.7**	46.7	**90.9**	63.7
MT20_F108_24	182	98.2	4.4	37.9	61.5	42.7	**90.8**	59.2
MT20_F108_12	183	**104.1**	5.0	36.8	61.6	43.5	90.6	58.2

Table 2. continued								
Variety/Line	HD (julian)	HT (cm)	DM Forage Biomass (tons/A)	ADF (%)	NDF (%)	TWT (lb/bu)	DM (%)	YLD (bu/A)
Mean	**186**	**95.53**	4.78	**37.69**	**63.08**	**48.43**	**90.77**	**83.66**
LSD(0.05)	**0.93**	**9.04**	1.02	**1.96**	**2.84**	**1.01**	**0.41**	**18.77**
C.V.	**0.30**	**5.79**	13.12	**3.18**	**2.76**	**1.29**	**0.27**	**13.71**

Bold = top performer, **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

HD = heading date, HT = height, LOD = lodging, YLD = yield, TWT = test weight, ADF = acid detergent fiber, NDF = neutral detergent fiber, DM = dry matter

Project Title: 2022 Forage Barley Intrastate Advanced Yield Trial

Objective: To evaluate the performance of developmental forage barley lines in northwestern Montana

Personnel: Clint Beiermann, Jamie Sherman, Jessica Pavelka, Gregory Lutgen

Summary:

Forage barley varieties were seeded on April 29th, 2022 and harvest on August 17th, 2022 (Table 1). They were managed under rainfed conditions with a total of 8.1 inches of rainfall received during the growing period (April-Aug).

The highest yielding variety was MT17F02410 with an average yield of 110.2 bu/A. The lowest yielding variety was MT19_F01_03 with an average yield of 74.3 bu/A. The overall yield average was 88.08 bu/A. The average forage dry matter was 28.56% and ranged from 30.8% for MT19_F04_01 to 27% for MT18F00812. The average ADF was 37.65% and ranged from 39.9% for Haymaker to 35% for MT19_F04_02. The average NDF was 62.0%, with the highest being 65.6% for Haymaker and the lowest at 58.8% for MT19_F04_02.

Table 1. Management information

Seeding date:	4/29/2022	**Field Location:**	Y5
Julian date:	119	**Harvest date:**	8/17/2022
Seeding rate:	NA	**Julian date:**	229
Previous crop:	Spring Wheat	**Soil type:**	Silty Clay Loam
Herbicide	CleansweepM 1pt/A + Axial Bold 15oz/A	**Tillage:**	Conventional
Insecticide	None	**Soil residual nutrient (NO3-1, P, K lb/A):**	108-10-248
Fungicide	None	**Nutrient fertilizer applied (N, P2O5, K20 lb/A):**	50-40-50

Table 2. Agronomic performance of forage barley

Variety/Line	Heading (julian)	HT (cm)	Forage Biomass (tons/A)	DM (%)	ADF (%)	NDF (%)	YLD (bu/a)	TWT (lb/bu)
MT17F02410	184	94.1	4.8	27.8	**38.2**	**64.0**	**110.2**	50.1
MT16F02401	183	94.9	**6.0**	27.4	**38.2**	**64.4**	**104.3**	45.9
MT16F02406	186	97.2	4.8	27.5	36.8	60.6	**101.6**	**50.6**
Haymaker	**187**	98.7	4.8	28.5	**39.9**	**65.6**	**100.1**	50.3
MT18F00503	**187**	100.4	**5.3**	27.6	38.1	**63.5**	**97.4**	48.9
MT18F00803	184	95.2	**5.5**	28.9	36.1	61.4	96.2	46.7
Lavina	183	93.8	**5.2**	28.2	38.1	**63.4**	95.2	48.4
MT16F01601	182	96.3	4.6	27.9	36.2	61.2	93.7	48.7
MT19_F06_02	182	89.9	4.5	29.2	37.1	**62.8**	92.8	45.6
MT16F02405	181	97.0	**5.1**	**30.5**	36.9	59.8	90.1	48.8
MT18F00507	**187**	95.2	**5.2**	27.4	36.3	61.6	89.1	47.7
MT16F02903	183	**107.6**	**5.0**	27.4	**39.0**	**64.0**	88.0	50.1
MT18F00714	**187**	100.3	4.6	28.3	36.6	62.0	86.9	46.4
MT19_F07_04	179	93.7	**4.9**	**29.8**	**38.2**	61.9	86.0	46.2
MT19_F01_01	181	100.8	**5.0**	29.2	**39.2**	**64.0**	84.7	49.2
MT17F01612	180	95.0	4.7	28.2	36.6	60.1	81.9	48.1
MT18F00812	**188**	101.2	**5.2**	27.0	**39.1**	**64.8**	81.4	43.3
MT Cowgirl	183	99.2	**5.0**	28.8	**38.2**	**64.1**	80.2	48.4
MT19_F04_01	179	95.7	4.9	**30.8**	36.5	60.5	80.1	48.4
MT19_F03_01	179	96.4	4.8	**29.3**	37.5	62.7	80.0	47.0
MT19_F05_03	177	97.3	4.8	**30.4**	37.7	62.2	80.0	47.8
MT18F00607	**188**	**102.5**	4.1	27.5	37.5	**64.5**	78.2	47.2
MT19_F04_02	183	97.8	**5.1**	29.2	35.0	58.8	75.1	46.6
MT18F00908	183	**103.8**	4.8	**29.7**	**38.9**	**64.6**	74.3	47.7
MT19_F01_03	180	**108.5**	**5.4**	27.5	**39.4**	62.5	74.3	48.2
Mean	**183.04**	**98.10**	**4.94**	**28.56**	**37.65**	**62.60**	**88.08**	**47.86**
LSD(<.05)	**1.88**	**6.88**	**1.15**	**1.46**	**1.67**	**2.74**	**13.12**	**0.53**
C.V.	**0.52**	**3.81**	**13.14**	**2.99**	**2.89**	**2.40**	**8.55**	**0.68**

Bold = top performer, **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

HD = heading date, HT = height, LOD = lodging, YLD = yield, TWT = test weight, ADF = acid detergent fiber, NDF = neutral detergent fiber, DM = dry matter

Project Title: 2022 Off-Station Barley

Objective: To evaluate the performance of selected barley varieties in a production environment in northwestern Montana

Personnel: Clint Beiermann, Jamie Sherman, Jessica Pavelka, Gregory Lutgen

Summary:

Twenty-five barley varieties were planted on May 16th, 2022 and harvested on September 6th, 2022 (Table 1). They were managed with overhead sprinkler irrigation and received 8.1" of rainfall throughout their growing period (Apr – Aug).

The average yield of all varieties was 76.3 bu/A, ranging from 118.6 bu/A for Lexy to 11.3 bu/A for MT16F01601. The average protein content was 13.9% ranging from 17.0% for Haymaker to 12.4% for MT17M02507. The percent plump rate varied greatly, with an average of 13.64%. The variety with the highest percent plump was MT16H09302 at 44.7%, while the lowest was Diablo at 3.0% (Table 2). Average test weight was 49.4 lb/bu with the lowest weight at 44.8 lb/bu for the variety Haymaker to the highest at 59.2 lb/bu for Havener.

Table 1. Management information

Seeding date:	5/16/2022	Field Location:	Creston
Julian date:	136	Harvest date:	9/6/22
Seeding rate:	NA	Julian date:	249
Previous crop:	Barley	Soil type:	Fine Sandy Loam
Herbicide:	Axial – 6/16 Axial, Comet & Power – 7/10	Tillage:	Conventional
		Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):	17-70-19-12.5S

Table 2. Agronomic performance of barley varieties

Variety/Line	YLD (bu/A)	Plump (%)	TWT (lb/bu)	PRO (%)
Lexy	**118.6**	4.0	49.0	12.4
Buzz	**111.8**	3.7	51.3	12.5
ABI Eagle	**107.4**	9.2	50.1	14.0
Ellinor	**106.7**	6.9	48.2	12.7
Opera	**105.4**	11	47.2	13.2
Leandra	**100.8**	6.1	47.7	13.7
2IM14-8212	**99.8**	3.9	50.0	13.3
MT18M06011	**99.7**	5	51.4	12.5
2IM16-0154	**97.1**	5.3	51.3	13.8
MT16M02201	**96.8**	4.9	48.2	13.0
MT16M02101	**96.2**	5.7	49.0	12.8
Diablo	**95.0**	3.0	48.4	12.9
Merit 57	**93.5**	12.5	49.3	14.1
MT17M01711	91.0	7.3	49.3	12.9
Odyssey	86.8	4.8	48.4	12.9
Havener	82.4	21.0	**59.2**	15.2
MT18H02702	63.7	17.6	56.7	**16.4**
Hockett	59.2	6.3	50.8	14.2
Haxby	47.8	15.5	49.4	14.5
MT17M02507	47.4	10.5	50.4	12.4
MT16F02902	27.5	29.9	45.5	15.2
MT16H09302	21.8	**44.7**	47.8	14.8
Lavina	21.6	36.1	44.9	15.9
Haymaker	19.0	**43.7**	44.8	**17.0**
MT16F01601	11.3	22.4	46.3	**16.4**
Mean	**76.33**	**13.64**	**49.39**	**13.94**
LSD	**25.98**	**5.74**	**1.92**	**0.92**
C.V.	**19.09**	**25.42**	**2.51**	**3.72**

Bold = top performer, **Bolding** = equal value to highest value within a column based on LSD(0.05)
YLD = yield, TWT = test weight, PRO = protein

Project Title: 2022 Forage Barley Nitrogen Rate

Objective: To evaluate the agronomic performance of forage barley with different nitrogen fertilizer rates in environments and cropping systems representative of northwestern Montana

Personnel: Clint Beiermann, Jessica Pavelka

Summary:

Forage barley was planted on April 29th, 2022 with four different nitrogen rates of 47, 114, 182, and 249 lbs/A (Table 1), and five different varieties (Table 2).

N rates had an influence on all aspects tested. Variety influenced the ADF %, NDF %, heading date, heading height, grain yield, grain protein, and test weight. The highest yielding variety was MT16F01601 at 182 lbs/A N, while the lowest averaging forage yield came from the five varieties given 47 lbs/A N. The lowest forage yield came from MT17M02507 at 182 lbs/A N, although it had the highest grian yield at 106.7 bu/A. The highest grain protein was 14.5% in Cowgirl at 249 lbs/A N, and the lowest was 9.3% from MT17M02507 at 47 lbs/A N (Table 2).

Forage yield increased with N plateauing at about 1.5 N (182 lbs N/ac) (Figure 1). Nitrates increased with N, however, most varieties had acceptable nitrates at and below 1.5 N (Figure 2). NDF and ADF were relatively stable across N treatments (Figure 3). If a grower could feed an awned line, then from the data MT17MO2507 performs well for forage yield and outperforms all other lines for grain yield.

Table 1. Management information

Seeding date:	4/29/2022	**Field Location:**	Y9
Julian date:	119	**Harvest date:**	8/18/2022
Seeding rate:	25 plants/ft^2	**Julian date:**	230
Previous crop:	Canola	**Soil type:**	Swims Silty Clay Loam
Herbicide:	Axial Bold + Cleansweep - 6/1/22	**Tillage:**	Conventional
Insecticide:	NA	**Soil residual nutrient (NO_3^{-1}, P, K lb/A):**	47-40-342-30s
Fungicide:	NA	**Nutrient fertilizer applied (lbs/A):**	0, 67, 135, 202 N

Table 2. Agronomic performance

Variety/Line	N treatment	Forage YLD[2] tons/A	Nitrate[2] mg/L	ADF[1,2]	NDF[1,3]	HD[1,3] julian	HT[1,2] cm	Grain YLD[1,2] bu/A	Grain PRO[1,2] %	Test WT[1,3] lbs/bu
Lavina	0x	2.4	0.0	34.4	61.1	185	55.5	28.5	11.3	46.9
Cowgirl	0x	2.1	0.0	35.4	61.0	**183**	61.6	24.6	11.9	46.9
MMT18F00803	0x	2.2	0.0	32.7	57.5	185	56.7	33.1	11.1	43.4
MT16F01601	0x	2.4	0.0	32.7	57.3	**183**	57.8	32.7	11.3	46.6
MT17M02507	0x	2.0	0.0	34.5	60.2	**183**	59.7	49.2	9.3	51.0
Lavina	1x	3.9	12.4	35.1	60.8	186	70.9	34.8	11.8	46.8
Cowgirl	1x	4.2	0.0	**36.5**	**62.4**	185	83.2	30.2	12.2	46.3
MMT18F00803	1x	4.5	55.1	33.0	57.2	186	80.7	41.7	12.0	45.0
'MT16F01601	1x	4.1	34.9	33.3	57.1	**183**	82.4	48.8	12.1	47.7
MT17M02507	1x	4.5	7.6	35.4	60.3	184	81.5	90.4	9.9	**52.0**
Lavina	1.5x	**5.2**	469.7	**36.6**	**62.4**	185	90.2	40.7	14.0	46.4
Cowgirl	1.5x	4.9	405.9	**36.4**	**61.6**	185	**96.5**	34.1	**14.4**	45.7
MMT18F00803	1.5x	4.8	142.5	33.4	58.0	187	85.1	53.6	13.5	44.9
'MT16F01601	1.5x	**5.5**	130.4	35.3	61.1	184	92.5	56.9	13.4	47.1
MT17M02507	1.5x	1.9	511.2	35.7	61.4	184	89.1	**106.7**	10.8	**52.3**
Lavina	2x	4.5	386.0	35.2	60.5	186	89.5	42.6	13.9	45.8
Cowgirl	2x	**5.3**	**1066.5**	**36.8**	**61.9**	185	**99.9**	46.9	**14.5**	45.9
MMT18F00803	2x	5.0	317.2	33.3	58.2	187	87.4	38.7	14.1	44.5
'MT16F01601	2x	**5.3**	510.4	34.3	59.0	**183**	90.8	57.5	**14.2**	46.3
MT17M02507	2x	**5.4**	603.9	36.1	**61.9**	184	91.5	**101.1**	11.0	**52.0**
MEAN		**4.2**	**232.7**	**34.8**	**60.0**	**184**	**80.3**	**49.6**	**12.3**	**47.2**
LSD		**0.4**	**219.3**	**0.5**	**0.9**	**0.6**	**3.0**	**6.0**	**0.3**	**0.5**
CV		**16.1**	**148.8**	**2.3**	**2.3**	**0.5**	**5.9**	**19.2**	**4.1**	**1.6**

[1]Trait variance due to variety P<.001, [2]Trait variance due to N Treatment P<.00001, [3]P<0.05

Bold = top performer, **Bold** = statistically equivalent to the top performer, ADF = acid detergent fiber, NDF = neutral detergent fiber, YLD = yield, HD = heading date, HT = height, PRO = protein, WT = weight

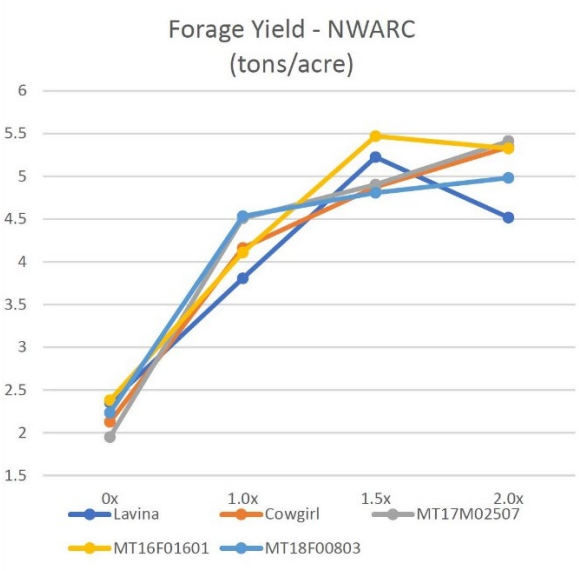


Figure 1. Forage yield with N treatment

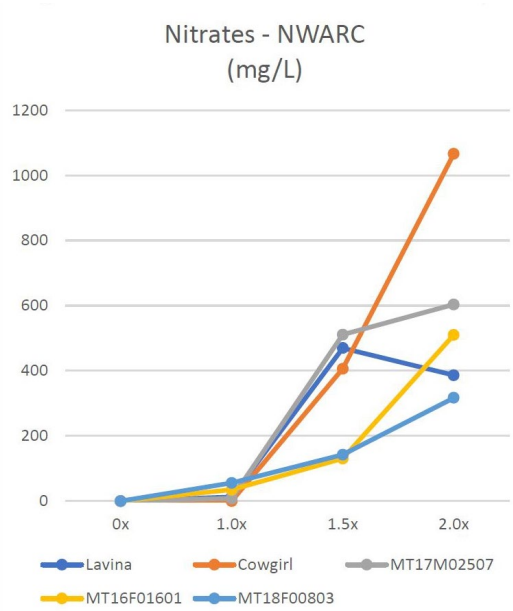


Figure 2. Nitrate with N treatment

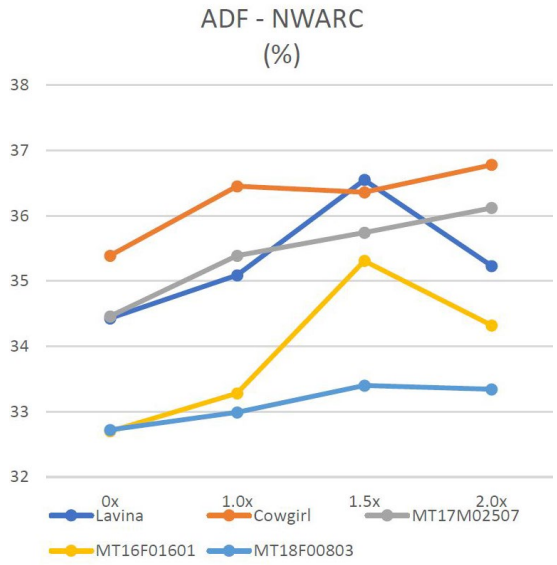


Figure 3. Acid detergent fiber with N treatment

Project Title: 2022 Spring Wheat Advanced Yield Trial

Objective: To evaluate the performance of developmental spring wheat lines in northwestern Montana

Personnel: Clint Beiermann, Jason Cook, Hwa-Young Heo, Jessica Pavelka

Summary:

Spring Wheat was seeded on April 27th, 2022 and managed under rainfed conditions (Table 1). A total of 8.8 inches of rainfall was received during the growing period (April-August).

The highest yielding variety was LCS HammerAX with an average yield of 106.7 bu/A. The lowest yielding variety was THATCHER with an average yield of 55.4 bu/A. The overall yield average was 78.4 bu/A. The average protein content was 10.7%. The highest protein content was 11.6% from MT 21091 and the lowest was 9.7% for MT 2063. The average test weight was 63.3 lb/bu and ranged from 65.6 lb/bu for WB 9719 to 61.6 lb/bu for MT 2049. The average heading date was 185 julian with the earliest heading date at 183 julian for eighteen of the varieties, to the latest at 189 julian from NS PRESSER CLP.

Table 1. Management information

Seeding date:	4/27/2022	**Field Location:**	NWARC Y-8
Julian date:	117	**Harvest date:**	8/30/2022
Seeding rate:	NA	**Julian date:**	242
Previous crop:	Canola	**Soil type:**	Creston Silt Loam
Herbicide:	MCPA+bromoxynil+flur-oxypyr+pinoxadin	**Tillage:**	Conventional
Insecticide:	None	**Soil residual nutrient (NO_3^{-1}, P, K lb/A):**	71-40-342
Fungicide:	None	**Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):**	80-20-25-10s

Table 2. Agronomic performance of spring wheat

Variety/Line	HD (julian)	YLD (bu/A)	TWT (lb/bu)	PRO (%)	TKW (g)
LCS HammerAX	184	**106.7**	63.0	10.2	39.0
MT 21105	185	94.4	63.2	10.7	43.3
DUCLAIR	**184**	93.2	62.8	10.5	39.4
MT 1939	184	92.6	63.5	10.6	41.8
DAGMAR	184	88.8	63.8	10.8	42.4
MT 21104	184	88.6	63.7	10.4	40.9
MT 21082	**183**	87.9	62.7	11.1	37.9
LCS Dual	184	87.4	63.1	9.9	37.9
MT 21016	**183**	87.3	63.2	**11.4**	37.4
MT 21019	**183**	86.9	62.9	10.6	44.2
MT 2063	**183**	85.9	64.2	9.7	42.2
MT 2022	**183**	85.8	63.9	10.4	39.8
MT 2050	185	83.9	63.0	10.9	38.7
MT 21023	184	83.5	64.2	11.0	39.8
MT 21031	**183**	83.1	65.1	**11.3**	40.5
SY ROCKFORD	186	83.0	62.5	10.8	40.1
MT 21003	186	82.7	63.5	10.7	37.8
MS Ranchero	**184**	82.6	62.8	10.6	38.5
WB 9929	186	82.5	62.0	10.2	43.3
MT 21091	184	82.1	62.4	**11.6**	41.6
MT 21074	186	82.0	63.9	10.9	40.6
MT 2030	184	81.9	62.4	10.8	42.1
MT SIDNEY	**183**	81.6	64.1	10.4	33.1
WB 9516	185	81.5	63.7	10.1	43.8
SY Longmire	184	81.2	63.9	10.6	37.3
MT 21024	**183**	81.0	64.3	10.2	39.9
LCS Ascent (LNR 0046)	**183**	80.6	64.0	10.3	35.0
MT 21073	184	80.6	63.6	11.1	40.1
AP Gunsmoke CL2	184	80.2	62.7	11.0	38.8
ROCKER	186	80.1	63.6	10.3	36.7
CORBIN	184	78.8	63.5	9.9	46.0
AP Smith	186	78.7	63.6	**11.3**	35.4
CHOTEAU	185	78.6	63.3	10.3	37.9
WB GUNNISON	186	78.2	63.1	10.6	46.8
WB 9879 CLP	185	77.9	63.8	10.4	35.8
MT 21005	**183**	77.8	62.7	11.2	39.0
SY INGMAR	186	77.1	64.0	**11.3**	34.7
MT 21062	**183**	77.0	63.7	10.2	38.9

Table 2. continued					
Variety/Line	**HD (julian)**	**YLD (bu/A)**	**TWT (lb/bu)**	**PRO (%)**	**TKW (g)**
MT 2054	184	75.9	63.1	10.9	**48.8**
MT 1809	186	75.2	62.3	10.8	40.1
AAC Concord	188	74.8	62.5	11.1	41.2
ND HERON	184	74.4	64.6	11.1	37.6
MT 21021	**183**	74.3	64.4	10.8	42.6
WB 9668	**183**	73.8	64.0	10.9	35.9
MT 2013	**183**	73.1	63.9	10.4	39.3
MT 21111	**183**	73.1	63.5	11.2	43.3
WB 9719	186	73.0	**65.6**	10.1	38.0
MT 2038	**183**	72.8	62.5	11.2	44.7
MT 21075	185	72.5	63.8	11.1	39.7
SY 611 CL2	185	72.3	63.5	10.9	36.6
MS Cobra	184	71.4	63.7	10.6	35.7
MT 21037	184	71.2	62.9	10.8	40.9
NS PRESSER CLP	189	71.2	62.6	10.0	41.4
MT 21102	184	70.9	64.5	11.1	38.4
MT 2049	**183**	69.7	61.6	10.9	39.5
VIDA	186	69.5	63.2	10.2	41.4
MT 21089	184	68.8	62.0	11.2	43.5
MT 21099	188	68.8	62.4	10.2	40.0
MT 2007	**183**	66.9	63.0	10.7	41.7
REEDER	185	66.3	63.3	11.0	41.1
LANNING	184	66.1	62.6	11.1	40.0
MCNEAL	186	65.2	62.8	10.9	41.9
MT 21076	187	64.5	62.1	10.7	37.0
THATCHER	187	55.4	62.6	10.7	33.0
Mean	**185**	**78.4**	**63.3**	**10.7**	**39.9**
C.V.	**0.3**	**7.2**	**0.3**	**2.3**	**1.7**
LSD(0.05)	**1.1**	**9.7**	**0.3**	**0.4**	**1.1**
PR>F	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Bold = highest value in column; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

HD = heading date, YLD = yield, PRO = protein, TWT = test weight, TKW = thousand kernel weight

Project Title: 2022 Spring Wheat Preliminary Yield Trial

MONTANA wheat & barley

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

Personnel: Clint Beiermann, Jason Cook, Hwa-Young Heo, Jessica Pavelka

Summary:

One hundred and twenty-one spring wheat lines were planted on April 27th, 2022 and managed under rainfed conditions (Table 1). A total of 8.9 inches of rainfall was received during the growing period (April-September).

Average spring wheat yield was 79.1 bu/A and ranged from 98.6 bu/A for MT 21272 to 59.1 bu/A for MT 21359. The protein content averaged 10.5% for the study. The highest protein content was 11.8% for MT 21439, while the lowest was 9.3% for MT 21286. The average heading date was 185 julian days, with the earliest at 181 for MT 21215 to the latest at 188 for MT 21288. The average test weight was 63.6 lb/bu, with the highest at 65.2 lb/bu from MT 21297 and the lowest at 62.0 lb/bu from MT 21430.

Table 1. Management information

Seeding date:	4/27/2022	**Field Location:**	Y8
Julian date:	117	**Harvest date:**	9/7/2022
Seeding rate:	NA	**Julian date:**	250
Previous crop:	Canola	**Soil type:**	Creston Silt Loam
Herbicide:	MCPA+bromoxynil+flur-oxypyr+pinoxadin	**Tillage:**	Conventional
Insecticide:	None	**Soil residual nutrient (NO_3^{-1}, P, K lb/A):**	71-40-342
Fungicide:	None	**Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):**	80-20-25-10s

Table 2. Agronomic performance of spring wheat

Variety/Line	HD (julian)	YLD (bu/A)	TWT (lb/bu)	PRO (%)	TKW (g)
MT 21272	187.1	**98.6**	63.6	9.4	39.5
MT 21280	186.0	**95.9**	63.5	10.4	42.3
MT 21124	186.8	**95.3**	64.0	11.0	40.8
MT 21186	184.9	**95.1**	62.6	11.2	40.4
MT 21183	186.9	**94.5**	62.6	10.5	37.0
MT 21178	185.4	**94.2**	63.8	10.1	38.3
MT 21214	185.0	**94.0**	63.9	10.4	36.5
MT 21247	184.2	**93.0**	62.7	11.1	41.4
MT 21320	185.5	**92.4**	63.5	11.2	43.4
MT 21337	186.9	**90.5**	64.6	11.3	39.8
DAGMAR	183.5	**89.8**	63.9	10.8	42.6
MT 21224	184.3	**89.8**	64.5	10.6	38.7
MT 21148	186.5	**89.8**	64.3	10.6	36.6
MT 21218	186.6	**89.5**	64.2	10.3	35.7
MT 21230	186.3	**89.4**	64.2	10.2	43.0
MT 21176	184.5	88.1	63.5	9.9	35.9
MT 21366	**183.1**	88.1	63.5	10.3	42.8
MT 21127	184.9	87.9	63.6	10.9	36.1
MT 21345	186.6	87.2	63.9	10.6	46.6
CHOTEAU	187.2	86.5	63.8	10.6	37.2
MT 21262	185.2	86.3	63.6	10.9	35.9
MT 21455	185.0	86.3	64.5	10.7	41.5
MT 21196	187.2	86.0	62.8	10.8	41.1
MT 21121	185.2	85.6	63.3	10.4	39.1
MT 21212	187.6	85.6	63.9	10.3	43.0
REEDER	186.0	85.4	63.5	11.2	40.2
MT 21149	185.4	85.4	62.9	11.1	41.9
MT 21305	184.3	85.1	63.7	10.6	39.4
MT 21429	187.3	84.6	64.1	10.6	34.3
MT 21173	184.7	84.3	63.8	9.9	39.9
MT 21352	183.6	83.9	64.1	10.1	44.5
MT 21150	187.1	83.9	64.1	9.9	33.0
MT 21147	186.1	83.8	63.0	11.1	39.0
MT 21250	**182.7**	83.5	63.9	10.3	39.3
MT 21215	**181.4**	83.2	63.4	9.8	34.7
MT 21184	185.0	83.0	63.2	10.9	39.2
MT 21380	185.9	82.9	64.1	10.6	35.1
MT 21171	186.1	82.9	63.7	10.9	36.1

Table 2. continued

Variety/Line	HD (julian)	YLD (bu/A)	TWT (lb/bu)	PRO (%)	TKW (g)
MT 21384	184.3	82.9	63.1	9.8	40.9
MT 21401	185.7	82.6	63.6	10.3	39.1
MT 21460	186.8	82.6	62.7	10.6	40.1
MT 21485	184.1	82.4	63.5	10.4	38.9
MT 21234	185.1	82.3	64.8	11.2	38.1
MT 21450	186.3	82.2	64.3	10.0	40.8
MT 21229	186.9	81.6	64.2	10.8	38.6
MT 21210	184.2	81.5	**65.1**	10.7	38.9
MT 21325	184.4	81.5	**65.1**	10.3	42.7
MT 21174	184.5	81.3	63.7	11.1	40.0
MT 21235	185.6	81.3	64.9	**11.5**	43.3
MT 21152	187.5	81.3	63.0	9.7	40.0
MT 21306	183.5	81.2	64.2	10.7	41.4
MT 21387	186.7	81.2	64.0	9.7	37.4
MT 21432	184.6	81.1	63.4	**11.7**	38.2
MT 21161	187.2	80.9	64.6	11.0	38.0
MT 21261	186.1	80.9	64.5	10.0	37.5
MT 21342	185.8	80.4	62.7	10.4	**47.1**
MT 21120	186.2	80.2	63.5	10.4	39.0
MT 21439	**183.0**	79.9	63.5	**11.8**	40.0
MT 21270	185.3	79.8	63.3	11.0	42.3
MT 21375	185.9	78.8	63.1	10.8	39.8
MT 21456	187.0	78.8	63.2	10.3	36.4
MT 21371	186.2	78.4	63.6	9.5	42.9
MT 21479	**183.0**	78.4	64.0	10.8	40.5
MT 21286	185.8	78.0	64.3	9.3	33.6
MT 21266	185.6	77.9	63.7	10.4	38.5
MT 21301	184.8	77.8	**65.1**	10.6	41.6
MT 21232	**182.7**	77.7	62.3	10.5	44.9
MT 21297	187.0	77.7	**65.2**	**11.4**	41.6
MT 21282	184.0	77.6	64.8	10.8	37.6
MT 21459	**183.2**	77.4	63.5	10.9	40.4
MT 21143	186.8	77.2	64.4	10.2	37.1
MT 21275	186.7	77.1	63.5	10.6	37.0
MT 21487	184.7	77.0	64.8	10.3	39.2
MT 21170	186.8	76.9	63.2	11.2	41.4
MT 21430	186.0	76.9	62.0	10.6	35.0
MT 21476	184.6	76.2	62.7	**11.5**	45.8

Table 2. continued

Variety/Line	HD (julian)	YLD (bu/A)	TWT (lb/bu)	PRO (%)	TKW (g)
MT 21220	183.7	76.0	64.0	9.5	33.8
MT 21346	184.5	76.0	62.7	10.0	41.0
MT 21242	185.0	75.7	64.1	11.2	38.8
MT 21309	185.0	75.7	64.7	10.3	33.7
MT 21222	185.8	75.6	63.7	9.9	33.5
MT 21466	185.2	75.4	63.5	10.7	39.1
MT 21480	184.3	75.3	63.9	10.5	40.3
MT 21284	184.4	75.2	64.4	9.9	33.8
MT 21323	186.2	74.8	63.7	**11.4**	40.0
MT 21458	186.7	74.8	62.4	10.5	37.2
MT 21211	186.1	74.7	64.3	10.4	39.4
MT 21335	185.5	74.0	63.4	10.2	39.1
MT 21314	**183.3**	73.8	62.6	10.5	44.7
MT 21473	184.5	73.5	62.4	10.3	37.6
MT 21313	184.3	73.4	62.6	10.1	40.7
MT 21239	185.1	73.1	64.5	**11.4**	42.6
VIDA	186.5	73.0	63.4	10.1	39.8
MT 21356	**182.8**	72.8	63.3	**11.8**	38.7
MT 21373	184.1	72.8	63.0	**11.4**	39.0
MT 21425	184.0	72.7	62.3	10.0	39.7
MT 21257	186.6	72.3	64.3	10.8	38.8
MT 21304	185.0	71.9	64.7	11.0	38.8
MT 21263	186.7	71.8	64.3	10.1	38.6
MCNEAL	186.4	71.3	63.1	10.0	39.1
MT 21180	184.3	71.3	62.7	10.3	38.7
MT 21269	186.6	71.1	62.9	**11.4**	40.0
MT 21288	188.3	71.0	64.3	9.4	33.8
MT 21472	185.6	71.0	62.9	11.0	37.0
MT 21354	184.7	70.4	62.3	10.2	**48.0**
MT 21241	185.6	70.3	64.1	10.2	36.1
MT 21125	183.6	70.1	63.1	10.1	33.0
MT 21484	184.7	69.5	64.5	10.2	41.3
MT 21415	185.2	69.4	62.8	9.8	34.7
MT 21157	185.7	69.2	**65.0**	11.0	39.0
MT 21467	185.8	69.1	63.4	10.4	38.1
MT 21160	185.8	68.2	63.4	10.0	39.7
MT 21395	187.5	66.9	63.0	10.4	33.2
MT 21298	184.4	66.6	64.1	10.1	39.6

Table 2. continued					
Variety/Line	**HD (julian)**	**YLD (bu/A)**	**TWT (lb/bu)**	**PRO (%)**	**TKW (g)**
MT 21470	186.0	65.7	63.5	10.3	43.7
MT 21490	**182.3**	64.7	62.7	10.7	38.4
MT 21478	187.4	64.6	63.3	**11.5**	41.3
MT 21341	184.3	63.0	63.4	9.5	40.0
MT 21324	186.9	61.7	63.9	10.6	39.6
MT 21362	184.3	60.4	62.2	10.5	41.5
MT 21359	184.7	59.1	62.2	10.8	42.6
Mean	**185.4**	**79.1**	**63.6**	**10.5**	**39.3**
C.V.	**0.5**	**5.7**	**0.3**	**2.4**	**1.5**
LSD(0.05)	**2.0**	**9.5**	**0.3**	**0.5**	**1.2**
PR>F	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Bold = highest value in column; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

HD = heading date, HT = height, LOD = lodging, YLD = yield, PRO = protein, TWT = test weight, TKW = thousand kernel weight

Project Title: 2022 Kochia and Wild Oat Control in Spring Wheat

Objective: To evaluate herbicide combinations on weed control performance in spring wheat in environments and cropping systems representative of northwestern Montana

Personnel: Clint Beiermann, Lovreet Shergill, Jessica Pavelka

Summary:

Spring wheat was planted on April 27th, 2022 and thirteen different herbicide combinations were tested, with a non-treated as a control (Tables 1 & 2).

Treatments (2) Sharpen fb Axial Star, (5) Anthem Flex fb Axial Star, (6) Prowl fb Axial Star, (7) Axial Star, (8) Axial Star + Affinity TankMix, (9) Axial XL + Talinor + CoAct+, (10) Huskie + Axial XL, (11) Opensky, (12) Opensky + 2,4-D, and (13) Varro + Fluroxypyr all provided greater than 90% wild oat control. Treatments (3) Zidua and (14) WideMatch + Affinty TankMix had 30% or less control, while treatment (4) Zidua fb Axial Star had an average of 78% control (Table 3). All herbicide treatments applied, excluding treatment (3) Zidua, resulted in a high level of lambsquarter control.

Weed density was assessed four weeks after the final post treatments were applied. Wild oat was only present in the treatments (1) non-treated, (3) Zidua, (4) Zidua fb Axial Star, (12) Opensky + 2,4-D, & (14) WideMatch + Affinity (Table 4). Lambsquarter density was higher in treatments with poor control performance, including (2) Sharpen fb Axial Star, (3) Zidua, (4) Zidua fb Axial Star, (5) Anthem Flex fb Axial Star, (7) Axial Star, and (13) Varro + Affinity TankMix(Table 4). Treatment (7) Axial Star had an even higher density of lambsquarter than the non-treated, indicating little to no control.

Crop injury was generally low across treatments, excluding treatment (9) Axial XL + Talinor + CoAct+, (11) Opensky, and (12) Opensky + 2,4-D. These treatments caused 36.5-47.5% injury at two weeks after treatment (Table 5). The yields from treatments 9 and 11 were statistically less than many of the other treatments, indicating the injury may have influenced the yield (Table 5). There was a significant effect of herbicide treatment on spring wheat yield. Treatments (1) non-treated, (3) Zidua, (9) Axial Xl + Talinor + CoAct+, (11) Opensky, and (14) WideMatch + Affinty TankMix resulted in yield lower than other treatments. The yields ranged from 66.6 bu/A to 98.0 bu/A with non-treated and (13) Varro + Fluroxypry, respectively.

Table 1. Management Information

Seeding date:	4/27/2022	**Field Location:**	R6
Julian date:	117	**Harvest date:**	8/23/2022
Seeding rate:	NA	**Julian date:**	235
Previous crop:	Alfalfa	**Soil type:**	Creston Silt Loam
Herbicide:	4/22, 5/9, 6/2	**Tillage:**	Conventional
Insecticide:	NA	**Soil residual nutrient (NO3-1, P, K lb/A):**	78.5-6-122
Fungicide:	NA	**Nutrient fertilizer applied (N, P2O5, K20 lb/A):**	80-50-60-10s

Table 2. Spring Wheat Wild Oat & Kochia Herbicide - Treatments

Trt No.	Treatment Name	Rate	Rate Unit	Appl Timing
1	Non-treated			
2	Roundup	32	fl oz/a	PRE
	Sharpen	4	fl oz/a	PRE
	Axial Star	16.4	fl oz/a	POST
3	Roundup	32	fl oz/a	PRE
	Zidua	1.5	oz wt/a	PRE
4	Roundup	32	fl oz/a	PRE
	Zidua	1.5	oz wt/a	PRE
	Axial Star	1.75	fl oz/a	POST
5	Anthem Flex	2.75	fl oz/a	PRE
	Axial Star	16.4	fl oz/a	POST
6	Prowl	1.5	pt/a	Early POST
	Axial Star	16.4	fl oz/a	POST
7	Axial Star	16.4	fl oz/a	POST
8	Axial Star	16.4	fl oz/a	POST
	Affinity TankMix	1	oz wt/a	POST
9	Axial XL	16.4	fl oz/a	POST
	Talinor	13.7	fl oz/a	POST
	CoAct+	2.75	fl oz/a	
10	Huskie	11	fl oz/a	POST
	Axial XL	16.4	fl oz/a	POST
11	Opensky	1	pt/a	POST
12	Opensky	1	pt/a	POST
	2,4-Dester LV6	7	fl oz/a	POST
13	Varro	6.85	fl oz/a	POST
	Fluroxypyr	0.3	pt/a	POST
14	WideMatch	1	pt/a	POST
	Affinity TankMix	1	oz wt/a	POST
* Included in each POST application				
	AMS	17	lb/100 gal	
	NIS	0.25	% v/v	

Table 3. Weed Control (6 WAT)

Treatment	Wild Oat %	Lambsquarter %
2	**99.0**	**92.0**
3	30.0	64.5
4	78.8	**91.8**
5	**99.0**	**92.0**
6	**99.0**	**96.8**
7	**99.0**	**90.8**
8	**99.0**	**99.0**
9	**99.0**	**99.0**
10	**99.0**	**99.0**
11	**99.0**	**99.0**
12	**99.0**	**99.0**
13	**99.0**	**99.0**
14	22.5	**99.0**
Mean	**86.3**	**93.9**
CV	**8.8**	**13.2**
LSD	**10.8**	**17.8**
PR>F	**<0.001**	**0.025**

Bold = highest value in column; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05), WAT = weeks after treatment

Table 4. Weed Density (4 WAT)

Treatment	Wild Oat plants/m^2	Lambsquarter plants/m^2
1	**<u>12.3</u>**	**13.0**
2	0.0	5.0
3	3.3	5.8
4	0.3	3.8
5	0.0	4.8
6	0.0	0.0
7	0.0	**<u>18.5</u>**
8	0.0	1.0
9	0.0	0.0
10	0.0	0.3
11	0.0	0.3
12	0.3	1.3
13	0.0	4.0
14	**11.8**	0.0
Mean	**2.0**	**4.1**
CV	**101.9**	**99.5**
LSD	**2.9**	**5.8**
PR>F	**<0.001**	**<0.001**

<u>Bold</u> = highest value in column; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05),
WAT = weeks after treatment

Table 5. Crop Injury & Yield

Treatment	Injury (%) 2 WAT	Yield (bu/A)
1	0.0	66.6
2	5.0	**92.5**
3	2.5	88.4
4	3.8	**92.3**
5	7.3	**93.4**
6	6.0	**91.7**
7	6.0	**91.8**
8	3.8	**90.6**
9	**47.5**	85.0
10	11.0	**93.4**
11	43.0	87.1
12	36.5	**89.3**
13	4.5	**98.0**
14	4.3	70.8
Mean	**13.9**	**88.2**
CV	**14.1**	**7.3**
LSD	**2.8**	**-**
PR>F	**<0.001**	**<.001**

Bold = highest value in column; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05),
WAT = weeks after treatment

Project Title: 2022 Spring Wheat Pre & Post Herbicide Treatments

Objective: To evaluate herbicide combinations applied pre planted and/or post planted on weed control performance in spring wheat in environments and cropping systems representative of northwestern Montana

Personnel: Clint Beiermann, Jessica Pavelka

Summary:

Spring wheat was planted on April 27th, 2022 and thirteen different herbicide combination were tested (Tables 1, 2).

At four weeks after application there was 90% or greater control of wild oat in treatments (2) Axial Bold, (6) Prowl followed by (fb) Axial Bold, (7) Zidua SC fb Axial Bold, (8) Anthem Flex fb Axial Bold, (9) Prowl H2O + Axial Bold, (10) Zidua SC + Axial Bold, and (11) Anthem Flex + Axial Bold. Lambsquarters control was 88% or higher in treatments (3) Prowl H2O, (4) Zidua SC, (6) Prowl followed by (fb) Axial Bold, (7) Zidua SC fb Axial Bold, (8) Anthem Flex fb Axial Bold, (9) Prowl H2O + Axial Bold, and (11) Anthem Flex + Axial Bold (Table 3).

Weed density was assessed four weeks after the final POST treatments were applied. High amounts of wild oat were present in treatments (1) non-treated, (3) Prowl H2O, (4) Zidua SC, and (5) Anthem Flex. Lambsquarters density was higher in treatments with poor control, including (1) non-treated, (2) Axial Bold, and (10) Zidua SC + Axial Bold (Table 5).

There was a significant effect of herbicide treatment on crop injury. Treatments (2) Axial Bold, (6) Prowl H2O fb Axial Bold, (7) Zidua SC fb Axial Bold, and (8) Anthem Flex + Axial Bold ranged from 16-21.3% crop injury; however, spring wheat recovered from these injuries, as each of these treatments resulted in high yield. The highest yielding treatment was (8) Anthem Flex fb Axial Bold at 98.6 bu/A, while the non-treated yielded the lowest at 52.5 bu/A (Table 3). We cannot conclude that Prowl, Zidua, or Anthem Flex provided improved wild oat control beyond using Axial Bold as a POST treatment. Prowl, Zidua, and Anthem Flex did improve lambsquarters control compared to non-treated.

Table 1. Management Information

Seeding date:	4/27/2022	Field Location:	R6
Julian date:	117	Harvest date:	8/23/2022
Seeding rate:		Julian date:	235
Previous crop:	Alfalfa	Soil type:	Creston Silt Loam
Herbicide:	Study Treatments	Tillage:	Conventional
Insecticide:	NA	Soil residual nutrient (NO_3^{-1}, P, K lb/A):	78.5-6-122-8s
Fungicide:	NA	Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):	80-50-60-10s

Table 2. Spring Wheat Pre & Post Combinations

Trt No.	Trt Name	Form Concentration	Form Unit	Rate	Rate Unit	Appl Timing
1	Non-trt					
2	Axial Bold	0.685	LBA/GAL	15	fl oz/a	POST
3	Prowl H2O	3.8	LBA/GAL	2	pt/a	Early POST
4	Zidua SC	4.17	LBA/GAL	2.5	fl oz/a	PRE
5	Anthem Flex	4	LBA/GAL	3	fl oz/a	PRE
6	Prowl H2O	3.8	LBA/GAL	2	pt/a	Early POST
	Axial Bold	0.685	LBA/GAL	15	fl oz/a	POST
7	Zidua SC	4.17	LBA/GAL	2.5	fl oz/a	PRE
	Axial Bold	0.685	LBA/GAL	15	fl oz/a	POST
8	Anthem Flex	4	LBA/GAL	3	fl oz/a	PRE
	Axial Bold	0.685	LBA/GAL	15	fl oz/a	POST
9	Prowl H2O	3.8	LBA/GAL	2	pt/a	Early POST
	Axial Bold	0.685	LBA/GAL	15	fl oz/a	Early POST
10	Zidua SC	4.17	LBA/GAL	2.5	fl oz/a	Early POST
	Axial Bold	0.685	LBA/GAL	15	fl oz/a	Early POST
11	Anthem Flex	4	LBA/GAL	3	fl oz/a	Early POST
	Axial Bold	0.685	LBA/GAL	15	fl oz/a	Early POST

Table 3. Crop Injury & Yield

Treatment	Injury (%) 1 WAT	Yield (bu/A)
1	-	52.5
2	16.3	**91.6**
3	**5.0**	81.4
4	**7.5**	81.6
5	**6.3**	84.6
6	21.3	**96.8**
7	21.0	**90.9**
8	16.0	**98.6**
9	**9.0**	**91.3**
10	**7.3**	**92.8**
11	**6.0**	**98.0**
Mean	**11.6**	**87.3**
CV	**38.4**	**8.4**
LSD	**6.4**	**10.6**
PR>F	**<0.001**	**<0.001**

WAT = weeks after treatment

Table 4. Weed Control (4 WAT)

Treatment	Wild Oat %	Lambsquarters %
2	**99.0**	10.0
3	16.3	**99.0**
4	18.8	**89.5**
5	22.5	68.5
6	**99.0**	**99.0**
7	**99.0**	**89.5**
8	**99.0**	**88.3**
9	**99.0**	**99.0**
10	**96.8**	32.5
11	**99.0**	**99.0**
Mean	**74.8**	**77.4**
CV	**6.9**	**17.9**
LSD	**7.5**	**20.2**
PR>F	**<0.001**	**<0.001**

WAT = weeks after treatment

Table 5. Weed Density (4 WAT)

Treatment	Wild Oat plants/m^2	Lambsquarters plants/m^2
1	**18.5**	**19.0**
2	0.0	**20.0**
3	**18.5**	0.0
4	**11.5**	4.0
5	**17.0**	3.5
6	0.5	0.0
7	0.5	5.0
8	0.0	1.5
9	0.0	0.5
10	0.0	10.0
11	0.0	2
Mean	**6.0**	**6.0**
CV	**72.2**	**92.9**
LSD	**6.3**	**8.0**
PR>F	**<0.001**	**<0.001**

WAT = weeks after treatment

Project Title: 2022 Spring Wheat Off-Station Trial

Objective: To evaluate the performance of selected spring wheat varieties in a production environment in northwestern Montana

MONTANA wheat & barley

Personnel: Clint Beiermann, Jason Cook, Hwa-Young Heo, Jessica Pavelka

Summary:

The spring wheat off-station trial was planted on April 28th, 2022 (Table 1). A total of 3 inches of rainfall was received during the growing period. The trial was placed in an irrigated field near Polson, MT.

The average yield was 107.3 bu/A, with a high of 119.1 bu/A for Lannin/MT 1338 to a low of 89.1 bu/A for NS Presser CLP. The average test weight was 61.3 lb/bu. The highest test weight was 64.0 lb/bu for SY Soren and the lowest test weight was 56.6 lb/bu for NS Presser CLP. The average protein content was 14.9%. The highest protein content was 15.6% from VIDA and the lowest was 13.7% from WB Gunnison. Lodging was visible on all but seven varieties, ranging from slight to severe with the highest lodging percentage at 98% for MT1572/MT1133/CHOTEAU/YELLOWSTONE and VIDA (Table 2).

Table 1. Management Information

Seeding date:	4/28/2022	**Field Location:**	Polson
Julian date:	118	**Harvest date:**	8/25/2022
Tillage:	Conventional	**Julian date:**	237
Previous crop:	Spring Wheat	**Soil type:**	McCollum fine sandy loam
Herbicide:	Rezuvant	**Nutrient fertilizer applied (N, P2O5, K20 lb/A):**	13-30-10-7S 180-0-0 Top Dress

Table 2. Agronomic performance of spring wheat

Variety/Line	HT (in)	LOD (%)	Yield (bu/A)	TWT (lb/bu)	PRO (%)	TKW (g)	FN (sec)
MT 2030	35.5	62	**119.1**	**62.8**	15.0	40.7	**409**
MT 1939	33.3	**0**	**117.0**	62.5	14.2	41.0	375
MT 2013	35.8	**5**	**116.7**	**63.5**	15.0	41.0	**416**
WB9879CLP	35.8	**0**	**116.0**	62.2	14.4	36.7	385
MT 2050	34.8	**0**	**115.7**	62.0	14.6	42.2	379
ND 695	**39.3**	**7**	**115.4**	61.7	**15.3**	38.1	358
BZ 92413R	34.8	**0**	**115.2**	61.9	13.7	43.8	377
AGRIPR 14	31.8	**0**	**114.8**	**64.0**	14.9	35.7	359
PI 633974	35.0	**28**	**114.1**	60.9	14.6	35.7	366
MT 2063	35.0	98	**113.7**	60.7	14.7	32.4	364
MT 2007	34.0	**0**	**111.5**	62.2	14.2	38.7	348
MT 2049	32.7	**8**	**110.9**	61.4	**15.2**	41.9	355
PI 690450	36.1	97	**110.2**	61.5	**15.3**	40.0	363
MT 2054	**39.1**	38	**107.7**	61.0	14.7	**48.5**	357
MT 2038	37.0	88	106.0	61.4	**15.4**	41.4	380
PI 660981	34.9	38	105.1	60.6	14.9	38.3	357
PI 676978	34.3	**33**	104.3	62.5	**15.5**	40.8	357
MT 1809	36.7	95	104.0	59.7	**15.4**	35.1	348
AGRIPR141	30.6	**0**	102.2	**62.9**	14.8	36.6	354
MT 2022	34.3	96	99.0	60.9	15.0	40.1	383
BZ 996434	36.6	88	94.1	60.2	14.9	42.2	368
AGRIPR 10	30.8	**0**	94.0	62.2	15.0	39.2	376
PI 642366	36.4	98	93.9	58.1	**15.6**	32.9	348
MT 1716	34.2	95	92.5	60.0	14.7	28.4	357
PI 679964	**37.8**	87	89.1	56.6	14.5	34.4	335
Mean	**35.1**	**42**	**107.3**	**61.3**	**14.9**	**38.6**	**367**
C.V.	**3.6**	**49.2**	**7.3**	**1.8**	**1.9**	**4.5**	**3.3**
LSD(0.05)	**1.9**	**35**	**11.5**	**1.4**	**0.5**	**2.6**	**19**
PR>F	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Bold = top performer, **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

HT= height, LOD=lodging, YLD= yield, PRO= protein, TWT= test weight, TKW= thousand kernel weight

Project Title: Near-isoline Gene for Tillering in Spring Wheat

Objective: To test agronomic performance of gene pairs of spring wheat genetic lines with tillering traits.

Personnel: J.A. Torrion, Daniel Porter, Jason Cook

Summary:

Six tiller near-isoline gene pairs were studied to examine the performance of genes with high tiller compared with the no tiller gene check. This study was in a randomized complete block with three replications. The six gene pairs were planted at lower and higher seeding rates (16 and 24 live seeds/ft^2). Detailed management is provided in Table 1. There were no yield differences among the genetic lines regardless of seeding rates (Table 2). The plant height of entry 19 and 20 are the tallest, whereas entry 2 is the shortest regardless of seeding rates. Protein ranged 13.6% (entry 16 at 16 seeding rate) to 15.5% (entry 19 at 24 seeding rate). Both entries 1 and 2 had low test weights compared with the rest of the entries. Entries 19 and 20, showed the largest seed size, as shown in the thousand kernel weights. Falling number quality analysis were above the market critical levels and ranging from 407 (entry 16 at 16 seeding rate) to 483 (entry 2 at 16 seeding rate).

Table 1. Management Information

Seeding date:	April 21st, 2022	**Field Location:**	R6
Julian date:	111	**Harvest date:**	8/29/2022
Seeding rate:	24 seeds/ft2 & 16 seeds/ft2	**Julian date:**	241
Previous crop:	Alfalfa	**Soil type:**	fine sandy loam
Herbicide:	Axial Bold, CleansweepM (6/1/2022)	**Tillage:**	conventional
		Soil residual nutrient (NO_{3}-, P, K lb/A):	78-6-122
Insecticide:			
Fungicide:		**Nutrient fertilizer applied (N, P_2O_5, K20 lb/A):**	80-50-60-10s (4/6/2022)

Table 2. Agronomic Performance

Entry	Parent Material	Seed No./ft^2	YLD^1 bu/ac	MC %	HT, in	PRO^2 %	TWT^1, lb/bu	TKW, g	FN, sec
1	Reeder/Choteau	24	82.4	11.7	31.8	14.3	55.5	33.2	471
1	Reeder/Choteau	16	78.8	11.6	31.3	14.1	55.6	33.2	437
2	Reeder/Choteau	24	83.3	11.7	30.7	13.8	56.2	33.6	461
2	Reeder/Choteau	16	80.9	11.6	30.7	14.1	55.7	33.1	483
15	McNeal/Vida	24	81.7	12.1	38.4	13.7	60.4	34.1	411
15	McNeal/Vida	16	82.7	12.1	38.8	14.1	60.1	33.7	430
16	McNeal/Vida	24	79.9	12.1	39.1	14.0	59.6	32.6	433
16	McNeal/Vida	16	80.9	12.1	37.5	13.6	59.8	32.8	407
19	Reeder/Hank	24	76.2	12.0	46.2	15.5	60.6	42.9	446
19	Reeder/Hank	16	74.1	12.0	46.2	15.4	60.6	42.9	456
20	Reeder/Hank	24	77.3	12.0	46.7	15.1	61.3	40.2	461
20	Reeder/Hank	16	73.7	12.0	46.3	15.4	61.4	40.3	478
		Mean	79.3	11.9	38.6	14.4	58.9	36.0	447.9
		CV	5.9	0.9	3.4	3.0	1.0	4.0	5.8
		LSD	ns	0.1	1.9	0.6	1.0	2.1	37.4
		PR > F	0.0618	0.0001	0.0001	0.0001	0.0001	0.0001	0.0019

TRT: treatment, YLD: yield, HT: plant height inches, PRO: protein, MC: moisture content, TWT: test weight, TKW: thousand kernel weight, FN: falling numbers

1 adjusted to 13% moisture

2 adjusted to 12% moisture

Project Title: Test Five Elite Spring Wheat Varieties to Evaluate Impact of Reduced Seeding and Nitrogen Rates on End-Use Quality and Agronomic Performance in Drought Conditions

Objective: To assess the effects of reducing inputs on end-use quality and yield performance

Personnel: J.A. Torrion, Daniel Porter, J. Cook, J. Vetch, C. Beiermann

Summary:
This study was conducted at Creston and Conrad locations. The study was laid out in a split-split-plot design where the main plot was nitrogen (N) treatments. The subplot was the five elite spring wheat varieties (Vida, Dagmar, Egan, MT Sidney, and Sy Ingmar), and the sub-subplot was the seeding rates randomly arranged within each variety. This study was replicated three times. For the Creston location, the N treatments were: control (no added N), 150 lbs total N (residual + added Urea), and 200 lbs total N (residual +added Urea). The seeding rates were: 24, 16, and 12 live seeds/ft^2. Management information for the Creston location is detailed in Table 1.

There was no yield response with increasing N levels in either Creston or Conrad locations. As for the seeding rates, the yield in Creston was reduced with decreasing seeding rate (Fig. 1). For Creston, 24 live seeds/ft^2 is optimal. In previous studies, during extreme drought, we typically observed no yield response to seeding rates. Under a drier environment (Conrad), seeding at 18 live seeds/ft^2 is optimal this year – that is, between 50-70 lbs/Ac seeds depending on seed size (Fig. 2). For either of the locations, Vida followed by Dagmar consistently outperformed the other varieties regardless of seeding rates (Figs. 3 and 4). The relationship between yield and protein of the five elite varieties for the Creston location is shown in Figure 5. The highest yielding (Vida) also had the lowest protein, whereas, the lower yielding (Egan) had the highest protein. For Creston and Conrad sites, the grain protein content responded with increasing N (see Fig. 6 for Creston*, Conrad data not shown*). For the Creston location, based on the estimated adjusted gross income in Fig. 7, 150 lbs/A total N input (residual + applied) is optimal. This is consistent with our historical studies of this location.

Table 1. Management Information, Creston, MT

Seeding date:	4/20/2022	**Field Location:**	R6
Julian date:	110	**Harvest date:**	8/23/2022
Seeding rate:	Various	**Julian date:**	235
Previous crop:	Alfalfa	**Soil type:**	fine sandy loam
Herbicide:	Axial Bold, CleansweepM (6/1/2022)	**Tillage:**	conventional
		Soil residual nutrient (NO_{3}-, P, K lb/A):	79-4-84
Insecticide:			
Fungicide:	Headline (7/1/2022)	**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	varied-45-100

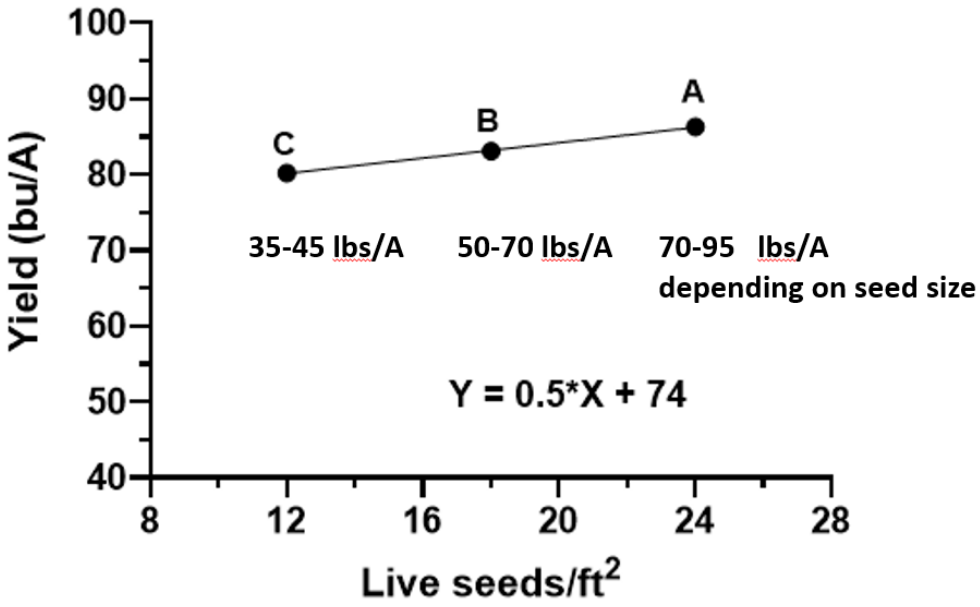


Figure 1. Yield response to seeding rates, Creston, MT. The same letter of assignment denotes nonsignificance at α=0.05.

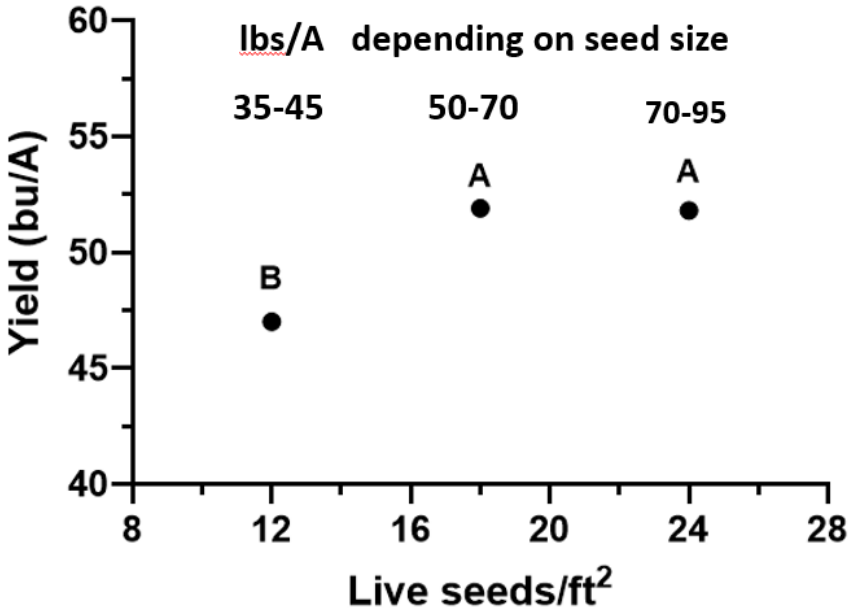


Figure 2. Yield response to seeding rates, Conrad, MT. The same letter of assignment denotes nonsignificance at α=0.05.

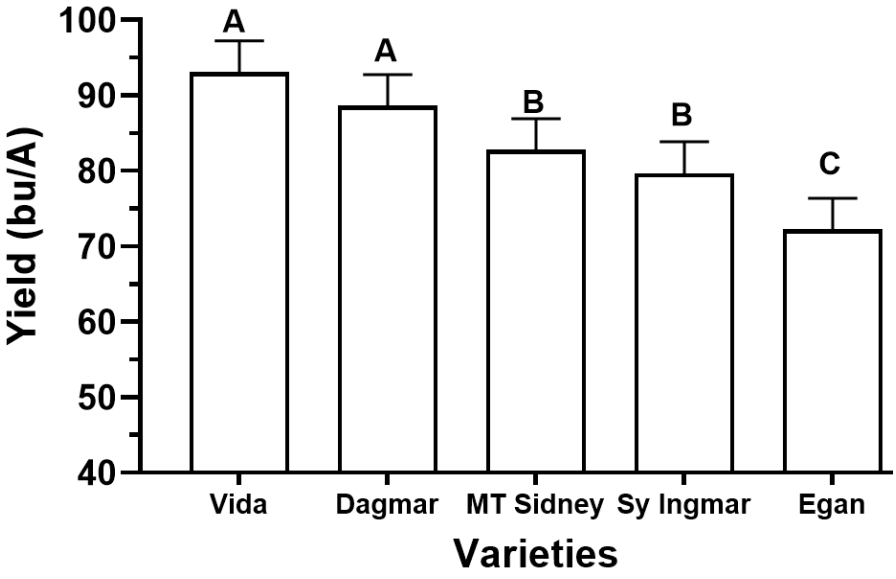


Figure 3. Yield response with the elite varieties, Creston, MT. The same letter of assignment denotes nonsignificance at α=0.05.

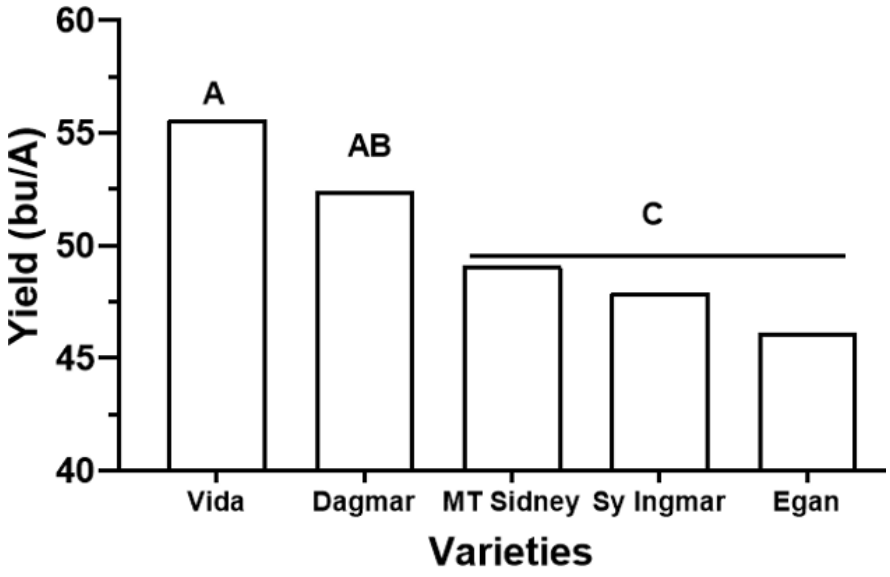


Figure 4. Yield response with the elite varieties, Conrad, MT. The same letter of assignment denotes nonsignificance at α=0.05.

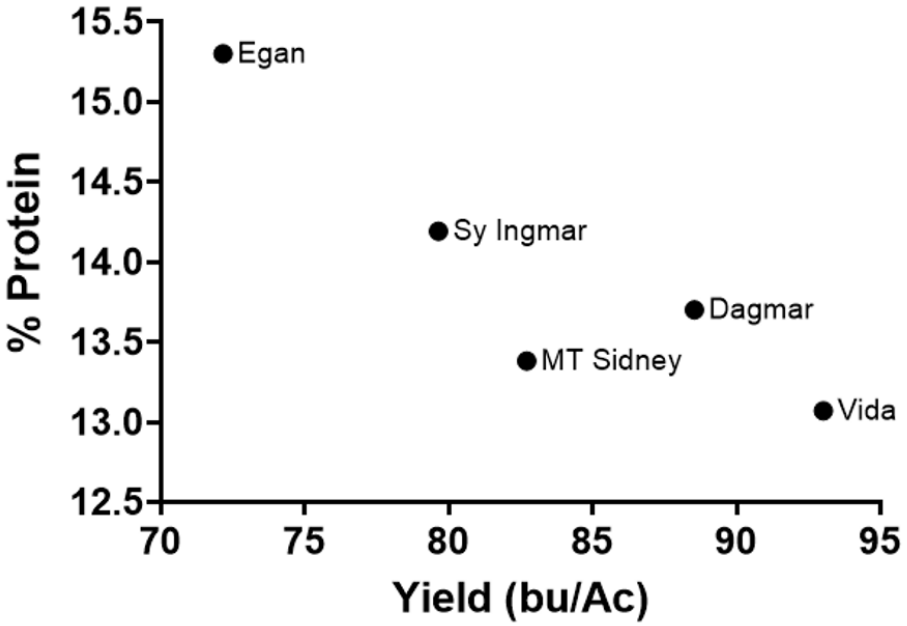


Figure 5. Yield vs. protein relationship amongst the elite varieties, Creston, MT.

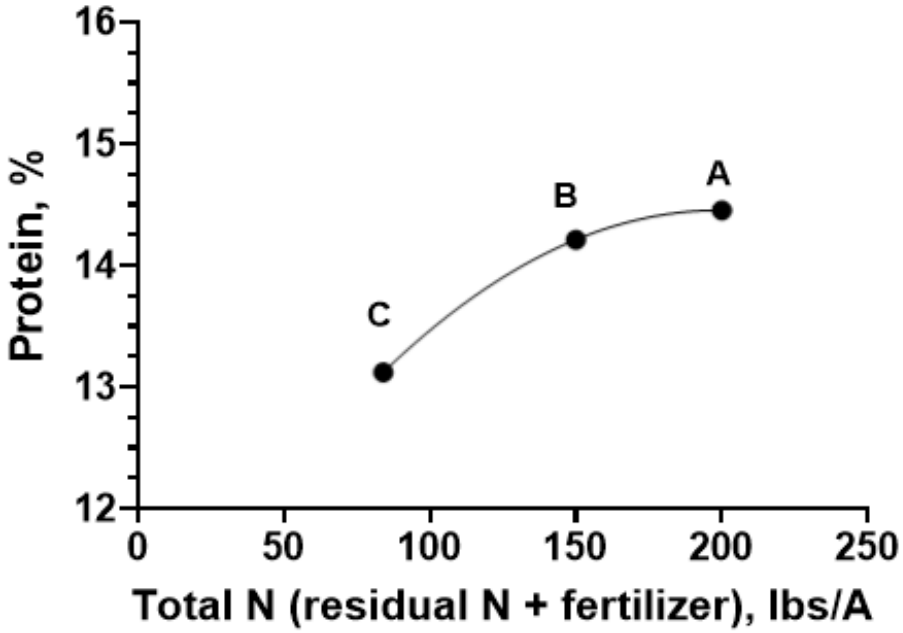


Figure 6. Protein response with nitrogen (N) treatment, Creston, MT

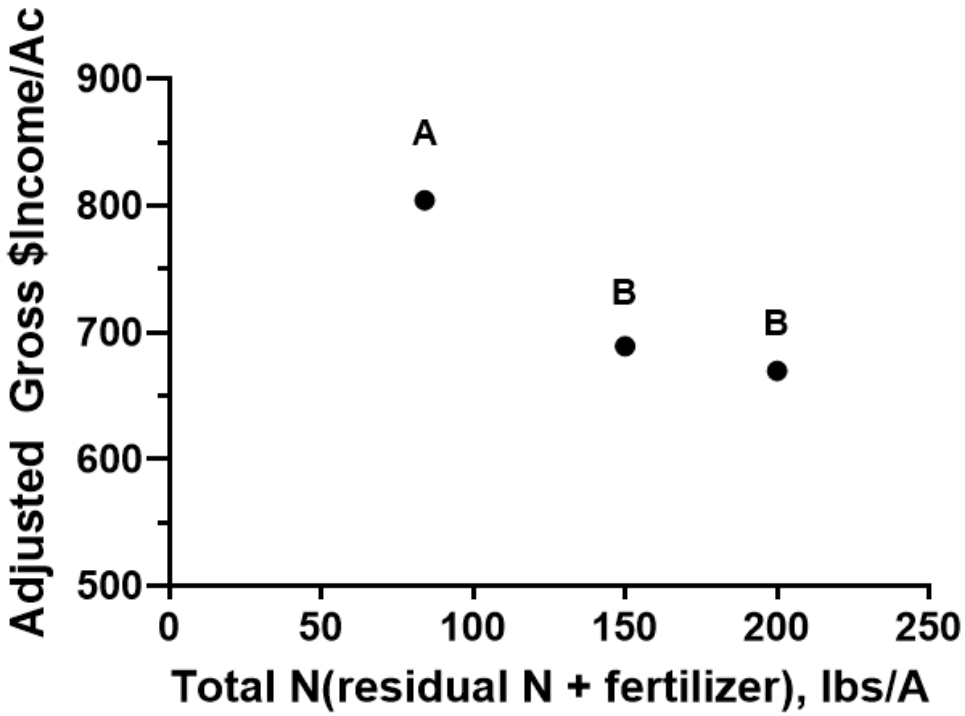


Figure 7. Adjusted gross income with nitrogen (N) treatments, Creston, MT. The same letter of assignment denotes nonsignificance at α=0.05.

Project Title: Locus Ag industry trial in spring wheat

Objective: To test different Locus Ag treatments for quality and yield for spring wheat.

Personnel: J.A. Torrion, Daniel Porter

Summary: WB9668 (Westbred) hard spring wheat was planted with the three Locus treatments and a grower practice as a check on two different locations: 1) rainfed silt-loam soil with subsurface recharge and 2) rainfed fine sandy loam soil. The management is shown in Table 1.

All the parameters observed were not significant for both studies. In study 1 with subsurface recharge (Table 3), yield and protein were low compared with the drier environment in Study 2 (Table 4). Study 1, with subsurface recharge, was flooded during the vegetative stage from runoff. We anticipated that there was significant nitrogen loss in this location, thus, with also low protein.

Table 1. Management Table

Seeding date:	April 25th, 2022	**Field Location:**	Y8
Julian date:	115	**Harvest date:**	8/30/2022
Seeding rate:	Standard	**Julian date:**	242
Previous crop:	Canola	**Soil type:**	Creston silt loam
Herbicide:	Axial Bold, CleansweepM 6/1/2022	**Tillage:**	conventional
		Soil residual nutrient (NO3-, P, K lb/A):	71-40-342
Insecticide:			
Fungicide:		**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	80-20-25-10s (4/18/22)

Table 2. Management Table

Seeding date:	April 21st, 2022	**Field Location:**	R6
Julian date:	111	**Harvest date:**	8/29/2022
Seeding rate:	Standard	**Julian date:**	241
Previous crop:	Alfalfa	**Soil type:**	fine sandy loam
Herbicide:	Axial Bold, CleansweepM 6/1/2022	**Tillage:**	conventional
		Soil residual nutrient (NO3-, P, K lb/A):	78-6-122
Insecticide:			
Fungicide:		**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	80-50-60-10s (4/6/2022)

Table 3. Spring wheat performance under silt loam soil with subsurface recharge (Study 1)

TRT No.	TREATMENT	Plant count/ft²		HT	YLD[1]	PRO[2]	TWT[1]	TKW	FN
		May 25	Harvest	in.	bu/Ac	%	lb/bu	g	seconds
1	Grower's Practice	25	24	27.1	56.7	10.5	63.7	34.5	414
2	Pantego® BA	21	24	26.5	51.1	10.5	63.7	34.7	395
3	Rhizolizer Duo BA®	26	29	26.1	55.2	10.6	63.5	34.8	422
4	LASTW21	19	27	27.7	56.2	10.5	63.8	34.2	416
	Mean	21.5	25.6	26.8	54.8	10.5	63.7	34.5	417.6
	CV	23.1	21.3	4.3	14.0	2.6	0.3	2.1	4.8
	LSD	ns	ns	ns	ns	ns	ns	ns	ns
	Pr<F	0.253	0.5456	0.318	0.734	0.925	0.201	0.726	0.836

HT = plant height at harvest, FN=falling number; PRO=protein, TWT = test weight, TKW = thousand kernel weight, YLD=yield, ns=nonsignificant, [1]adjusted to 13% moisture, [2]adjusted to 12% moisture

Table 4. Spring wheat performance under Flathead fine sandy loam soil (Study 2)

TRT No.	TREATMENT	Plant count/ft²		HT	YLD[1]	PRO[2]	TWT[1]	TKW	FN
		May 25	Harvest	in.	bu/Ac	%	lb/bu	g	seconds
1	Grower's Practice	21	26	28.2	76.7	14.6	59.6	29.7	457
2	Pantego® BA	24	25	27.7	72.4	14.9	59.5	29.5	443
3	Rhizolizer Duo BA®	22	27	27.5	75.6	14.7	59.6	29.6	457
4	LASTW21	20	26	27.5	74.4	14.7	59.8	30.4	453
	Mean	21.7	26.1	27.7	74.8	14.7	59.6	29.8	452.8
	CV	18.0	23.3	4.2	7.4	1.7	0.9	3.8	2.3
	LSD	ns	ns	ns	ns	ns	ns	ns	ns
	Pr<F	0.468	0.989	0.802	0.726	0.688	0.886	0.711	0.234

HT = plant height at harvest, FN=falling number; PRO=protein, TWT = test weight, TKW = thousand kernel weight, YLD=yield, ns=nonsignificant, [1]adjusted to 13% moisture, [2]adjusted to 12% moisture

Project Title: 2022 Winter Wheat Intrastate

MONTANA wheat & barley

Objective: To evaluate the performance of selected winter wheat varieties in a production environment in northwestern Montana

Personnel: Clint Beiermann, Suchismita Mondal, Jacob Tracy, Jessica Pavelka

Summary:

The winter wheat intrastate trial was planted on September 24th, 2021 (Table 1) with 49 varieties and managed with supplemental overhead sprinkler irrigation.

The average yield for the study was 126.7 bu/A. The lowest yield was 91.9 bu/A for CP7909 while the highest yield came from LCS Helix AX at 149.0 bu/A which also had one of the lowest protein contents at 11.0%. The average protein was 12.0% and the highest protein content was up to 13.4% for CP7050AX. Winter survival ratings ranged from 99% to 77.3%, forty-two of the varieties were statistically equal to the highest value based on Fischer's LSD($\alpha = 0.05$), while seven of the varieties were statistically different. The average heading date was 160 julian days, with the earliest date being 154 julian days from CP7909 to the latest date at 166 julian days from MT WarCat (Table 2).

Table 1. Management information

Seeding date:	9/24/2021	**Field Location:**	R5
Julian date:	267	**Harvest date:**	8/12/2022
Seeding rate:	NA	**Julian date:**	224
Previous crop:	Peas	**Soil type:**	Creston Silt Loam
Herbicide:	Axial Bold & Cleansweep M 5/11/22	**Tillage:**	Conventional
Insecticide:	None	**Soil residual nutrient (NO3-1, P, K lb/A):**	199-14-188
Fungicide:	None	**Nutrient fertilizer applied (N, P2O5, K20 lb/A):**	9.5-45-90-15S Fall 2021

Table 2. Agronomic performance of winter wheat varieties

Cultivar/Line	HD (Julian)	HT (in)	Winter Survival (%)	YLD (bu/ac)	TWT (lb/bu)	PRO (%)
LCS Helix AX	158	39.0	**98.3**	**149.0**	64.6	11.0
MTCS20156	163	32.6	**96.3**	**148.6**	64.3	12.6
Keldin	161	35.9	**94.0**	**147.1**	63.9	12.0
MT19175	164	33.8	**91.3**	**144.8**	62.7	11.1
SY Clearstone 2CL	161	39.9	**97.7**	**144.4**	63.6	12.0
Milestone	159	33.0	**97.0**	**144.4**	62.7	12.0
SY Wolverine	158	34.8	**99.0**	**142.6**	64.6	11.7
Whistler	161	40.4	**97.7**	**141.1**	64.7	11.0
AP Bigfoot	160	37.0	**97.7**	**141.0**	**64.9**	11.5
MT1745	162	35.4	**93.3**	**136.1**	64.2	11.3
AAC Wildfire	166	35.5	**96.0**	**135.8**	64.2	11.5
Ramsay	160	33.2	**94.7**	**134.2**	63.7	12.1
Bobcat	163	32.7	**93.3**	**134.2**	64.7	11.7
MT2019	160	31.3	**96.3**	**132.7**	63.6	11.6
Flathead	156	36.6	**98.3**	**130.5**	64.1	11.7
LCS Steel AX	163	35.8	**92.3**	**130.5**	63.3	11.3
Balance	160	37.8	**90.0**	**129.7**	63.8	**13.0**
Northern	163	35.4	**96.3**	**129.7**	63.3	11.8
WB4510 CLP	161	35.8	**92.3**	**129.3**	**65.5**	12.0
MTFH19132	162	37.3	88.0	**129.0**	63.5	12.1
Warhorse	162	38.8	**99.0**	**128.2**	63.5	12.7
AP Solid	161	33.9	**98.3**	**127.8**	**65.1**	12.2
StandClear CLP	161	36.6	**96.3**	**127.8**	64.3	12.7
MS Maverick	160	35.7	**95.7**	**127.1**	**64.9**	12.0
Yellowstone	162	37.5	**96.0**	**126.3**	63.2	11.2
FourOsix	161	35.0	**93.7**	**126.3**	63.8	12.0
MTS2068	164	31.4	**97.7**	**125.9**	64.0	11.5
MTS1903	164	33.6	**94.3**	**125.5**	63.9	11.3
MTS1908	165	32.8	**90.7**	**125.5**	63.7	12.0
MS Sundown (MS 1022)	**156**	39.1	**97.3**	**124.8**	64.2	12.0
AP18 AX	157	35.8	**96.0**	**123.6**	64.3	11.4
LCS Julep	**155**	32.9	**90.0**	**123.3**	**64.9**	12.2
MT WarCat	166	32.4	77.3	**122.9**	62.9	12.0
Loma	164	32.1	84.3	**122.5**	63.0	11.4
MTCL19151	159	34.9	**95.7**	121.4	63.5	12.0
Battle AX	**155**	33.3	88.3	120.2	63.9	12.1
CP7017AX	156	33.4	**90.0**	119.9	**64.9**	11.7

Table 2. continued						
Cultivar/Line	HD (Julian)	HT (in)	Winter Survival (%)	YLD (bu/ac)	TWT (lb/bu)	PRO (%)
Judee	161	34.3	**97.0**	117.6	64.7	11.9
MTCL2010	158	33.2	**95.0**	117.2	63.6	12.3
WB4619	158	34.0	**96.7**	116.8	61.6	11.5
20Nord148	160	39.1	86.7	115.7	63.2	11.6
MTFH20166	162	37.1	**97.0**	113.4	63.4	**13.0**
Brawl CL Plus	**155**	35.6	**96.0**	112.7	64.3	**13.3**
MT19159	163	31.6	86.7	112.3	63.0	11.5
MTF20189	163	**50.0**	**93.7**	110.8	63.4	**13.2**
CP7050AX	**154**	36.3	**96.3**	109.3	64.2	**13.4**
MS Iceman	158	33.3	**92.3**	108.1	**65.4**	12.7
Fortify SF	160	35.5	89.0	107.8	64.1	11.4
CP7909	**154**	34.0	**99.0**	91.9	64.6	12.4
Average	**160**	**35.4**	**94.0**	**126.7**	**63.95**	**12.0**
LSD (0.05)	**2.22**	**4.17**	**9.59**	**27.23**	**0.633**	**0.50**
C.V	**0.71**	**6.07**	**5.26**	**11.12**	**0.51**	**2.15**
PR>F	**<0.0001**	**<0.0001**	**0.0003**	**0.0005**	**<0.0001**	**<0.0001**

Bold = top performer; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

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

Project Title: 2022 Winter Wheat Off-Station Trial

Objective: To evaluate the performance of selected winter wheat varieties in a production environment in northwestern Montana

Personnel: Clint Beiermann, Suchismita Mondal, Jacob Tracy, Jessica Pavelka

Summary:

The off-station winter wheat trial was planted on September 30th, 2021, harvested on August 9th, 2022, and managed under rainfed conditions (Table 1).

There was no significant difference between the yield of the winter wheat varieties. Yields ranged from 50.7 bu/A for Northern to 85.6 bu/A for AAC Wildfire, with an overall average of 68.9 bu/A. The average test weight was 63.5 lb/bu. Ray had the lowest test weight at 62.1 lb/bu while Judee had the highest at 65.3 lb/bu. The average protein content was 13.6% with the lowest being 12.1% for AAC Wildfire and the highest at 15.0% for Warhorse. There was no significant difference between survival rates of the varieties, they ranged from a 90-98%. The average time for falling numbers was 406.0 seconds, with the lowest falling number variety being MT Warcat at 366.5 seconds, and Northern being the highest at 572.8 seconds, which also had the highest yield (Table 2).

Table 1. Management information

Seeding date:	9/30/2021	**Field Location:**	Ronan, MT
Julian date:	273	**Harvest date:**	8/9/2022
Tillage:	Conventional	**Julian date:**	221
Previous crop:	Spring wheat	**Soil type:**	Round Butte Silty Clay Loam
Herbicide:	MCPA+ pinoxadin+ thifensulfuron+ tribenuron	**Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):**	120-52-30

Table 2. Agronomic performance of winter wheat varieties

Variety/Line	Stand (%)	HT (in)	YLD (bu/A)	TWT (lb/bu)	PRO (%)	FN (sec)
AAC Wildfire	93	31.4	85.6	**64.5**	12.1	423.8
MTS1908	97	33.9	83.6	**64.4**	12.9	416.0
MT1745	97	31.3	81.5	63.7	13.3	445.9
Bobcat	96	26.4	80.5	**64.7**	13.1	432.9
MTFH19132	96	30.7	80.1	63.5	13.1	462.1
FourOsix	95	30.7	79.8	63.9	13.4	427.9
SY Clearstone 2CL	96	**35.0**	79.4	63.3	13.1	458.7
MT19175	94	29.0	79.0	**64.5**	12.9	437.9
MT WarCat	90	24.5	74.5	62.6	14.3	366.5
Yellowstone	96	32.9	74.2	63.2	14.2	**545.9**
Keldin	92	28.3	73.7	62.8	13.8	463.5
Judee	94	29.6	73.4	**65.3**	14.0	451.0
StandClear CLP	98	31.4	70.3	**64.0**	13.7	423.5
MTS1903	94	32.1	67.3	**64.4**	13.2	478.7
LCS Jet	96	25.1	65.0	62.4	12.3	372.7
Loma	95	27.0	64.3	63.5	14.8	403.9
Ray	92	32.4	61.3	62.1	14.7	**516.1**
Brawl CL Plus	96	28.7	60.5	**64.3**	13.9	471.2
MTCL19151	96	26.3	58.2	63.2	13.9	**533.0**
MTCS20156	94	28.6	57.5	63.1	14.5	434.5
MTF20189	95	**39.9**	57.1	62.7	15.0	**527.4**
Warhorse	96	28.8	55.2	63.3	15.0	**531.3**
SY Monument	95	26.9	55.2	62.9	13.3	393.2
Flathead	94	31.4	54.1	63.2	14.7	**509.6**
Northern	91	26.6	50.7	62.8	12.1	**572.8**
Average	**94.7**	**30.0**	**68.9**	**63.5**	**13.6**	**460.0**
LSD (0.05)	**-**	**5.7**	**-**	**1.4**	**-**	**66.0**
C.V. (%)	**2.6**	**9.6**	**23.2**	**1.1**	**12.8**	**8.7**
P>F	**0.1212**	**<0.0001**	**0.1647**	**0.0001**	**0.7422**	**<0.0001**

Bold = highest value in column, **Bolding** indicates varieties with values equal to highest variety based on LSD (p =0.05)

HT = height, YLD = yield, TWT = test weight, PRO = protein, FN = falling number

Project Title: 2022 Winter Wheat Nitrogen x Variety

Objective: To evaluate the agronomic performance of winter wheat with combinations of varieties, populations, and nitrogen fertilizer rates in environments and cropping systems representative of northwestern Montana

Personnel: Clint Beiermann, Jessica Torrion, Jessica Pavelka, Dan Porter

Summary:

Winter wheat was planted on October 5th, 2021 with three treatment factors: nitrogen rate, winter wheat variety, and winter wheat population. The levels of each treatment can be reviewed in tables 2 - 4. The was a significant main effect of nitrogen rate on yield with an increase in average yield from 125 bu/acre at the 125 lbs N rate, to 133 bu/acre at 180 lbs N rate. There is not an indication of a significant increase in yield by the 250 lbs/acre rate (Table 2). Winter wheat test weight was higher, between 62.8 and 62.5 lbs/bu at the lower two N rates and was decreased to 62.1 lbs/bu at the 250 lbs/acre N rate (Table 2). Protein increased from 10.7% at the lowest N rate, up to 11.7% at the highest N rate. Thousand kernel weight (TKW) was negatively affected by increasing N rate. Higher TKW indicates larger seed size or higher seed density, which was reduced with increasing nitrogen from 46.2 g at 125 lbs/acre N, to 42.8 g at 250 lbs/acre N (Table 2).

Table 1. Management information

Seeding date:	10/5/2021	**Field Location:**	R5
Julian date:	278	**Harvest date:**	8/15/2022
Seeding rate:	16-40 plt/ft2	**Julian date:**	227
Previous crop:	Peas	**Soil type:**	Creston Silt Loam
Herbicide:	CleansweepM+ Axial Bold	**Tillage:**	Conventional
Insecticide:	NA	**Soil residual nutrient (NO3-1, P, K lb/A):**	106.5-18-250
Fungicide:	NA	**Nutrient fertilizer applied (lbs/A):**	18.5, 73.5, 143.5 N

Table 2. Nitrogen Rate				
Nitrogen	Yield	Test wt	Protein	TKW[a]
lbs/acre	bu/acre	lbs/bu	%	g
125	125 b	62.8 a	10.7 b	46.2 a
180	133 a	62.5 a	11.2 ab	44.5 b
250	134 a	62.1 b	11.7 a	42.8 c

[a]TKW, thousand kernel weight

There is an interaction of nitrogen rate and winter wheat variety affecting yield. The varieties Jet and WB1720 respond to increasing N in a linear fashion with subtle yield increase from increasing N rate (Figure 1). The varieties Keldin and WB 1783 show great increase in yield between the 125 lbs/A to 180 lbs/A N, there is minimal gain from 180 lbs/A up to 250 lbs/A (Figure 1). This indicates that the yield of these two varieties is more responsive to N inputs than Jet and WB1720. The variety Jet maintained a higher average yield across N rates than WB 1720, and at higher N rates yielded equivalent to Keldin and WB1783. This indicates that Jet may be a good choice for maintaining yield in situations with limited available N. Of the four varieties WB1720 had the poorest response of yield to increased N inputs.

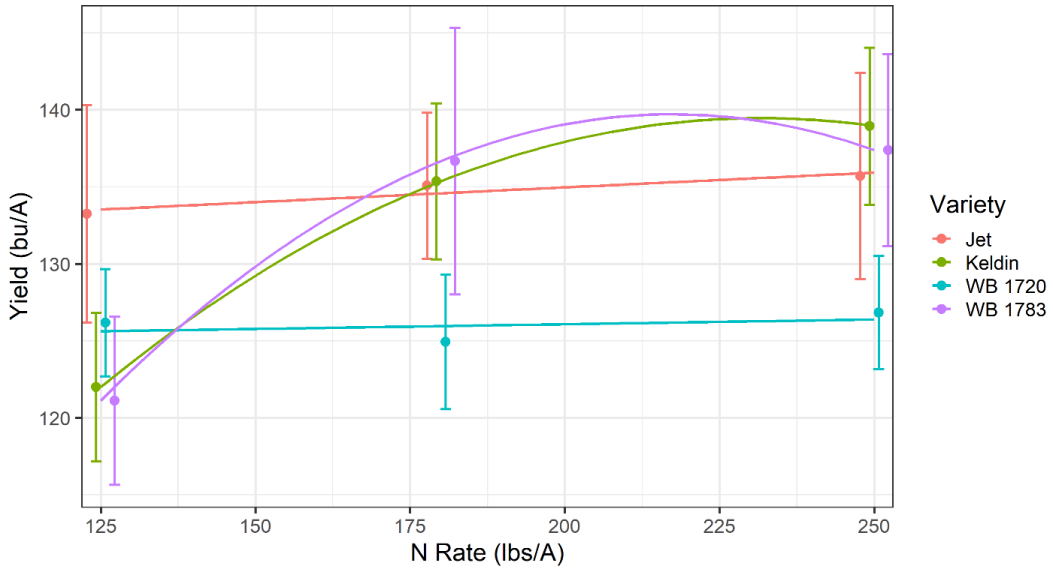


Figure 4. Winter wheat yield

There are several main effects of winter wheat variety on yield and yield components. Test weight is distinctly different for each of the four varieties evaluated. Keldin has the highest average test wt overall, and the highest of the hard red varieties, at 64.1 lbs/bu. WB 1783 is the second highest test wt variety and the highest of the soft white varieties, at 63.2 lbs/bu (Table 3, Figure 2). Keldin has the highest protein of the hard red varieties, and the highest protein overall, at 11.6%. WB 1783 has the lowest protein of all the varieties tested at 10.7% (Table 3).

The variety Keldin has a lower number of seeds per head that the other varieties. However, Keldin has the highest thousand kernel weight (TKW) and highest test wt (Table 3). This is likely how Keldin remains a top yielding variety despite having a lower number of individual seeds per head. The two hard red varieties have a higher TKW than the soft white varieties (Table 3).

Table 3. Winter Wheat Market Class & Variety

Market Class	Variety	Yield	Test wt	Protein	Seeds/head	TKW[a]
		bu/acre	lbs/bu	%	#	g
Hard red	Jet	134 a	61.5 c	11.2 b	46.4 ab	45.5 b
	Keldin	132 ab	64.1 a	11.6 a	43.5 b	48.6 a
Soft white	WB 1720	125 b	61.1 d	11.3 b	47.5 a	40.6 d
	WB 1783	131 ab	63.2 b	10.7 c	47.9 a	43.3 c

[a]TKW, thousand kernel weight

Test weight was generally reduced by increasing N application in all four varieties tested. There is a distinct difference in test weight reduction between hard red and soft white varieteis. The hard red varieties (Jet and Keldin) show minimal test weigh decrease over inceasing N rates, while the test weight of soft white varieties (WB1720 and WB1783) reduces at a greater rate (Figure 2). WB 1720 had the lowest test weight of all varieties at the 180 and 250 lb/A N treatments, this likely why this variety showed the lowest yield response to increasing N rates.

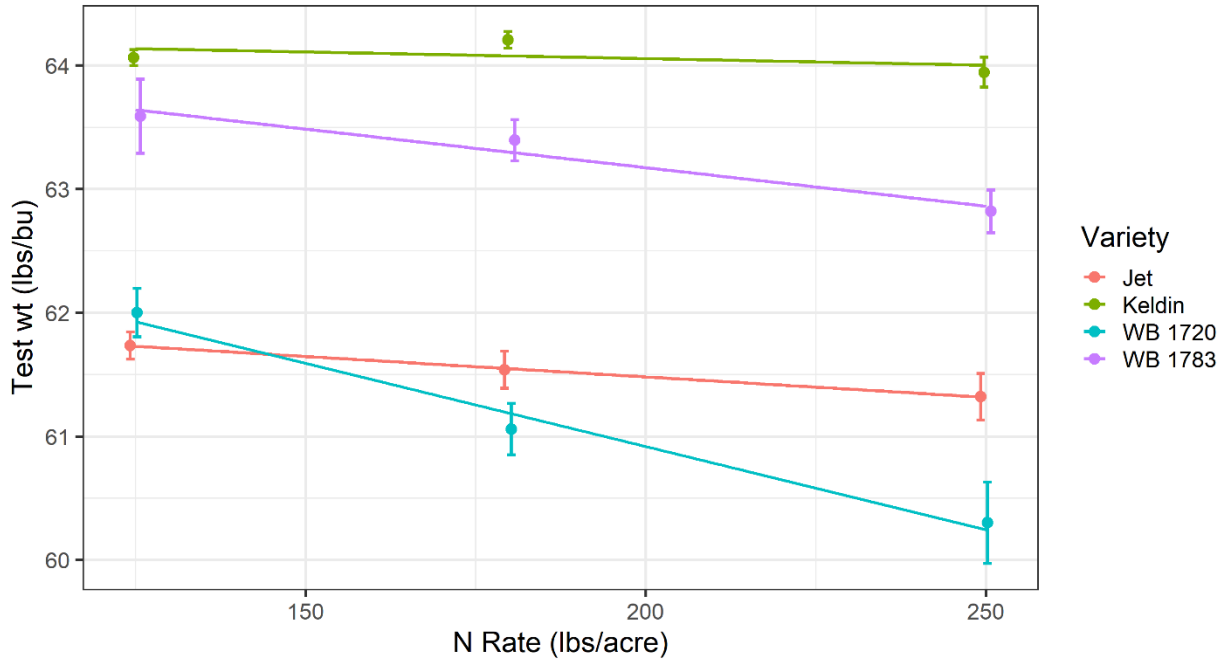


Figure 5. Winter wheat test weight

Of similar response to test weight, thousand kernel weight (TKW) is reduced in each winter wheat variety as nitrogen rate inceases (Figure 3). Of the four varieties tested WB1720 has the lowest average TKW across the range of nitrogen treatments. The TKW of WB1783 is reduced at a more rapid rate by increasing N application, compared to the other varieties (Figure 3).

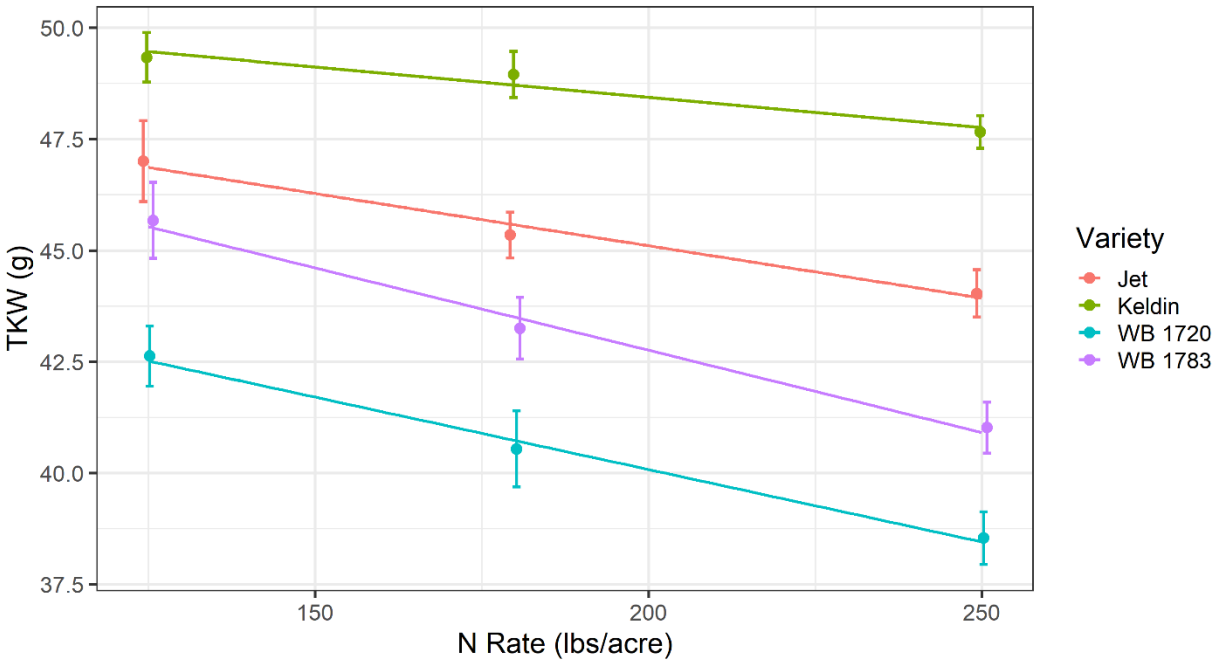


Figure 6. Winter wheat thousand kernel weight

Winter wheat yield increased an average of 8 bu/acre when population was increased from 16 to 24 plants/ft^2. Test weight was generally higher when winter wheat was planted at higher densities. The plant population 16 plants/ft^2 resulted a test wt of 62.3 lbs/bu; increasing plant population above 16 plants/ft^2 resulted in test weights of 62.5 lbs/bu or higher (Table 4).

Average number of heads per plant was 2.7 at the 16 plants/ft^2 population. At 24 plants/ft^2 heads per plant was reduced to 2.3 and there was further reduction to 1.9 heads per plant when plant population was further increased (Table 4). The number of heads per plant is directly related to the number of tillers that individual wheat plants developed and carried through to maturity. This data indicates that increasing wheat plant population up to 32 plants/ft^2, reduced wheat tillers. The number of seeds per wheat head was 50.2 when winter wheat was planted at 16 plants/ft^2; seeds per head was reduced to 45.9 when population was increased to 24 plants/ft^2 (Table 4). This data shows limited to no yield benefit to increasing seeding rates above 24 plants/ft^2.

Table 4. Winter Wheat Plant Population

Population	Yield	Test wt	Protein	Heads/plant	Seeds/head
plants/ft^2	bu/acre	lbs/bu	%	#	#
16	124 b	62.3 b	11.3 a	2.7 a	50.2 a
24	132 a	62.5 ab	11.2 b	2.3 b	45.9 b
32	133 a	62.6 a	11.2 ab	1.9 c	44.9 b
40	133 a	62.6 a	11.1 b	1.7 c	44.4 b

Project Title: Winter Wheat Preliminary Yield Trial

Objective: To test for agronomic performance of early winter wheat lines.

Personnel: J.A. Torrion, Daniel Porter, Suchismita Mondal, Jacob Tracy

Summary:
Thirty-six winter wheat genetic lines were tested in this preliminary trial. See table 1 for the detailed management practices. Yield (bu/ac) ranged from 81.3 (MTFH2290) to 144.8 (MT2280). Protein percentage ranged from 10.8 (MTFH2292 & MT2280) to 13 (MT2278). Test weight (lb/bu) ranged from 62 (MT2278) to 65.8 (MT2286). Heading dates (Julian) ranged from 158 (MT2282) to 168 (MTFH2290). Plant height ranged from 28.4 in (MTFH2289) to 39.6 in (Yellowstone). The greatest stripe rust infection was 50.5% (Warhorse) and the rest of the lines had none to very slight infection. See table 2 for agronomic performance of all early genetic lines tested.

Table 1. Management Information

Seeding date:	9/24/2021	**Field Location:**	R5
Julian date:	267	**Harvest date:**	8/9/2022
Seeding rate:	Standard	**Julian date:**	221
Previous crop:	Peas	**Soil type:**	fine sandy loam
Herbicide:	Cleanswsweep, axial bold (5/10/2022)	**Tillage:**	conventional
		Soil residual nutrient (NO_{3}-, P, K lb/A):	106-9-125
Insecticide:			
Fungicide:		**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	85-0-0 (4/14/2022)

Seed treatment: CruiserMax Vibrance Cereal
Emergence: 10/2

Table 2. Agronomic Performance

Entry	Line/Cultivar	YLD[1], bu/ac	PRO[2] %	TWT, lb/bu	HD	HT, in
24	MT2280	144.8	10.8	64.7	165	35.6
14	MT2270	142.0	11.1	64.5	161	33.0
8	MT2264	140.6	11.3	64.4	161	31.9
6	MT2262	140.6	11.2	64.6	158	30.5
16	MT2272	140.1	11.2	65.1	160	34.4
13	MT2269	138.7	11.6	65.0	162	34.3
15	MT2271	137.0	11.9	64.7	164	31.4
9	MT2265	136.7	11.6	64.9	162	33.8
27	MT2283	136.1	11.5	65.6	163	32.9
4	Flathead	135.9	11.3	63.8	159	35.3
12	MT2268	135.2	10.9	64.7	161	32.5
10	MT2266	134.7	11.0	64.9	161	34.3
30	MT2286	134.7	11.4	65.8	163	36.6
23	MT2279	132.6	11.9	64.5	158	29.0
18	MT2274	132.6	11.9	65.5	159	32.9
1	Yellowstone	132.4	11.4	62.9	164	39.6
17	MT2273	130.9	12.0	65.1	164	34.2
20	MT2276	129.8	11.0	64.9	164	32.6
7	MT2263	129.6	11.8	64.8	164	32.3
31	MT2287	128.9	12.1	64.2	162	36.1
5	MT2261	127.9	12.2	65.2	158	30.3
2	Warhorse	127.9	12.2	63.5	166	35.0
3	SY Monument	126.8	11.4	62.8	164	32.2
11	MT2267	126.3	12.4	64.8	162	33.9
29	MT2285	125.3	12.1	65.1	163	32.5
19	MT2275	124.8	11.6	64.7	161	31.9
28	MT2284	123.8	12.0	65.3	163	31.1
32	MT2288	123.3	11.8	63.5	164	32.5
26	MT2282	122.4	11.6	64.8	158	32.4
33	MTFH2289	120.2	11.2	63.4	166	28.4
25	MT2281	117.5	12.1	65.2	159	33.5
21	MT2277	116.4	12.2	65.1	159	32.9
35	MTFH2291	116.1	11.5	63.3	165	33.1
36	MTFH2292	111.9	10.8	64.0	166	30.1
22	MT2278	98.1	13.0	62.0	164	33.4
34	MTFH2290	81.3	11.5	62.6	168	29.9
	Mean	127.9	11.6	64.4	162.0	32.9
	CV	6.3	2.0	0.6	0.8	5.0
	LSD	20.0	0.6	0.9	3.3	4.1
	PR > F	<0.0001	<0.0001	<0.0001	<0.0001	0.0008

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

1 adjusted to 13% moisture

2 adjusted to 12% moisture

Project Title: Quantifying the Impact of Irrigation and Precipitation Timings on Winter Wheat Yield and Quality

Objective: To determine the agronomic impacts of the various irrigation strategies and simulated rain winter wheat cultivars.

Personnel: J.A. Torrion, Daniel Porter, Eeusha Nafi

Summary:

This study was laid out in a split-plot design, where the water regime treatment was the main plot, and the eight-winter wheat (four hard reds and four soft whites) was the subplot. This was also conducted over two environments: 1) rainfall received for the whole study was from the naturally occurring rainfall events, and 2) received additional simulated rainfall via overhead sprinklers over the grain-filling duration to quantify the effect of rainfall timings on grain quality and yield. See Table 1 for the management information.

There was no interaction between the water regime treatments and the two environments. Overall, under the 2022 condition, applying the final irrigation at or just after flowering was enough to achieve the optimal yield (Fig. 1). Additional irrigation after that, either in full amount or via deficit (66ET), did not show any yield advantage. This year, the total rain received was 7.6”, and the established winter wheat rooting system in spring can utilize both the stored soil moisture and the early rains in spring. In an environment where a total additional 1.0” rainfall was simulated using the overhead sprinkler (four events at 0.25” each across the grain filling stages), gained +14 bushels more across water regime treatments. There was no relation between water regimes and grain protein. In this study, grain protein was strongly related to the variety used and the market class. In Figure 2, the hard red winter wheat (Flathead, FourOSix, Northern, and Bobcat) had higher protein (but lower yield) compared with the soft whites (Mary, Puma, Bobtail, and Sockeye). The soft whites have higher yields but lower protein than the hard reds (as shown in the negative relationship between protein and yield, Fig. 2).

As for the falling number (FN) test, applying irrigation later in the season (regardless of the amount tend to lower FN further regardless of market class (Fig. 3). The soft white is even more susceptible to lowered FN. In other areas of the United States, soft whites tend to have lower FN and tend to be susceptible to preharvest sprout. Applying irrigation later in the season does not improve yield but aggravates lowered FN. Terminating irrigation earlier then, is advantageous. This outcome is similar to our 5-year of research in spring wheat. Further, the additional rainfall events via the simulated rainfall using the overhead sprinkler lowered FN values even more, regardless of market class (Fig. 4). Most of the varieties are below the 1:1, except Bobcat and Northern, indicating that most of the varieties regardless of market class tended to reduce FN values with the simulated rainfall events (y-axis of Fig. 4) later in the season.

Table 1. Management Information

Seeding date:	9/23/2021	**Field Location:**	R5
Julian date:	266	**Harvest date:**	8/10/2022
Seeding rate:	Standard	**Julian date:**	222
Previous crop:	Peas	**Soil type:**	fine sandy loam
Herbicide:	Clean SweepM & Axial Bold (5/10/22)	**Tillage:**	Conventional
Insecticide:		**Soil residual nutrient (NO_3-, P, K lb/A):**	106-18-250
Fungicide:	Headline (6/9/2022)	**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	85-0-0 (5/3/2022)

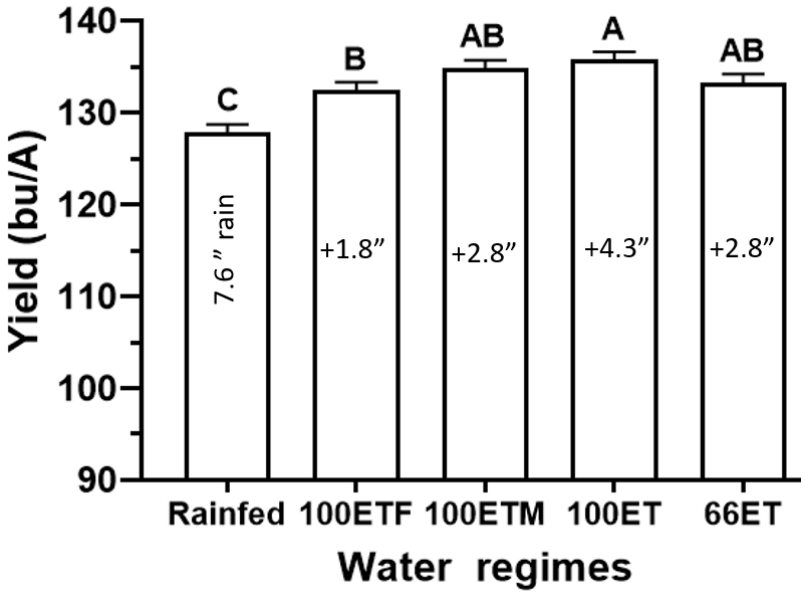


Figure 1. Yield responses with water regimes. The '+' symbols are the irrigation amounts received per treatment. The 100 percent evapotranspiration (100ET) is with no stress. The 100ETF is a no-stress treatment until after flowering (the final irrigation was applied within the flowering stage). The 100ETM is also a no-stress treatment until after milk (the final irrigation was applied at the milk stage). The 66ET is the deficit treatment (applying only 2/3 of what was applied in the 100ET treatment at each irrigation event). The same letter assignment denotes non-significance at α=0.05.

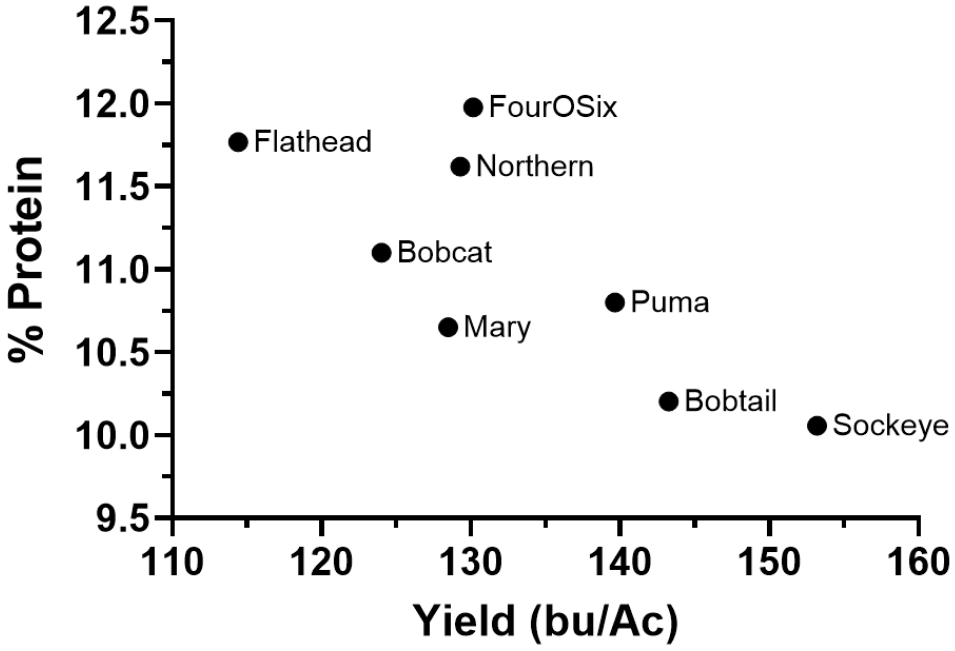


Figure 2. Grain protein and yield relationship of the varieties. The hard reds are Flathead, FourOSix, Northern, and Bobcat. The soft whites are Mary, Puma, Bobtail, and Sockeye.

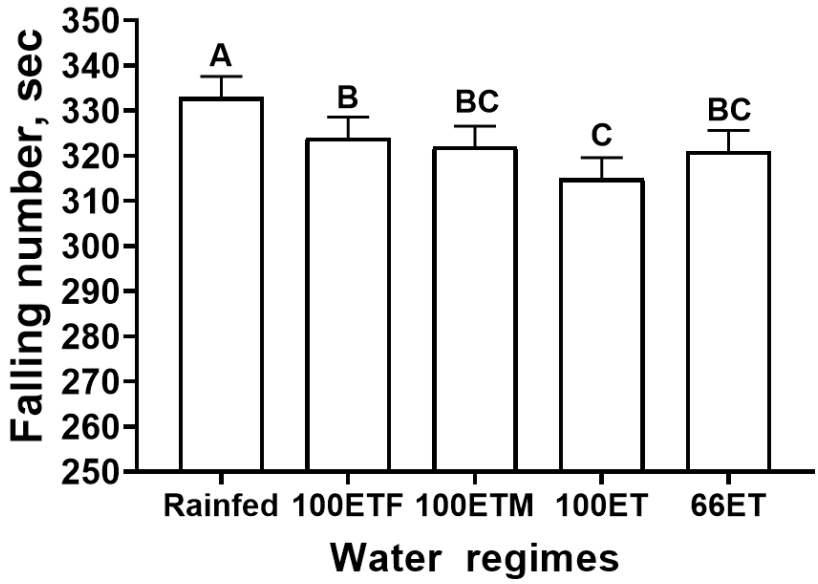


Figure 3. Falling number response with water regimes. The 100 percent evapotranspiration (100ET) is with no stress. The 100ETF is a no-stress treatment until after flowering (the final irrigation was applied within the flowering stage). The 100ETM is also a no-stress treatment until after milk (the final irrigation was applied at the milk stage). The 66ET is the deficit treatment (applying only 2/3 of what was applied in the 100ET treatment at each irrigation event). The same letter assignment denotes non-significance at α=0.05.

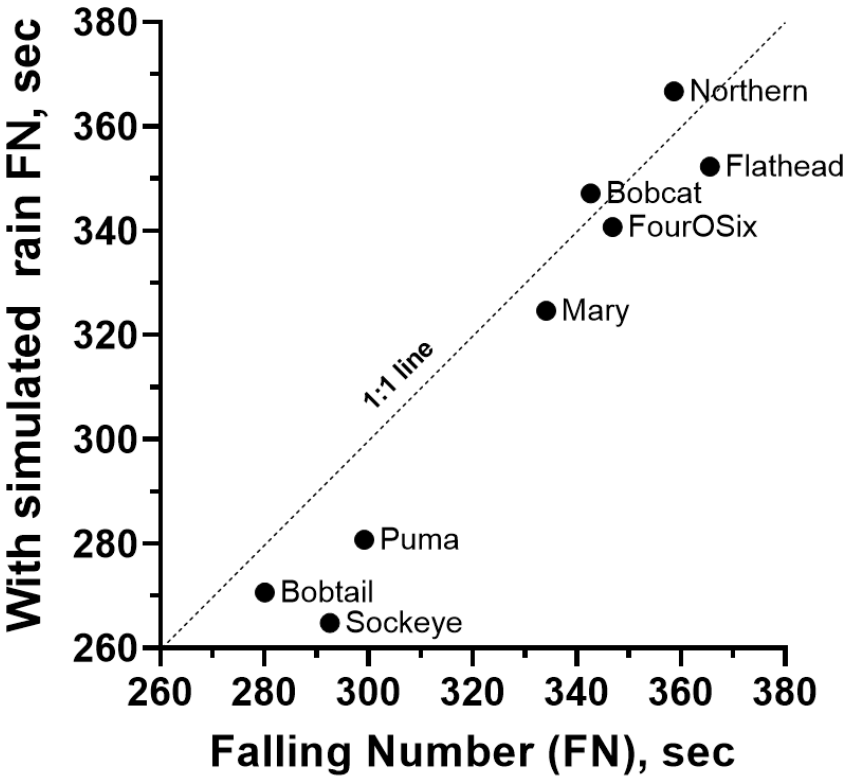


Figure 4. Falling number relationship between the irrigated environment with simulated rainfall events (y-axis) vs. the irrigation environment without the simulated rainfall events (x-axis). The hard reds are Flathead, FourOSix, Northern, and Bobcat. The soft whites are Mary, Puma, Bobtail, and Sockeye.

FORAGES

Project Title: 2022 Sorghum Sudangrass Planting Date

Objective: To identify the effect of planting data and harvest date on sorghum sudangrass yield and forage quality in northwestern Montana

Personnel: Clint Beiermann, Jessica Pavelka

Summary:

Sorghum sudangrass was planted on three dates: May 1st, May 15th, and June 1st of 2022. All planting date treatments were harvested at three distinct harvest dates: August 1st, August 15th, and September 15th. Treatments that were harvested on August 1st and August 15th were harvested again on September 15th to assess the amount of regrowth that occurred between the first harvest event and the end of the growing season (Table 1).

There was no significant difference on forage yield or plant heights between planting dates, however there was a significant increase in yield as harvest date was delayed. The September 15th harvest date showed a significantly higher yield across planting dates, with an average of 23.4 tons/A. The August 15th harvest date also had a significantly higher yield than the August 1st date, yielding 15 tons/A and 8.1 tons/A, respectively (Table 3). This trend is also true for plant height at harvest. The September 15th harvest had an average height of 147.2 cm while the August 1st harvest had an average height of 87.5 cm (Table 3). The regrowth was significantly higher for the August 1st regrowth harvest than the August 15th regrowth harvest, as the earlier harvest date had more time for regrowth. The total forage yield, a combination of main harvest and regrowth harvest was comparable, at 16.4 ton/A for August 1st and 16.7 for August 15th (Table 3).

Nitrate levels declined as harvest date was delayed. Nitrate levels were near 120 ppm for the August 1st harvest and declined to near 40 ppm by the September 15th harvest date (Figure 2). Protein levels also decreased as harvest was delayed. Protein levels were near 12% when sorghum sudangrass was harvested August 1st and decreased to near 5% by the September 15th harvest date (Figure 3). ADF levels increased as harvest was delayed, and ADF was significantly lower for the June 1st planting date, compared to earlier planting dates (Figure 4).

Table 1. Management information

Seeding date:	5/1, 5/15, 6/1	**Field Location:**	X4
Julian date:	122, 135, 152	**Harvest date:**	8/1, 8/15, 9/15
Seeding rate:	9 plt/ft^2	**Julian date:**	213, 227, 258
Previous crop:	Canola	**Soil type:**	Creston Silt Loam
Herbicide:	2, 4-D @ 12 oz/A & Destiny HC @6.4 oz/A 6/7/22	**Tillage:**	Conventional
Insecticide:	NA	**Soil residual nutrient (NO_3^{-1}, P, K lb/A):**	109-16-312
Fungicide:	NA	**Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):**	100-20-30

Table 2. Agronomic performance by planting date

Planting Date	Yield (ton/A)	Height (cm)
May 1st	16.0	116.0
May 15th	16.4	119.8
June 1st	14.1	116.4
Mean	15.5	117.4
C.V.	11.1	5.6
LSD	ns	ns
PR>F	0.091	0.459

Table 3. Agronomic performance by harvest date

Harvest Date	Main Harvest		*Regrowth Harvest		Total Yield
	Yield (ton/A)	Height (cm)	Yield (ton/A)	Height (cm)	(ton/A)
1st August	8.1 c	87.5 b	**8.3** a	**83.5** a	16.4
15th August	15.0 b	-	1.7 b	45.0 b	16.7
15th September	**23.4** a	**147.2** a	-	-	23.4
Mean	15.5	117.4	5.0	64.3	
C.V.	18.1	5.4	32.6	13.7	
LSD	2.4	5.5	1.4	7.5	
PR>F	<.001	<.001	<.001	<.001	

*Regrowth harvested 15-Sep

Letters represent differences (α=0.05)

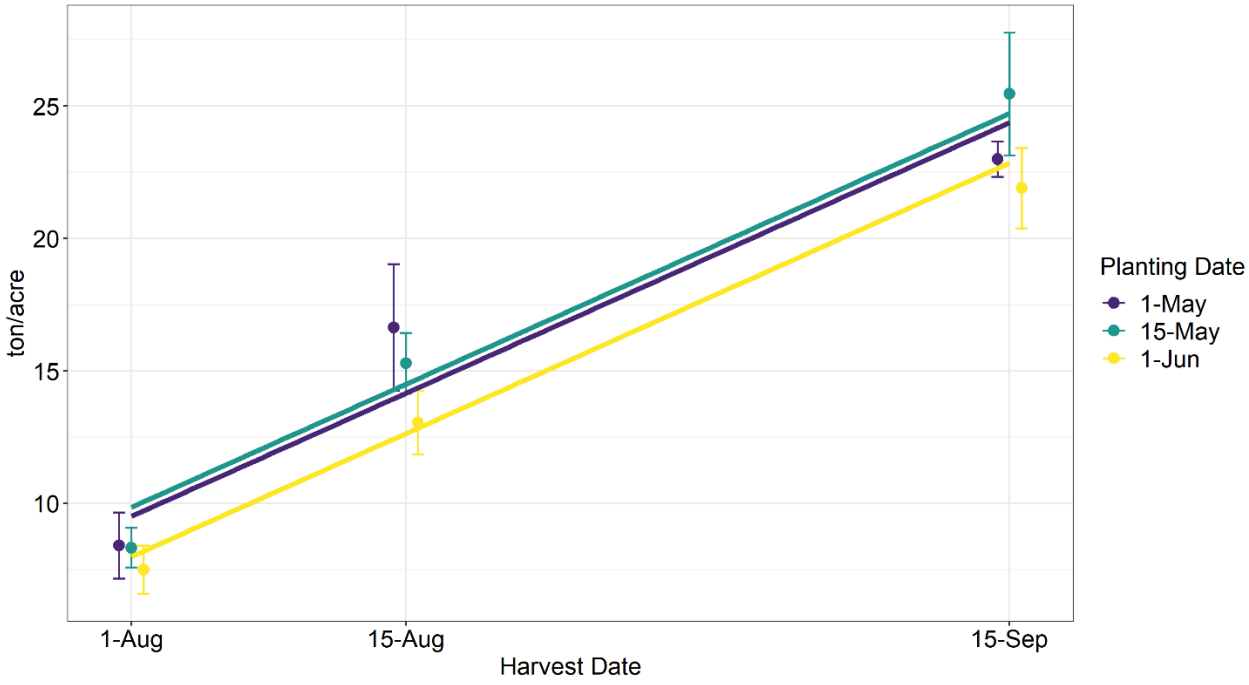


Figure 1. Forage yield

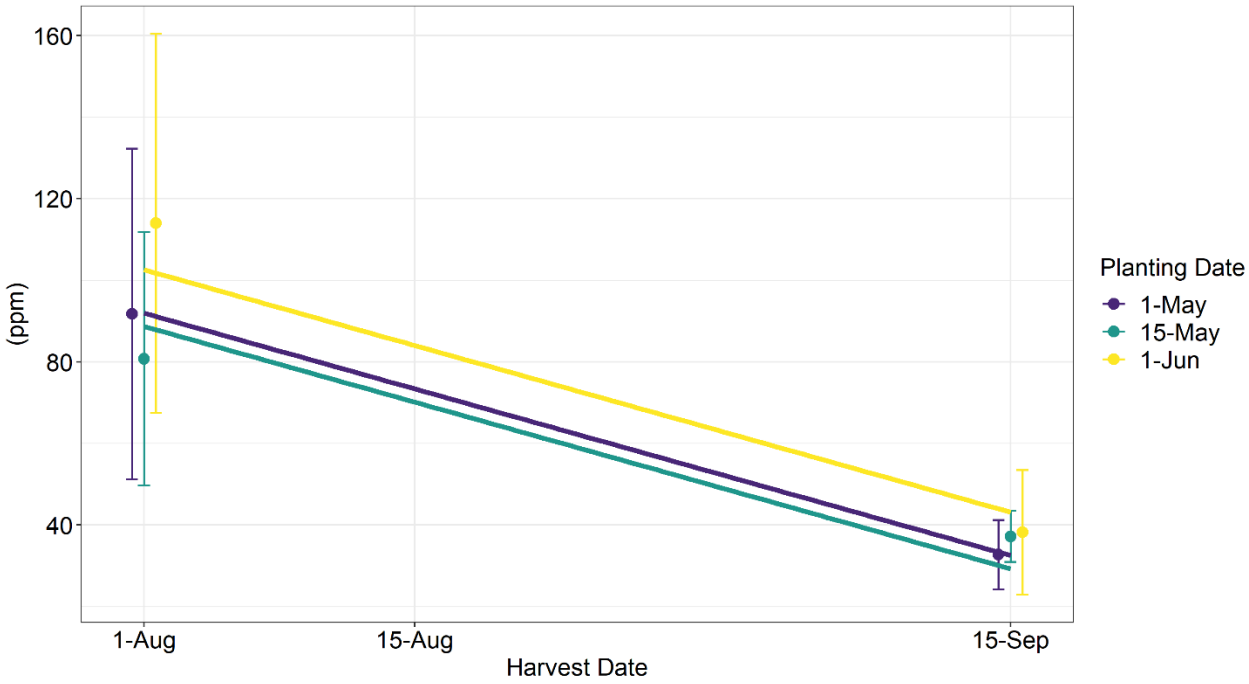


Figure 2. Nitrate content

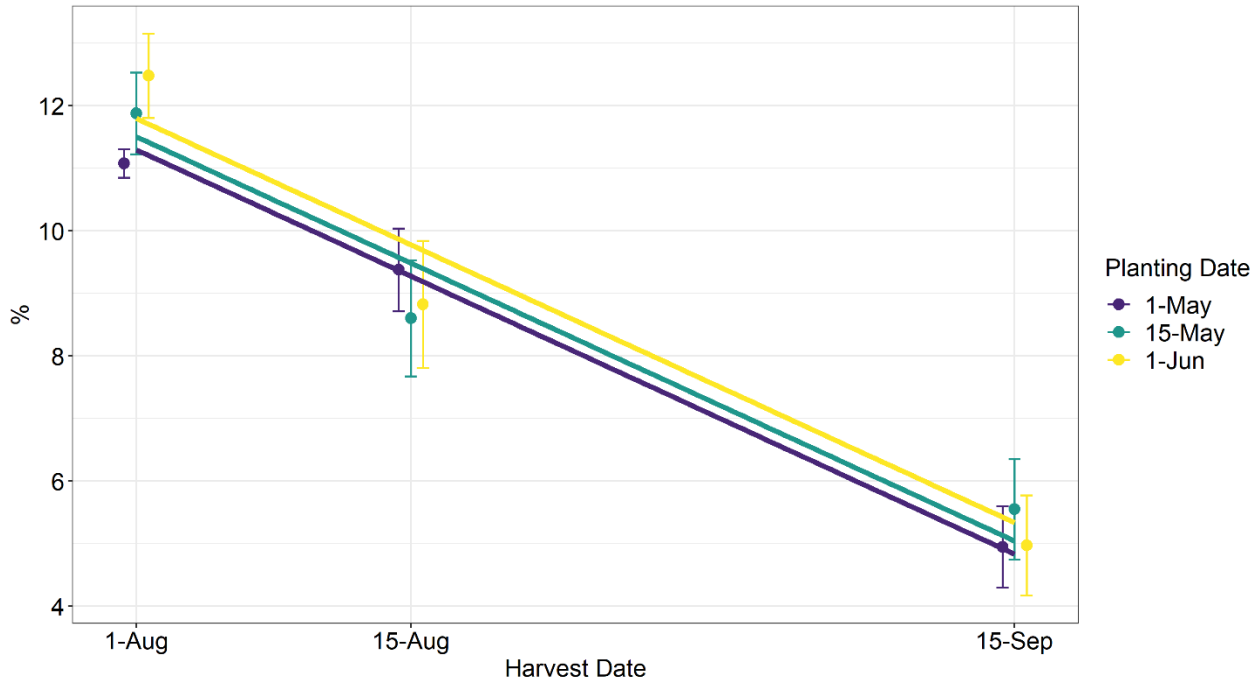


Figure 3. Percent crude protein

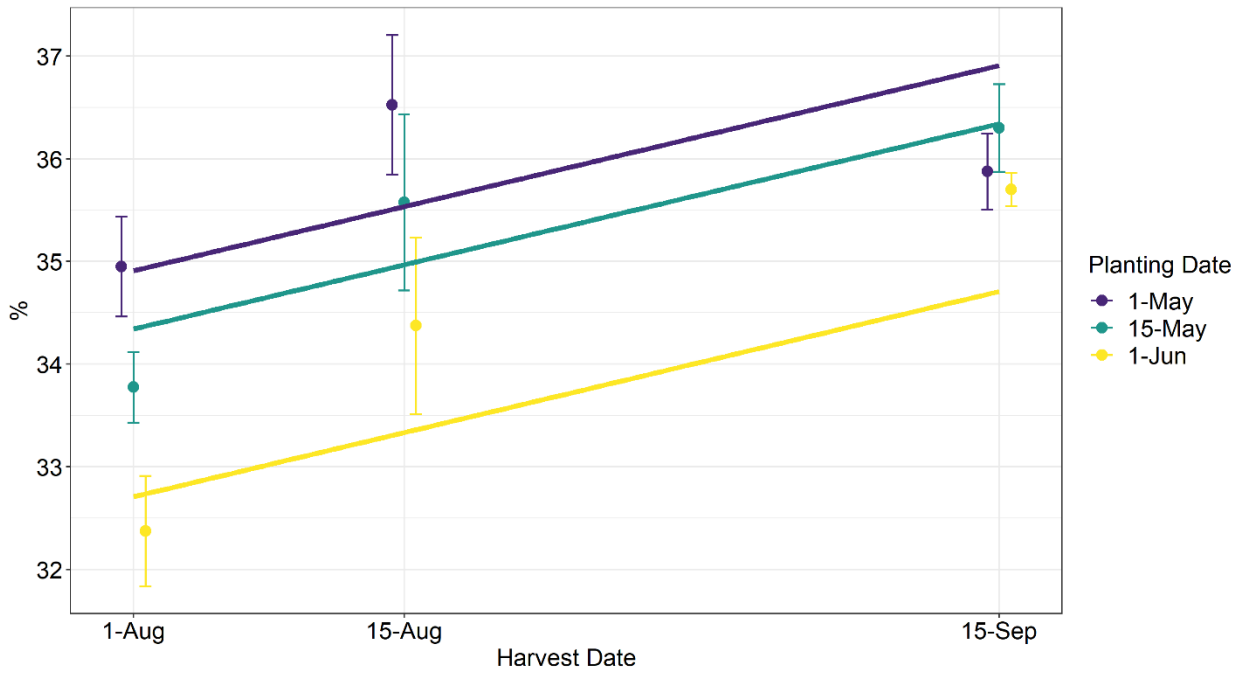


Figure 4. Percent acid detergent fiber

Montana Fertilizer Advisory Committee (MFAC)

Project Title: Nitrogen Requirement for Sustained Yield and Optimal Quality of Cool-season Perennial Forages

Objective: To test for N requirement, yield, and quality of selected cool-season perennial forage grasses.

Personnel: J.A. Torrion, Daniel Porter, Hayes Goosey, Peggy Lamb

Summary:
Cool-season perennial grasses were planted on April 21st, 2022, see Table 1 for details. This study was under split-plot design where four N levels are the main plots and four forage species are the subplots. The species were meadow brome, smooth brome, tall fescue, and a dryland mix (comprised of meadow brome, smooth brome, tall fescue, and intermediate wheatgrass). The second harvest this year was done post-first killing frost in October. The total forage yield was influenced by both the N treatments and the forage species. The highest forage yield was observed at N treatment 4 (50 lbs N at tiller + 50 lbs N after 1st cut). The doubling of the fertilizer application in treatment 4, relative to treatment 2, only garnered 20% increase in forage yield. The 50 lbs applications, either applied at planting or split applied at the tiller and after the first cut, had the same yield (Table 2).

As for the yield by species, both the tall fescue and meadow brome had the highest total yield (Fig. 1). The dryland mix and the smooth brome had the same yields. Notably, the smooth brome only had minimal biomass regrowth after the first cut. The dryland mix also had the lowest forage biomass during the first cut. We insinuate that the dryland mix had the least weed competitive ability. Early in the season, there were several broadleaf weeds observed while waiting for the optimal stage timing of the grass species for herbicide application.

Table 1. Management Information

Seeding date:	April 21st, 2022	**Field Location:**	R3
Julian date:	111	**Harvest dates:**	*See below
Seeding rate:	variety dependent	**Julian dates:**	*See below
Previous crop:	Canola	**Soil type:**	fine sandy loam
Herbicide:	Detonate, Cleaver (6/7/2022)	**Tillage:**	Conventional
Insecticide:		**Soil residual nutrient: (NO_{3}-, P, K lb/A):**	40-14-260
Fungicide:		**Nutrient fertilizer applied: (N, P_2O_5, K20 lb/A):**	Varied - 20.2 - 14.9

Harvest 1 dates: 8/17/2022, 8/18/2022, & 8/30/2022 (Julian 229, 230, & 242)

Harvest 2 post-frost dates: 10/24/2022 & 10/25/2022 (297, & 298)

Table 2. Forage yield by N treatment, Creston, MT. This site had a 40 lbs/A residual NO_3^{-1} and received 2.75 inches of irrigation. The same letter assignment denotes nonsignificant differences at α =0.05 across N treatment.

N treatment ID	N Treatment	Yield (tons/Ac)
1	Control	0.88c
2	50 lbs N at planting	1.55b
3	25 lbs N at tiller + 25 lbs N after 1st cut	1.53b
4	50 lbs N at tiller + 50 lbs N after 1st cut	1.87a

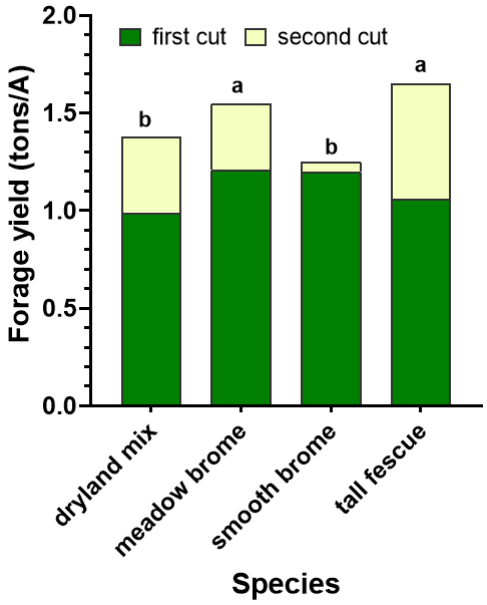


Figure 1. Forage yield by species at 30% dry matter. The same letter assignment denotes non-significance at α = 0.05. The second cut was done just after the first killing frost. The dryland mix comprises of meadow brome, smooth brome, tall fescue, and intermediate wheatgrass.

Table 3. Cut 1 Quality Creston, MT

Species	CP %	ADF	NDF	RFV	TDN	NFC %	WSC %
dryland mix	14.8	31.7	52	115.2	66.4	23.3	10.5
meadow brome	13.6	35.1	53.6	107.1	62.6	22.8	10
smooth brome	13.4	32.2	50.7	117.5	65.8	26.8	10.6
tall fescue	14	28.3	48.7	127.7	70.3	26.4	12
Mean	14.0	31.8	51.3	116.9	66.3	24.8	10.8
CV	11.0	9.5	5.6	8.5	5.2	14.0	9.2
LSD	1.4	2.8	2.8	8	3.2	3.1	0.6
PR > F	0.042	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001

CP: crude protein, ADF: acid detergent fiber, NDF: neutral detergent fiber, RFV: relative feed value, TDN: total digestible nutrient, NFC: non-fibrous carbohydrate, WSC: water-soluble carbohydrate

Forage quality was species-dependent, and N application did not influence them. Tall fescue had the highest relative feed value, including total digestible nutrients, non-fibrous carbohydrates, and water-soluble carbohydrates (Table 3). Tall fescue had the highest relative feed value in the second cutting (data not shown).

We also evaluated the relationship between N uptake and forage yield of the first cutting (Fig. 2). As with other forages, the plant can take excessive available N with no observed yield advantage but only increases tissue nitrate level (Fig. 3).

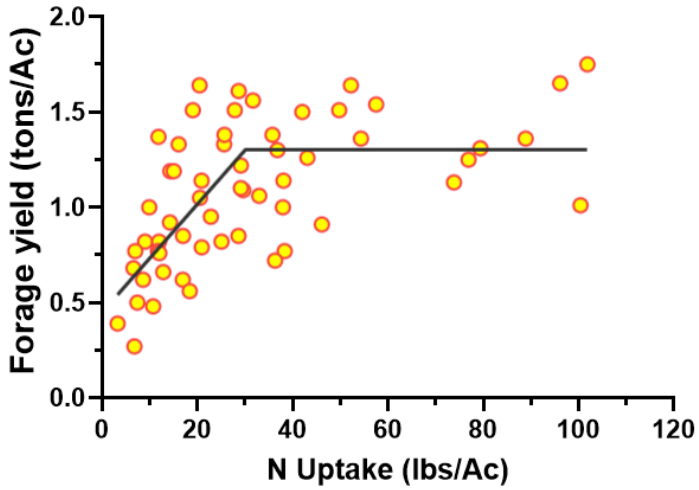


Figure 2. Non-linear upper plateau regression between N uptake and forage yield, cut 1, Creston, MT**.**

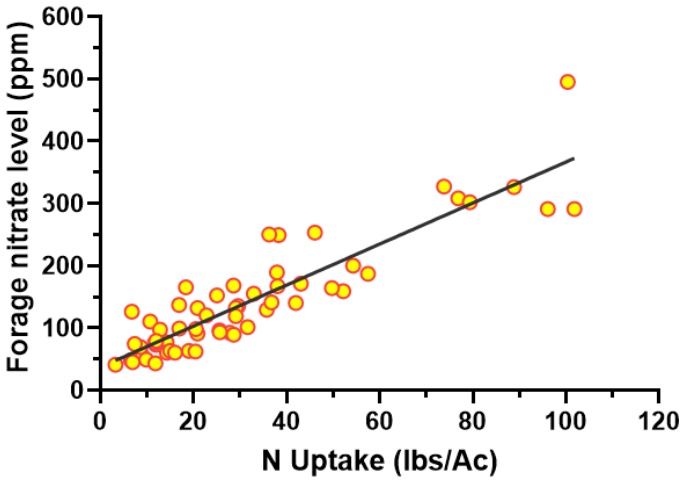


Figure 3. The linear relationship between nitrogen update and forage nitrate level, cut 1, Creston, MT.

Project Title: 2022 Spring Cereal Forage Variety Trial

Objective: To evaluate the performance of selected barley varieties in northwestern Montana

Personnel: Clint Beiermann, Pat Carr, Jessica Pavelka

Summary:

Thirteen forage varieties were planted on May 2nd, 2022 and managed under rainfed conditions (Table 1). Species planted included eight varieties of barley, one variety triticale, three varieties of oat, and one variety of spring wheat (Table 2).

Forage biomass was harvested on July 18th and the overall average yield was 8.2 tons/A. There was not a significant effect of variety on forage biomass yield. The average yield of oat was 9.3 tons/A, average yield of barley was 8.1 tons/A, and triticale had an average yield of 8.4 tons/A. The average heading date was 161 julian, however there was no significant difference between heading date based on variety. The highest ADF % and NDF % came from Tritical 141. The highest sulfur content came from MT Cowgirl at .1%, and the average was .073%. The average protein content was 10.1%, with the highest value being 10.9% for MT18F00607 and the lowest at 8.6% for Goliath (Table 2).

Table 1. Management information

Seeding date:	5/2/2022	**Field Location:**	X4
Julian date:	122	**Harvest date:**	NA
Seeding rate:	NA	**Julian date:**	NA
Previous crop:	Canola	**Soil type:**	Creston Silt Loam
Herbicide:	2,4-D (12fl oz/A) - 6/7/22	**Tillage:**	Conventional
Insecticide:	NA	**Soil residual nutrient (NO_3^{-1}, P, K lb/A):**	109-16-312
Fungicide:	NA	**Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):**	4-20-30

Table 2. Agronomic performance of spring cereal forage

Variety	Type	Biomass (tons/A)	Heading (julian)	ADF (%)	NDF (%)	Sulfur (%)	Protein (%)
GOLIATH	Oat	9.3	163	36.3	59.3	0.050	8.6
LAVINA	Barley	7.6	162	29.6	51.5	**0.083**	**10.9**
MT COWGIRL	Barley	8.9	161	32.4	55.6	**0.100**	**10.8**
MT16F01601	Barley	7.5	161	30.3	52.1	**0.095**	**10.2**
MT16F02401	Barley	8.1	163	32.2	55.7	**0.073**	**10.6**
MT18F00503	Barley	8.3	160	28.4	48.0	**0.090**	**10.3**
MT18F00607	Barley	7.7	166	32.8	58.2	**0.085**	**10.9**
MT18F00714	Barley	9.6	161	29.6	50.7	**0.083**	**10.2**
MT18F00803	Barley	7.1	162	27.8	48.0	**0.083**	**10.5**
RUSHMORE	Oat	9.1	161	35.3	57.4	0.045	8.9
SD170463	Oat	9.4	160	37.6	61.6	0.030	8.7
TRICAL 141	Triticale	8.4	163	**39.9**	**66.4**	0.053	**10.6**
WB PATRON	Spring Wheat	5.3	155	33.0	51.1	**0.083**	**10.7**
Mean		**8.2**	**161**	**32.7**	**55.0**	**0.073**	**10.1**
CV		**21.2**	**2.6**	**4.8**	**5.3**	**34.6**	**7.1**
LSD		**-**	**-**	**2.3**	**4.2**	**0.0**	**1.0**
PR>F		**0.068**	**0.125**	**<.001**	**<.001**	**0.006**	**<.001**

Bolding denotes equal value to highest or earliest value within a column based on LSD(0.05)
ADF = acid detergent fiber, NDF = neutral detergent fiber

Project Title: Cool Season Forage Trial

Objective: To test for yield and quality of selected cool-season forage grasses.

Personnel: J.A. Torrion, Daniel Porter

Summary:
The cool-season perennial forage species were planted on April 22, 2020 (see management table 1 for details). Data from fourteen grass forages species were gathered for this third year of establishment in 2022.

There were two harvest cuts this year. The total yield for 2022 ranged from 2.0 ton/A (Ryegrass-Remington NEA2) to 3.6 ton/A (Dryland mix-Barricade raw). All forage species had statistically similar forage yields (Table 2). This year's harvest showed plant vitality decreasing compared with the year 2021. The forage quality data for the first cut this year are also shown in Table 2, with no observed statistical differences among the species.

Table 1. Management Information

Seeding date:	4/22/2020	**Field Location:**	P2
Julian date:	113	**Harvest date:**	6/7/22, 6/16/22, 9/7/22
Seeding rate:	Variety-dependent	**Julian date:**	158, 167, 252
Previous crop:	Winter Wheat	**Soil type:**	Creston Silt Loam
Herbicide:	None in 2022	**Tillage:**	Conventional
Insecticide:	N/A	**Soil residual nutrient: (NO_3-, P, K lb/A):**	122-20-376 (Fall, 2019)
Fungicide:	N/A	**Nutrient fertilizer applied: (N, P_2O_5, K20 lb/A):**	84-10-35-10(S) [2020], 50 lbs N was reapplied in 2021, & 50 lbs N was reapplied in 2022

Table 2. Third year of establishment (2022) total dry biomass yields and forage qualities of the first cut

Brand	Variety	Total YLD, t/A	CP %	RFV	RFQ	Lignin %	Fat %	NFC %	WSC %
Barricade raw	Dryland mix	3.6	10.8	95.3	138.3	3.5	2.3	20.3	10.5
Arsenal	Meadow brome	3.2	10.7	100.3	149.7	2.9	2.4	23.2	11.6
Armory	Dryland tall fescue	3.0	10.9	94	141.3	3.2	2.1	20.1	10.7
Milkway	Tall fescue/meadow fescue mix	2.8	10.5	98.3	144	2.8	2.0	21.8	10.9
HLR	Orchardgrass	2.8	10.2	99.7	143.7	3.0	2.3	22.8	11.6
Remington	Perennial ryegrass	2.7	9.4	102	152.7	2.4	2.2	25.2	13.0
STF-43	Tall fescue	2.7	10.8	100.3	151	2.5	2.1	22.1	11.7
Driftless	Meadow fescue	2.6	12.1	96	150	3.0	2.1	19.7	10.1
Artillery	Smooth brome	2.4	10.9	101.3	154	2.6	2.3	23.3	11.4
Hamann	Creeping wheatgrass	2.3	10.2	100.7	143	3.2	2.3	22.7	11.8
HDR	Meadow fescue	2.3	9.6	104.7	152.7	2.4	2.1	26.0	13.3
Barricade w/Yellow Jacket	Dryland mix	2.2	9.2	106.7	146.7	2.8	2.2	26.2	13.2
Ammo	Dryland orchardgrass	2.2	10.0	117	162.3	2.3	2.7	28.9	14.3
Remington NEA2	Perennial ryegrass	2.0	9.7	95.3	139	3.3	2.1	21.9	11.8
	Mean	2.6	10.4	100.8	147.7	2.8	2.2	23.2	11.9
	CV	27.8	15.0	11.2	10.2	26.5	12.4	20.2	17.1
	LSD	ns	ns	ns	ns	ns	ns	ns	ns
	PR > F	0.452	0.724	0.637	0.837	0.743	0.457	0.528	0.436

YLD: yield, CP: crude protein, RFV: relative feed value, RFQ: relative forage quality, NFC: non-fibrous carbohydrate, WSC: water-soluble carbohydrate

Project Title: Intrastate Winter Cereal Forage Trial

Objective: To test forage and grain yields and quality of winter cereal forages.

Personnel: J.A. Torrion, Daniel Porter, McKenna Brown, P. Carr

Summary:
Nine cereal forages varieties were studied in this trial in a randomized complete block replicated four times. Height at forage maturity ranged from 35.3 in. (Ray-1432) to 67.4 in. (WCF 1060 (FX1001)). Forage yield ranged from 4 tons/A (MTF 22137) to 7.5 tons/A (WCF 1060 (FX1001)). Grain protein ranged from 9.9% (MTF 22138) to 12.9% (Willow Creek). WCF 1060 (FX1001) had the highest grain harvest yield at 100.7 bu/ac whereas MTF 22136 had the lowest grain yield at 76 bu/ac. See table 2 for agronomic performance.

Table 1. Management Information

Seeding date:	9/24/2021	**Field Location:**	R5
Julian date:	267	**Harvest date:**	8/10/2022
Seeding rate:	standard	**Julian date:**	222
Previous crop:	Peas	**Soil type:**	fine sandy loam
Herbicide:	Clean SweepM - 1pt/A, Axial Bold - 15oz/A (5/10/2022)	**Tillage:**	conventional
Insecticide:	N/A	**Soil residual nutrient (NO_{3^-}, P, K lb/A):**	119-14-188
Fungicide:	N/A	**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	85-0-0 (4/14/2022)

Table 2. Agronomic Performance

Cereal Type	Species	Forage YLD, ton/A	Forage HT, in	Grain YLD[1], bu/ac	PRO[2] %	TWT[1], lb/bu
WCF 1060 (FX1001)	Triticale	7.5	67.4	100.7	11.3	59.3
Willow Creek	Wheat	6.6	54.9	81.2	12.9	65.2
MTF 21204	Wheat	6.0	42.4	93.5	11.0	60.6
MTF 21207	Wheat	5.6	38.5	95.7	10.6	64.3
Ray-1432	Wheat	5.5	35.3	87.3	10.5	63.3
MTF 20189	Wheat	5.4	46.7	86.0	12.4	65.0
MTF 22138	Wheat	5.3	36.3	94.2	9.9	63.3
MTF 22136	Wheat	4.4	40.6	76.0	12.3	65.1
MTF 22137	Wheat	4.0	36.4	97.0	10.6	64.3
Mean		5.6	44.3	90.2	11.3	63.4
CV		18.2	3.6	9.3	2.4	0.9
LSD		1.5	2.3	12.2	0.4	0.8
PR > F		0.0025	0.0001	0.0058	0.0001	0.0001

TRT: treatment, YLD: yield, HT: plant height inches, PRO: protein, TWT: test weight

1 adjusted to 13% moisture

2 adjusted to 12% moisture

OIL CROP

Project Title: 2022 Winter Canola Variety Trial

Objective: To evaluate the performance of selected winter canola varieties in northwestern Montana

Personnel: Clint Beiermann, Jessica Pavelka
Michael Stamm - KSU

Summary:

Twenty varieties of winter canola were planted on August 23rd, 2021. Irrigation was utilized in 2021 to establish a stand. Canola only received rainfed moisture in 2022 until harvest on August 16th, 2022 (Table 1). There were 8.9" of rainfall during the 2022 growing period (Apr-Aug).

The average yield was 46.84 bu/A with the lowest at 39.7 bu/A for KSR4839S and the highest yield being 55.6 bu/A from KSU103 (Figure 1). The average maturity height was 48.15 inches, but there was no significant difference in heights between varieties. The average spring stand was 6.1 plants/ft^2, with the highest stand at 8.3 plants/ft^2 from KSR4925 and the lowest stand at 2.8 plants/ft^2 from KSU102, which also had the second highest yield.

Winter survival averaged 78.35%, the highest survival rate was 88.3% for KSR4854S, while the lowest was 67.3% for TFW104. There was minimal lodging across varieties, however the highest percentage was 15% for TFW103, which also had the highest yield. Generally low amounts of lodging overall.

Table 1. Management information

Seeding date:	8/23/2021	**Field Location:**	Y7
Julian date:	235	**Harvest date:**	8/16/2022
Seeding rate:	NA	**Julian date:**	228
Previous crop:	Fallow	**Soil type:**	Silty Clay Loam
Herbicide:	None	**Tillage:**	Conventional
Insecticide:	Lambda-CY 5/24/22	**Soil residual nutrient (NO3-1, P, K lb/A):**	167-12-143-72S
Fungicide:	None	**Nutrient fertilizer applied (N, P2O5, K20 lb/A):**	Applied Spring 2022 100-42-37-20S

Table 2. Agronomic performance of canola varieties

Variety	Spring Stand (plt/ft$^{2)}$	Winter Survival (%)	FLWR (julian)	LOD (%)	HT (in)	YLD (bu/A)
KSU103	5.6	74.0	146.0	15.0	50.3	**55.6**
KSU102	2.8	70.0	146.0	**1.7**	49.7	**53.0**
KSU104	3.6	67.3	146.0	**0.0**	49.7	**51.3**
KSU107D	4.9	77.0	**144.3**	**0.0**	41.7	49.0
KSR4854S	**7.3**	**88.3**	146.0	**1.7**	49.3	49.0
KSR4927S	5.3	80.0	146.0	**1.7**	46.3	48.3
KSR4925	**8.3**	75.0	149.3	**0.0**	46.3	48.1
CP320WRR	5.6	**86.3**	146.0	**0.0**	45.0	47.3
KSR4767	**6.9**	77.3	146.0	**0.0**	51.3	47.2
KSR4848	**6.7**	**80.7**	146.0	**1.7**	50.3	46.6
KSR4837	**6.6**	75.0	147.0	**0.0**	48.0	46.2
KSR4928	**6.2**	79.3	147.7	**0.0**	55.0	46.0
KSR4852S	5.6	**83.0**	146.0	**0.0**	46.0	45.9
KSR4926S	**7.0**	77.3	146.0	**1.7**	45.0	45.2
CP225WRR	**6.8**	**84.7**	146.0	**1.7**	45.3	44.9
KSR4966S	**7.1**	76.0	146.3	**5.3**	49.0	44.3
KSR4846	5.1	75.7	146.0	**3.3**	45.3	44.2
KSR4850	**7.0**	**85.0**	146.0	**1.7**	47.0	43.4
KSR4967	5.8	72.7	146.3	**0.0**	50.3	41.6
KSR4839S	**7.7**	**82.3**	146.0	**1.7**	52.0	39.7
Mean	**6.1**	**78.4**	**146.3**	**1.9**	**48.2**	**46.8**
CV	**22.2**	**6.2**	**0.7**	**224.0**	**9.0**	**7.3**
LSD	**2.2**	**8.0**	**1.6**	**6.9**	**7.1**	**5.7**
PR>F	**0.003**	**<.001**	**<.001**	**0.035**	**0.123**	**<.001**

Bolding denotes equal value to highest or earliest value within a column based on LSD(0.05)
FLWR = flowering, HT = height, YLD = yield, LOD = lodging

Project Title: 2022 Winter Canola Planting Date

Objective: To identify the optimum planting dates and varieties of winter canola to ensure winter survival and high yield potential in Northwest Montana

Personnel: Clint Beiermann, Jessica Pavelka

Summary:

Six varieties of winter canola were planted at three planting dates: August 15th, September 1st, and September 15th of 2021. They were irrigated in the establishment year to establish a stand, then received only rainfed moisture, and were harvested on August 16th of 2022 (Table 1).

Yield was affected by planting date and canola variety. Canola planted on August 15 and Sep 1 yielded 61.1 bu/A and 70.3 bu/A, respectively, outyielding canola planted September 15 at 41.0 bu/A. The highest yielding variety was Mercedes, planted on 1st planting date at 77.9 bu/A, with seven other varieties being statistically equivalent within the August 15th and September 1st planting dates (Table 2, Figure 2). Between the August 15th and September 1st planting dates, Photosyntech Quartz, Rubisco Mercedes, and Rubisco PluraxCL were all within the top yielding varieties (Table 2).

Oil content is generally high for all varieties planted in the study, with oil content values ranging from 45.2% up to 48.2%. Oil content was affected by variety and closely reflects seed yield, with Rubisco Mercedes having the highest oil content at 48.2% (Table 3).

Canola survival rate during the overwinter period was affected by planting date. Canola planted on August 15th experienced a 20% stand reduction while September 1st had a stand reduction of 31%. However, Canola planted on September 15th resulted in significantly poorer survival with a 78.8% stand reduction observed during the overwintering period (Table 4).

Based on two seasons of results, planting dates between August 15th to September 1st would be optimum to establish winter canola in northwestern Montana. Repeated years of research on this study will strengthen results.

Table 1. Management information

Seeding date:	8/20, 9/3, 9/21	**Field Location:**	Y7
Julian date:	232, 246, 264	**Harvest date:**	8/16/22
Seeding rate:	18.4 plants/ft2	**Julian date:**	228
Previous crop:	Fallow	**Soil type:**	Silty Clay Loam
Herbicide:	None	**Tillage:**	Conventional
Insecticide:	Lambda-CY 5/24/22	**Soil residual nutrient (NO3-1, P, K lb/A):**	167-12-143-72S
Fungicide:	None	**Nutrient fertilizer applied (N, P2O5, K20 lb/A):**	Applied Spring 2022 100-42-37-20S

Table 2. Agronomic performance of the winter canola varieties based on planting date

Planting Date	Yield (bu/A)	Variety	Survival %	Yield (bu/A)
August 15	**61.1**	CP1022WC	**94.8**	58.7
		CP225WRR	82.5	50.8
		CP320WRR	**94.0**	59.3
		Photosyntech Quartz	74.5	**64.9**
		Rubisco Mercedes	**90.5**	**68.4**
		Rubisco PluraxCL	83.0	**64.4**
September 1	**70.3**	CP1022WC	77.5	**64.3**
		CP225WRR	79.3	62.0
		CP320WRR	82.0	**72.1**
		Photosyntech Quartz	76.3	**68.5**
		Rubisco Mercedes	**87.5**	**77.9**
		Rubisco PluraxCL	80.8	**76.8**
September 15	41.0	CP1022WC	6.3	7.9
		CP225WRR	21.0	50.7
		CP320WRR	26.8	**63.3**
		Photosyntech Quartz	4.3	5.9
		Rubisco Mercedes	24.0	41.3
		Rubisco PluraxCL	33.0	**76.9**
CV	**35.60**		**12.46**	**19.02**
LSD	**14.45**		**11.02**	**15.56**
Mean	**57.47**		**62.10**	**57.47**
PR>F	**<.0001**		**0.003**	**<.0001**

Bold = top performer; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

Table 3. Oil content by variety

Variety	Oil (%)
Rubisco Mercedes	**<u>48.2</u>**
Rubisco PluraxCL	**47.9**
Photosyntech Quartz	**47.5**
CP1022WC	46.5
CP320WRR	45.3
CP225WRR	45.2
CV	2.0
Mean	46.7
PR>F	<.0001

<u>Bold</u> = top performer; **Bolding** denotes equal value to highest or earliest value within a column based on LSD(0.05)

Table 4. Stand reduction by planting date

Treatment	Fall Stand plants/m^2	Spring Stand plants/m^2	% Stand Reduction
August 15	132.6	103.9* a	20.00 b
September 1	143.6	96.6 a	31.00 b
September 15	124.3	26.0 b	78.82 a
***Treatments denoted by different letters are significantly different at α=0.05**			

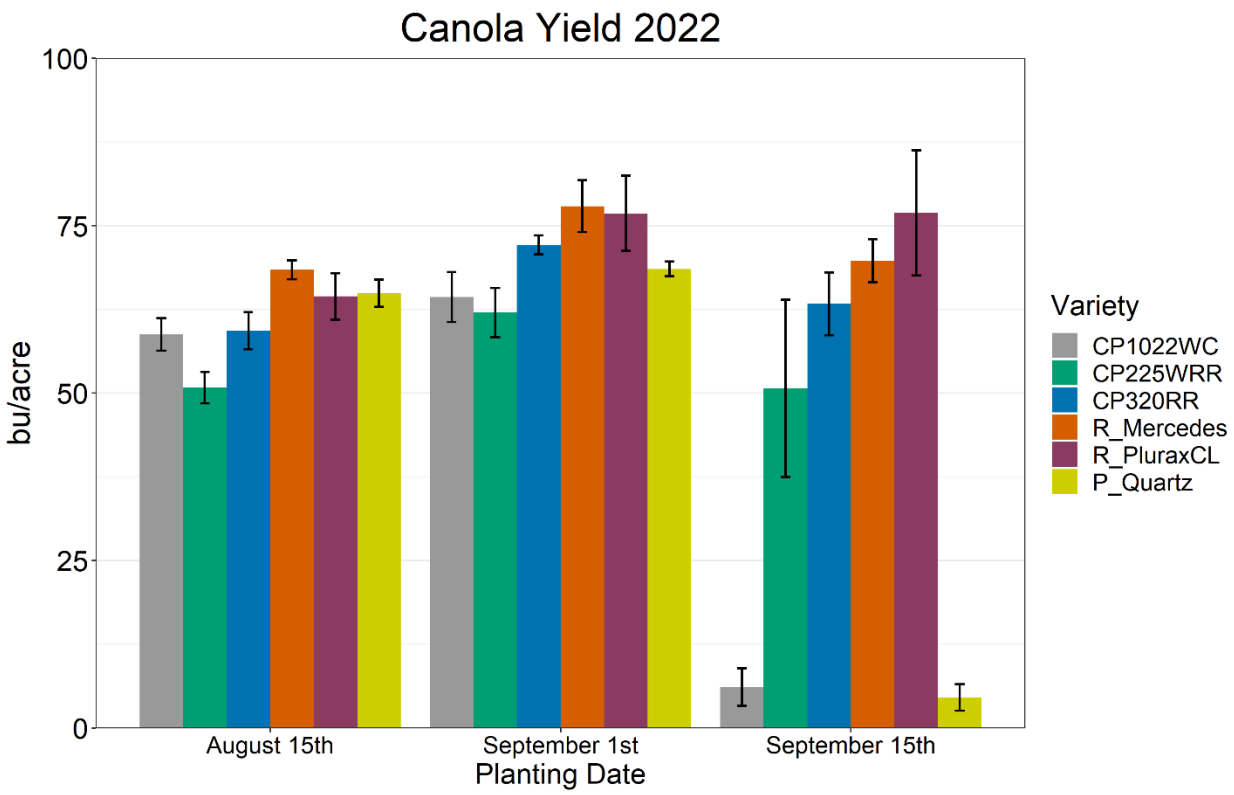


Figure 7. Winter canola yield by planting date

Project Title: 2022 NWARC Statewide Spring Canola Variety Trial

Objective: To evaluate the agronomic performance of currently available or soon to be released varieties and breeding lines of canola in the many diverse climates of Montana

Personnel: Clint Beiermann, Jessica Pavelka

Summary:

Twenty-six varieties of canola were planted on April 29th, 2022 and managed under rainfed conditions until harvest on September 8th, 2022 (Table 1). This trial was one of five that were conducted across the state on Montana (Figure 1). Eight seed companies contributed seed for the twenty-six varieties, with eight different herbicide resistance traits used for the varieties.

The average yield was 65.5 bu/A with the lowest at 53.6 bu/A for CP9919RR and the highest yield being 74.2 bu/A from InVigor L345PC. The highest oil content came from CP930RR at 50.4% and the lowest from NCC101S at 44.4%. The average oil content was 48.1%. The average height across all varieties was 47.0", with the tallest being BY 6217TF at 58.7" and the shortest, CP9919RR, at 31.7". The earliest flowering date was shared by NCC101S and CP9919RR at 175 julian, and the latest was BY 6217TF at 181 julian. The average julian flowering date was 178.

Table 1. Management Information

Seeding date:	4/29/2022	**Field Location:**	X1
Julian date:	119	**Harvest date:**	
Seeding rate:		**Julian date:**	
Previous crop:	Spring Wheat	**Soil type:**	Creston Silt Loam
Herbicide:	None	**Tillage:**	Conventional
Insecticide:	Lambda-CY 6/2/22	**Soil residual nutrient (NO_3^{-1}, P, K lb/A):**	129-32-254
Fungicide:	None	**Nutrient fertilizer applied (N, P_2O_5, K_20 lb/A):**	50-25-40

Table 2. Agronomic performance of canola varieties

[1]Herb Resistance	Cultivar	Flowering Date	Plant Height (in)	Lodging (%)	Yield (bu/A)	TWT (lb/bu)	Oil Content (%)
CL	BY 5125CL	**179**	**48.8**	**22.5**	**70.0**	**50.5**	**48.8**
	DG280CLC	179	**54.2**	**10.0**	**64.7**	**50.0**	47.9
LL	CP7130LL	**179**	44.8	**15.0**	**64.4**	**50.0**	47.3
	CP7144LL	180	**49.2**	**17.5**	**65.2**	**50.0**	48.0
	CS4000 LL	**177**	40.1	**37.5**	**60.7**	**50.5**	**48.9**
	DG660LCM	179	47.8	**22.5**	**59.8**	**49.8**	48.4
	InVigor L233P	180	**49.5**	**22.5**	**72.6**	49.8	48.0
	InVigor L340PC	**178**	**51.0**	**17.5**	**72.7**	**50.0**	46.4
	InVigor L343PC	**179**	43.0	**25.0**	**73.5**	49.1	47.1
	InVigor L345PC	179	44.0	**20.0**	**74.2**	**50.2**	48.2
	InVigor L356PC	**179**	46.6	**17.5**	**67.9**	**50.0**	48.2
None	NCC101S	**175**	45.5	**22.5**	**64.3**	**49.9**	44.4
	NCC1825/8-S	**176**	44.5	**27.5**	**68.5**	**50.4**	48.1
RR	CP930RR	**176**	41.5	60.0	58.8	49.8	**50.4**
	CP9919RR	**175**	31.7	85.0	53.6	49.4	47.2
RR/TF/LL	InVigor LR344PC	180	46.1	**27.5**	**67.6**	49.8	47.6
TF	BY 6211TF	**179**	42.3	**30.0**	**68.0**	**51.0**	48.2
	BY 6217TF	181	**58.7**	**10.0**	**66.3**	**50.2**	**49.0**
	CP9978TF	**178**	42.5	57.5	**64.6**	49.8	48.4
	CS2600 CR-T	**178**	41.1	**22.5**	**62.9**	**50.4**	**49.4**
	CS3000 TF	**178**	45.3	**25.0**	**62.2**	**50.3**	**49.0**
	DG760TM	**178**	**51.0**	**10.0**	**62.4**	**50.4**	48.2
	DG781TCM	**178**	**51.6**	**15.0**	**63.1**	49.6	**48.5**
	NC155 TF	**177**	**50.8**	**10.0**	**60.9**	**50.6**	48.1
	NC471 TF	**177**	**56.4**	**12.5**	**66.2**	**50.6**	48.1
	NC527CR TF	**178**	**54.4**	**15.0**	**68.6**	49.7	**49.4**
Mean		178.1	47.0	25.3	65.5	50.1	48.1
CV		0.8	8.0	44.4	7.7	0.9	1.5
Pr>F		<.001	<.001	<.001	<.001	<.001	<.001

Bold = top-performer within a column; **Bold** = statistically equivalent to top-performer by Tukey pairwise comparisons ($p > 0.05$)

[1]CL = Clearfield; LL = Liberty Link; RR = Roundup Ready; TF = TruFlex

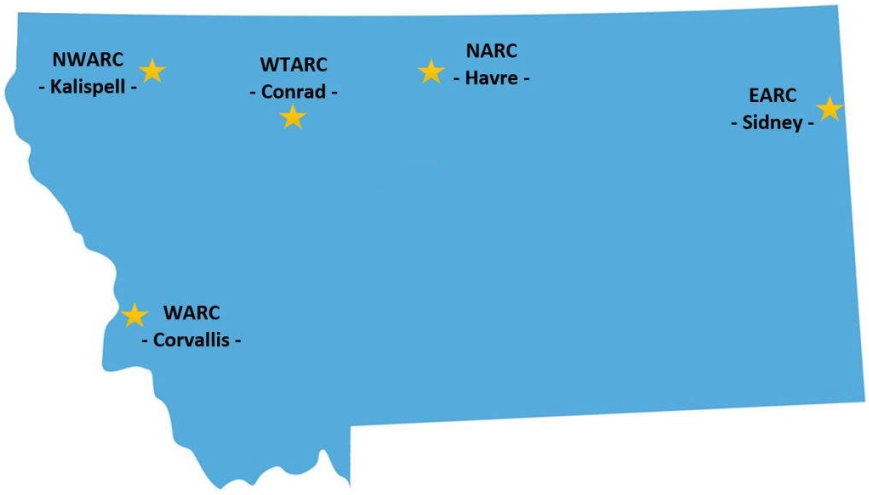


Figure 1. Location of study sites throughout Montana

Project Title: Locus Ag Industry Trial in Spring Canola

Objective: To test different Locus Ag treatments for quality and yield for canola.

Personnel: J.A. Torrion, Daniel Porter

Summary:

Invigor canola was planted with the four Locus seed treatments and a grower practice as a check on April 29, 2022 (see respective management Tables 1 and 2 for details). The seeding rate was 4.5 lbs/Ac targeting 10 seeds/ft^2 at a 0.99% germination rate based on the germination test. The trial was under a randomized complete block design with four replications. Each plot was separated by a buffer plot to ensure spatial separation between individual treatment plots.

Two environments were tested under Creston Silt Loam with subsurface recharge (Study 1, high moisture) and Creston silt loam without subsurface recharge (Study 2, low moisture). Subsurface recharge is evident in Study 1 location with historical yield and soil moisture sensor data over the years. The management table is shown in Table 1.

In study 1 (Table 3), only the thousand kernel weights were significant where 'Code T T' treatment had a smaller seed size than the other treatments. 'Code B T T' had the largest seed size. All of the treatments had the same yield as well as the rest of the agronomic performance. In study 2 (Table 4), no significant differences were observed in all parameters gathered.

Table 1. Management information

Seeding date:	4/29/2022	**Field Location:**	X1
Julian date:	119	**Harvest date:**	9/2/2022
Seeding rate:	10 seeds/ft2	**Julian date:**	252
Previous crop:	Spring Wheat	**Soil type:**	Creston silt loam
Herbicide:	Liberty 6/1/2022	**Tillage:**	conventional
Insecticide:	Lambda-CY AG 6/2/2022	**Soil residual nutrient (NO3-, P, K lb/A):**	129-32-254
Fungicide:		**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	50-25-40 (4/20/2022)

Table 2. Management information

Seeding date:	4/29/2022	**Field Location:**	D3
Julian date:	119	**Harvest date:**	9/2/2022
Seeding rate:	10 seeds/ ft2	**Julian date:**	252
Previous crop:	Spring Wheat	**Soil type:**	Creston Silt Loam
Herbicide:	Liberty 6/1/2022	**Tillage:**	Conventional
Insecticide:	Lambda-CY AG 6/2/2022	**Soil residual nutrient (NO3-, P, K lb/A):**	53-38-414
Fungicide:		**Nutrient fertilizer applied (N, P_2O_5, K_2O lb/A):**	80-20-25-10s (4/18/2022)

Table 3. Performance of canola under silt loam soil with subsurface recharge (Study 1)

TRT No.	TREATMENT	Plant Count/ft²		HT	YLD[1]	Oil	Moisture	TWT[1]	TKW
		May 23	Harvest	in	bu/Ac	----------%----------		lb/bu	g
1	Grower's Practice	13	14	57.7	79.7	47.0	5.7	51.5	4.4
2	Code T T	14	12	58.6	81.3	47.2	5.7	51.5	4.2
3	Rhizolier Duo	10	13	56.4	79.3	47.4	5.7	51.5	4.4
4	Code B T T	13	12	57.6	81.0	47.1	5.7	51.6	4.5
5	LASRY22	11	10	57.5	74.9	47.5	5.7	51.5	4.4
	Mean	12.0	12.1	57.6	79.2	47.2	5.7	51.5	4.4
	CV	31.1	32.2	4.1	8.8	0.9	3.6	0.3	2.2
	LSD	ns	ns	ns	ns	ns	ns	ns	0.146
	PR>F	0.474	0.598	0.761	0.704	0.430	0.992	0.940	0.049

HT = plant height at harvest, TWT = test weight, TKW = thousand kernel weight, YLD=yield, ns=nonsignificant, [1]adjusted to 8.5% moisture

Table 4. Performance of canola under silt loam soil without subsurface recharge (Study 2)

TRT No.	TREATMENT	Plant Count/ft²		HT	YLD[1]	Oil	Moisture	TWT[1]	TKW
		May 23	Harvest	in	Bu/Ac	---------%----------		lb/bu	g
1	Grower's Practice	12	14	57.5	46.9	48.9	5.3	52.5	4.2
2	Code TT	9	14	58.3	47.8	48.8	5.3	52.5	4.2
3	Rhizolier Duo	11	12	57.6	40.7	49.3	5.3	52.3	4.2
4	Code B T T	12	11	54.2	40.9	49.1	5.2	52.3	4.2
5	LASRY22	11	12	55.6	38.8	49.2	5.3	52.3	4.2
	Mean	10.9	12.5	56.4	43.0	49.1	5.3	52.4	4.2
	CV	23.3	27.6	6.6	15.5	1.5	4.1	0.6	1.8
	LSD	ns	ns	ns	ns	ns	ns	ns	ns
	PR>F	0.414	0.794	0.446	0.273	0.892	0.735	0.599	0.984

HT = plant height at harvest, TWT = test weight, TKW = thousand kernel weight, YLD=yield, ns=nonsignificant, [1]adjusted to 8.5% moisture