2018 Agricultural Research Update

NDSU Williston Research Extension Center

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MSU Eastern Agricultural Research Center

Serving the MonDak Region

Regional Report No. 24 – December 2018

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Upcoming Events for 2019

January 15	Diversity Direction & Dollars - Ramada Grand Dakota Lodge – Dickinson, ND
January 28-29	Northern Pulse Growers Assn. Conf. - Riverside Holiday Inn – Minot, ND
Jan. 30-Feb. 1	Ag Expo-North Dakota State Fair Center-Minot, ND
February 1-2	2019 NDFMGA & Local Foods Conference - Grand Hotel-Mandan, ND
February 5	Best of the Best in Wheat Production in the West - Grand Hotel – Minot, ND
February 7	MonDak Pulse Day - Williston ARC - Williston, ND
February 8-9	GATE - Eastern Plains Event Center – Glendive, MT
February 12-13	Agri International Trade Show - Bismarck Event Center – Bismarck, ND
March 5-6	Western Crop/Pest Management School - Sleep Inn-Minot, ND
March 7 & 8	MonDak Ag Days - Richland County Event Center – Sidney, MT
March 11-13	National Hard Spring Wheat Show - Raymond Center – Williston, ND
March 15-16	KATQ Northeast Montana Farm Expo – Plentywood, MT
June 18 (tentative)	USDA-ARS/MSU-EARC/Extension Dryland Field Tour – Sidney, MT
June 24-26	UMVF – Williston, ND
June 27	Northern Ag Research Center Field Day – Havre, MT
July 2	Richland Pulse Plot Tour – Richland, MT
July 9	Hettinger Research Extension Center Field Day – Hettinger, ND
July 10	Dickinson Research Extension Center Field Day – Dickinson, ND
July 10	Williston Research Ext. Center Field Day (4:00 p.m.) – Williston, ND
July 11	Nesson Valley Irrigation Field Day - Nesson Valley, ND
July 11	Central Ag Research Center Field Day – Moccasin, MT
July 15	Agronomy Seed Farm Field Days – Casselton, ND
July 16	Carrington Research Extension Center Field Days – Carrington, ND
July 16	Eastern Ag Research Center Field Day – Sidney, MT
July 17	North Central Research Extension Center Field Day – Minot, ND
July 18	Langdon Research Extension Center Field Day – Langdon, ND
July 18	Northwestern Ag Research Center Field Day – Kalispell, MT
July 22-30	North Dakota State Fair – Minot, ND
July 25	Western Ag Research Center Field Day – Corvallis, MT
July 31-August 3	Richland County Fair – Sidney, MT
October 11	Northeast Montana Ag Expo-Valley Event Center – Glasgow, MT
November 14	MonDak Ag Research Summit - Richland County Event Center – Sidney, MT

Off-Station Cooperators – Producers – CES Agents

MONTANA

SMALL GRAIN--PULSES:

Dagmar - Brian Kaae - Agent Colleen Buck
Nashua - Bill Lauckner - Agent Shelley Mills
Poplar - Mark Swank - Agent Jeff Chilson
Richland - Richard Fulton - Agent Shelley Mills
Wibaux - Rick Miske - Agent Danielle Harper

SUGARBEET:

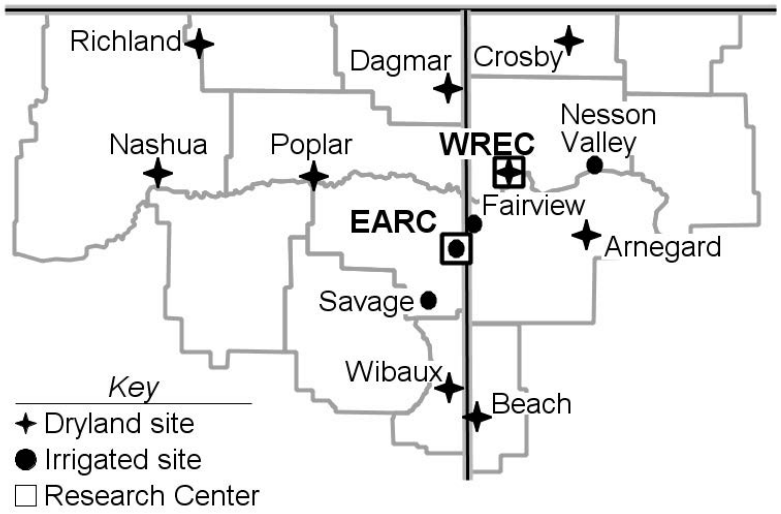
East Fairview - Phillip & Laurie Hurley
East Fairview - Texas-Red Enterprises, Inc.
Fairview - 4B Farms, Inc.
Savage - Triple C Farms, Inc.

NORTH DAKOTA

SMALL GRAIN--PULSES--OIL SEEDS:

Crosby - Harlan Johnson - Agent Brandon Biwer
Crosby - Robert Kostek - Agent Brandon Biwer
Arnegard - Phil Moen - Agent Morgan Myers
Beach - Tim Oech - Agent Ashley Krause

Location of Test Sites



We would like to take this opportunity to thank the County Agents, the County Ag Improvement Associations and especially the farm operators who permit the location of off-station plots on their land. ***All are to be commended for their cooperative efforts in helping determine crops and variety performance in the MonDak region.***

Results from tillage, chemical fallow, and field scale no-till trials, as well as other management trials on dryland and irrigated crops can be obtained by visiting with Center personnel.

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Weather Information

Weather Summary Williston, ND

Month	Precipitation 2018	Precipitation Avg	Temperature 2018	Temperature Avg	*
	- inches -		- degrees F -		
Oct-Dec. 2017	1.16	1.74			
January-March	1.30	1.19			
April	0.83	1.16	36.3	46.0	0
May	1.49	2.25	61.4	57.0	2
June	3.52	2.68	66.5	65.0	1
July	4.44	2.23	69.4	72.0	9
August	0.76	1.56	69.4	71.0	11
September	1.29	1.38	54.8	60.0	3
April-July	10.28	8.31			
April-Sept	12.33	11.25			
Total-Oct 17-Sept 18	14.79	14.18			

*Number of Days over 89° F

Last Spring Frost – April 26, 2018 (31° F)

First Fall Frost – September 21, 2018 (31° F)

Weather Summary Sidney, MT

Month	Precipitation 2018	Precipitation Avg	Temperature 2018	Temperature Avg	*
	- inches -		- degrees F -		
Oct-Dec. 2017	1.50	1.84			
January-March	1.96	1.30			
April	0.58	1.15	37.5	44.5	0
May	3.63	2.17	60.5	56.1	1
June	2.49	2.49	66.4	64.6	3
July	1.80	2.05	69.4	70.2	8
August	1.02	1.46	66.7	68.7	9
September	1.21	1.28	53.8	58.0	0
April-July	8.50	7.86			
April-Sept	10.73	10.60			
Total- Oct 17-Sept 18	14.18	13.74			

*Number of Days over 89° F

Last Spring Frost – April 24, 2018 (28.3° F)

First Fall Frost – September 24, 2018 (31.6° F)

Off-Station Precipitation* North Dakota

Site	April	May	June	July	Aug	Total
Beach	0.97	1.47	3.90	1.52	0.77	8.63
Crosby	0.54	2.01	3.80	1.14	0.12	7.61
Nesson Valley	0.40	1.54	4.67	2.27	0.98	9.86

*Actual rainfall received at plot location may have been more or less.

Off-Station Precipitation* Montana

Site	April	May	June	July	Aug	Total
Dagmar	0.81	1.41	1.91	3.28	0.20	7.61
E Fairview	0.77	3.91	2.49	1.95	1.09	10.21
Nashua	0.41	3.19	2.39	0.98	1.10	8.07
Poplar	0.44	2.29	1.98	.015	0.59	5.45
Richland	0.47	1.11	1.77	1.05	0.43	4.83
Savage	0.88	4.54	4.12	2.40	1.17	13.11
Wibaux	1.43	0.99	3.16	1.24	1.10	7.92

*Actual rainfall received at plot location may have been more or less.

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NDSU Extension Service North Dakota State University

MONTANA STATE UNIVERSITY Montana Agricultural Experiment Station

MONTANA STATE UNIVERSITY Extension

HARD SPRING WHEAT VARIETY DESCRIPTIONS

Variety	Origin[1]	Year released	Height	Maturity	Resistance to[2]						Quality Factors	
					Lodging	Stem Rust	Leaf Rust	Foliar Disease	Head Scab	Sawfly	Test Weight	Grain Protein
AAC Brandon	Canada	2014	M TALL	M EARLY	M	NA	MR	NA	M	NA	NA	NA
AAC Goodwin	Canada	2018	M TALL	M EARLY	M	NA	MR	NA	NA	NA	NA	NA
AAC Penhold	Canada	2015	MEDIUM	MEDIUM	MR	NA	MR	NA	NA	NA	NA	NA
AKF-Astro	AKF-Astro	2016	SHORT	MEDIUM	NA	MR	MR	NA	S	NA	LOW	LOW
Ambush	Dynagro	2016	MEDIUM	M EARLY	M	R	MR/MS	NA	M	NA	NA	NA
Barlow	NDSU	2009	MEDIUM	M EARLY	M	R	MR/MS	MR	M	S	M HIGH	M HIGH
Bolles	MN	2015	SHORT	M LATE	MR	NA	MR	MR	MR	NA	MEDIUM	HIGH
Boost	SD	2016	MEDIUM	MEDIUM	M	R	MR/MS	NA	M	NA	MEDIUM	HIGH
Brennan	AgriPro	2009	SHORT	M EARLY	MR	R	MR	M	MS	S	MEDIUM	MEDIUM
Caliber	Dynagro	2016	SHORT	MEDIUM	R	R	MR	NA	S	NA	NA	NA
Choteau	MT	2004	M SHORT	M LATE	MS	R	MR/MS	MR	S	R	MEDIUM	MEDIUM
Duclair	MT	2011	MEDIUM	MEDIUM	MR	R	NA	NA	NA	R	MEDIUM	MEDIUM
Egan3	MT	2014	MEDIUM	M LATE	MR	NA	NA	NA	NA	S	HIGH	M HIGH
Elgin-ND	NDSU	2012	TALL	MEDIUM	M	R	MS	NA	M	S	M LOW	LOW
Faller	NDSU	2007	M TALL	MEDIUM	M	R	S	MR	M	S	MEDIUM	LOW
Glenn	NDSU	2005	M TALL	M EARLY	MR	R	MR/MS	M	MR	S	HIGH	M HIGH
HRS 3100	Croplan	2016	MEDIUM	MEDIUM	MR	R	MR/MS	NA	MS	NA	NA	NA
HRS 3419	Croplan	2014	M SHORT	LATE	MR	NA	MR	MR	MR	NA	M HIGH	MEDIUM
HRS 3504	Croplan	2015	M SHORT	MEDIUM	MR	R	R	NA	MS	NA	NA	NA
HRS 3530	Croplan	2015	TALL	LATE	MR	NA	NA	NA	NA	NA	M HIGH	HIGH
HRS 3616	Croplan	2016	MEDIUM	MEDIUM	MR	NA	NA	NA	NA	NA	NA	NA
HRS 3888	Croplan	2017	M TALL	MEDIUM	MR	NA	R	NA	MR	NA	NA	NA
Lang-MN	MN	2017	M TALL	MEDIUM	MR	R	MR	NA	MS	NA	M HIGH	MEDIUM
Lanning	MT	2017	MEDIUM	MEDIUM	MR	NA	NA	NA	M	NA	NA	NA
LCS Anchor	Limagrain	2016	M SHORT	MEDIUM	MR	NA	NA	NA	NA	NA	NA	NA
LCS Breakaway	Limagrain	2011	M SHORT	M EARLY	M	NA	R	MS	M	S	M HIGH	MEDIUM
LCS Cannon	Limagrain	2018	M SHORT	EARLY	MR	NA	MS	NA	M	NA	NA	NA
LCS Nitro	limagrain	2015	SHORT	MEDIUM	MR	NA	NA	NA	NA	NA	M HIGH	MEDIUM
LCS Prime	limagrain	2015	MEDIUM	M EARLY	MR	MR	MR/MS	NA	M	NA	M HIGH	LOW
LCS Rebel	limagrain	2017	MEDIUM	M EARLY	M	R	MS	NA	M	NA	NA	NA
LCS Trigger	limagrain	2016	MEDIUM	LATE	M	R	R	NA	M	NA	NA	NA
Linkert	MN	2013	M SHORT	M EARLY	R	R	MR	NA	M	NA	MEDIUM	HIGH
Mott	NDSU	2009	TALL	M LATE	MR	MR	S	MS	MS	R	MEDIUM	MEDIUM
MS Barracuda	Meridian	2018	MEDIUM	M EARLY	MR	NA	MR	NA	NA	NA	NA	NA
MS Camaro	Meridian	2016	M SHORT	M EARLY	M	R	R	NA	MR	NA	HIGH	HIGH
MS Chevelle	Meridian	2014	SHORT	M EARLY	M	MR	R	NA	MR	NA	HIGH	HIGH
ND VitPro	ND	2016	MEDIUM	M EARLY	MR	R	MA	NA	M	NA	HIGH	HIGH
Prestige	Pulse USA	2015	MEDIUM	M EARLY	MR	NA	NA	NA	NA	S	MEDIUM	MEDIUM
Prevail	SDSU	2014	M SHORT	EARLY	M	NA	NA	NA	M	NA	HIGH	M HIGH
Prosper	NDSU	2011	MEDIUM	MEDIUM	MR	R	S	M	M	S	MEDIUM	M HIGH
Redstone	Pulse USA	2015	SHORT	M LATE	R	NA	R	NA	MR	MA	M LOW	MEDIUM
Reeder	NDSU	1999	MEDIUM	MEDIUM	MR	R	MS	S	S	S	MEDIUM	MEDIUM
Rollag	MN	2011	MEDIUM	MEDIUM	MR	R	MS	MR	MR	NA	M HIGH	M LOW
Shelly	MN	2016	MEDIUM	MEDIUM	MR	NA	MR/MS	NA	M	NA	NA	NA
Surpass	SDSU	2016	M SHORT	EARLY	MR	NA	MR/MS	NA	MR	NA	NA	NA
SY Ingmar	Syngenta	2014	MEDIUM	MEDIUM	MR	MR	MR	MS	MR	S	M HIGH	M HIGH
SY Rockford	Syngenta	NA	MEDIUM	M LATE	M	MR	M	MR	MR	NA	M HIGH	M HIGH
SY Rowyn	Syngenta	2013	M SHORT	M EARLY	MR	MR	MR	NA	MR	S	M HIGH	M LOW
SY Soren	Syngenta	2011	M SHORT	M EARLY	MR	R	MR	M	M	S	M HIGH	MEDIUM
SY Valda	Syngenta	2015	MEDIUM	M EARLY	MR	R	MR	MR	M	NA	MEDIUM	M HIGH
TCG-Climax	21st C Gen.	2017	M SHORT	LATE	MR	R	S	NA	MS	NA	HIGH	HIGH
TCG-Cornerstone	21st C Gen.	2015	M SHORT	MEDIUM	MR	R	MR/MS	NA	MA	NA	NA	HIGH
TCG-Glenville	21st C Gen.	2018	M SHORT	M EARLY	MR	NA	R	NA	M	NA	NA	NA
TCG-Spitfire	21st C Gen.	2015	M SHORT	MEDIUM	MR	R	NA	NA	MS	NA	NA	NA
Velva	NDSU	2011	M SHORT	M LATE	R	R	MR/MS	M	MS	S	MEDIUM	MEDIUM
Vida	MT	1998	MEDIUM	MEDIUM	MR	MS	MS	MR	S	MR	MEDIUM	MEDIUM
WB9879CLP*	WB	2012	MEDIUM	MEDIUM	R	S	S	MR	MS	R	MEDIUM	HIGH
WB9479	WB	2017	M SHORT	M EARLY	R	R	R	NA	MS	NA	NA	NA
WB9590	WB	2017	M SHORT	M EARLY	NA	R	MR	NA	MS	NA	NA	NA
WB9653	WB	2015	M SHORT	M EARLY	R	NA	MR	NA	MS	NA	MEDIUM	MEDIUM
WB9719	WB	2013	MEDIUM	M EARLY	R	NA	S	S	S	T	M HIGH	MEDIUM
WB Mayville	WB	2011	SHORT	M EARLY	R	R	MR/MS	MS	S	S	M HIGH	M HIGH

[1]Refers to developer: CANADA represents developer from that country; MN = University of Minnesota**;** MT = Montana State University; NDSU = North Dakota State University; SD = South Dakota State University; TS = Tigren Seed; WB = WestBred.

[2]M = Intermediate; MR = Moderately resistant; MS = Moderately susceptible; NA = Not adequately tested; R = Resistant; S = susceptible; VS = Very susceptible.

[3]Resistant to orange wheat blossom midge. *Clearfield wheat with imidazolinone tolerance.

Spring Wheat Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Days to heading	Plant height	Protein†	Test weight ‡	Yield#		
					2018	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(in)	(%)	(lb/bu)	----------(bu/a)----------		
WB9719	50.3	25.5	13.5	65.1	65.2	-	-
Lanning	51.3	26.4	13.4	61.9	63.0	-	-
TCG-Spitfire	52.0	27.7	13.9	61.6	61.6	-	-
Caliber	49.3	22.9	14.5	62.6	61.2	-	-
LCS Trigger	53.0	28.5	12.7	61.0	60.9	-	-
Elgin-ND	48.0	27.8	15.1	60.6	59.4	43.0	38.9
Shelly	49.0	25.2	13.3	62.7	57.8	40.0	-
HRS 3616	51.0	28.2	13.8	63.3	57.1	40.6	-
ND VitPro	48.0	28.1	13.6	64.5	56.8	40.6	-
Rollag	46.7	28.5	14.7	63.1	56.4	42.6	38.1
WB9653	47.3	25.6	12.9	61.7	56.1	44.0	42.1
SY Rockford	50.7	28.7	13.4	61.8	55.5	-	-
Prestige	47.0	26.5	13.6	62.1	54.9	40.6	37.8
Glenn	46.0	31.2	14.5	65.1	54.6	41.0	36.8
WB9590	48.0	24.5	13.7	61.9	54.3	-	-
Prosper	50.3	28.8	13.1	61.3	54.2	38.1	36.0
Linkert	47.7	25.2	15.1	61.3	54.0	39.4	37.2
Faller	50.0	29.3	13.3	61.2	53.8	39.3	36.7
HRS 3530	51.7	27.7	14.6	62.3	53.7	-	-
HRS 3504	48.3	25.9	13.8	61.0	53.5	45.3	-
SY Valda	48.7	27.3	13.4	62.2	53.2	42.4	40.7
WB9479	49.0	25.2	14.9	60.3	52.7	-	-
TCG-Climax	50.7	27.9	14.9	64.6	52.6	36.5	-
AAC Penhold	51.0	26.3	13.6	62.7	52.6	-	-
Barlow	44.3	29.5	14	63.5	52.4	40.4	35.7
HRS 3100	46.7	25.7	14.3	61.6	52.3	43.2	-
Surpass	46.0	28.7	14.2	62.5	52.3	42.5	-
MS Camaro	47.7	25.7	15.4	62.9	52.0	-	-
AAC Goodwin	46.7	27.3	15.1	62.8	51.0	-	-
LCS Cannon	42.3	23.9	14.7	63.7	50.8	-	-
TCG-Glenville	48.3	24.4	15.5	64.5	50.2	-	-
AAC Brandon	46.7	25.2	14.2	60.0	50.2	-	-
LCS Breakaway	44.0	24.8	15	63.7	50.1	39.1	35.0
SY Soren	46.7	26.8	15	62.8	49.4	42.3	38.3
LCS Rebel	46.7	27.7	15.2	62.3	49.4	-	-
MS Chevelle	45.0	26.1	13.4	62.3	48.7	43.6	40.8
HRS 3888	47.7	28.5	14.9	62.3	46.3	-	-
Ambush	47.3	27.9	13.9	63.1	46.2	-	-
MS Barracuda	42.7	25.3	14.5	61.8	44.3	-	-
Bolles	51.3	27.6	15.4	61.7	43.2	35.7	34.9
SY Ingmar	47.0	26.9	15.4	62.9	41.7	40.0	37.4
HRS 3419	52.0	28.7	13.5	60.2	40.2	-	-
Lang-MN	48.3	28.7	15.1	60.7	39.5	-	-
Redstone	53.0	28.9	15.9	62.2	39.2	38.5	35.6
Boost	51.7	31.1	14.8	61.1	38.7	38.9	-
Mean	48.4	27.1	14.3	62.3	52.1	-	-
CV (%)	1.84	4.37	4.9	1.86	9.5	-	-
LSD (5%)	1.20	1.62	1.1	1.45	8.1	-	-
LSD (10%)	1.44	1.93	1.0	1.74	6.7	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Cover Crop.

Planted: 05/15/2018. Harvested: 08/24/2018.

Soil test (0-6"): P=26 ppm; K=289 ppm; pH=5.8; OM=2.5%. Soil type: Williams-Bowbells loam.

(0-24"): NO_3-N=27 lb/a.

Applied fertilizers in lb/a: N=98; P_2O_5=18; K_2O=5.

Chemical applications: Goldsky @ 16 oz/a (6/1/18).

†Protein adjusted to 12.0% moisture. ‡Test Weight = Reported on a 13.5% moisture basis.

#Yield = Reported on a 13.5% moisture basis.

*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017.

[1]DAP = Days after planting.

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.

06/23/2018: Wind speed=46 mph; Precipitation=1.53".

06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.

07/09/2018: Wind speed=48 mph; Precipitation=1.67".

Spring Wheat Divide Dryland Variety Trial - NDSU **Divide County, ND 2018**

Variety	Protein[†]	Test weight[‡]	Yield[#]		
			2018	2-Yr Avg	3-Yr Avg
	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
Barlow	17.5	59.9	26.5	27.4	45.0
Bolles	17.8	58.7	26.7	25.1	-
Elgin-ND	17.2	56.3	26.5	28.3	39.3
Faller	15.6	56.9	27.4	26.2	42.4
Glenn	16.1	59.5	21.5	25.2	44.0
Mott	16.1	59.3	26.5	23.3	43.0
ND-VitPro	16.4	59.9	26.7	-	-
SY Ingmar	15.6	59.7	30.5	26.7	36.7
SY Soren	15.6	59.6	35.1	30.7	44.4
Velva	15.3	58.1	29.6	30.5	45.2
Mean	16.3	58.8	27.7	-	-
CV (%)	3.0	0.7	7.8	-	-
LSD (5%)	0.8	0.8	3.7	-	-
LSD (10%)	0.7	0.6	3.1	-	-

Location: Crosby, ND; Latitude 48° 48' N; Longitude 103° 18' W; Elevation 2044 ft. Previous crop: Soybean.
Planted: 06/04/2018. Harvested: 08/10/2018.
Soil test (0-6"): N/A. Soil type: Farnuf-Alkabo.
(0-24"): NO3-N=24 lb/a.
Applied fertilizers in lb/a: N=77; P_2O_5=21; S=5.
[†]Protein adjusted to 12% moisture.
[‡]Test weight reported on a 13.5% moisture basis.
[#]Yield reported on a 13.5% moisture basis.

2018 WREC Field Day

Spring Wheat Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9+)	Protein† 2018 (%)	Protein† 2-Yr Avg (%)	Protein† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2018 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
Prestige	32	57	0	14.2	14.3	14.1	61.0	93.5	99.4	101.0
HRS 3419	30	56	0	14.3	14.3	14.0	60.2	92.0	98.7	99.9
MS Chevelle	28	48	1	14.8	14.6	14.4	61.5	88.2	98.7	94.6
SY Ingmar	29	50	0	15.6	15.3	15.4	62.0	84.8	98.1	93.6
Faller	31	48	1	14.5	14.6	14.6	61.1	83.9	100.4	93.3
HRS 3530	31	52	1	15.5	15.4	14.9	60.6	86.3	95.1	93.2
Prosper	31	53	0	15.4	14.9	15.1	60.9	80.1	97.0	92.4
Elgin-ND	34	51	1	16.0	15.6	15.8	60.8	82.1	92.8	91.8
LCS Iguacu	28	51	0	14.1	13.9	13.9	61.3	77.0	96.3	91.4
Reeder	30	49	1	16.3	15.9	15.9	61.2	84.7	96.7	91.3
Mott	33	51	0	16.3	16.3	15.9	61.0	87.4	95.0	89.9
Velva	30	51	0	15.2	15.3	15.3	61.1	85.6	93.6	89.8
Redstone	31	57	0	14.3	14.8	15.2	61.2	89.8	99.9	89.7
SY Valda	29	50	1	14.8	14.7	15.1	61.1	84.9	98.6	89.2
Steele-ND	33	48	1	15.8	15.6	15.8	61.9	82.6	94.8	88.5
SY Soren	27	49	0	16.1	15.6	15.5	62.3	76.1	93.7	88.3
Bolles	29	53	0	17.7	17.3	17.4	60.3	77.4	92.5	88.1
LCS Prime	29	48	1	14.5	14.4	14.7	62.4	84.2	100.3	87.7
Prevail	30	50	0	14.8	14.5	14.8	60.9	82.6	94.4	87.6
Rollag	30	49	1	15.6	15.4	15.7	62.1	79.4	94.1	87.5
Linkert	27	50	0	16.3	15.9	16.1	61.6	77.6	94.5	86.9
Barlow	30	48	1	16.4	16.1	16.2	61.3	76.6	89.2	85.0
Egan	32	52	1	16.9	16.9	16.9	59.2	76.1	86.3	84.4
Glenn	31	47	1	16.0	16.2	16.2	63.4	82.7	90.5	83.6
LCS Anchor	26	48	0	16.7	16.2	16.1	61.4	68.2	88.3	79.3
TCG-Spitfire	30	52	0	14.2	13.9	-	61.9	103.5	109.7	-
SY Rockford	30	52	0	15.2	15.0	-	60.5	89.5	102.4	-
LCS Trigger	31	57	0	13.3	13.5	-	61.6	91.1	99.9	-
HRS 3504	27	50	0	15.0	14.7	-	59.8	85.5	94.4	-
LCS Rebel	33	48	1	16.1	16.0	-	62.5	87.9	93.4	-
Surpass	29	47	1	15.5	15.1	-	61.2	75.5	92.9	-
TCG-Climax	30	54	0	17.0	17.1	-	62.9	81.2	91.0	-
ND-VitPro	29	49	0	16.1	15.9	-	62.7	76.6	89.7	-
MS Camaro	26	48	1	16.9	16.3	-	60.8	67.8	87.6	-
Boost	30	52	0	16.0	15.9	-	60.6	79.0	87.5	-
WB9653	27	49	0	14.7	15.0	-	60.4	91.5	83.9	-
Lanning	30	52	0	16.1	-	-	59.8	89.1	-	-
NDHRS16-13-13	31	50	1	16.0	-	-	60.9	84.1	-	-
ND828	31	51	1	16.0	-	-	62.3	83.8	-	-
NDHRS16-13-97	31	48	1	15.4	-	-	61.6	83.1	-	-
Shelly	27	52	0	14.5	-	-	61.5	82.9	-	-
NDHRS16-13-89	29	47	1	16.2	-	-	62.2	81.7	-	-
SY Rowyn	27	48	1	15.0	-	-	60.6	80.2	-	-
Dyna-Gro Caliber-1667	25	50	0	16.2	-	-	61.1	78.7	-	-
LCS Cannon	27	47	1	15.6	-	-	62.9	73.2	-	-
LCS Breakaway	27	48	0	16.4	-	-	61.8	71.6	-	-
TCG-Glenville	26	48	0	16.6	-	-	62.2	67.8	-	-
MEAN	30.1	50.5	0.4	15.52	15.37	15.40	61.27	82.19	94.97	89.80
C.V. (%)	-	-	-	2.28	-	-	0.81	6.11	-	-
LSD (5%)	-	-	-	0.56	-	-	0.69	7.05	-	-
LSD (10%)	-	-	-	0.47	-	-	0.58	5.91	-	-

* Days after planting + 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 12% moisture

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W
Elevation: 1902 ft
Soil test to (0-6"): P=23 ppm; K=160 ppm; pH=7.6; OM=1.9%
Previous crop: Potato
(0-24"): NO3-N= 20 lb/a
Planted: 5/4/2018
Yield goal: 90 bu/a
Harvested: 8/16/2018
Planting population: 1.5 million seeds/a
Soil Type: Lihen Loamy Fine Sand
Applied fertilizer in lb/a broadcast: 333 lbs of 46-0-0 (4/25/2018), and 76 lbs of 46-0-0 (6/4/2018)‡
Plot size: 92 ft^2
Herbicides applied: Axial XL 10.5 oz/a, Starane 10.5 oz/a, and Bison 2 pt/a (5/24/2018)
Rainfall: 8.5 in (5/4/2018 - 8/16/2018)
Fungicides applied: Prosaro 421 8 oz/a (7/3/2018)
Irrigation: 8.0 in (5/4/2018 - 8/16/2018)
‡ Additional fertilizer applied due to a 2.44 inch rainfall on June 1st

Dryland Spring Wheat Advanced Yield (DAY) - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height (in)	Days to Heading (julian*)	Test Weight † (lb/bu)	Protein (%)	Grain Yield † (bu/a)
ALUM	29.7	173.0	65.1	14.5	61.8
CHOTEAU	28.7	172.0	63.3	15.7	51.4
CORBIN	30.8	170.7	64.0	15.1	51.6
DUCLAIR	29.1	167.7	63.1	15.3	54.3
EGAN	29.0	174.0	62.2	17.3	50.3
FORTUNA	33.9	172.3	63.1	14.7	44.3
HRS 3419	29.7	176.3	63.0	12.9	56.1
HRS 3504	27.6	174.7	63.3	14.4	64.3
HRS 3616	28.7	171.3	63.6	15.8	45.8
LANNING	29.4	169.3	63.1	15.8	56.8
LCS CANNON	28.3	166.3	65.0	13.9	55.7
LCS PRO	33.7	171.7	64.5	15.5	56.5
LCS REBEL	31.1	170.0	65.1	15.9	52.7
MCNEAL	32.1	173.0	63.2	14.5	65.0
MT 1451	29.3	171.0	63.6	14.4	64.5
MT 1509	30.1	177.0	63.5	14.9	49.5
MT 1601	29.9	170.0	62.7	15.7	54.2
MT 1617	29.8	176.7	63.4	13.3	61.5
MT 1621	31.6	168.3	63.9	15.4	59.2
MT 1625	30.2	170.7	64.2	16.0	56.4
MT 1653	31.2	172.7	63.6	14.7	59.3
MT 1673	29.9	170.7	63.0	15.1	51.3
MT 1711	28.6	172.3	63.2	14.7	51.0
MT 1713	28.9	166.0	65.3	14.7	64.9
MT 1714	27.0	171.0	64.1	14.7	48.5
MT 1716	27.7	170.0	65.4	14.1	57.1
MT 1719	31.0	170.7	64.3	15.9	50.2
MT 1729	34.6	170.3	63.8	16.1	53.3
MT 1731	32.5	170.7	61.9	15.6	51.3
MT 1732	29.7	169.7	63.7	16.6	49.7
MT 1734	34.6	170.3	64.5	14.7	59.3
MT 1736	29.8	175.3	62.6	14.9	56.3
MT 1738	30.4	175.0	62.5	15.4	45.0
MT 1739	31.5	168.7	64.5	14.3	60.5
MT 1742	29.7	168.7	64.0	14.8	52.5
MT 1743	29.1	173.0	62.7	14.5	60.5
MT 1745	32.4	171.7	63.7	15.4	48.5
MT 1748	34.9	176.7	62.6	15.8	63.4
MT 1749	32.0	171.3	63.1	16.0	56.7
MT 1750	30.3	170.0	64.6	15.6	56.1
MT 1754	34.8	174.3	61.1	15.6	47.2
MT 1756	31.4	171.7	62.1	15.2	55.8

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Dryland Spring Wheat Advanced Yield (DAY) - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)
MT 1764	33.1	171.7	62.1	17.1	39.5
MT 1766	30.1	170.0	63.1	15.7	45.7
MT 1767	30.6	168.7	62.5	15.9	56.0
MT 1770	28.3	173.0	61.2	17.7	41.0
MT 1773	33.2	173.0	61.6	15.7	40.8
MT 1775	32.2	172.3	62.7	15.1	60.1
ND 828	32.9	172.3	64.4	17.0	48.2
NS PRESSER CLP	31.9	176.3	63.1	14.2	57.8
REEDER	32.0	171.3	63.9	14.8	64.7
SY INGMAR	28.2	172.0	65.1	15.8	48.6
SY Rockford	30.4	173.7	63.2	14.3	52.0
SY Valda	29.7	171.3	64.3	14.7	59.5
SYN 181	29.4	170.7	65.4	16.4	51.3
SYN 182	27.8	171.0	65.0	14.9	58.9
SYN 183	28.0	170.0	65.4	15.0	56.1
THATCHER	36.1	177.3	60.7	16.2	45.9
VIDA	30.3	172.7	63.7	14.7	64.6
WB 9590	27.0	171.3	64.8	15.3	60.1
WB 9653	27.7	172.7	63.9	13.6	59.2
WB 9719	27.8	172.3	66.3	15.2	62.9
WB 9879 CLP	27.6	174.7	63.8	15.0	53.3
WB GUNNISON	27.7	173.0	63.7	14.4	57.4
Mean	30.4	171.8	63.6	15.2	54.6
P-value	<0.0001	<0.0001	<0.0001	0.0005	<0.0001
CV (%)	7.3	0.9	0.9	7.2	10.8
LSD	3.6	2.5	0.9	1.8	9.5

Location: EARC Dryland Farm, Sidney, MT — Previous crop: Fallow

Planted: 4/26/2018 — Harvested: 8/20/2018

Soil Test N Avail (lb/a): 44.5 — Soil Type: Williams Clay Loam

Soil Test P205 (lb/a): 30 — Plot Width (ft): 5'

N added (lb/a): 73.4 — Precip 2018: 14.19"

P2O5 added (lb/ac): 20.8 — Irrigation (sprinkler): n/a

(julian*) is a continuous count of days since January 1.

†Test Weight and Grain Yield adjusted to 12.0% moisture basis

"What you see depends on how you view the world. To most people, this is just dirt. To a farmer, it is potential."
Doe Zantamata

Irrigated Spring Wheat Advanced Yield (IAY) - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height (in)	Days to Heading (julian*)	Test Weight † (lb/bu)	Protein (%)	Grain Yield † (bu/a)
ALUM	32.5	175.0	63.7	15.2	97.6
CHOTEAU	30.8	178.3	62.1	15.3	86.2
CORBIN	30.4	172.7	63.1	15.3	81.3
DUCLAIR	30.7	174.0	62.4	15.1	90.4
EGAN	33.7	177.7	61.7	15.9	81.6
FORTUNA	35.2	177.7	61.6	15.4	70.7
HRS 3419	31.0	178.3	62.4	14.2	112.1
HRS 3504	28.7	176.7	62.9	14.9	101.5
HRS 3616	29.5	177.7	62.3	16.4	94.5
LANNING	31.1	173.0	62.6	16.0	93.3
LCS CANNON	28.2	170.0	61.8	15.6	95.5
LCS PRO	32.1	173.0	64.3	15.3	104.0
LCS REBEL(LNR 13-0594)	31.4	173.0	64.5	16.1	95.9
MCNEAL	31.9	178.3	62.2	15.5	89.1
MT 1451	31.4	175.7	61.9	15.1	85.5
MT 1509	31.8	179.0	62.5	15.6	90.3
MT 1601	31.9	174.0	61.8	15.6	91.8
MT 1617	31.2	177.3	62.5	15.1	104.3
MT 1621	30.1	171.3	62.7	16.6	94.8
MT 1625	31.0	172.3	62.7	16.9	76.4
MT 1653	32.0	177.7	62.2	15.5	98.7
MT 1673	30.7	173.7	61.7	16.1	93.8
MT 1711	30.4	177.3	60.8	15.5	91.0
MT 1713	24.3	172.0	61.5	15.7	70.8
MT 1714	29.5	173.0	62.8	16.6	87.5
MT 1716	31.9	173.0	63.9	15.4	105.1
MT 1719	30.2	174.0	63.6	16.5	77.9
MT 1729	31.8	172.7	62.4	17.2	78.8
MT 1731	34.0	173.0	60.3	17.3	92.7
MT 1732	32.8	173.0	63.1	16.6	83.4
MT 1734	32.7	173.0	62.7	15.4	87.8
MT 1736	30.4	176.3	61.1	15.6	93.8
MT 1738	33.2	176.3	60.3	15.8	79.2
MT 1739	29.9	172.0	62.8	15.4	93.9
MT 1742	30.2	172.7	62.7	15.1	89.7
MT 1743	29.5	179.3	61.0	14.9	92.8
MT 1745	32.4	173.0	62.7	16.0	92.5
MT 1748	36.1	180.3	61.6	15.9	91.8
MT 1749	30.6	174.3	62.5	17.0	87.3
MT 1750	29.7	172.7	63.9	15.6	89.0
MT 1754	35.3	179.0	61.3	15.9	86.3
MT 1756	30.7	174.0	60.9	14.8	92.4

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Irrigated Spring Wheat Advanced Yield (IAY) - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)
MT 1764	33.2	176.0	61.8	17.4	85.8
MT 1766	29.5	172.7	61.9	15.4	85.5
MT 1767	27.6	174.0	61.5	15.5	83.7
MT 1770	29.5	178.0	59.9	16.8	86.1
MT 1773	32.9	177.3	61.5	14.9	90.2
MT 1775	30.7	177.7	62.1	14.7	97.6
ND 828	34.9	177.7	64.4	16.3	92.8
NS PRESSER CLP	34.0	180.3	60.8	14.9	81.2
REEDER	32.8	176.0	63.1	16.0	95.8
SY INGMAR	29.0	177.0	64.4	15.6	98.2
SY Rockford	30.7	178.0	62.2	15.0	98.6
SY Valda	31.0	175.0	63.9	15.1	108.6
SYN 181	30.2	172.7	64.3	16.3	81.2
SYN 182	29.3	177.0	62.9	15.7	91.5
SYN 183	27.2	175.7	64.4	15.6	98.8
THATCHER	36.6	173.0	61.8	15.7	73.4
VIDA	31.5	177.3	62.1	14.8	94.8
WB 9590	27.3	173.0	62.9	16.3	95.2
WB 9653	28.0	175.7	62.5	14.9	108.7
WB 9719	30.6	178.3	65.8	15.1	105.1
WB 9879 CLP	30.2	177.0	62.5	15.5	87.5
WB GUNNISON	29.5	175.0	63.1	15.0	82.2
Mean	31.1	175.3	62.5	15.7	90.9
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.9	0.9	0.6	2.2	6.0
LSD	2.4	2.6	0.6	0.6	8.9

Location: EARC
Previous crop: Sugarbeet
Soil Test N Avail (lb/a): 38.6
Soil Type: Savage Silty Clay
Soil Test P2O5 (lb/ac): 15
Planted: 5/4/2018
N added (lb/a): 104.2
Harvested: 8/24/2018
P2O5 added (lb/a): 29.5
Precip 2018: 14.19"
Plot Width (ft): 5'
Irrigation (sprinkler): 2.68"

(julian*) is a continuous count of days since January 1.

†Test Weight and Grain Yield adjusted to 12.0% moisture basis.

Dryland Recrop Spring Wheat - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)
CHOTEAU	27.7	170	62.6	16.5	41.3
CORBIN	24.1	169	63.3	16.3	34.8
DUCLAIR	26.9	170	62.6	15.3	49.0
EGAN	23.4	170	60.5	18.2	36.3
FORTUNA	32.4	171	62.8	15.4	39.0
HRS 3504	22.8	171	63.1	15.1	48.2
HRS 3616	25.7	170	63.0	16.2	40.2
LANNING	24.0	173	60.8	17.1	37.8
NS PRESSER CL+	26.2	176	60.8	15.9	37.1
REEDER	26.1	170	63.7	15.3	49.8
SY SOREN	23.9	170	64.3	16.2	41.8
VIDA	25.9	170	63.1	15.1	50.0
Mean	25.8	170.9	62.5	16.0	42.1
P-value	0.0010	0.0001	0.0001	0.0069	0.0049
CV (%)	8.2	0.8	1.4	5.5	13.4
LSD	3.6	2.4	1.4	1.5	9.4

Location: EARC Soil Type: Williams Clay Loam

Soil Test N Avail (lb/a): 28.3 Planted: 4/27/2018

Soil test P2O5 (lb/a): 14 Harvested: 8/8/2018

N added (lb/a): 73.4 Plot Width (ft): 5'

P2O5 added (lb/ac): 20.8 Precip 2018: 14.19"

(julian*) is a continuous count of days since January 1. Irrigation (sprinkler): n/a

†Test Weight and Grain Yield adjusted to 12.0% moisture basis

"Some of us grew up playing with tractors, the lucky ones still do."

Dryland Spring Wheat Evaluation - MSU **Roosevelt County, MT 2018**

Variety	Plant height	Test Weight †	Protein	Grain Yield †
	(in)	(lb/bu)	(%)	(bu/a)
CHOTEAU	19.2	61.3	17.4	23.0
CORBIN	19.6	61.7	17.6	18.8
DUCLAIR	22.3	59.8	17.0	22.8
EGAN	20.1	59.6	19.7	21.5
FORTUNA	24.7	62.3	16.6	22.4
HRS 3504	19.9	60.4	17.0	26.8
HRS 3616	23.1	61.9	17.2	26.3
LANNING	21.7	61.2	17.4	24.8
NS PRESSER CL+	20.3	61.9	16.9	27.2
REEDER	19.3	62.6	16.8	26.3
SY SOREN	19.7	61.8	17.5	26.7
VIDA	19.6	61.8	16.6	27.8
Mean	20.8	61.4	17.3	24.5
P-value	0.2266	<0.0001	<0.0001	0.3260
CV (%)	12.3	0.9	2.1	17.8
LSD	4.3	0.9	0.6	7.4

Planted: 05/01/2018 Previous crop: Peas

Harvested: 8/09/2018 Fertilizer: 75 lb/ac MESZ (10-40-0-10s-1zN)

† Test Weight and Grain Yield adjusted to 12.0% moisture basis.

Dryland Spring Wheat Evaluation - MSU **Valley County, MT 2018**

Variety	Plant Height	Test Weight †	Protein	Grain Yield †
	(in)	(lb/bu)	(%)	(bu/a)
CHOTEAU	29.4	64.3	12.5	45.5
CORBIN	29.5	65.0	11.6	40.0
DUCLAIR	29.4	64.0	11.4	44.7
EGAN	30.4	62.8	12.6	37.2
FORTUNA	33.7	63.9	11.8	38.7
HRS 3504	27.8	64.1	10.2	45.2
HRS 3616	30.8	65.4	12.3	42.0
LANNING	29.9	64.0	10.8	44.4
NS PRESSER CL+	31.0	64.0	11.3	47.8
REEDER	30.7	64.6	11.8	46.1
SY SOREN	28.6	65.0	12.0	41.7
VIDA	31.1	64.7	10.8	47.5
Mean	30.2	64.3	11.6	43.4
P-value	0.0801	0.0120	0.3192	0.2891
CV (%)	6.1	1.1	9.8	12.1
LSD	3.1	1.1	1.9	8.8

Planted: 5/1/2018 Previous crop: Wheat

Harvested: 8/14/2018 Fertilizer: Nitrogen 73.4 lb/ac

P205 20.8 lb/ac

† Test Weight and Grain Yield adjusted to 12.0% moisture basis.

Dryland Spring Wheat Evaluation - MSU **Wibaux County, MT 2018**

Variety	Plant Height	Test Weight †	Protein	Grain Yield †
	(in)	(lb/bu)	(%)	(bu/a)
CHOTEAU	29.1	58.3	14.6	35.6
CORBIN	29.3	59.0	14.8	36.8
DUCLAIR	29.4	58.0	14.8	39.9
EGAN	28.5	57.4	14.4	37.2
FORTUNA	37.0	58.6	14.1	27.7
HRS 3504	27.8	55.8	13.9	40.2
HRS 3616	30.2	58.3	15.4	40.5
LANNING	29.1	58.1	14.3	38.7
NS PRESSER CL+	29.9	57.1	13.8	36.1
REEDER	30.1	59.5	13.3	39.0
SY SOREN	29.0	59.7	15.0	35.5
VIDA	29.5	58.9	13.8	43.3
Mean	29.9	58.2	14.4	37.5
P-value	<0.0001	0.0137	0.1722	0.4552
CV (%)	4.0	1.9	5.8	17.7
LSD	2.0	1.8	1.4	11.2

Planted: 5/4/2018 Previous crop: Wheat

Harvested: 8/31/2018 Fertilizer: Nitrogen 73.4 lb/ac

P205 20.8 lb/ac

† Test Weight and Grain Yield adjusted to 12.0% moisture basis.

Thomas Gross and Becky Garza with wheat samples.

Photo by Calla Kowatch-Carlson.

Wheat Variety Comparisons, Williston, ND 2018

Gautam Pradhan, Jerald Bergman, Kyle Dragseth

The gross return per acre was calculated by multiplying 3-year average yield from dryland varietal trials, 2015, 2016, 2017; and the market price obtained in the second week of December 2018 from different grain elevators in and around Williston. The market price of each spring wheat variety was adjusted for protein premium by using a linear equation obtained by plotting wheat market prices against percent proteins. In the case of durum, the choice rate was used.

Spring Wheat

Variety	3 Yr Avg. (2015–2017) Yield	Protein	Gross Return	+ or - Barlow
	bu/a	%	$/a	$/a
Prevail	42.3	15.0	216.54	34.34
WB9653	41.0	15.0	209.85	27.65
MS Chevelle	40.8	14.6	208.63	26.43
SY Valda	40.6	15.1	208.00	25.80
Velva	40.5	15.8	207.18	24.98
Elgin-ND	38.9	15.8	199.22	17.02
Mott	38.9	16.6	198.95	16.75
Linkert	38.8	15.9	198.61	16.41
SY Ingmar	38.3	15.4	196.24	14.04
WB-Mayville	38.2	16.0	195.40	13.20
SY Rowyn	37.4	14.9	193.33	11.14
Prestige	37.7	15.1	192.94	10.75
Rollag	37.4	15.3	191.61	9.41
Prosper	37.2	14.8	191.24	9.04
Redstone	37.0	15.8	189.60	7.41
SY Soren	36.6	15.7	187.52	5.33
LCS Nitro	36.5	15.7	186.89	4.70
Glenn	36.5	15.3	186.78	4.59
Faller	36.1	14.7	185.13	2.94
Barlow	35.6	15.8	182.20	0.00
ND VitPro	35.2	16.4	180.22	-1.97
LCS Bolles	34.7	15.8	177.67	-4.53
	33.7	17.0	172.48	-9.72

Durum

Variety	3 Yr Avg. (2015–2017) Yield	Protein	Gross Return	+ or - Ben
	bu/a	%	$/a	$/a
ND Grano	33.2	18.77	155.88	22.16
Tioga	32.7	17.2	153.78	20.06
AC Navigator	30.8	17.3	144.91	11.19
Carpio	30.7	18.1	144.15	10.43
Joppa	30.6	17.8	143.76	10.04
Alkabo	30.4	17.5	142.83	9.11
VT Peak	30.2	18.4	141.83	8.11
Alzada	30.1	17.5	141.36	7.64
Divide	29.7	17.9	139.38	5.66
ND Riveland	29.6	19.5	139.28	5.56
Grenora	29.6	17.8	139.09	5.37
AC Commander	29.6	18.3	138.91	5.19
Normanno	29.1	17.6	136.61	2.89
Mountrail	28.8	18.0	135.56	1.84
Ben	28.5	18.4	133.72	0.00
Pierce	28.1	17.7	131.89	-1.83
Lebsock	27.4	17.9	128.55	-5.17
Strongfield	27.1	18.5	127.33	-6.39
Rugby	26.7	18.3	125.57	-8.15
CDC Verona	26.4	19.6	124.31	-9.41
Maier	26.1	18.9	122.67	-11.05
Silver	24.3	18.3	113.98	-19.74

DURUM VARIETY DESCRIPTIONS

Variety	Origin[1]	Year released	Height	Maturity	Resistance To[2]					Quality Factors			
					Lodging	Leaf Rust	Foliar Disease	Root Rot	Scab	Test Weight	Kernel Size[3]	Grain Protein	Overall Quality
AC Commander	Canada	2002	M short	late	M	R	MS	M	VS	medium	large	M high	good
AC Navigator	Canada	1999	M short	M late	M	R	M	S	S	medium	V large	medium	good
Alkabo	NDSU	2005	medium	medium	R	R	M	M	MS	high	large	M low	good
Alzada	WB	2004	short	early	M	R	S	M	VS	medium	large	medium	excellent
Ben	NDSU	1996	tall	medium	MR	R	MR	M	S	V high	V large	M high	average
Carpio	NDSU	2012	tall	M late	MS	R	M	NA	M	medium	large	M high	excellent
CDC Verona	Canada	2010	M tall	M late	M	R	MR	NA	S	medium	large	M high	good
Divide	NDSU	2005	M tall	M late	M	R	M	M	MR	medium	medium	M high	excellent
Grenora	NDSU	2005	medium	M early	M	R	M	MR	MS	medium	medium	medium	good
Joppa	NDSU	2013	medium	medium	R	R	M	NA	M	medium	large	medium	good
Lebsock	NDSU	1999	M tall	medium	R	R	M	MS	MS	high	large	medium	average
Maier	NDSU	1998	M tall	M late	M	R	M	M	S	high	medium	high	average
Mountrail	NDSU	1998	M tall	M late	M	R	M	M	S	medium	medium	medium	average
ND Grano*	NDSU	2017	medium	M late	MS	R	NA	NA	M	high	medium	M high	good
ND Riveland*	NDSU	2017	tall	medium	M	R	NA	NA	M	high	medium	Mhigh	good
Pierce	NDSU	2001	M tall	medium	M	R	MS	MR	S	V high	medium	medium	excellent
Rugby	NDSU	1973	tall	M early	R	R	MR	M	S	medium	medium	medium	poor
Silver	MT	2012	short	early	R	NA	M	NA	S	M high	small	M high	good
Strongfield*	Canada	2004	M tall	M late	M	R	MS	NA	S	medium	M large	V high	good
Tioga	NDSU	2010	tall	M late	MR	R	M	NA	MS	M high	medium	M high	excellent
VT Peak	Viterra	2010	M tall	medium	MS	NA	NA	NA	NA	medium	M small	M high	good

[1]Refers to developer: CANADA represents developer from that country; DGP = Dakota Growers Pasta; MT = Montana State University; NDSU = North Dakota State University; WB = WestBred.

[2]MR = Moderately resistant; M = Intermediate; MS = Moderately susceptible; NA = Not adequately tested; R = Resistant; S = Susceptible; VS = Very susceptible. All varieties are resistant to current stem rust races. Foliar Disease = reaction to tan spot and septoria leaf spot complex.

[3]Number seeds/lb: Small = Less than 11,000; Medium = 11,000-12,000; Large = More than 12,000.

*Indicates low cadmium accumulating variety.

Durum Dryland Variety Trial - NDSU^

WREC, Williston, ND 2018

Variety	Days to Heading	Plant Height	Protein[†]	Test Weight[‡]	Yield[#]		
					2018	2-yr Avg.*	3-yr Avg.**
	(DAP[1])	(in)	(%)	(lb/bu)	--------(bu/a)--------		
Alkabo	52	19	13.2	60.8	18.65	27.9	30.4
Carpio	54	20	13.8	60.3	20.6	28.3	30.7
Divide	55	25	13.8	60.6	25.5	27.1	30.1
Joppa	52	21	13.4	60.9	17.8	27.2	30.6
Mountrail	53	22	14.0	60.5	20.4	26.0	28.8
ND Grano	54	23	13.7	60.9	21.8	33.1	-
ND Riveland	53	25	13.3	60.9	24.9	32.6	-
Mean	53	22	13.6	60.7	21.4	-	-
CV (%)	1.3	8.7	-	0.6	13.2	-	-
LSD (5%)	1.2	2.8	-	0.6	23.3	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft

Previous crop: Cover Crop.

Planted: 05/03/2018

Harvested: 08/10/2018.

^Trial was planted under till-condition. [1]DAP = Days after planting

Soil type: Williams-Bowbells loam.

[†]Protein adjusted to 12.0% moisture, and data was from bulked sampled.

[‡]Test Weight = Reported on a 13.5% moisture basis.

[#]Yield = Reported on a 13.5% moisture basis.

*Averages of years 2016 and 2017; **Averages of years 2015, 2016, and 2017; averaged yields were from no-till planting.

Chemical Applications: Goldsky @ 16 oz/ac (6/1/18)

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.

06/23/2018:Wind speed=46 mph; Precipitation=1.53"; 06/28/2018:Wind speed=61 mph; Precipitation=0.94"; Hail.
07/09/2018:Wind speed=48 mph; Precipitation=1.67".

Durum Divide Dryland Variety Trial - NDSU **Divide County, ND 2018**

Variety	Protein†	Test weight‡	Yield#		
			2018	2-Yr Avg	3-Yr Avg
	(%)	(lb/bu)	-------(bu/a)-------		
Alkabo	16.9	29.3	22.2	25.4	36.3
Carpio	17.3	28.9	23.6	25.6	36.5
Divide	17.4	29.2	23.0	25.1	37.6
Grenora	16.7	29.3	17.9	-	-
Joppa	16.5	29.4	25.0	25.9	38.5
Lebsock	16.4	29.5	20.7	24.1	39.1
Mountrail	16.2	29.4	26.5	27.3	40.8
ND Grano	16.4	29.4	24.8	26.4	-
ND Riveland	16.8	29.1	29.7	29.3	-
Tioga	16.0	29.6	31.1	30.1	39.7
Mean	16.7	29.3	24.4	-	-
CV (%)	1.9	0.5	11.3	-	-
LSD (5%)	0.5	0.3	6.0	-	-
LSD (10%)	0.4	0.2	4.9	-	-

Location: Crosby, ND; Latitude 48° 48'N; Longitude 103° 18'W; Elevation 2044 ft. Previous crop: Soybean
Planted: 06/04/2018. Harvested: 8/10/2018.
Soil test (0-6"): N/A. Soil type: Farnuf-Alkabo.
(0-24"): NO3-N=24 lb/a.
Applied fertilizer in lb/a: 75.33 N : 18 P : 0 K : 4.5 S Broadcasted.

†Protein adjusted to 12% moisture.

‡Test weight reported on a 13.5% moisture basis.

#Yield reported on a 13.5% moisture basis.

Durum Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9+)	Protein† 2018 (%)	Protein† 2-Yr Avg (%)	Protein† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield# 2018‡ (bu/a)	Yield# 2-Yr Avg (bu/a)	Yield# 3-Yr Avg (bu/a)
ND Riveland	32	55	0	16.4	16.4	16.2	61.0	65.4	88.9	88.0
Carpio	30	57	1	16.1	16.4	15.9	61.2	64.7	85.4	81.1
ND Grano	28	57	0	15.8	16.1	16.1	61.3	55.7	80.6	80.8
Grenora	27	55	0	16.1	16.1	15.9	60.7	63.6	81.3	79.2
Tioga	31	57	0	16.1	16.4	16.0	61.2	60.5	79.0	78.6
Mountrail	29	56	0	15.9	16.2	16.1	60.6	57.0	78.2	78.1
Joppa	27	54	1	15.7	15.8	15.6	61.0	58.1	80.5	76.2
Divide	33	59	0	16.7	16.8	16.3	60.4	61.0	79.5	75.5
CDC Verona	32	58	0	18.1	17.6	16.8	60.8	60.3	80.0	75.5
Alkabo	28	54	0	15.5	15.4	15.3	61.1	62.4	81.9	75.3
Strongfield	32	57	0	17.6	17.7	17.2	61.3	59.6	74.8	73.5
Pierce	28	54	0	16.0	16.2	15.9	61.2	50.9	72.5	73.1
Maier	28	57	0	17.0	17.4	16.8	61.1	53.6	76.8	71.6
DG Max	31	55	1	17.1	17.1	16.8	61.5	55.4	72.0	71.0
Lebsock	29	55	0	16.2	16.3	15.7	61.3	55.8	72.2	70.9
Ben	30	56	0	16.6	16.5	16.5	61.3	54.7	69.8	68.4
Normanno	23	53	0	15.9	16.3	16.1	57.8	49.9	72.1	68.1
AC Navigator	26	52	0	15.6	15.9	15.9	60.6	50.7	70.5	67.7
AC Commander	25	53	0	15.9	15.9	15.6	58.8	51.6	69.2	67.4
Rugby	31	54	1	16.5	16.6	16.0	61.3	55.0	72.3	66.7
Alzada	26	51	1	15.6	15.9	16.1	59.4	53.8	72.1	66.6
Silver	24	52	1	15.8	15.9	16.2	59.5	43.8	67.4	64.8
MEAN	28.6	55.0	0.3	16.29	16.41	16.15	60.65	56.51	76.21	73.54
C.V. (%)	-	-	-	2.46	-	-	0.79	7.68	-	-
LSD (5%)	-	-	-	0.64	-	-	0.67	6.13	-	-
LSD (10%)	-	-	-	0.54	-	-	0.56	5.12	-	-

* Days after planting + 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 12% moisture ‡ Yields affected by herbicide injury

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W Elevation: 1902 ft
Soil test to (0-6"): P=23 ppm; K=160 ppm; pH=7.6; OM=1.9% Previous crop: Potato
(0-24"): NO3-N= 20 lb/a Planted: 5/3/2018
Yield goal: 90 bu/a Harvested: 8/16/2018
Planting population: 1.5 million seeds/a Soil Type: Lihen Loamy Fine Sand
Applied fertilizer in lb/a broadcast: 333 lbs of 46-0-0 (4/25/2018), and 76 lbs of 46-0-0 (6/4/2018)‡ Plot size: 92 ft^2
Herbicides applied: Axial XL 10.5 oz/a, Starane 10.5 oz/a, and Bison 2 pt/a (5/24/2018) Rainfall: 8.5 in (5/3/2018 - 8/16/2018)
Fungicides applied: Prosaro 421 8 oz/a (7/3/2018) Irrigation: 8.0 in (5/3/2018 - 8/16/2018)
‡ Additional fertilizer applied due to a 2.44 inch rainfall on June 1st

Dryland Statewide Durum (DSD) - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height (in)	Days to Heading (julian*)	Test Weight † (lb/bu)	Protein (%)	Grain Yield † (bu/a)
Alkabo	37.1	177	64.5	14.6	59.6
Alzada	29.8	172	64.1	13.8	57.4
Carpio	35.8	177	64.7	14.4	64.4
Divide	39.8	178	64.0	14.3	61.9
Dynamic	38.3	178	64.7	13.9	65.7
Fortitude	34.1	176	63.9	14.3	61.8
Grenora	35.3	176	63.7	14.8	65.0
Joppa	37.9	177	64.6	14.2	60.2
MT112219	26.6	172	65.7	13.3	60.8
MTD16001	37.4	178	64.1	12.9	67.0
MTD16002	39.1	179	64.1	14.1	65.7
MTD16003	36.0	176	64.5	13.1	59.7
MTD16004	36.1	177	65.3	13.1	64.8
MTD16005	37.0	178	63.4	13.7	59.2
MTD16006	36.9	178	63.8	13.9	58.1
MTD16007	35.6	177	64.5	14.1	56.6
MTD16008	36.1	176	62.8	14.1	61.7
MTD16009	38.8	178	60.7	15.1	59.2
MTD16010	37.7	178	64.2	15.2	56.8
MTD16011	36.5	178	63.7	13.5	57.3
Mountrail	36.4	177	64.4	14.3	63.4
Precision	37.9	177	64.5	14.4	61.6
Tioga	38.3	176	64.5	14.1	64.9
Vivid	35.6	177	64.1	15.3	64.2
Mean	36.3	176.8	64.1	14.1	61.5
P-value	<0.0001	<0.0001	<0.0001	0.1118	0.0364
CV (%)	3.9	0.4	0.5	6.5	6.4
LSD	2.3	1.0	0.6	1.5	6.5

Soil Test N Avail (lb/a): 44.5 Previous crop: Fallow

Soil Test P2O5 (lb/a): 30 Planted: 4/27/2018

N added (lb/a): 73.4 Harvested: 8/22/2018

P2O5 added (lb/ac): 20.8 Plot Width (ft): 5'

(julian*) is a continuous count of days since January 1. Precip 2018: 14.19"

†Test Weight and Grain Yield adjusted to 12.0% moisture basis

"Do what you can, with what you have, where you are."
Theodore Roosevelt

Irrigated Statewide Durum (ISD) - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)
Alkabo	34.6	178	63.3	14.7	92.0
Alzada	25.9	176	60.0	15.3	76.6
Carpio	35.8	180	64.1	14.8	101.5
Divide	38.7	182	64.3	14.6	103.7
Dynamic	37.3	183	64.8	15.4	112.2
Fortitude	31.0	179	62.4	15.6	100.9
Grenora	34.4	178	62.8	14.6	106.6
Joppa	37.9	178	63.5	15.0	94.5
MT112219	26.4	176	61.9	14.2	82.9
MTD16001	36.2	183	63.5	14.4	110.2
MTD16002	43.7	183	63.2	15.3	98.7
MTD16003	35.3	179	64.6	13.4	103.8
MTD16004	34.6	178	63.8	15.3	96.1
MTD16005	36.6	183	63.7	14.6	101.3
MTD16006	37.1	182	63.3	15.2	98.6
MTD16007	34.6	179	64.4	15.3	104.9
MTD16008	36.2	179	62.5	15.3	103.8
MTD16009	37.9	183	61.6	15.4	104.3
MTD16010	37.1	182	64.5	15.3	100.5
MTD16011	37.1	183	63.5	14.7	88.7
Mountrail	35.8	179	63.3	15.4	98.7
Precision	36.6	179	63.9	15.5	103.3
Tioga	37.8	179	63.3	15.4	105.3
Vivid	34.6	179	63.6	15.9	92.4
Mean	35.6	180.0	63.3	15.0	99.2
P-value	<0.0001	<0.0001	<0.0001	0.0004	0.0307
CV (%)	3.8	0.4	0.7	3.5	10.4
LSD	2.2	1.3	0.7	0.9	16.9

Soil Test N Avail (lb/a): 38.6
Soil Test P2O5 (lb/ac): 15
N added (lb/ac): 100 lbs/ac 11-52 + 300 lbs/ac Urea
P2O5 added (lb/ac): 29.5
(julian*) is a continuous count of days since January 1.
†Test Weight and Grain Yield adjusted to 12.0% moisture basis

Previous crop: Sugarbeet
Planted: 5/4/2018
Harvested: 8/24/2018
Soil Type: Savage Silty Clay
Plot Width (ft): 5'
Precip 2018: 14.19"
Irrigation Sprinkler: 2.68"

Dryland Recrop Durum - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)
Alkabo	29.7	171	63.2	15.3	39.6
Alzada	25.3	170	62.5	14.7	44.6
Carpio	31.5	173	62.0	15.4	40.5
Divide	31.8	173	62.6	14.8	38.2
Dynamic	29.8	174	62.0	17.8	36.7
Fortitude	30.1	173	62.2	16.6	40.5
Grenora	29.3	170	62.5	14.6	43.8
Joppa	31.8	173	63.1	15.7	38.0
MT112219	26.0	170	64.3	14.2	43.5
MTD16001	30.7	176	62.1	14.4	41.9
MTD16002	32.7	175	62.3	16.1	41.6
MTD16003	30.3	172	63.1	13.3	38.7
MTD16004	31.2	173	63.2	14.8	38.6
MTD16005	29.3	174	61.8	14.9	36.0
MTD16006	32.3	173	62.0	15.8	36.8
MTD16007	30.1	174	62.6	15.7	42.6
MTD16008	30.6	172	59.9	17.1	34.9
MTD16009	29.7	175	59.4	16.4	39.0
MTD16010	30.7	173	62.6	16.3	39.5
MTD16011	31.5	174	61.7	15.8	38.9
Mountrail	32.1	173	63.0	14.7	37.9
Precision	31.2	173	62.3	16.4	41.6
Tioga	32.1	173	62.6	15.7	42.2
Vivid	29.9	172	62.4	16.4	42.6
Mean	30.4	172.8	62.3	15.5	39.9
P-value	0.0003	<0.0001	<0.0001	<0.0001	0.4399
CV (%)	5.5	0.6	0.7	4.5	11.1
LSD	2.8	1.7	0.7	1.1	7.3

Soil Test N Avail (lb/ac): 28.3 Previous crop: Wheat

Soil Test P2O5 (lb/ac): 14.0 Planted: 4/27/2018

N added (lb/ac): 73.4 Harvested: 8/8/2018

P2O5 added (lb/ac): 20.8 Soil Type: Williams Clay Loam

(julian*) is a continuous count of days since January 1. Plot Width (ft): 5'

† Test Weight and Grain Yield are adjusted to 12.0% moisture basis. Precip 2018: 14.19"

Dryland Durum Evaluation - MSU **Roosevelt County, MT 2018**

Variety	Plant Height	Test Weight †	Protein	Grain Yield †
	(in)	(lb/bu)	(%)	(bu/a)
Alkabo	20.2	62.6	16.8	16.4
Alzada	21.4	60.6	16.3	22.2
Carpio	20.1	61.6	17.5	15.2
Divide	21.7	61.6	17.2	15.2
Dynamic	20.1	61.6	19.5	15.5
Fortitude	23.0	61.6	18.5	20.6
Grenora	19.6	61.3	16.8	17.5
Joppa	22.4	62.6	17.2	18.9
MT112219	19.8	62.3	16.0	20.1
MTD16001	22.2	61.5	16.7	16.8
MTD16002	25.2	60.8	19.0	12.3
MTD16003	22.7	61.3	16.1	17.6
MTD16004	24.4	61.2	7.3	17.0
MTD16005	22.6	60.8	18.2	18.8
MTD16006	24.3	61.5	17.2	17.4
MTD16007	23.4	61.8	18.0	20.0
MTD16008	23.6	60.6	18.2	13.8
MTD16009	21.3	58.8	19.0	14.2
MTD16010	21.7	61.6	17.9	14.6
MTD16011	22.6	60.2	18.0	15.0
Mountrail	22.4	61.0	17.9	19.1
Precision	22.3	62.3	18.6	17.3
Tioga	22.8	62.1	17.4	15.2
Vivid	23.2	61.0	18.4	17.0
Mean	22.2	61.3	17.2	17.0
P-value	0.0651	<0.0001	<0.0001	0.3403
CV (%)	9.1	0.9	2.1	23.0
LSD	3.3	0.9	0.6	6.4

Previous crop: Peas Planted: 5/1/2018

Fertilizer: 75 lb/ac MESZ (10-40-0-10S-1Zn) Harvested: 8/9/2018

† Test Weight and Grain Yield are adjusted to 12.0% moisture basis.

"I had rather be on my farm than be emperor of the world."
George Washington

Dryland Durum Evaluation - MSU **Wibaux County, MT 2018**

Variety	Plant Height	Test Weight †	Protein	Grain Yield †
	(in)	(lb/bu)	(%)	(bu/a)
Alkabo	34.4	60.0	15.0	39.6
Alzada	27.4	59.6	15.6	37.0
Carpio	33.6	59.3	15.3	35.9
Divide	37.3	60.2	16.1	41.4
Dynamic	37.9	60.1	17.1	43.4
Fortitude	32.0	59.8	17.0	37.1
Grenora	34.0	58.6	15.6	43.8
Joppa	36.4	60.1	15.5	41.2
MT112219	25.1	60.8	14.5	38.8
MTD16001	38.2	59.3	16.3	38.0
MTD16002	39.8	60.2	15.5	38.8
MTD16003	35.7	60.4	14.6	37.1
MTD16004	36.1	60.3	16.8	35.1
MTD16005	37.3	58.8	15.9	37.1
MTD16006	37.0	60.2	14.2	38.7
MTD16007	34.3	60.5	16.1	41.5
MTD16008	35.2	59.6	16.1	39.7
MTD16009	38.4	56.8	15.7	36.7
MTD16010	35.7	60.7	15.8	40.5
MTD16011	37.1	59.1	16.1	41.4
Mountrail	34.6	60.4	15.5	38.7
Precision	34.9	59.8	16.9	33.9
Tioga	38.4	59.6	16.1	44.1
Vivid	33.9	60.5	16.6	26.0
Mean	35.2	59.8	15.8	38.6
P-value	<0.0001	<0.0001	0.1692	0.5835
CV (%)	5.1	0.8	7.2	17.9
LSD	3.0	0.8	1.9	11.4

Fertilizer: Nitrogen 73.4 lb/ac
P205 20.8 lb/ac

Previous crop: Wheat
Planted: 5/4/2018
Harvested: 8/31/2018

† Test Weight and Grain Yield are adjusted to 12.0% moisture basis.

"Do not educate your children to be rich. Educate them to be happy. So when they grow up, they'll know the value of things, not the price."

HARD RED WINTER WHEAT VARIETY DESCRIPTIONS

VARIETY	ORIGIN[1]	YEAR RELEASED	HEIGHT	MATURITY	WINTER HARDINESS[3]	RESISTANCE TO[2]				QUALITY FACTORS	
						LODGING	STEM RUST	LEAF RUST	FOLIAR DISEASE	TEST WEIGHT	GRAIN PROTEIN
AAC GATEWAY	CANADA	2012	M SHORT	MEDIUM	**GOOD**	R	R	R	NA	MEDIUM	MEDIUM
AAC GOLDRUSH	CANADA	2017	MEDIUM	MEDIUM	**GOOD**	NA	MR	R	M	NA	NA
AAC WILDFIRE	CANADA	2015	MEDIUM	MEDIUM	**GOOD**	NA	M	MS	NA	NA	NA
ACCIPITER	CANADA	2008	SHORT	MEDIUM	**GOOD**	R	R	MS	S	MEDIUM	MEDIUM
BEARPAW*	MT	2011	M SHORT	MEDIUM	FAIR	R	R	S	NA	MEDIUM	LOW
BRAWL CL PLUS	CO	2011	SHORT	EARLY	FAIR	NA	NA	NA	NA	M HIGH	M HIGH
BROADVIEW	CANADA	2009	MEDIUM	MEDIUM	**GOOD**	R	R	R	NA	MEDIUM	MEDIUM
CDC CHASE	CANADA	2013	MEDIUM	MEDIUM	**GOOD**	M	R	MR	R	M HIGH	MEDIUM
DECADE	MT/NDSU	2010	MEDIUM	M EARLY	**GOOD**	R	R	S	M	MEDIUM	MEDIUM
DENALI	CO/KSU	2011	MEDIUM	M LATE	NA	NA	MR	S	NA	MEDIUM	M HIGH
EMERSON	CANADA	2011	SHORT	MEDIUM	**GOOD**	NA	R	MS	NA	M HIGH	MEDIUM
FLOURISH	CANADA	2010	SHORT	EARLY	**GOOD**	R	MR	R	NA	MEDIUM	M LOW
IDEAL	SDSU	2011	SHORT	MEDIUM	**GOOD**	R	MR	MR	MS	MEDIUM	MEDIUM
KELDIN	WB	2011	SHORT	MEDIUM	**GOOD**	NA	MR	MR	MR	NA	NA
JERRY	NDSU	2001	MEDIUM	MEDIUM	**GOOD**	MR	R	MR	M	MEDIUM	M HIGH
JUDEE*	MT	2011	MEDIUM	MEDIUM	FAIR	R	S	S	NA	MEDIUM	M HIGH
LOMA	MT	2016	MEDIUM	M LATE	**GOOD**	NA	R	NA	NA	MEDIUM	MEDIUM
LYMAN	SDSU	2008	MEDIUM	MEDIUM	FAIR	M	R	R	MR	M HIGH	M HIGH
MOATS	CANADA	2010	MEDIUM	MEDIUM	**GOOD**	MS	R	MR	NA	M HIGH	MEDIUM
NORTHERN	MT	2015	M SHORT	M LATE	FAIR	NA	R	NA	NA	MEDIUM	MEDIUM
OVERLAND	NE	2006	M TALL	MEDIUM	FAIR	MS	MS	MR	NA	M HIGH	MEDIUM
PEREGRINE	CANADA	2008	MEDIUM	M LATE	V **GOOD**	MR	R	MR	NA	M HIGH	M LOW
REDFIELD	SD	2013	SHORT	MEDIUM	FAIR	R	S	MS	NA	M HIGH	MEDIUM
SY MONUMENT	AGRIPRO	2015	M SHORT	MEDIUM	FAIR	NA	MR	MR	NA	M LOW	MEDIUM
SY SUNRISE	AGRIPRO	2015	SHORT	MEDIUM	**GOOD**	NA	NA	NA	NA	NA	NA
SY WOLF	AGRIPRO	2010	M SHORT	MEDIUM	POOR	R	R	MR	MR	HIGH	M LOW
THOMPSON	SD	2017	MEDIUM	M EARLY	NA	R	MR	MR	NA	NA	NA
WARHORSE	MT	2013	SHORT	M LATE	FAIR	MR	R	S	NA	MEDIUM	MEDIUM
WB 4614	WB	2013	MEDIUM	MEDIUM	**GOOD**	NA	NA	NA	NA	M HIGH	MEDIUM
WB4483	WB	2016	M SHORT	LATE	**GOOD**	NA	MS	MR	MR	MEDIUM	M LOW
WB4575	WB	2016	M SHORT	MEDIUM	NA	NA	NA	NA	NA	MEDIUM	M LOW
WB-MATLOCK	WB	2010	MEDIUM	MEDIUM	**GOOD**	MR	R	MS	MS	MEDIUM	MEDIUM
WB-QUAKE*	WB	2011	MEDIUM	LATE	FAIR	MR	NA	MR	NA	M LOW	M LOW
YELLOWSTONE	MT	2005	MEDIUM	MEDIUM	**GOOD**	M	S	MS	M	LOW	M HIGH

[1]REFERS TO DEVELOPER: CANADA REPRESENTS DEVELOPERS FROM THAT COUNTRY; MT = MONTANA STATE UNIVERSITY; NDSU = NORTH DAKOTA STATE UNIVERSITY; NE = UNIVERSITY OF NEBRASKA; SDSU = SOUTH DAKOTA STATE UNIVERSITY; WB = WESTBRED.

[2]M = INTERMEDIATE; MR = MODERATELY RESISTANT; MS = MODERATELY SUSCEPTIBLE; NA = DATA NOT AVAILABLE; R = RESISTANT, S = SUSCEPTIBLE.

[3]VARIETIES WITH FAIR TO POOR WINTER HARDINESS SHOULD NOT BE SEEDED ON BARE SOIL.

*SAWFLY RESISTANT.

HARD WHITE WINTER WHEAT VARIETY DESCRIPTIONS

VARIETY	ORIGIN[1]	YEAR RELEASED	HEIGHT	MATURITY	WINTER HARDINESS[3]	RESISTANCE TO[2]				QUALITY FACTORS	
						LODGING	STEM RUST	LEAF RUST	FOLIAR DISEASE	TEST WEIGHT	GRAIN PROTEIN
ALICE	SDSU	2006	SHORT	EARLY	FAIR	MR	MR	S	NA	M HIGH	M LOW
GARY	ID	2001	MEDIUM	M LATE	FAIR	MR	NA	NA	NA	MEDIUM	LOW
HYALITE*	MT/WB	2005	M SHORT	M EARLY	FAIR	MR	R	S	NA	MEDIUM	MEDIUM
NUDAKOTA	AGRIPRO	2007	SHORT	MEDIUM	POOR	R	MR	MR	NA	MEDIUM	MEDIUM
NUFRONTIER	GM/AGRIPRO	NA	M SHORT	EARLY	FAIR	R	NA	NA	NA	M HIGH	LOW
NUHORIZON	GM/AGRIPRO	NA	SHORT	EARLY	POOR	R	NA	NA	NA	HIGH	M LOW
NUSKY	MSU	2001	MED	M LATE	GOOD	R	MR	S	MR	MEDIUM	MEDIUM
NUWEST	MSU/GM	1994	MED	MEDIUM	GOOD	R	MR	S	MR	M LOW	MEDIUM
WENDY	SDSU	2004	SHORT	EARLY	GOOD	NA	NA	NA	NA	MEDIUM	MEDIUM

[1]REFERS TO DEVELOPER: GM = GENERAL MILLS; ID = UNIVERSITY OF IDAHO; MT = MONTANA STATE UNIVERSITY; SDSU = SOUTH DAKOTA STATE UNIVERSITY; WB = WESTBRED.

[2]R = RESISTANT, MR = MODERATELY RESISTANT; S = SUSCEPTIBLE; NA = DATA NOT AVAILABLE.

[3]VARIETIES WITH FAIR TO POOR WINTER HARDINESS SHOULD NOT BE SEEDED ON BARE SOIL.

*CLEARFIELD WHEAT WITH IMIDAZOLINONE TOLERANCE.

Winter Wheat Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Plant height	Days to heading	Protein†	Test weight‡	Yield		
					2018	2-Yr Avg*	3-Yr Avg**
	(in)	(julian)	(%)	(lb/bu)		-----(bu/a)-----	
AC Broadview	22.6	157	13.2	57.8	51.0	45.2	48.3
Peregrine	25.5	158	13.8	59.5	51.0	49.3	48.1
Accipiter	22.8	158	14.0	58.2	50.1	40.5	43.8
AAC Wildfire	21.5	160	14.9	58.7	49.6	-	-
AAC Goldrush	25.2	158	14.9	58.8	49.0	-	-
Keldin	22.8	157	12.9	58.5	49.0	34.1	-
SY Sunrise	19.3	153	13.0	57.6	48.5	38.2	-
Jerry	23.1	157	14.5	57.7	48.3	42.9	47.1
Loma	19.7	159	14.4	57.5	48.0	-	-
Ideal	23.9	156	13.2	58.2	47.7	42.7	43.8
Thompson	23.5	155	13.9	58.4	47.3	-	-
WB Matlock	24.9	157	14.8	58.6	47.2	48.4	49.6
Moats	27.8	158	14.7	59.4	47.2	44.2	44.8
Redfield	21.1	155	14.3	58.2	46.9	46.3	46.4
Northern	21.5	158	14.7	57.9	46.8	37.5	42.5
Lyman	23.1	154	14.5	57.6	46.7	39.9	43.2
SY Monument	22.2	156	13.2	56.3	46.6	45.2	-
AAC Gateway	22.2	156	15.1	59.3	46.5	40.7	41.6
Overland	23.6	154	14.1	58.1	45.7	39.5	41.6
CDC Chase	26.0	157	14.8	58.9	44.9	42.6	43.9
SY Wolf	21.3	155	14.6	58.8	44.8	33.4	35.1
Overland-Fhb1	24.4	154	14.3	58.2	44.6	-	-
NHH1444913-3	23.8	154	14.0	56.6	43.6	-	-
Oahe	24.8	156	13.9	58.6	43.3	-	-
Decade	23.1	155	15.1	57.5	42.8	47.3	47.4
AC Emerson	24.0	158	16.4	59.0	42.0	38.3	41.3
Mean	22.6	157	13.2	57.8	51.0	-	-
CV (%)	6.3	0.6	2.3	0.6	5.4	-	-
LSD (5%)	2.4	1.6	0.5	0.6	4.1	-	-
LSD (10%)	2.0	1.4	0.4	0.5	3.4	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: cover crop.
Planted: 9/13/2017. Harvested: 7/23/2018.
Soil test (0-6"): P=27 ppm; K=226 ppm; pH=6.6; OM=2.5% Soil type: Williams-Bowbells loam.
(0-24"): NO_3-N=24 lb/a.

Applied fertilizers in lb/a: N=76; P_2O_5=26; K_2O=0.

†Protein adjusted to 12% moisture.

‡Test weight reported on a 13.5% moisture basis.

#Yield reported on a 13.5% moisture basis.

Chemical Applications: Goldsky @ 1.0 pt/a (5-16-18).

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.

06/23/2018: Wind speed=46 mph; Precipitation=1.53".
06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.
07/09/2018: Wind speed=48 mph; Precipitation=1.67".

"If we never had any storms, we couldn't appreciate the sunshine."
Dale Evans

Dryland Intrastate Winter Wheat Evaluation - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)
07CL046-2	25.1	160	63.0	12.1	62.4
AAC Wildfire	28.5	163	62.1	10.3	68.0
Bearpaw	26.6	162	63.1	11.9	70.8
Brawl CLP	23.9	156	64.5	12.5	55.8
CO13003C	26.6	158	62.5	9.7	71.7
Decade	25.6	159	62.7	10.7	69.5
Incline AX	25.6	161	62.5	10.7	65.8
Judee	27.2	161	64.2	11.0	61.5
Keldin	28.6	160	64.2	10.2	84.3
LCS Chrome	26.1	158	64.1	10.9	65.8
LCS Jet	23.1	163	57.5	12.6	44.5
LCS Link	25.5	157	64.3	11.6	61.1
LWW14-73915	23.4	161	54.5	13.0	45.0
Langin	24.4	155	63.1	9.4	66.1
Loma	26.0	162	62.0	11.6	66.3
Long Branch	23.2	156	63.1	10.0	61.6
MT1265	30.6	162	62.9	11.2	79.7
MT1465	26.5	161	62.3	11.1	69.2
MT1547	25.7	161	62.7	11.0	70.9
MT1563	26.4	161	62.5	9.2	61.1
MT1564	25.2	157	63.8	10.7	59.3
MT16101	27.2	162	62.5	12.5	44.4
MT1642	29.8	163	61.6	12.2	63.8
MT1683	28.7	162	62.1	10.7	72.5
MT1687	25.1	157	62.7	11.8	66.8
MT1688	25.6	159	62.1	12.2	66.8
MT1695	25.2	159	62.3	12.3	47.4
MTCS1601	26.9	161	64.8	9.5	65.7
MTF1432	31.9	163	60.3	11.4	68.8
MTF1435	31.9	163	60.5	10.8	52.2
MTF1631	32.0	161	62.3	10.8	67.2
MTS1588	24.7	162	63.8	11.2	66.1
MTV1681	27.4	160	62.2	11.2	74.3
MTW1491	27.7	161	63.2	10.7	72.4
NSA10-2196	22.8	162	M	12.6	5.4
Northern	27.6	162	63.0	11.2	76.2
Oahe	28.0	157	64.2	10.6	68.7
PSB13NEDH-7-140	28.7	158	64.9	12.0	76.8
SY 517 CL2	24.7	156	64.2	11.2	59.5
SY Clearstone 2CL	29.4	163	61.6	11.6	65.8
SY Monument	25.3	158	62.1	9.7	76.6
SY Sunrise	23.9	156	63.2	10.5	71.3
SY Wolf	25.2	157	64.6	10.8	71.8
WB4483	27.7	162	62.0	12.2	71.0
WB4575	26.4	159	65.0	12.0	76.9
WB4614	23.9	161	63.4	10.6	67.0
WB4623CLP	23.6	164	62.2	13.6	54.7
Warhorse	26.6	162	62.7	11.6	65.9
Yellowstone	28.3	161	62.3	10.4	74.1
Mean	26.5	160.0	62.7	11.2	64.7
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	6.6	1.0	1.3	7.7	16.0
LSD	2.9	2.5	1.3	1.4	16.8

Planted: 9/13/2017 Previous crop: Fallow

Harvested: 7/31/2018 Soil Type: Williams Clay Loam

N added (lb/a): 30 Plot Width (ft): 5'

(julian*) is a continuous count of days since January 1. Precip 2018: 14.19"

† Test Weight and Grain Yield adjusted to 12.0% moisture basis.

M data missing

Barley Variety Descriptions

Variety	Origin[1]	Use[2]	Year released	Height	Maturity	Resistance to[3]					Quality Factors	
						Lodging	Stem Rust	Loose Smut	Net Blotch	Spot Blotch	Test Weight	Grain Protein
Two-Row												
AAC Synergy	SY	M/F	2015	M SHORT	M LATE	MR	MR	NA	MR	MR	NA	NA
Abi Balster	BARI	M/F	2015	M SHORT	MEDIUM	M	NA	NA	NA	NA	NA	NA
Abi Growler	BARI	M/F	2015	M SHORT	MEDIUM	MR	NA	NA	NA	S	NA	NA
AC Metcalfe	Canada	M	1997	MEDIUM	LATE	M	S	MR	MS	MS	MEDIUM	MEDIUM
CDC Copeland	Canada	M	1999	TALL	M LATE	MS	MR	S	MS	VS	LOW	MEDIUM
CDC Meredith	Canada	M	2008	MEDIUM	LATE	M	MR	NA	MS	S	NA	NA
Celebration	BARI	M/F	2008	M SHORT	MEDIUM	MR	S	NA	MS/S	MR/R	NA	NA
Champion	WB	F	1997	MEDIUM	MEDIUM	MR	R	S	MR	NA	M LOW	MEDIUM
Conlon	NDSU	F/M	1996	M SHORT	EARLY	MS	S	S	MR	MS	M HIGH	M LOW
Conrad	BARI	M	2007	M TALL	M LATE	MR	NA	S	NA	NA	M HIGH	M LOW
Craft	MT	F/M		TALL	MEDIUM	MR	NA	S	S	NA	M HIGH	M HIGH
Eslick	MT	F	2003	MEDIUM	M LATE	MS	S	NA	NA	MS	MEDIUM	M LOW
Harrington	Canada	F/M	1981	M SHORT	LATE	S	S	S	MS	S	MEDIUM	M LOW
Explorer	Secobra	M	NA	M SHORT	M LATE	MR	NA	NA	MR	S	NA	NA
Haxby	MT	F	2003	MEDIUM	MEDIUM	MS	S	S	S	MS	V HIGH	MEDIUM
Hockett	MT	F/F	2008	MEDIUM	MEDIUM	MS	S	S	NA	NA	MEDIUM	M HIGH
LCS Genie	Lime	M	NA	SHORT	MEDIUM	MR	NA	NA	MS	S	NA	NA
LCS Odyssey	Lime	M/F	NA	SHORT	MEDIUM	M	NA	NA	NA	NA	NA	NA
ND Genesis	NDSU	F/F	2015	MEDIUM	M LATE	MR	S	NA	MR	MR	HIGH	LOW
Pinnacle	NDSU	F/F	2006	MEDIUM	M LATE	MR	S	S	MS	MR	HIGH	LOW
Sirish	SYNGENTA	M	NA	SHORT	M LATE	MR	S	S	MS	MS	MEDIUM	MEDIUM
Six-Row												
Celebration	BARI	F/M	2008	M SHORT	MEDIUM	R	S	S	MS/S	MR/R	MEDIUM	MEDIUM
Innovation	BARI	M	2009	M SHORT	MEDIUM	MR	S	S	MS/S	MR/R	MEDIUM	MEDIUM
Lacey	MN	F/M	1999	M SHORT	MEDIUM	MR	S	S	MS/S	MR/R	MEDIUM	MEDIUM
Quest	MN	M	2010	M SHORT	MEDIUM	MS	S	S	MR	MR/R	M LOW	MEDIUM
Stellar-ND	NDSU	F/M	2005	M SHORT	MEDIUM	R	S	S	MS/S	MR/R	MEDIUM	M LOW
Tradition	BARI	F/M	2003	M SHORT	MEDIUM	R	S	S	MS/S	MR/R	MEDIUM	M LOW
Specialty												
Haybet	MT	H	1989	TALL	MEDIUM	S	NA	S	NA	NA	LOW	MEDIUM
Hays	MT	H	2003	M TALL	MEDIUM	MS	NA	NA	NA	NA	LOW	MEDIUM

[1]Refers to developer: BARI = Busch Ag Resources; Inc.; CANADA represents developers from that country; Lime = Limagrain; MN = University of Minnesota; MT = Montana State University; NDSU = North Dakota State University; SY = Syngenta; WB = WestBred.
[2]F = Feed; M = Malt.

[3]MR = Moderately resistant; M = Intermediate; MS = Moderately susceptible; NA = Not available; R = Resistant; S = Susceptible; VS = Very susceptible.

"Agriculture is our wisest pursuit, because it will in the end contribute most to real wealth, good moral, and happiness."
Thomas Jefferson

Barley Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Days to heading	Plant height	Plumps	Protein†	Test weight‡	Yield#		
						2018	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(in)	(%)	(%)	(lb/bu)	----------(bu/a)----------		
Six-rowed								
Innovation	57	17.5	95.0	13.9	52.6	54.7	63.9	57.9
Quest	56	21.0	90.9	15.2	53.1	54.4	62.5	57.9
Tradition	55	19.8	93.4	15.4	53.1	53.6	67.1	60.9
Celebration	58	18.6	94.6	15.6	52.9	51.7	73.6	62.2
Lacey	59	16.3	95.2	14.0	53.4	45.9	67.2	59.0
Stellar-ND	60	16.1	95.4	14.3	52.4	41.6	62.9	58.2
Two-rowed								0.0
AAC Synergy	55	18.6	95.2	12.5	53.5	67.0	69.5	-
LCS Genie	73	17.1	90.7	14.6	53.9	65.3	71.8	-
ABI Balster	71	17.7	90.8	14.1	53.6	61.3	66.8	-
Sirish	70	17.8	93.5	15.3	54.6	58.7	67.0	-
Pinnacle	57	17.2	90.7	13.2	53.2	57.8	67.9	65.6
ABI Growler	69	17.1	90.9	14.7	52.9	54.9	64.2	-
ND Genesis	60	20.5	90.7	13.2	52.8	54.5	68.1	59.5
Explorer	70	15.9	95.6	13.4	53.5	52.3	-	-
Hockett	70	18.1	92.7	14.4	55.2	49.2	69.8	63.5
Conlon	61	18.9	96.7	14.7	54.7	49.1	57.8	50.5
Mean	63	18.0	93.2	14.3	53.5	54.5	-	-
CV (%)	4.7	8.6	2.7	5.8	1.3	10.7	-	-
LSD (5%)	4.7	2.5	4.2	1.3	1.2	9.6	-	-
LSD (10%)	3.9	2.1	3.5	1.1	1.0	8.0	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Cover Crop.
Planted: 04/25/2018. Harvested: 08/15/2018.
Soil test (0-6"): P=22 ppm; K=350 ppm; pH=5.9; OM=2.6%. Soil type: Williams-Bowbells loam.
(0-24"): NO3-N=53 lb/a.
Applied fertilizers in lb/a: N=36; P_2O_5=26; K_2O=0.
†Protein adjusted to 0% moisture.
‡Test weight reported on a 13.5% moisture basis.
#Yield reported on a 13.5% moisture basis.
*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017.
[1]DAP = Days after planting.
Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.
06/23/2018: Wind speed=46 mph; Precipitation=1.53".
06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.
07/09/2018: Wind speed=48 mph; Precipitation=1.67".

Barley Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9+)	Protein†			Test Weight (lb/bu)	Plump >6/64 %	Yield#		
				2018 (%)	2-Yr Avg (%)	3-Yr Avg (%)			2018 (bu/a)	2-Yr Avg (bu/a)	3-Yr Avg (bu/a)
Six Row											
Tradition	29	53	0	14.6	14.6	14.6	52.7	86	109.2	134.6	117.3
Quest	29	52	1	15.1	14.9	15.0	52.4	86	105.4	130.8	116.8
Lacey	30	51	0	14.5	14.5	14.7	52.8	90	109.2	130.6	116.2
Celebration	30	52	1	16.0	15.4	15.5	51.8	85	118.4	131.1	115.4
Stellar-ND	29	51	0	13.9	14.1	14.3	50.8	89	108.9	125.5	110.6
Innovation	25	52	0	15.1	15.1	14.7	50.6	86	119.7	102.9	-
Two Row											
CDC Meredith	29	58	2	14.6	14.4	14.3	52.0	88	111.3	121.3	117.6
ND Genesis	27	54	0	12.8	13.0	13.0	53.2	93	98.2	114.6	110.1
Pinnacle	30	52	0	13.3	13.1	13.1	54.2	93	100.3	114.5	107.4
Hockett	30	54	2	13.6	14.1	13.9	53.8	86	95.6	114.9	107.2
Conlon	29	49	0	14.5	14.8	15.2	52.5	93	87.4	111.9	102.9
ABI Balster	31	57	1	14.7	14.4	14.4	52.2	86	105.2	131.9	-
AAC Synergy	31	59	1	14.5	14.2	14.2	52.9	92	105.4	125.4	-
LCS Odyssey	24	61	1	13.9	13.4	13.4	51.3	88	105.4	122.7	-
LCS Genie	26	61	1	15.2	14.2	14.2	50.8	76	101.2	122.3	-
ABI Growler	28	55	1	15.3	14.8	14.8	50.7	85	106.4	121.6	-
Sirish	26	61	0	14.2	14.1	14.1	51.9	90	94.2	118.8	-
Explorer	23	57	0	15.1	14.8	14.8	52.1	85	75.3	109.9	-
MEAN	28.2	54.8	0.6	14.50	14.33	14.34	52.15	87.6	103.14	121.40	112.14
C.V. (%)	-	-	-	4.30	-	-	1.03	3.02	13.20	-	-
LSD (5%)	-	-	-	0.74	-	-	0.64	3.14	16.13	-	-
LSD (10%)	-	-	-	0.88	-	-	0.76	3.76	19.33	-	-

* Days after planting + 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 0% moisture

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W Elevation: 1902 ft
Soil test to (0-6"): P=7 ppm; K=153 ppm; pH=7.5; OM=2.1% Previous crop: Soybean
(0-24"): NO3-N= 8 lb/a Planted: 5/2/2018
Yield goal: 120 bu/a Harvested: 8/14/2018
Planting population: 1.25 million seeds/a Soil Type: Lihen Loamy Fine Sand
Applied fertilizer in lb/a broadcast: 257 lbs of 46-0-0 (4/27), and 76 lbs of 46-0-0 (6/4)‡ Plot size: 92 ft^2
Herbicides applied: Axial XL 10.5 oz/a, Starane 10.5 oz/a, and Bison 2 pt/a (5/24/2018) Rainfall: 8.5 in (5/2/2018 - 8/14/2018)
Fungicides applied: Prosaro 421 8 oz/a (7/3/2018) Irrigation: 7.2 in (5/2/2018 - 8/14/2018)
‡ Additional fertilizer applied due to a 2.44 inch rainfall on June 1st

Dryland Intrastate Barley - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Plump >6/64	Thin	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(%)	(%)	(lb/bu)	(%)	(bu/a)
2B11-4949	23.9	176	86.9	11.7	51.9	11.7	66.8
2B11-5166	26.8	171	91.3	7.7	51.8	12.8	80.2
Bow	29.0	177	96.1	3.3	53.4	14.1	73.2
Fraser	26.8	176	93.7	5.8	51.3	13.4	84.3
Genie	23.8	177	83.2	15.0	51.0	13.5	85.4
Hockett	26.2	172	96.7	3.1	55.5	12.5	84.4
MT16M00105	29.0	173	94.5	4.8	51.7	11.6	70.1
MT16M00202	27.4	165	98.4	1.3	55.4	12.9	75.3
MT16M00305	26.2	170	96.3	3.3	52.0	12.6	92.5
MT16M00307	26.5	167	98.5	1.2	53.6	12.9	83.2
MT16M00407	28.1	170	98.3	1.4	53.8	13.4	74.6
MT16M00508	28.7	169	98.6	1.3	52.9	12.8	82.7
MT16M00603	29.0	171	97.7	1.9	52.7	12.6	88.6
MT16M00707	28.9	172	96.8	2.8	54.9	12.7	85.7
MT16M00801	29.5	170	95.9	3.8	54.4	13.2	89.9
MT16M00806	28.9	172	95.9	3.8	53.5	12.0	81.5
MT16M01106	29.8	170	98.1	1.7	55.2	12.5	94.0
MT16M01204	26.2	165	98.0	1.6	54.0	12.8	76.2
MT16M01409	31.2	168	98.8	1.0	54.6	13.3	96.8
MT16M01701	26.8	170	94.9	4.5	52.5	13.1	80.6
MT16M01705	24.8	164	95.5	4.0	53.2	11.4	68.0
MT16M01709	24.5	172	97.4	2.3	52.0	13.8	71.1
MT16M01801	28.6	174	97.2	2.3	53.6	12.1	94.6
MT16M01804	27.0	170	97.5	2.1	53.4	13.5	91.1
MT16M01805	28.2	172	97.0	2.6	52.8	12.3	90.2
MT16M01809	30.1	170	93.5	5.5	53.7	12.1	81.9
MT16M01812	29.3	166	97.6	2.0	54.3	13.1	75.5
MT16M01901	27.0	169	97.5	2.1	54.6	11.6	89.1
MT16M01903	29.8	170	96.6	2.8	54.4	12.4	84.7
MT16M01904	30.2	169	97.7	2.0	53.8	12.5	90.8
MT16M02004	29.7	171	97.0	2.5	53.7	11.9	95.2
MT16M02106	30.6	167	92.0	7.0	52.2	11.6	90.6
MT16M02107	26.2	171	96.7	2.8	54.6	13.0	76.5
MT16M02204	25.1	171	96.2	3.0	54.7	11.7	81.2
MT16M05909	28.5	169	94.0	5.4	55.8	13.6	78.5
MT16M06110	26.1	171	95.6	3.9	54.6	11.4	60.4
MT16M06402	26.2	174	95.3	4.4	54.1	13.1	86.5
MT16M06404	28.7	172	95.5	4.1	54.8	12.8	74.3
MT16M06409	29.3	174	94.2	5.4	54.7	13.8	80.8
MT16M07108	29.1	170	97.3	2.3	55.7	14.2	91.1
MT16M07706	27.6	172	93.4	5.9	52.3	12.3	80.4
MT16M07806	24.8	173	96.5	3.1	55.6	13.0	73.2

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Dryland Intrastate Barley - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height (in)	Days to Heading (julian*)	Plump >6/64 (%)	Thin (%)	Test Weight † (lb/bu)	Protein (%)	Grain Yield † (bu/a)
MT16M08502	26.8	172	94.1	5.0	55.0	11.8	84.8
MT16M08601	26.2	168	91.8	7.2	54.4	12.9	87.7
MT16M08808	28.5	170	97.1	2.6	54.2	12.1	90.7
Merit 57	27.3	175	88.1	10.6	51.2	12.4	77.5
Metcalfe	25.9	171	93.9	5.5	54.6	14.4	61.9
Odyssey	23.5	178	93.8	5.1	52.0	11.0	79.9
Synergy	29.1	172	95.8	3.8	53.5	13.3	88.3
Mean	27.6	171.0	95.4	4.0	53.7	12.7	82.1
P-value	0.0002	<0.001	<0.001	<0.001	<0.001	0.0002	0.0108
CV (%)	7.8	0.9	2.4	49.8	1.8	7.1	13.9
LSD	3.5	2.6	3.8	3.3	1.5	1.5	18.4

Soil Test N Avail (lb/ac): 44.5
Planted: 4/26/2018
Soil Test P2O5 (lb/ac): 30
Harvested: 8/16/2018
N added (lb/ac): 73.4
Previous crop: Fallow
(julian*) is a continuous count of days since Janu
Soil Type: Williams Clay Loam
†Test Weight and Grain Yield adjusted to 12.0% moisture basis
Plot Width (ft): 5'
Precip 2018: 14.19"

Dr. Jamie Sherman, Barley Breeder at MSU-Bozeman, presenting "Improving Barley for Montana" at the MSU-EARC/Extension Annual Field Day held July 17, 2018.

Irrigated Intrastate Barley - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Plump >6/64	Thin	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(%)	(%)	(lb/bu)	(%)	(bu/a)
2B11-4949	31.4	178	84.0	13.7	52.1	12.6	120.0
2B11-5166	31.0	177	80.4	17.2	50.4	12.6	118.0
BOW	35.0	183	96.6	3.0	53.0	13.0	125.9
Fraser	35.6	181	85.3	4.0	51.8	12.8	127.9
Genie	29.7	183	90.7	8.2	52.2	12.4	122.2
Hockett	30.6	177	85.7	11.5	52.2	12.3	115.4
MT16M00105	35.0	178	92.5	6.4	51.7	12.0	109.3
MT16M00202	33.7	171	96.4	3.1	53.4	13.2.	96.0
MT16M00305	33.2	172	95.0	4.3	51.3	12.7	123.8
MT16M00307	32.7	171	96.6	2.7	51.9	13.2	100.7
MT16M00407	32.9	175	95.3	3.9	52.4	12.9	119.9
MT16M00508	34.1	173	96.0	3.5	52.2	13.5	116.7
MT16M00603	31.9	177	94.9	4.3	51.7	12.8	111.3
MT16M00707	35.4	178	94.3	5.0	53.5	12.4	107.7
MT16M00801	32.7	172	93.7	5.6	53.1	13.5	129.6
MT16M00806	36.0	177	94.0	5.3	52.6	13.0	130.1
MT16M01106	31.2	177	94.3	5.1	53.6	11.8	124.5
MT16M01204	28.9	171	96.5	3.0	52.8	11.9	102.5
MT16M01409	35.4	174	97.6	2.0	53.1	12.3	127.3
MT16M01701	31.4	174	91.3	6.9	52.2	12.5	128.6
MT16M01705	31.6	170	94.5	4.5	53.1	12.3	107.7
MT16M01709	30.2	178	95.0	4.6	51.3	13.3	111.2
MT16M01801	32.5	178	93.6	5.4	52.7	11.9	135.4
MT16M01804	31.1	177	96.0	3.5	52.7	13.3	134.1
MT16M01805	32.7	176	94.3	4.8	52.2	12.1	125.9
MT16M01809	34.0	177	90.3	8.1	52.6	12.2	123.7
MT16M01812	33.1	171	93.6	5.4	52.3	12.6	112.5
MT16M01901	32.5	178	66.7	4.3	53.2	11.9	114.4
MT16M01903	34.3	171	94.6	4.4	53.4	11.7	123.1
MT16M01904	32.1	175	91.0	8.1	52.4	12.7	81.7
MT16M02004	32.1	177	95.5	3.8	53.5	11.9	140.6
MT16M02106	35.6	177	92.3	6.7	50.9	11.7	118.9
MT16M02107	32.0	173	91.2	7.4	53.3	13.1	127.0
MT16M02204	32.7	177	93.6	5.2	53.6	11.5	121.6
MT16M05909	35.0	172	92.1	6.8	55.5	14.0	110.0
MT16M06110	32.7	176	91.7	7.1	53.2	11.4	101.7
MT16M06402	32.5	178	90.3	8.7	53.7	13.4	126.2
MT16M06404	34.0	178	91.0	7.8	53.4	13.2	109.7
MT16M06409	36.0	178	91.9	6.9	54.2	14.1	98.6
MT16M07108	36.5	175	96.4	3.2	54.4	13.9	130.5
MT16M07706	30.3	178	94.5	4.7	53.6	13.0	129.0
MT16M07806	33.3	179	94.3	4.9	54.1	12.3	117.5

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Irrigated Intrastate Barley - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height (in)	Days to Heading (julian*)	Plump >6/64 (%)	Thin (%)	Test Weight † (lb/bu)	Protein (%)	Grain Yield † (bu/a)
MT16M08502	33.5	177	94.2	4.6	54.5	12.9	134.8
MT16M08601	31.6	172	87.8	10.1	53.0	13.1	114.8
MT16M08808	33.7	172	93.5	5.7	52.8	12.7	105.5
Merit 57	34.4	179	83.4	14.4	51.3	13.3	130.6
Metcalfe	35.7	181	92.7	6.8	53.6	13.4	113.9
Odyssey	30.2	183	95.2	4.3	51.5	12.1	132.3
Synergy	36.6	179	93.7	5.5	52.9	12.8	133.1
Mean	33.1	176.1	92.2	6.0	52.8	12.7	118.8
P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.7	0.7	2.7	35.0	1.2	3.7	8.7
LSD	2.5	1.9	4.1	3.4	1.0	0.8	16.8

Soil test N avail (lb/ac): 21.8 Previous crop: Sugarbeet

Soil Test P2O5 (ppm): 15 Planted: 5/3/2018

N added (lb/ac): 104.2 Harvested: 8/17/2018

P2O5 added (lb/ac): 29.5 Soil Type: Savage Silty Clay

(julian*) is a continuous count of days since January 1. Plot width (ft): 5'

†Test Weight and Grain Yield adjusted to 12.0% moisture basis Precip 2018: 14.19"

^0: no lodging - 9: plants lying flat on ground Irrigation (sprinkler): 2.68"

Attendees ride trailers to each stop at the 38th Annual MSU-EARC/Extension Field Day tour held July 17, 2018. Lunch was served after the tour.

Irrigated Hulless Barley - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)
09WA-265.12	36.6	183	62.7	14.8	85.1
Havener	34.0	184	62.3	14.7	78.6
MT16H09204	34.0	178	59.2	14.6	85.5
MT16H09205	33.2	179	61.6	14.6	65.1
MT16H09206	32.0	183	60.1	14.8	56.2
MT16H09208	32.3	178	60.1	13.5	50.0
MT16H09210	34.0	177	58.2	13.5	88.6
MT16H09302	33.5	177	60.2	13.8	89.0
MT16H09303	31.6	177	60.2	13.8	37.1
MT16H09304	30.3	176	60.2	13.6	58.7
MT16H09306	31.8	177	58.6	14.4	61.0
MT16H09308	31.6	177	62.1	13.5	44.3
MT16H09407	34.6	180	57.6	17.0	66.6
MT16H09409	35.6	177	56.4	17.0	57.3
MT16H21503	28.6	184	62.9	15.7	37.3
MT16H22201	30.8	176	61.4	14.2	82.8
Mean	32.8	178.9	60.2	14.6	65.2
P-value	0.0011	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	5.7	0.8	2.0	3.4	17.3
LSD	3.1	2.3	2.0	0.8	18.8

Soil test N avail (lb/a): 38.6 Previous crop: Sugarbeet

N added (lb/a): 104.2 Planted: 05/03/18

P2O5 added (lb/ac\): 29.5 Harvested: 8/24/2018

Plot width (ft): 5' Soil Type: Savage Silty Clay

(julian*) is a continuous count of days since January 1.

† Test Weight and Grain Yield adjusted to 12.0% moisture basis

^0: no lodging - 9: plants lying flat on ground

"I believe in the future of agriculture with a faith born not of words but of deeds."
E.M. Tiffany

Dryland Recrop Barley - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Plump >6/64	Thin	Test Weight †	Protein	Grain Yield †
	(in)	(julian*)	(%)	(%)	(lb/bu)	(%)	(bu/a)
Accordine	23.1	178	94.4	5.2	53.0	14.5	68.7
Balster	23.6	181	94.0	5.4	52.6	14.4	76.0
Bill Coors 100	21.9	181	96.6	3.0	53.6	15.4	78.3
Bow	26.2	181	96.5	3.0	53.9	14.3	68.0
Champion	26.6	177	93.3	6.0	54.4	14.2	84.0
Conrad	22.4	181	93.9	5.6	52.8	15.4	73.0
Copeland	24.1	178	84.7	4.8	53.0	14.4	72.7
Esma	22.0	176	91.0	7.8	52.8	14.8	76.7
Fraser	24.0	179	92.8	6.6	51.6	14.3	75.0
Genie	20.3	178	85.0	13.6	54.4	14.2	80.5
Growler	24.5	181	90.9	8.2	51.7	15.6	64.1
Haxby	23.9	178	93.8	5.5	56.0	14.3	80.1
Haybet	28.9	177	64.6	32.6	51.5	15.3	62.9
Hays	22.4	179	81.4	16.8	51.1	15.1	78.7
Hockett	20.2	181	95.3	4.1	54.8	14.4	59.8
Lavina	25.6	177	81.1	17.4	51.3	15.0	76.0
MT124069	24.5	179	91.8	7.1	53.5	13.6	68.9
MT124071	23.5	182	89.6	9.1	51.7	14.0	71.5
MT124112	23.1	178	97.4	2.2	54.8	12.6	74.2
MT124134	23.4	176	97.8	2.0	55.6	12.2	67.4
Merit 57	26.0	178	87.4	11.3	51.3	15.7	60.7
Metcalfe	23.9	179	94.3	5.0	54.2	15.8	59.8
Moravian 165	22.3	177	94.0	5.2	53.9	15.4	75.5
Odyssey	22.3	183	96.5	3.0	53.1	14.1	92.8
Synergy	24.0	181	95.0	4.4	54.0	14.4	73.1
Mean	23.7	179.0	90.9	7.8	53.2	14.5	72.7
P-value	0.0310	0.0006	<0.0001	<0.0001	<0.0001	0.0004	0.0174
CV (%)	10.3	1.1	2.1	23.0	1.2	6.0	13.2
LSD	4.0	3.2	3.2	2.9	1.0	1.4	15.7

Soil test N avail (lb/ac): 28.3 Previous crop: Wheat

Soil Test P2O5 (lb/ac): 14 Planted: 4/27/2018

N added (lb/ac):73.4 Harvested: 8/15/2018

P2O5 added (lb/ac): 20.8 Soil Type: Williams Clay Loam

(julian*) is a continuous count of days since January 1. Precip 2018: 14.19"

† Test Weight and Grain Yield adjusted to 12.0% moisture basis. Plot width (ft): 5'

^0: no lodging - 9: plants lying flat on ground

Dryland Forage Barley - MSU **EARC, Sidney, MT 2018**

Variety	Plant Height	Days to Heading	Test Weight †	Protein	Grain Yield †	Forage Yld
	(in)	(julian*)	(lb/bu)	(%)	(bu/a)	(ton/a)
HAYES	29.5	182	49.7	13.1	73.2	3.1
LAVINA	30.7	181	49.4	13.5	76.1	3.2
MT16F01601	32.1	179	49.9	12.6	83.9	3.4
MT16F01602	32.1	179	47.9	13.3	68.2	3.9
MT16F01603	29.9	179	47.8	14.3	57.6	2.5
MT16F01604	34.1	181	49.2	14.2	68.4	3.3
MT16F02401	31.0	181	47.3	11.8	70.8	2.8
MT16F02406	31.2	182	51.1	12.0	70.0	2.9
MT16F02408	32.0	179	50.6	13.9	66.2	2.7
MT16F02410	31.1	180	50.0	13.1	78.2	2.7
MT16F02901	35.0	179	49.4	12.9	75.0	2.6
MT16F02902	33.2	182	49.7	12.9	71.5	3.1
MT16F02903	33.5	179	50.3	12.9	70.3	3.1
MT16F02906	33.1	179	50.5	14.3	67.5	3.0
MT16F02908	36.2	179	50.3	14.7	54.8	2.8
MT16F02910	33.2	179	47.1	13.3	66.3	3.0
Mean	32.4	179.9	49.4	13.3	69.9	3.0
P-value	0.0097	0.1501	<0.0001	0.0002	0.0345	0.7301
CV (%)	6.0	0.9	1.2	5.2	12.1	23.6
LSD	3.2	2.7	1.0	1.1	14.0	1.2

Soil test N avail (lb/ac): 30 Previous crop: Fallow

Soil Test P2O5 (lb/ac): 20 Planted: 5/7/2018

N added (lb/ac): 43.6 Harvested: 8/14/2018

P2O5 added (lb/ac): 10.4 Precip 2018: 14.19"

(julian*) is a continuous count of days since January 1. Plot width (ft): 5'

† Test Weight and Grain Yield adjusted to 12.0% moisture basis.

^0: no lodging - 9: plants lying flat on ground

"Farming is not just a job, it's a way of life."

OAT VARIETY DESCRIPTIONS

VARIETY	ORIGIN[1]	YEAR RELEASED	GRAIN COLOR	HEIGHT	MATURITY	RESISTANCE TO[2]				QUALITY FACTORS	
						LODGING	STEM RUST	CROWN RUST	BARLEY YELLOW DWARF	TEST WEIGHT	GRAIN PROTEIN
AC PINNACLE	CANADA	1999	WHITE	TALL	LATE	MS	R	R	S	MEDIUM	LOW
BEACH	NDSU	2004	WHITE	TALL	M LATE	MR	S	MR/MS	MS	MEDIUM	M HIGH
CDC DANCER	CANADA	2000	WHITE	TALL	LATE	MR	S	MS	S	HIGH	MEDIUM
CDC MINSTREL	CANADA	2006	WHITE	TALL	LATE	MR	S	S	S	M HIGH	MEDIUM
CS CAMDEN	CANTERRA	2016	WHITE	MEDIUM	MED	R	S	MS	NA	NA	NA
DEON	MN	2013	YELLOW	TALL	LATE	R	S	R	T	V HIGH	NA
HAYDEN	SDSU	2014	WHITE	MEDIUM	MED	M	S	MR/MS	MR	M HIGH	MEDIUM
HIFI	NDSU	2001	WHITE	TALL	LATE	MR	MR	R	T	M HIGH	MEDIUM
HYTEST	SDSU	1986	WHITE	TALL	EARLY	MS	S	MS	S	V HIGH	HIGH
JURY	NDSU	2012	WHITE	TALL	LATE	MS	R	R	MR	M HIGH	MEDIUM
KILLDEER	NDSU	2000	WHITE	MED	MED	MR	S	MS	MR	M HIGH	MEDIUM
LEGGETT	CANADA	2005	WHITE	TALL	LATE	MR	MR	R	S	MEDIUM	MEDIUM
NEWBURG	NDSU	2011	WHITE	TALL	LATE	MS	R	R	MR	MEDIUM	MEDIUM
OTANA	MT	1977	WHITE	TALL	LATE	S	S	S	S	HIGH	MEDIUM
PAUL	NDSU	1994	HULLESS	V TALL	LATE	MS	R	MR	T	V HIGH	HIGH
ROCKFORD	NDSU	2008	WHITE	TALL	LATE	R	S	R	MR	M HIGH	MEDIUM
SOURIS	NDSU	2006	WHITE	MED	MED	R	MS	R	MS	HIGH	MEDIUM
STALLION	SDSU	2006	WHITE	TALL	LATE	M	S	MR	NA	HIGH	MEDIUM

[1]Refers to developer: CANADA represents developers from that country; MN = Minnesota; MT = Montana State University; NDSU = North Dakota State University; SDSU = South Dakota State University.
[2]M = Intermediate; MR = Moderately resistant; MS = Moderately susceptible; NA = Not available; R = Resistant; S = Susceptible; T = Tolerant; VS = Very susceptible.

Flax Variety Descriptions

Variety[1]	ORIGIN[2]	YEAR RELEASED	RELATIVE MATURITY[3]	SEED COLOR	PLANT HEIGHT[3]	RESISTANCE TO WILT[4]
Bison	NDSU	1926	MEDIUM	BROWN	MEDIUM	MR
Carter	NDSU	2004	MEDIUM	YELLOW	MEDIUM	MR
CDC Bethume	Canada	1999	M LATE	BROWN	M TALL	MR
CDC Glas	Canada	2012	M LATE	BROWN	M TALL	MR
CDC Melyn	Canada	2016	M LATE	YELLOW	MEDIUM	MR
CDC Neela	Canada	2013	M LATE	BROWN	MEDIUM	MR
CDC Plava	Canada	2015	MEDIUM	BROWN	MEDIUM	MR
CDC Sanctuary	Canada	2012	MEDIUM	BROWN	M TALL	MR
CDC Sorrel	Canada	2007	M LATE	BROWN	M TALL	MR
Gold ND	NDSU	2014	MEDIUM	YELLOW	M TALL	MR/R
ND Hammond	NDSU	2018	NA	BROWN	NA	MS
Nekoma	NDSU	2002	LATE	BROWN	MEDIUM	MR
Omega	NDSU	1989	MEDIUM	YELLOW	MEDIUM	MS
Pembina		1998	MEDIUM	BROWN	MEDIUM	MR
Prairie Blue	Canada	2003	M LATE	BROWN	MEDIUM	NA
Prairie Grande	Canada	2008	M EARLY	BROWN	MEDIUM	MR
Prairie Sapphire	Canada	2012	MEDIUM	BROWN	MEDIUM	MR
Prairie Thunder	Canada	2006	MEDIUM	BROWN	SHORT	NA
Rahab 94	SDSU	1994	MEDIUM	BROWN	MEDIUM	MR
Shape	Canada	2010	MEDIUM	BROWN	MEDIUM	R
Webster		1998	LATE	BROWN	TALL	MR
York	NDSU	2002	LATE	BROWN	MEDIUM	R

[1]All varieties have resistance to prevalent races of rust; all have good yield and oil quality.

[2]Refers to developer: CANADA represents developers from that country; NDSU = North Dakota State University; SD = South Dakota State University.

[3]M = Medium. [4]MR = Moderately resistant; MS = Moderately susceptible; NA = Data not available; R = Resistant; S = Susceptible.

Oat Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Days to heading	Plant height	Test weight‡	Yield#		
				2018	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(in)	(lb/bu)	----------(bu/a)----------		
Jury	55	32	43.5	87.2	73.8	70.2
Newburg	52	32	43.0	85.4	74.7	70.4
Stallion	53	31	43.4	84.0	71.2	59.9
AC Pinnacle	55	31	43.8	83.7	88.1	79.8
Beach	53	31	44.3	83.4	71.2	65.0
Leggett	54	30	43.1	82.7	83.7	76.0
CDC Dancer	53	34	43.7	82.0	83.7	79.8
Deon	54	33	42.4	80.6	76.6	73.4
Otana	56	34	42.3	79.9	77.4	72.3
Killdeer	50	31	43.2	78.3	89.7	81.6
HiFi	55	30	43.5	78.3	77.0	71.2
CS Camden	53	30	40.9	77.4	-	-
CDC Minstrel	51	33	42.5	75.2	85.1	-
Souris	55	33	42.1	72.6	79.1	73.7
Hayden	51	30	43.7	72.0	-	-
Rockford	52	32	42.7	71.5	81.6	72.7
Hytest	50	32	43.5	57.9	63.4	60.0
Paul***	57	29	50.9	55.3	52.7	55.3
Mean	53	31	43.9	74.9	-	-
CV (%)	2.4	8	1.4	11.6	-	-
LSD (5%)	2.1	4	1.0	14.1	-	-
LSD (10%)	1.7	3	0.8	11.8	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Cover Crop.

Planted: 05/03/2018. Harvested: 08/02/2018.

Soil test (0-6"): P=18 ppm; K=312 ppm; pH=5.7; OM=2.6%. Soil type: Williams-Bowbells loam.

(0-24"): NO3-N=39 lb/a.

Applied fertilizers in lb/a: N=42; P_2O_5=18; K_2O=5.

‡Test Weight = Reported on a 13.5% moisture basis. #Yield = Reported on a 13.5% moisture basis.

*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017.

[1]DAP = Days after planting.

***Hull-less variety. When comparing yield of hull-less oat varities and varieties with hulls, multiply the yield of the hull-less oats by 1.35 (the hull of a hulled kernel is 35 percent of the weight).

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.

06/23/2018: Wind speed=46 mph; Precipitation=1.53".

06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.

07/09/2018: Wind speed=48 mph; Precipitation=1.67".

Oats Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9⁺)	Test Weight (lb/bu)	Yield 2018 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
Deon (MN)	38	60	4	45.6	223.3	168.0	181.2
Hayden	39	56	4	46.5	189.3	155.8	166.8
Jury (ND030349)	37	61	6	45.9	186.4	147.1	163.8
Souris	37	56	2	45.9	170.7	142.9	160.2
Rockford	38	59	5	44.7	170.5	141.2	156.6
AC Pinnacle	39	55	7	45.5	150.8	130.4	156.5
Leggett	37	61	7	45.4	157.3	133.4	153.4
Beach	44	56	5	45.7	172.6	142.0	153.1
HiFi	37	60	7	45.7	164.6	135.6	149.7
Goliath	40	59	6	45.9	165.0	130.1	147.3
Otana	39	60	7	43.6	128.0	114.9	142.7
Killdeer	35	56	4	44.7	192.3	151.5	-
Furlong	40	61	3	45.2	170.8	147.5	-
Hytest	38	55	4	46.5	142.0	116.8	-
Summit	35	59	2	45.6	220.1	-	-
CS Camden	38	59	2	44.1	188.8	-	-
MEAN	38.1	58.3	4.6	45.41	174.54	139.79	157.38
C.V. (%)	-	-	-	1.19	19.33	-	-
LSD (5%)	-	-	-	0.77	48.06	-	-
LSD (10%)	-	-	-	0.64	40.07	-	-

* Days after planting ⁺ 0: no lodging - 9: plants lying flat on the ground

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft

Soil test to (0-6"): P=7 ppm; K=153 ppm; pH=7.5; OM=2.1% — Previous crop: Soybean

(0-24"): NO3-N= 8 lb/a — Planted: 5/2/2018

Yield goal: 120 bu/a — Harvested: 8/15/2018

Planting population: 1.25 million seeds/a — Soil Type: Lihen Loamy Fine Sand

Applied fertilizer in lb/a broadcast: 417 lbs of 46-0-0 (4/27/2018), and 76 lbs pf 46-0-0 (6/4/2018)‡ — Plot size: 92 ft^2

Herbicides applied: Axial XL 10.5 oz/a, Starane 10.5 oz/a, and Bison 2 pt/a (5/24/2018) — Rainfall: 8.5 in (5/4/2018 - 8/16/2018)

Fungicides applied: Prosaro 421 8 oz/a (7/3/2018) — Irrigation: 7.2 in (5/2/2018 - 8/15/2018)

‡ Additional fertilizer applied due to a 2.44 inch rainfall on June 1st

"It's not about how bad you want it...it's about how hard you are willing to work for it."

Flax Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Days to Flowering	Days to Maturity	Plant height	Oil†	Yield	
					2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(DAP[1])	(in)	(%)	-----(bu/a)-----	
Brown Seeded						
Bison	49	82	24.9	42.6	16.4	19.6
CDC Bethune	48	83	26.6	42.3	16.3	20.1
CDC Glas	51	83	23.1	42.9	17.5	21.8
CDC Neela	48	81	22.2	42.3	18.2	22.6
CDC Sanctuary	48	83	23.2	42.1	19.4	22.3
CDC Sorrel	51	83	24.8	42.5	17.6	21.6
ND Hammond	48	84	23.2	41.0	-	-
Nekoma	50	82	23.4	42.7	16.6	20.2
Pembina	49	82	24.5	42.3	16.1	20.0
Prairie Blue	50	84	25.1	42.2	17.3	21.0
Prairie Sapphire	50	82	24.0	43.6	17.3	20.5
Prairie Thunder	49	85	23.8	41.8	17.2	20.6
Rahab 94	50	85	24.7	41.2	16.4	20.1
Webster	51	85	23.8	42.1	16.8	20.3
York	48	83	23.4	41.7	15.3	19.1
Yellow Seeded						
Carter	46	83	23.0	42.4	16.1	20.8
Gold ND	49	81	26.1	42.8	17.0	21.3
Omega	46	81	23.8	41.6	14.2	18.6
Mean	49	83	23.8	42.3	-	-
CV (%)	2.3	2.6	9.9	1.0	-	-
LSD (5%)	1.8	NS	NS	0.7	-	-
LSD (10%)	1.5	NS	NS	0.6	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft

Planted: 05/08/2018 Previous crop: Spring Wheat

Soil test (0-6"): P=43 ppm; K=332 ppm; pH=6.3; OM=2.0% Harvested: 08/20/2018

(0-24"): NO3-N=35 lb/a Soil type: Williams-Bowbells loam

Applied fertilizers in lb/a: N=42; P_2O_5=18.2; K_2O=4.6; S=0.5

DAP[1]=Days After Planting

Oil†=Adjusted to a 9% moisture

*Average of years 2016 and 2017. **Average of year 2015, 2016, and 2017

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield. Therefore, this year's yield has not been reported.

23-Jun-18 Wind speed=46 mph; Precipitation=1.53".

28-Jun-18 Wind speed=61 mph; Precipitation=0.94"; Hail.

9-Jul-18 Wind speed=48 mph; Precipitation=1.67".

Flax Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Days to Flower (DAP+)	Days to Maturity (DAP+)	Plant Lodge (0 - 9*)	Plant Height (inch)	Oil†			Test Weight (lb/bu)	Yield		
					2018 (%)	2-Yr Avg (%)	3-Yr Avg (%)		2018 (bu/a)	2-Yr Avg (bu/a)	3-Yr Avg (bu/a)
CDC Glas	63	93	1	26	38.5	39.6	37.9	53.6	23.7	30.7	39.3
Bison	61	96	1	26	38.2	39.3	37.8	54.3	21.7	30.3	38.5
Gold ND	62	97	1	25	38.0	39.3	37.4	54.7	22.2	30.3	38.5
York	58	92	3	26	37.7	38.9	37.0	54.3	23.0	29.8	38.1
Prairie Blue	62	96	1	26	38.6	39.3	37.6	54.0	20.5	28.6	37.1
CDC Sorrel	62	94	2	27	38.8	39.4	37.6	53.9	21.2	27.5	36.4
CDC Sanctuary	61	96	3	26	37.6	38.8	-	53.3	23.0	30.4	-
ND Hammond	61	96	1	26	37.5	-	-	53.9	23.3	-	-
Pembina	60	96	1	26	38.5	-	-	54.2	23.2	-	-
Rahab 94	61	94	2	25	37.9	-	-	53.9	22.8	-	-
Prairie Thunder	64	96	1	27	37.2	-	-	54.5	19.6	-	-
MEAN	61.4	95.0	1.5	26.2	38.06	39.23	37.56	54.03	22.31	29.64	37.99
C.V. (%)	-	-	-	-	0.70	-	-	0.54	21.08	-	-
LSD (5%)	-	-	-	-	0.53	-	-	0.42	ns	-	-
LSD (10%)	-	-	-	-	0.44	-	-	0.35	ns	-	-

+ Days after planting * 0: no lodging - 9: plants lying flat on the ground † Oil content adjusted to 9% moisture

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W Elevation: 1902 ft

Soil test to (0-6"): P=30 ppm; K=188 ppm; pH=7.7; OM=2.3% Previous crop: Durum

(0-24"): NO3-N= 95 lb/a Planted: 5/8/2018

Applied fertilizer in lb/a broadcast: 69 lbs of 46-0-0 (5/1/2018) Harvested: 8/23/2018

Yield goal: 50 bu/a Soil Type: Lihen Loamy Fine Sand

Planting population: 52 lbs/a Plot size: 48.75 ft^2

Herbicides applied: Section 3 8 oz/a (6/4/2018), Bison 1 pt/a (6/6/2018), and Section 3 8 oz/a (6/20/2018) Rainfall: 8.5 in (5/8/2018 - 8/23/2018)

Irrigation: 8.4 in (5/8/2018 - 8/23/2018)

Fungicides applied: Headline 12 oz/a (7/3/2018)

Safflower Variety Descriptions

Variety	Origin[1]	PVP[2]	Hull Type[3]	Oil Type[4]	Irrigated Yield[5]	Dryland Yield[5]	TWT[5]	Oil[5]	Maturity	Tolerance[6]	
										Alt	BB
Baldy	MT	YES	N	HIGH LINO	GOOD	GOOD	V HIGH	LOW	MED	NA	NA
Cardinal	MT/NDSU	YES	N	HIGH LINO	V GOOD	V GOOD	HIGH	FAIR	MED	T	MT
Finch	MT/NDSU	NO	N	HIGH LINO	GOOD	V GOOD	V HIGH	FAIR	M EARLY	MS	T
Hybrid 200	STI	YES	N	HIGH OLEIC	V GOOD	V GOOD	V HIGH	FAIR	MED	MT	NA
Hybrid 300	STI	YES	N	HIGH OLEIC	V GOOD	V GOOD	V HIGH	FAIR	MED	MT	NA
Hybrid 446	STI	YES	N	HIGH OLEIC	V GOOD	V GOOD	V HIGH	FAIR	MED	MT	NA
Hybrid 528	STI	YES	STP	HIGH OLEIC	GOOD	GOOD	M HIGH	GOOD	MED	MT	NA
Hybrid 621	STI	YES	STP	HIGH OLEIC	GOOD	GOOD	M HIGH	GOOD	MED	MT	NA
Hybrid 1601	STI	YES	STP	HIGH OLEIC	V GOOD	V GOOD	MED	GOOD	M LATE	MT	MT
Hybrid 9049	STI	YES	N	HIGH OLEIC	V GOOD	V GOOD	V HIGH	FAIR	MED	MT	MT
MonDak	MT/NDSU	YES	N	HIGH OLEIC	GOOD	V GOOD	HIGH	FAIR	M EARLY	T	MT
Montola 2000	MT/NDSU	YES	N	HIGH OLEIC	M GOOD	GOOD	MED	GOOD	EARLY	MS	MS
Montola 2001	MT/NDSU	YES	STP	HIGH OLEIC	GOOD	FAIR	MED	GOOD	MED	MT	MT
Montola 2003	MT/NDSU	YES	N	HIGH OLEIC	V GOOD	V GOOD	M HIGH	GOOD	M EARLY	MT	MT
Montola 2004	MT/NDSU	YES	N	HIGH OLEIC	GOOD	GOOD	M HIGH	GOOD	M EARLY	MS	MT
Morlin	MT/NDSU	YES	STP	HIGH LINO	V GOOD	GOOD	MED	GOOD	M LATE	T	T
Nutrasaff	MT/NDSU	YES	RED	HIGH LINO	GOOD	GOOD	MED	HIGH	MED	T	MT
Rubis Red	MT	YES	N	HIGH LINO	GOOD	GOOD	V HIGH	LOW	MED	NA	NA
STI 1201	STI	YES	STP	HIGH OLEIC	GOOD	GOOD	M HIGH	GOOD	MED	MT	NA
STI 1401	STI	YES	STP	HIGH OLEIC	GOOD	GOOD	M HIGH	HIGH	MED	MT	NA

[1]Refers to developer: MT = Montana State University; NDSU = North Dakota State University; STI = Safflower Technologies International.

[2]PVP = Plant Variety Protection. "YES" indicates that the variety is protected, and the seed may be sold for planting purposes only as a class of certified seed (Title V option) and/or exclusive licensed variety.

[3]N = Normal; RED = Reduced; STP = Striped.

[4]Lino = Linoleic.

[5]Relative ratings of yield, test weight, and oil will vary under conditions of moderate-severe disease infestation.

[6]Alt = Alternaria leaf spot disease; BB = Bacterial blight; MS = Moderately susceptible; MT = Moderately tolerant; S = Susceptible; T = Tolerant. NA = Not Available

Safflower Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Plant Height	Oil	Test Weight	Yield		
				2018	2-yr avg*	3-yr avg**
	(in)	(%)	(lb/bu)	----------(lb/a)----------		
Montola 2003	12.7	36.5	41.6	1361.3	1384.0	1577.0
Cardinal	15.7	35.3	43.1	1241.0	1766.1	1809.0
Montola 2001	16.7	36.9	37.6	1232.3	1254.3	-
Chickadee	14.3	36.6	42.1	1136.3	-	-
Nutrasaff	20.3	46.4	36.4	1095.0	887.6	1098.2
Baldy	16.3	27.5	44.5	1045.7	1222.4	-
Morlin	15.3	39.0	39.6	988.7	1319.0	1505.0
Rubis Red	12.7	27.9	45.1	959.3	1448.4	-
Finch	16.0	35.5	42.7	925.7	1189.5	1310.2
MonDak	13.7	34.3	41.6	913.7	1569.2	1773.8
STI 1201	14.0	42.0	36.9	885.0	1114.9	1286.6
Mean	15.2	36.2	41.0	1071.3	-	-
CV	7.1	1.4	2.5	16.9	-	-
LSD 0.05	1.8	0.9	1.8	307.7	-	-
LSD 0.1	1.5	0.7	1.5	254.4	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Spring Wheat

Planted: 05/08/2018. Harvested: 09/14/2018.

Soil test (0-6"): P=43 ppm; K=332 ppm; pH=6.3; OM=2.0%. Soil type: Williams-Bowbells loam.

(0-24"): NO3-N=35 lb/a.

Applied fertilizers in lb/a: N=77; P_2O_5=18; K_2O=4.5; S=0.5.

*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017.

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.

06/23/2018: Wind speed=46 mph; Precipitation=1.53".

06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.

07/09/2018: Wind speed=48 mph; Precipitation=1.67".

"To everything there is a season and a time to every purpose under the heaven...a time to be born & a time to die; a time to plant and a time to pluck up that which is planted."

Safflower Golden Valley Dryland Variety Trial - NDSU **Golden Valley County, ND 2018**

Variety	Oil Type[1]	Oil[2]	Test Weight	Yield
		(%)	(lb/bu)	(lb/a)
Cardinal	LL	36.5	45.2	1232.5
Finch	LL	36.9	44.8	989.4
Hybrid 300	LO	33.6	44.4	1283.9
Hybrid 200	LO	32.2	44.5	1122.9
Hybrid 446	LO	31.9	45.0	1193.7
Hybrid 1601	LO	36.4	42.2	1859.9
STI 1401	HO	45.8	35.1	1124.8
MonDak	LO	36.2	41.8	1057.8
Montola 2003	LO	38.7	40.6	1229.2
NutraSaff	HL	46.5	37.7	1108.8
Mean		37.5	42.1	1220.3
CV		1.5	0.8	6.7
LSD 5%		1.0	0.6	139.5
LSD 10%		0.8	0.5	115.1

Location: Beach, ND; Latitude 46° 50' N; Longitude 103° 59' W; Elevation 2890 ft. Soil type: Grail-Grassna complex.

Planted: 06/01/2018. Harvested: 10/02/2018.

[1]Oil Type: LL=Low Linoleic; LO=Low Oleic; HO= High Oleic; HL= High Linoleic.

[2]Oil contents are reported on an oven-dried basis, 120 °F for 4 hours.

Dryland Sunflower Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Brand/Company	Hybrid Type	Oil Type	Days to Flower	Days to Mature	Plant height	Oil[1]	Test weight	Yield	
									2-Yr Avg*	3-Yr Avg**
				(DAP[2])	(DAP[2])	(in)	(%)	(lb/bu)	----(lb/a)----	
Proseed E-21	Proseed	Clearfield	NuSun	65	95	47.6	35.1	29.8	-	-
Proseed E-31	Proseed	Clearfield	NuSun	65	96	49.7	34.2	28.9	-	-
Proseed E-50016	Proseed	Clearfield	NuSun	65	94	40.8	37.4	31.2	-	-
Camaro II	Nuseed	Clearfield	NuSun	65	92	42.7	37.5	31.4	2422	2198
N4HP470	Nuseed	Clearfield	High Oleic	66	95	44.0	40.2	29.0	-	-
N4HE302	Nuseed	ExpressSun	High Oleic	65	92	42.3	39.0	29.7	-	-
N4HM354	Nuseed	Clearfield	NuSun	63	93	41.5	39.1	30.5	2567	2205
Falcon	Nuseed	ExpressSun	NuSun	65	94	39.9	37.2	31.3	2899	-
N5LM307	Nuseed	Clearfield	NuSun	61	92	45.4	32.6	28.5	-	-
Mean				65	93	46.6	36.9	29.8	-	-
CV (%)				1.6	1.0	7.5	1.7	2.5	-	-
LSD (5%)				1.5	1.3	4.9	0.9	1.1	-	-
LSD (10%)				1.2	1.1	4.1	0.8	0.9	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Spring Wheat

Planted: 06/06/2018. Hand Harvested: 9/12/2018.

Soil test (0-6"): P=29 ppm; K=278 ppm; pH=6.1; OM=1.8%. Soil type: Williams-Bowbells loam.

(0-24"): NO3-N=41 lb/a.

Applied fertilizers in lb/a: N=59; S=14.8.

[1]Seed Oil Content=Oils are reported on an oven-dried basis, 120 °F for 4 hours

*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017

[2]DAP = Days after planting.

reported.

06/23/2018: Wind speed=46 mph; Precipitation=1.53".

07/09/2018: Wind speed=48 mph; Precipitation=1.67".

06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.

Canola Dryland Roundup Ready Variety Trial - NDSU **WREC, Williston, ND**

Variety	Company/ Brand	Plant Height	Days to Maturity	Days to Flowering	Flowering Duration	Oil Content[1]	Yield		
							2018	2 yr avg*	3-yr avg**
		(in)	(DAP[2])	(DAP[2])	(days)	(%)	(lb/a)		
4187 RR	BrettYoung	34	87	47	12	45.8	981	-	-
6074 RR	BrettYoung	31	90	45	14	47.0	1216	1465	1328
6090 RR	BrettYoung	37	89	40	19	45.6	683	-	-
11H4030	Cargill	25	83	41	16	44.9	893	-	-
15RH1142	Cargill	33	89	47	12	44.8	1096	-	-
15RH1167	Cargill	35	88	47	12	45.5	1010	-	-
HyCLASS 730	Cropland	30	86	42	15	48.0	1160	-	-
HyCLASS 930	Cropland	29	85	42	15	48.7	1059	1577	-
HyCLASS 955	Cropland	25	85	43	15	46.6	971	1604	-
300 MAG	Proseed	30	88	45	13	46.9	1166	-	-
PS 5000	Proseed	37	88	46	12	45.8	1001	-	-
Star 402	Star	33	87	45	13	47.6	949	1591	1413
Mean		32	87	44	14	46.4	1015	-	-
CV%		8.9	1.5	2.5	8.3	2.6	15	-	-
LSD 0.05		4.0	1.8	1.6	1.6	1.7	219	-	-
LSD 0.10		3.4	1.5	1.3	1.3	1.4	183	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Harvested on: 08/14/2018.

Planted on: 05/14/2018. Previous crop: Cover crop.

Soil test (0-6"): P=28 ppm; K=332 ppm; pH=6.7; OM=3.0%. Soil type: Williams-Bowbells loam.

(0-24"): NO3-N=14 lb/a.

Applied fertilizers in lb/a: N=74; P_2O_5=20; K_2O=5; S=1.

Chemical applications: 8 oz./a of Secure, 8 oz/a of Stinger and 24 oz/a of RT3 applied 6/6/2018.

[1]Seed Oil Content = Oils are reported on a oven dried basis, 120 ° F for 4 hours.

*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017

[2]DAP: Days after planting.

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield:

06/23/2018: Wind speed=46 mph; Precipitation=1.53".

06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.

07/09/2018: Wind speed=48 mph; Precipitation=1.67".

Roundup Ready Canola Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Company / Brand	Days to Flower	Flower Duration	Days to Maturity	Plant Lodge	Plant Height	Oil†		Test Weight	Yield	
							2018	2-Yr Avg		2018	2-Yr Avg
		(DAP+)	(Days)	(DAP+)	(0 - 9*)	(inch)	(%)	(%)	(lb/bu)	(lb/a)	(lb/a)
HyClass 930	Croplan	47	15	95	6	35	42.4	41.8	49.9	2513	3219
HyClass 955	Croplan	46	11	96	6	32	41.4	41.3	50.3	2264	3116
Star 402	Star	48	15	102	6	41	41.7	42.3	49.2	2428	3083
6074 RR	BrettYoung	50	20	103	6	40	39.4	40.1	47.9	2027	2935
HyClass 730	Croplan	46	15	95	6	35	42.2	-	50.1	2258	-
6090 RR	BrettYoung	55	16	106	5	43	39.8	-	46.8	2254	-
4187 RR	BrettYoung	52	17	103	6	45	40.9	-	48.0	2251	-
CS2100	Canterra See	49	20	103	5	39	39.1	-	49.7	1722	-
CS2300	Canterra See	54	19	103	5	42	38.5	-	46.6	1524	-
MEAN		50.3	16.2	101.0	5.4	39.8	40.41	41.35	48.61	2123.79	3088.13
C.V. (%)		-	-	-	-	-	2.94	-	0.86	25.55	-
LSD (5%)		-	-	-	-	-	1.74	-	0.61	797.21	-
LSD (10%)		-	-	-	-	-	1.45	-	0.51	660.86	-

+ Days after planting * 0: no lodging - 9: plants lying flat on the ground † Oil content adjusted to 8.5% moisture

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W Elevation: 1902 ft

Soil test to (0-6"): P=24 ppm; K=207 ppm; pH=7.8; OM=2.3% Previous crop: Barley

(0-24"): NO3-N= 42 lb/a Planted: 5/8/2018

Applied fertilizer in lb/a broadcast: 124 lbs of 46-0-0 (5/1/2018) Harvested: 8/23/2018

Yield goal: 2500 lb/a Soil Type: Lihen Loamy Fine Sand

Planting population: 8 lbs/a Plot size: 48.75 ft^2

Herbicides applied: Cornerstone Plus 24 oz/a, Class Act 1 gal/100 gal (6/8/2018) Rainfall: 8.5 in (5/8/2018 - 8/23/2018)

Fungicides applied: Quadris 15 oz/a (7/13/2018) Irrigation: 8.4 in (5/8/2018 - 8/23/2018)

EARC-CARC Irrigated Canola Variety Trial - MSU **EARC, Sidney, MT 2018**

Variety	Adj. Yield (lb/ac)	Test wt (lb/bu)	Oil (%)	Days to Flower DAP[1]	Height (in)
11H4030	1570	49.9	48.1	42	31.1
15CH2081	1546	49.3	51.0	53	39.5
15RH1142	1259	49.8	49.2	54	42.7
15RH1167	1280	50.2	50.3	52	37.1
16CH5186	1172	50.2	50.1	51	36.4
4187 RR	1531	50.0	50.4	50	39.9
5545 CL	1411	49.8	50.2	46	39.5
6074 RR	1510	49.8	49.8	48	36.6
6090 RR	1175	49.7	49.7	53	45.3
C5507	1159	49.9	49.5	51	39.2
DKL 35-23	1581	50.3	49.5	43	29.6
DKL 70-10	1596	49.9	49.5	43	31.1
Exp201801	948	49.1	49.1	53	47.4
Exp201803	537	48.3	45.9	53	40.0
HyCLASS 730	1632	49.9	50.5	42	32.5
HyCLASS 930	1483	49.6	50.9	42	28.5
HyCLASS 955	1673	49.7	50.2	43	31.9
V32-1CL	1202	49.5	47.4	48	35.9
Mean	1347	49.7	49.5	48	37
P-values	<0.0001	0.6936	<0.0001	<0.0001	<0.0001
LSD (0.05)	234	NS	1.2	1.8	6.3
CV (%)	12.22	2.1	1.7	2.6	12.0

Location: Sidney, MT Previous crop: Sugarbeet

Planted: May 3, 2018 Harvested: Aug. 14, 2018

Applied fertilizers in lb/a: N=60 Soil type: Williams Clay Loam

Yield adjusted to 8% moisture content Rain fall (Apr-Aug) = 9.52"

Insecticide: Sprayed Sevin XLR Plus at 1 qrt/ac with 11 G water/ac on May 31, 2018 Irrigation = 2.68"

DAP[1] = Days after planting

"This farm is more than land and crops. It's our family's heritage and future."

EARC-Idaho Irrigated Canola Variety Trials - MSU **EARC, Sidney, MT 2018**

Variety	Adj. Yield (lb/ac)	Test wt (lb/bu)	Oil (%)	Days to Flower DAP[1]	Height (in)
07.IR.1.5.4.5	820	47.1	48	50	26.0
07.IR.7.8.8.7	1083	52.0	45	46	35.9
07.SI.8.A10	1150	52.4	47	42	23.2
10SN27.A7.9.10	1001	53.3	49	42	35.1
10SN27.A7.9.14	1029	54.7	49	42	28.7
14.SC.156.10	1244	54.0	46	43	29.5
14.SC.157.9	979	54.6	43	45	32.2
14.SC.4.8	792	51.3	43	45	36.4
14.SC.5.7	894	52.6	47	45	31.2
14.SC.81.5	1304	54.4	45	42	38.1
14.SC.88.11	1144	53.4	45	48	30.8
14.SC.94.16	1383	52.9	49	42	34.0
14.SC.96.9	1484	53.7	47	45	36.4
Empire	870	53.3	38	45	29.0
Gem	906	52.2	45	44	28.0
HyCLASS.930.RR	1711	52.7	49	44	31.4
Mean	1112	52.8	46	44	31.6
P-values	<0.0001	<0.0001	<0.0001	<0.0001	0.0017
LSD (0.05)	296.0	1.8	1.8	2.0	5.9
CV (%)	18.8	2.4	2.8	3.5	12.8

Location: Sidney, MT Previous crop: Sugarbeet

Planted: May 3, 2018 Harvested: Aug. 4, 2018

Applied fertilizers in lb/a: N=60 Soil type: Williams Clay Loam

Yield adjusted to 8% moisture content Rain fall (Apr-Aug) = 9.52"

Insecticide: Sprayed Sevin XLR Plus at 1 qrt/ac with 11 G water/ac on May 31, 2018 Irrigation = 2.68"

DAP[1] = Days after planting

Break time.

Soybean Dryland Conventional Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Company/ Brand	Days to Mature	Height	Oil[2]	Protein[3]	Test weight	Yield		
							2018	2-Yr Avg*	3-Yr Avg**
		(DAP[1])	(in)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
ND Stutsman	NDSU	106	16.6	14.2	36.0	53.4	13.8	-	-
AG 00632	Asgrow	93	19.1	14.1	35.9	51.1	13.5	22.3	-
AG 00932	Asgrow	99	19.4	14.1	35.9	52.6	12.5	21.8	-
AG 00835	Asgrow	98	16.1	14.8	35.3	52.5	12.3	-	-
AG 0832	Asgrow	118	16.8	13.6	38.5	52.9	12.1	-	-
ND Henson	NDSU	97	18.1	14.1	36.6	53.1	11.7	24.7	58.5
Xtend_Check		102	17.2	13.7	37.0	52.7	11.6	-	-
ND Bison	NDSU	106	15.0	13.7	36.7	53.3	10.1	-	-
ND Benson	NDSU	111	17.7	13.7	38.6	52.8	9.7	-	-
Mean		103.3	17.3	14.0	36.7	52.7	11.9	-	-
CV (%)		1.3	5.7	1.4	1.3	0.8	15.6	-	-
LSD (5%)		2.0	1.4	0.3	0.7	0.6	2.6	-	-
LSD (10%)		1.6	1.1	0.2	0.6	0.5	2.2	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Spring Wheat

Planted: 05/25/2018. Harvested: 08/28/2018.

Soil test (0-6"): P=29 ppm; K=278 ppm; pH=6.1; OM=1.8%. Soil type: Williams-Bowbells loam.

(0-24"): NO3-N=41 lb/a.

Applied fertilizers in lb/a: None, seed inoculated with a peat based inoculum at planting.

[1]DAP= Days After Planting.

[2]Oils reported on an oven dried basis, 120 °F for 4 hours.

[3]Protein adjusted to 13% moisture.

*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017.

Note: Trial received heavy rain, wind, hailstorms, and early hard fall freeze that damaged the crop and adversely affected yield.

06/23/2018: Wind speed=46 mph; Precipitation=1.53".

06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.

07/09/2018: Wind speed=48 mph; Precipitation=1.67".

09/28/2018; Hard Fall Freeze.

Soybean Dryland Roundup Ready Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Company/ Brand	Days to Mature	Height	Oil[2]	Protein[3]	Test weight	Yield	
							2018	2-Yr Avg*
		(DAP[1])	(in)	(%)	(%)	(lb/bu)	----(bu/a)----	
AG 00932	Asgrow	101	19.2	14.4	35.5	52.2	15.3	24.4
AG 0832	Asgrow	116	16.8	13.7	38.5	52.8	14.5	-
ND17009GT	NDSU	98	16.0	13.6	37.8	53.5	13.4	25.1
AG 00835	Asgrow	96	16.5	14.7	35.4	52.3	12.4	-
AG 00632	Asgrow	93	17.0	14.1	36.1	51.9	11.4	23.9
Mean		101	17.1	14.1	36.7	52.5	13.4	-
CV (%)		2.7	5.1	1.2	1.2	0.7	14.3	-
LSD (5%)		4.0	1.2	0.2	0.7	0.5	2.6	-
LSD (10%)		3.3	1.0	0.2	0.5	0.4	2.2	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Spring Wheat

Planted: 05/25/2018. Harvested: 09/29/2018.

Soil test (0-6"): P=29 ppm; K=278 ppm; pH=6.1; OM=1.8%. Soil type: Williams-Bowbells loam.

(0-24"): NO3-N=41 lb/a.

Applied fertilizers in lb/a: none, seed inoculated with a peat based inoculum at planting.

[1]DAP=Days After Planting.

[2]Oils are reported on a oven dried basis, 120°F for 4 hours.

[3]Protein content adjusted to 13% mositure.

*Averages of years 2016 and 2017.

Note: Trial received heavy rain, wind, hailstorms and early hard fall freeze that damaged the crop and adversely affected yield:

06/23/2018: Wind speed=46 mph; Precipitation=1.53".

06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.

07/09/2018: Wind speed=48 mph; Precipitation=1.67".

09/28/2018; Hard fall freeze.

Conventional Soybean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Company / Brand	Relative Maturity	Plant Height	Days to Maturity	Plant Lodge	Protein†			Oil‡			Test Weight	Yield		
						2018	2-Yr Avg	3-Yr Avg	2018	2-Yr Avg	3-Yr Avg		2018	2-Yr Avg	3-Yr Avg
			(in)	(DAP+)	(0 - 9*)	(%)	(%)	(%)	(%)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
ND Bison	NDSU	0.7	31	126	2	33.6	34.4	35.2	13.6	14.1	14.0	57.0	77.6	59.8	66.8
ND Henson	NDSU	0.0	29	112	2	35.2	35.5	36.1	14.5	14.5	14.4	58.6	68.2	56.5	65.1
ND Benson	NDSU	0.4	31	125	3	36.4	36.3	37.0	13.4	14.2	14.2	57.2	72.2	59.4	60.7
ND Stutsman	NDSU	0.7	33	124	4	32.5	34.5	-	14.1	13.9	-	58.0	81.6	78.1	-
MEAN			31.0	121.8	2.7	34.4	35.2	36.1	13.9	14.2	14.2	57.7	74.9	63.4	64.2
C.V. (%)			-	-	-	1.16	-	-	0.84	-	-	0.95	10.70	-	-
LSD (5%)			-	-	-	0.64	-	-	0.19	-	-	0.88	12.82	-	-
LSD (10%)			-	-	-	0.52	-	-	0.15	-	-	0.71	10.39	-	-

+ Days after planting * 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 13% moisture ‡ Oil content adjusted to 13% moisture

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft
Soil test to (0-6"): P=24 ppm; K=207 ppm; pH=7.8; OM=2.3% — Previous crop: Barley
(0-24"): NO3-N= 42 lb/a — Planted: 5/22/2018
Applied fertilizer in lb/a broadcast: none — Harvested: 10/17/2018
Yield goal: 50 bu/a — Soil Type: Lihen Loamy Fine Sand
Planting population: 200,000 seeds/a — Plot size: 61.25 ft^2
Herbicides applied: Cornerstone 5 Plus 24 oz/a, Spartan Charge 2 oz/a (5/22/2018), Section 3EC 8 oz/a (6/4/2018), Raptor 5 oz/a, Trophy Gold 1 qt/100 gal, 28-0-0 2 qt/a (6/6/2018) — Rainfall: 11.0 in (5/22/2018 - 10/17/2018)
Fungicides applied: Quadris 15 oz/a (7/17/2018) — Irrigation: 11.9 in (5/22/2018 - 10/17/2018)

Roundup Ready Soybean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Company / Brand	Relative Maturity	Plant Height	Days to Maturity	Plant Lodge	Protein†			Oil‡			Test Weight	Yield		
						2018	2-Yr Avg	3-Yr Avg	2018	2-Yr Avg	3-Yr Avg		2018	2-Yr Avg	3-Yr Avg
			(in)	(DAP+)	(0 - 9*)	(%)	(%)	(%)	(%)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
R00727	REA Hybrids	00.7	24	111	1	35.9	35.6	34.5	13.7	14.2	14.4	57.0	56.8	68.6	66.4
ND17009GT	NDSU	00.9	28	106	2	38.4	38.2	37.2	13.4	14.2	15.0	59.3	57.0	62.3	60.8
ND18008GT	NDSU	00.8	23	103	1	37.4	37.6	36.3	13.8	14.3	15.0	57.9	49.3	55.4	55.6
20300 R2Y	Integra	0.3	26	118	1	36.1	36.2	-	13.8	14.2	-	57.8	71.7	76.1	-
RX0628	REA Hybrids	0.6	26	123	2	35.9	35.8	-	13.6	14.3	-	56.8	65.2	72.5	-
RX0327	REA Hybrids	0.3	22	115	1	36.7	36.7	-	13.6	14.2	-	57.5	61.5	69.9	-
H03X8	Hefty	0.3	31	120	1	34.8	-	-	13.7	-	-	58.1	67.1	-	-
H009X7	Hefty	00.9	30	114	1	36.9	-	-	13.7	-	-	58.1	61.7	-	-
H02X7	Hefty	0.2	29	115	1	35.8	-	-	13.4	-	-	58.1	60.3	-	-
H005X8	Hefty	00.5	27	106	1	35.1	-	-	13.5	-	-	57.9	58.7	-	-
H008X8	Hefty	00.8	27	115	2	35.8	-	-	13.4	-	-	57.6	58.1	-	-
H03X7	Hefty	0.3	22	119	2	36.3	-	-	13.9	-	-	57.2	63.0	-	-
RX00619	REA Hybrids	00.6	24	102	1	35.6	-	-	13.7	-	-	58.1	52.6	-	-
H007X7	Hefty	00.7	26	112	1	36.1	-	-	13.6	-	-	58.8	52.2	-	-
RX00749	REA Hybrids	00.7	27	106	2	35.6	-	-	13.5	-	-	57.5	51.2	-	-
MEAN			26.1	112.1	1.2	36.17	36.69	36.02	13.62	14.24	14.78	57.84	59.11	67.47	60.95
C.V. (%)			-	-	-	1.65	-	-	2.42	-	-	1.17	9.21	-	-
LSD (5%)			-	-	-	0.85	-	-	0.47	-	-	0.97	7.77	-	-
LSD (10%)			-	-	-	0.71	-	-	0.39	-	-	0.81	6.47	-	-

+ Days after planting * 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 13% moisture ‡ Oil content adjusted to 13% moisture

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft
Soil test to (0-6"): P=24 ppm; K=207 ppm; pH=7.8; OM=2.3% — Previous crop: Barley
(0-24"): NO3-N= 42 lb/a — Planted: 5/23/2018
Applied fertilizer in lb/a broadcast: none — Harvested: 10/17/2018
Yield goal: 50 bu/a — Soil Type: Lihen Loamy Fine Sand
Planting population: 200,000 seeds/a — Plot size: 61.25 ft^2
Herbicides applied: Cornerstone Plus 24 oz/a, Calss Act 1 gal/100 gal (6/8/2018) — Rainfall: 11.0 in (5/23/2018 - 10/17/2018)
Fungicides applied: Quadris 15 oz/a (7/18/2018) — Irrigation: 11.9 in (5/23/2018 - 10/17/2018)

Navy Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Days to Maturity (DAP+)	Canopy Height (inch)	Plant Lodge (0 to 9*)	1000 KWT (gram)	Seeds/ Pound	Test Weight (lb/bu)	Yield 2018 (lb/a)	Yield 2-Yr Avg† (lb/a)
T9905	114	11	0	18.9	2399	62.2	1334	2983
HMS Medalist	116	10	0	18.7	2434	62.3	1258	2759
Ensign	112	9	1	19.9	2297	61.2	858	2340
MEAN	113.8	9.9	0.3	19.18	2376.7	61.88	1149.69	2694.18
C.V. (%)	-	-	-	6.26	6.1	0.82	11.05	-
LSD (5%)	-	-	-	ns	ns	0.88	219.71	-
LSD (10%)	-	-	-	ns	ns	0.70	174.48	-

+ Days after planting * 0: no lodging - 9: plants lying flat on the ground † 2 Year Average figured on yields from 2016 and 2018

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft
Soil test to (0-6"): P=16 ppm; K=126 ppm; pH=7.5; OM=2.1% — Previous crop: Soybean
(0-24"): NO3-N= 42 lb/a — Planted: 5/14/2018
Applied fertilizer in lb/a broadcast: 105 lbs of 46-0-0 (5/1/2018) — Harvested: 10/8/2018
Yield goal: 2500 lb/a — Soil Type: Lihen Loamy Fine Sand
Planting population: 125,000 seeds/a — Plot size: 61.25 ft^2
Herbicides applied: Prowl H2O 1.5 pt/a (5/15/2018), Section 3EC 8 oz/a (6/4/2018), Raptor 5 oz/a, Trophy Gold 1 qt/100 gal, 28-0-0 2 qt/a (6/6/2018), Gramaxone 2 pt/a, R-11 2 qt/100 gal (9/7/2018) — Rainfall: 11.3 in (5/14/2018 - 10/8/2018); Irrigation: 11.9 in (5/14/2018 - 10/8/2018)
Fungicides applied: Headline 12 oz/a (7/3/2018)

Pinto Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Days to Maturity (DAP+)	Canopy Height (inch)	Plant Lodge (0 - 9*)	1000 KWT (g)	Seeds/ Pound	Test Weight (lb/bu)	Yield 2018 (lb/a)	Yield 2-Yr Avg (lb/a)	Yield 3-Yr Avg (lb/a)
Monterrey	112	16	0	38.8	1170	60.4	2682	3786	4073
LaPaz	112	16	1	39.7	1144	60.3	2522	3362	3697
Lariat	115	17	0	39.6	1146	58.9	2408	3111	3389
Palomino	117	14	0	38.2	1194	57.2	1956	2215	3038
Windbreaker	111	13	1	40.4	1125	56.4	1881	2478	2885
Stampede	112	14	1	36.4	1257	59.3	2012	2774	2882
MEAN	113.1	15.0	0.4	38.84	1172.4	58.77	2243.69	2954.34	3327.23
C.V. (%)	-	-	-	6.11	-	1.66	20.82	-	-
LSD (5%)	-	-	-	3.58	-	1.47	704.18	-	-
LSD (10%)	-	-	-	2.94	-	1.21	579.17	-	-

+ Days after planting * 0: no lodging - 9: plants lying flat on the ground

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft
Soil test to (0-6"): P=16 ppm; K=126 ppm; pH=7.5; OM=2.1% — Previous crop: Soybean
(0-24"): NO3-N= 42 lb/a — Planted: 5/14/2018
Applied fertilizer in lb/a broadcast: 105 lbs of 46-0-0 (5/1/2018) — Harvested: 10/8/2018
Yield goal: 2500 lb/a — Soil Type: Lihen Loamy Fine Sand
Planting population: 125,000 seeds/a — Plot size: 61.25 ft^2
Herbicides applied: Prowl H2O 1.5 pt/a (5/15/2018), Section 3EC 8 oz/a (6/4/2018), Raptor 5 oz/a, Trophy Gold 1 qt/100 gal, 28-0-0 2 qt/a (6/6/2018), Gramaxone 2 pt/a, R-11 2 qt/100 gal (9/7/2018) — Rainfall: 11.3 in (5/14/2018 - 10/8/2018); Irrigation: 11.9 in (5/14/2018 - 10/8/2018)
Fungicides applied: Headline 12 oz/a (7/3/2018)

Misc. Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Market Class	Days to Maturity (DAP+)	Canopy Height (inch)	Plant Lodge (0 to 9*)	1000 KWT (gram)	Seeds/ Pound	Test Weight (lb/bu)	Yield 2018 (lb/a)	Yield 2-Yr Avg† (lb/a)
Eclipse	BL	114	11	0	21.6	2108	61.5	1796	3232
Loreto	BL	114	13	0	19.9	2289	63.0	1713	2837
Zorro	BL	107	12	1	19.4	2352	62.1	1311	2695
Rosetta	PK	116	13	0	33.9	1339	61.2	1429	2332
Powderhorn	GN	106	11	1	35.1	1294	56.9	1593	-
MEAN		113.0	12.5	0.3	23.68	2022.1	61.52	1542.85	2673.53
C.V. (%)		-	-	-	3.14	-	1.11	16.09	-
LSD (5%)		-	-	-	1.26	-	1.04	388.83	-
LSD (10%)		-	-	-	1.03	-	0.85	318.07	-

+ Days after planting * 0: no lodging - 9: plants lying flat on the ground † 2 Year Average figured on yields from 2016 and 2018

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft
Soil test to (0-6"): P=16 ppm; K=126 ppm; pH=7.5; OM=2.1% — Previous crop: Soybean
(0-24"): NO3-N= 42 lb/a — Planted: 5/14/2018
Applied fertilizer in lb/a broadcast: 105 lbs of 46-0-0 (5/1/2018) — Harvested: 10/8/2018
Yield goal: 2500 lb/a — Soil Type: Lihen Loamy Fine Sand
Planting population: 125,000 seeds/a — Plot size: 61.25 ft^2
Herbicides applied: Prowl H2O 1.5 pt/a (5/15/2018), Section 3EC 8 oz/a (6/4/2018), Raptor 5 oz/a, Trophy Gold 1 qt/100 gal, 28-0-0 2 qt/a (6/6/2018), Gramaxone 2 pt/a, R-11 2 qt/100 gal (9/7/2018) — Rainfall: 11.3 in (5/14/2018 - 10/8/2018); Irrigation: 11.9 in (5/14/2018 - 10/8/2018)
Fungicides applied: Headline 12 oz/a (7/3/2018)
Market Classes: BL = Black, GN = Great Northern, PK = Pink

Corn Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2018**

Variety	Company / Brand	Relative Maturity	Days to Silk (DAP*)	Ear Height (in)	Harvest Moisture (%)	Test Weight (lb/bu)	Yield† 2018 (bu/a)	Yield† 2-Yr Avg (bu/a)
2B861	REA Hybrid	86	63	38	19.6	51.1	223.9	227.8
1B811	REA Hybrid	81	63	35	18.3	53.5	188.8	208.1
H3902VT2PRIB	Hefty	89	64	38	20.2	50.3	225.9	-
RC 3601	Rob-See-Co	86	62	37	20.0	52.1	215.0	-
IC 2737	Innotech	77	61	34	19.7	53.2	207.0	-
H3302VT2PRIB	Hefty	83	63	38	18.9	52.8	204.4	-
H4102VT2PRIB	Hefty	91	67	38	24.5	47.5	201.0	-
1B780	REA Hybrid	79	62	35	18.5	52.4	198.3	-
H3712VT2PRIB	Hefty	87	65	37	20.7	49.0	197.3	-
H4012VT2PRIB	Hefty	90	67	37	24.6	47.0	195.7	-
H4612VT2PRIB	Hefty	96	65	40	24.3	50.6	192.3	-
3282 VT2PRO	Integra	82	63	39	18.9	51.8	189.1	-
2B872	REA Hybrid	86	64	36	18.7	51.8	188.6	-
3537 VT2PRIB	Integra	85	64	37	19.6	50.4	187.2	-
IC 3041	Innotech	80	61	36	19.4	55.5	182.7	-
H2802VT2PRIB	Hefty	78	63	38	18.6	52.4	174.0	-
H2602VT2PRIB	Hefty	76	59	36	18.2	55.5	172.0	-
H2512VT2PRIB	Hefty	75	58	35	19.6	56.1	169.0	-
RC3418	Rob-See-Co	84	64	33	21.2	49.1	155.1	-
MEAN			62.6	36.4	20.11	51.86	190.68	208.13
C.V. (%)			-	-	10.46	4.14	12.33	-
LSD (5%)			-	-	2.99	3.03	33.75	-
LSD (10%)			-	-	2.50	2.53	28.17	-

* Days after planting †Yields adjusted to harvest moisture

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft
Soil test to (0-6"): P=24 ppm; K=207 ppm; pH=7.8; OM=2.3% — Previous crop: Barley
(0-24"): NO3-N= 42 lb/a — Planted: 5/21/2018
Applied fertilizer in lb/a broadcast: 188 lbs of 46-0-0 (5/1/2018) — Harvested: 11/20/2018
Yield goal: 190 bu/a — Soil Type: Lihen Loamy Fine Sand
Planting population: 38,000 seeds/a — Plot size: 61.25 ft^2
Herbicides applied: Cornerstone Plus 24 oz/a, Class Act 1 gal/100 gal (6/8/2018) Rainfall: 11.1 in (5/21/2018 - 11/20/2018)
Fungicides applied: none — Irrigation: 11.9 in (5/21/2018 - 11/20/2018)

"There are two spiritual dangers in not owning a farm. One is the danger of supposing that breakfast comes from the grocery, and the other that heat comes from the furnace."
Aldo Leopold

LENTIL VARITY DESCRIPTIONS

VARIETY	ORIGIN[1]	SEED COLOR	RELATIVE MATURITY	RELATIVE HEIGHT	SEED SIZE	RESISTANCE TO[2]	
						ASCOCHYTA	ANTHRACNOSE
AVONDALE	USDA	GREEN	MEDIUM	TALL	MEDIUM	NA	NA
CDC DAZIL*	CANADA	RED	M EARLY	NA	SMALL	R	R
CDC GREENLAND	CANADA	GREEN	EARLY	MEDIUM	V LARGE	R	S
CDC IMIGREEN*	CANADA	GREEN	MEDIUM	MEDIUM	LARGE	R	S
CDC IMPALA*	CANADA	RED	EARLY	SHORT	EXTRA SMALL	R	R
CDC IMPACT*	CANADA	RED	LATE	SHORT	SMALL	NA	NA
CDC IMPRESS*	CANADA	GREEN	M LATE	SHORT	LARGE	R	NA
CDC IMVINCIBLE	CANADA	GREEN	EARLY	MEDIUM	SHORT	R	R
CDC LEMAY	CANADA	GREEN	EARLY	SHORT	SMALL	MS	S
CDC MAXIM*	CANADA	RED	M EARLY	MEDIUM	SMALL	R	R
CDC PERIDOT*	CANADA	GREEN	EARLY	NA	SMALL	R	NA
CDC PROCLAIM*	CANADA	RED	M EARLY	NA	SMALL	R	R
CDC REDBERRY	CANADA	RED	MEDIUM	MEDIUM	SMALL	R	R
CDC REDCOAT	CANADA	RED	M LATE	TALL	LARGE	R	R
CDC RED RIDER	CANADA	RED	M EARLY	MEDIUM	SMALL	MR	MS
CDC RICHLEA	CANADA	GREEN	M LATE	MEDIUM	MEDIUM	S	S
CDC ROSETOWN	CANADA	RED	EARLY	SHORT	SMALL	MR	MR
CDC ROULEAU	CANADA	RED	MEDIUM	MEDIUM	SMALL	MR	MS
CDC VICEROY	CANADA	GREEN	M EARLY	MEDIUM	SMALL	R	MR
CRIMSON	USDA	RED	EARLY	M SHORT	SMALL	S	S
ESSEX	USDA	GREEN	MEDIUM	M TALL	MEDIUM	NA	S
ESTON	CANADA	GREEN	EARLY	MEDIUM	SMALL	S	S
MERRITT	USDA	GREEN	M LATE	MEDIUM	LARGE	NA	NA
MORENA	USDA	BROWN	EARLY	TALL	SMALL	NA	S
ND EAGLE	NDSU	GREEN	EARLY	MEDIUM	SMALL	NA	NA
PARDINA	SPAIN	BROWN	EARLY	SHORT	SMALL	NA	NA
PENNELL	USDA	GREEN	MEDIUM	MEDIUM	LARGE	NA	S
RIVELAND	USDA	GREEN	M LATE	TALL	V LARGE	NA	S

[1]Refers to developer: NDSU = North Dakota State University; USDA = United States Department of Agriculture; CANADA and SPAIN represent developers from respective countries.

[2]MR = Moderately resistant; NA= Data not available; R = Resistant; S = Susceptible.

*Clearfield lentil with imidazolinone tolerance.

James Starika, WREC Soil Scientist

Lentil Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Days to Flower	Days to Mature	Canopy Height	Lodging	1000 Seed Weight	Test weight	Yield		
							2018	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(DAP[1])	(in)	(0-9[2])	(g)	(lb/bu)	---------(lb/a)---------		
French Green									
CDC Lemay	52	85	5	5	30.9	63.3	930	1170	1301
Large Green									
Pennell	49	86	8	2	42.6	59.6	711	1419	1478
Riveland	44	82	6	5	44.6	58.5	871	1494	1452
CDC Greenland	52	86	6	4	61.0	59.5	1303	1436	1393
Medium Green									
Avondale	47	83	6	5	45.7	61.1	937	1642	1671
CDC Richlea	50	83	6	5	44.7	61.2	1125	1512	1607
Small Green									
ND Eagle	45	80	8	5	50.0	62.2	907	1475	-
CDC Viceroy	50	83	8	3	29.9	63.0	1149	1333	1400
Small Red									
CDC Red Rider	51	85	8	4	42.6	62.3	1290	1616	1621
CDC Redberry	50	84	7	2	38.5	62.2	1349	1302	1369
CDC Rosetown	52	84	10	2	27.1	63.9	1104	1202	1294
CDC Rouleau	52	81	7	5	33.2	61.3	917	1710	1661
Spanish Brown									
Pardina	43	76	4	9	46.4	63.4	224	1343	1482
Mean	48	82	6	5	42.5	61.8	861.5	-	-
CV (%)	1.7	1.8	25.4	30.1	5.6	0.6	23.5	-	-
LSD (5%)	1.2	2.1	2.3	2.0	3.4	0.5	287.5	-	-
LSD (10%)	1.0	1.8	1.9	1.6	2.8	0.5	239.9	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Small Grains.
Planted: 05/05/2018. Harvested: 08/08/2018.
Soil test (0-6"): P=43 ppm; K=332 ppm; pH=6.3; OM=2.0%. Soil type: Williams-Bowbells loam.
(0-24"): NO3-N=35 lb/a.
Applied fertilizer in lb/a: none, seed inoculated with granular inoculant at planting.
*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017
[1]DAP=Days After Planting.
[2]0=no lodging. 9=plants lying flat on ground.
Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.
06/23/2018: Wind speed=46 mph; Precipitation=1.53".
06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.
07/09/2018: Wind speed=48 mph; Precipitation=1.67".

Lentil Divide Dryland Variety Trial - NDSU **Divide County, ND 2018**

Variety	1000 Seed Weight	Test weight	Yield
	(g)	(lb/bu)	(lb)
Avondale	48.8	61.3	1108
CDC Greenland	61.0	60.1	1347
CDC Viceroy	36.0	62.8	719
ND Eagle	38.1	62.6	857
Pennell	51.4	61.2	967
CDC Richlea	54.7	61.0	1124
Mean	48.3	61.5	1020.2
CV (%)	5.0	0.4	13.5
LSD (5%)	4.4	0.4	250.7
LSD (10%)	3.6	0.3	204.0

Location: Crosby, ND; Latitude 48° 48'N; Longitude 103° 18'W; Elevation 2044 ft. Previous crop: Soybean.
Planted: 06/04/2018. Harvested: 08/23/2018.
Soil test (0-6"): N/A. Soil type: Farnuf-Alkabo.
(0-24"): NO3-N=24 lb/a.
Applied fertilizers in lb/a: N=5.4, P=18.0,S=4.5.
Seed inoculated with peat-based inoculant prior to planting.

Irrigated Lentil Variety Evaluation - MSU **EARC, Sidney, MT 2018**

Lentil Variety	Days to Flower DAP[1]	Plant Height (in)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
Avondale	48	17.7	62.4	1489
CDC Impala CL	55	14.6	65.9	1466
CDC Imvincible CL	55	16.0	64.9	1683
CDC Maxim CL	50	14.0	63.8	1439
CDC Richlea	51	16.8	61.9	1492
LC99709065	59	15.4	65.5	1271
LC9976079	62	15.9	64.9	1197
LC9977019	53	16.0	65.0	987
LC9977116	55	17.6	65.3	962
LC99780571	53	14.4	65.1	679
LC9978094	60	15.1	65.0	785
LC9979016	68	16.0	65.3	1402
LC9979120	67	16.9	65.3	1356
WA8649090	59	14.7	65.5	1100
Mean	57	15.7	64.7	1236
P-Value	<0.0001	0.7062	<0.0001	0.0011
LSD (0.05)	2.8	NS	0.39	413
CV (%)	5.3	14.8	0.4	20.5

Location: Sidney, MT Previous crop: Sugarbeet

Planted: April 27, 2018 Harvested: Aug. 13, 2018

Applied fertilizers in lb/a: None Soil type: Williams Clay Loam

Yield adjusted to 13% moisture content Rain fall (Apr-Aug) = 9.52"

Irrigation = 2.68"

Herbicide Prowl H2O, Roundup and Outlook at 2.5 pt/ac, 22 oz/ac and 21 oz/ac, respectively.

DAP[1] = Days after planting

"Don't let your yearnings get ahead of your earnings."

Dryland Lentil Variety Evaluation - MSU **Richland, MT 2018**

Lentil Variety	Plant Height (in)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
Avondale	15.3	63.8	1993
CDC Impala CL	13.8	66.4	1690
CDC Imvincible CL	14.1	65.5	1769
CDC Maxim CL	14.4	65.0	2094
CDC Richlea	15.7	63.1	1886
LC08600113P	14.6	64.5	1595
LC146000088R	16.2	63.2	1967
LC146000100L	14.6	60.7	1799
LC99709065	13.7	66.3	1684
LC9976079	14.4	65.8	1377
LC9977019	13.5	65.4	1544
LC9977116	14.2	65.8	1729
LC99780571	14.5	66.0	1431
LC9978094	14.1	65.6	1265
LC9979016	15.0	66.0	1318
LC9979120	13.5	65.9	1410
WA8649090	15.1	66.0	1552
Mean	14.6	65.0	1651
P-Value	0.3130	<0.0001	<0.0001
LSD (0.05)	NS	0.495	173
CV (%)	9.7	0.5	7.4

Location: Richland, MT Previous crop: Canola

Planted: May 8, 2018 Harvested: Aug. 16, 2018

Yield adjusted to 13% moisture content

FIELD PEA VARIETY DESCRIPTIONS

VARIETY	ORIGIN OR SUPPLIER	VINE HABIT[1]	GROWTH HABIT[2]	VINE LENGTH	RELATIVE MATURITY	SEED SIZE	RESISTANCE[3] TO POWDERY MILDEW
YELLOW COTYLEDON							
AAC CARVER	CANADA	NA	NA	MEDIUM	EARLY	MEDIUM	R
AGASSIZ	CANADA	SL	SD	TALL	MEDIUM	MEDIUM	R
BRIDGER	LEGUME LOGIC	SL	SD	MEDIUM	MEDIUM	MEDIUM	MS
CDC AMARILLO	CANADA	SL	SD	MEDIUM	MEDIUM	MEDIUM	R
CDC INCA	MERIDIAN SEEDS	NA	NA	NA	MEDIUM	MEDIUM	R
CDC LEROY	CANADA	SL	SD	M SHORT	MED LATE	SMALL	R
CDC MEADOW	CANADA	SL	SD	MEDIUM	EARLY	MEDIUM	R
CDC SAFFRON	CANADA	SL	SD	MEDIUM	MEDIUM	MEDIUM	R
CDC TREASURE	CANADA	SL	SD	MEDIUM	EARLY	SMALL	R
DELTA	LIMAGRAIN	SL	SD	MEDIUM	MEDIUM	MEDIUM	MR
DS ADMIRAL	DANISCO	SL	SD	TALL	MEDIUM	LARGE	R
DURWOOD	PULSE USA	SL	SD	M SHORT	M LATE	MEDIUM	NA
EARLYSTAR	MERIDIAN SEEDS	SL	SD	TALL	EARLY	MEDIUM	R
HYLINE	LEGUME LOGIC	SL	NA	NA	MEDIUM	MEDIUM	R
JETSET	MERIDIAN	SL	SD	MEDIUM	MEDIUM	M SMALL	R
KORANDO	PULSE USA	SL	SD	MEDIUM	EARLY	MEDIUM	R
LG AMIGO	PULSE USA	SL	NA	NA	M EARLY	MEDIUM	R
MONTECH 4152	MONTECH	SL	SD	MEDIUM	EARLY	LARGE	NA
MYSTIQUE	PULSE USA	SL	SD	M SHORT	M LATE	M SMALL	MR
NAVARRO	GREAT NORTHERN AG	SL	NA	M TALL	EARLY	LARGE	MS
NETTE 2010	PULSE USA	SL	NA	SHORT	M EARLY	M SMALL	NA
SALAMANCA	GREAT NORTHERN AG	SL	NA	MEDIUM	EARLY	MEDIUM	MS
SPIDER	NICKERSON	SL	SD	MEDIUM	MEDIUM	LARGE	R
SW MIDAS	SWEDEN	SL	SD	SHORT	M LATE	SMALL	R
SW TRAPEZE	SWEDEN	SL	SD	M SHORT	MEDIUM	MEDIUM	NA
VEGAS	PULSE USA	SL	SD	SHORT	M LATE	LARGE	NA
GREEN COTYLEDON		A	NA	MEDIUM	MEDIUM	LARGE	R
AAC COMFORT	MERIDIAN SEEDS	SL	SD	M SHORT	M EARLY	M LARGE	NA
ARAGORN	PROGENE	SL	SD	MEDIUM	EARLY	SMALL	MS
ARCADIA	PULSE USA	NA	NA	M TALL	LATE	MEDIUM	R
CDC GREENWATER	MERIDIAN SEEDS	SL	SD	MEDIUM	MEDIUM	M LARGE	S
CDC STRIKER	CANADA	SL	SD	MEDIUM	MEDIUM	M SMALL	S
CRUISER	WA	SL	SD	MEDIUM	LATE	MEDIUM	R
DAYTONA	MERIDIAN	NA	NA	M SHORT	MEDIUM	SMALL	NA
GINNY	PROGENE	NA	NA	MEDIUM	MEDIUM	SMALL	MR
GREENWOOD	PROGENE	SL	SD	MEDIUM	EARLY	M SMALL	S
K-2	LEGUME LOGIC	SL	NA	MEDIUM	MEDIUM	MEDIUM	R
LG KODA	PULSE USA	SL	SD	MEDIUM	M LATE	MEDIUM	S
MAJORET	SWEDEN	SL	NA	NA	LATE	NA	S
SHAMROCK	GREAT NORTHERN AG	SL	SD	SHORT	EARLY	MEDIUM	R
STIRLING	WA	SL	SD	M SHORT	M EARLY	MEDIUM	MR
VIPER	PULSE USA	NA	NA	MEDIUM	EARLY	MEDIUM	R

[1]NA = Data not available; SL = Semi-leafless; [2]SD = Semi-dwarf; [3]MR = Moderately resistant; MS = Moderately susceptible; R = Resistant, S = Susceptible.

"Nature gave us all something to fall back on, and sooner or later we all land flat on it."

Field Pea Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Days to Flower	Days to Mature	Canopy Height	Lodging[2]	Protein[3]	1000 Seed Weight	Test weight[4]	Yield[4]		
								2018	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(DAP[1])	(in)	(0-9)	(%)	(g)	(lb/bu)	----------(bu/a)----------		
Yellow Cotyledon Type										
CDC Saffron	49	75	9	3	26.5	243	61.9	36.4	29.1	29.5
AAC Asher	48	75	11	2	26.5	259	61.6	35.8	-	-
Bridger	46	73	7	5	28.0	210	60.9	34.6	26.7	28.0
LGPN4906	42	72	8	3	26.0	229	61.2	34.6	-	-
AAC Profit	49	75	10	3	27.5	241	61.7	34.3	-	-
AAC Chrome	48	77	11	3	26.1	252	61.0	34.1	-	-
Agassiz	45	74	11	3	27.7	223	60.5	33.5	32.8	34.1
Nette 2010	46	73	9	5	25.7	218	62.2	33.1	30.4	-
SW Midas	46	73	9	5	24.9	206	60.6	32.7	-	-
Spider	48	76	11	2	27.6	229	61.1	32.5	26.6	-
Korando	41	71	8	6	28.0	272	60.6	32.2	29.3	29.4
Navarro	41	71	6	5	27.0	256	61.2	32.2	30.1	-
Pro 133-6243	42	71	7	6	26.4	261	61.1	31.8	-	-
LGPN4915	43	73	10	4	31.0	212	61.0	31.7	-	-
LG Sunrise	43	71	8	4	24.2	228	61.2	31.1	-	-
DS Admiral	46	72	10	4	24.9	236	61.2	30.9	28.2	29.8
CDC Dakota	53	77	12	1	30.2	187	61.6	30.7	-	-
AAC Carver	48	73	8	3	26.0	233	61.4	30.6	32.7	-
LGPN4908	45	74	8	4	27.7	224	61.6	29.6	-	-
Salamanca	48	75	8	3	29.7	245	60.8	29.2	32.4	-
Earlystar	48	74	10	3	25.4	204	61.2	29.2	-	-
Jetset	46	73	8	5	28.3	227	60.3	28.5	27.9	-
LGPN4913	46	73	7	4	27.3	236	61.2	28.2	-	-
LGPN4912	43	73	6	5	27.2	235	62.2	28.0	-	-
CDC Inca	49	77	10	2	27.4	217	62.3	27.8	-	-
LGPN4909	44	74	8	3	29.1	234	61.1	27.6	-	-
Hyline	47	74	6	4	27.0	217	61.2	27.2	32.6	33.8
LGPN4249	48	75	12	2	26.4	281	61.2	27.0	-	-
CDC Amarillo	49	76	11	2	26.3	241	62.0	26.7	28.4	29.3
Durwood	48	75	12	3	26.6	231	60.6	26.6	31.8	32.8
Majestic	49	76	11	2	28.1	245	60.9	25.2	-	-
LG Amigo	45	75	7	5	29.6	200	60.4	23.6	-	-
Green Cotyledon Type										
Arcadia	45	73	8	6	25.5	199	60.5	32.0	30.9	32.0
CDC Striker	46	72	8	7	26.0	192	60.4	31.2	29.4	32.2
LGPN1125	48	75	8	3	27.2	274	60.5	30.2	-	-
Bluemoon	48	73	7	5	26.1	229	60.7	28.8	-	-
Greenwood	46	72	9	6	23.0	189	61.3	28.4	-	-
Pro 121-7126	46	72	8	5	25.0	188	60.5	27.8	-	-
LG Koda	50	74	7	4	25.2	216	62.1	27.6	-	-
CDC Greenwater	50	78	11	1	26.1	248	61.6	27.3	-	-
Viper	45	72	7	5	28.5	215	59.4	27.1	26.2	-
Banner	42	71	6	7	23.6	190	60.6	26.1	-	-
Cruiser	43	71	7	6	25.9	209	59.8	24.8	27.9	28.1
Ginny	45	73	8	5	25.6	183	60.6	24.5	-	-
Shamrock	49	76	9	3	27.9	221	61.7	23.4	-	-
AAC Comfort	52	79	11	2	26.3	264	60.9	23.3	-	-
LGPN1131	46	72	8	5	27.4	206	60.2	23.0	-	-
Mean	46	74	9	4	26.8	227	61.1	29.3	-	-
CV%	2.0	1.5	29.9	32.6	2.4	6.0	0.6	10.4	-	-
LSD 0.05	1.3	1.5	3.6	1.7	0.9	18.9	0.5	4.3	-	-
LSD 0.10	1.7	2.0	4.8	2.3	1.2	25.0	0.7	5.6	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Spring Wheat

Planted: 05/09/2018. Harvested: 08/01/2018.

Soil test (0-6"): P=43 ppm; K=332 ppm; pH=6.3; OM=2.0%. Soil type: Williams-Bowbells loam.

(0-24"): NO3-N=35 lb/a.

Applied fertilizers in lb/a: N=5.4; P_2O_5=18; K_2O=4.5; S=0.5, seed inoculated with peat-based inoculant at planting.

[1]DAP = Days after planting.

[2]Lodging: 0 = none, 9 = lying flat on the ground. [3]Protein adjusted to 0% moisture. [4]Yield and test weight were adjusted at 13.5% moisture.

*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017.

Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield.

6/23/18: Wind speed=46 mph; Precipitation=1.53". 6/28/18: Wind speed=61 mph; Precipitation=0.94"; Hail. 7/9/18: Wind speed=48 mph; Precipitation=1.67".

Field Pea Divide Dryland Variety Trial - NDSU **Divide County, ND 2018**

Variety	Protein†	1000 Seed Weight	Test Weight	Yield*		
				2018	2-Yr Avg	3-Yr Avg
	(%)	(g)	(lb/bu)	-------(bu/a)-------		
Yellow Cotyledon Type						
DS Admiral	24.3	265.7	62.4	31.5	28	33.3
Agassiz	25.9	225.8	61.2	45.3	38	43.0
Spider	27.2	231.9	62.6	34.0	-	-
Nette 2010	24.4	262.2	64.4	33.3	30	-
Green Cotyledon Type						
Majoret	26.5	246.1	62.7	28.0	-	-
Arcadia	26.1	194.0	62.3	42.6	38	38.4
Mean	25.8	237.6	62.6	35.8	-	-
CV (%)	4.8	5.7	0.8	5.1	-	-
LSD (5%)	2.2	24.8	0.9	3.3	-	-
LSD (10%)	1.8	20.2	0.7	2.7	-	-

Location: Crosby, ND; Latitude 48° 8' N; Longitude 103° 18' W; Elevation 2044 ft. Previous crop: Soybean
Planted: 06/04/2018. Harvested: 08/31/2018
Soil test (0-6"): N/A. Soil type: Farnuf-Alkabo
(0-24"): NO3-N=24 lb/a.
Applied fertilizers in lb/a: N=5.4, P=18.0. S=4.5, seed inoculated with peat-based inoculant at planting.
†Protein adjusted to 0% moisture. *Yield adjusted to 13.5% moisture

EARC pea harvest - counting seeds in greenhouse

Dryland Green Dry Pea Variety Evaluation - MSU **EARC, Sidney, MT 2018**

Green Dry Pea Variety	Days to Flower DAP[1]	Plant Height (in)	Protein (%)	Test weight (lb/bu)	Adjusted Grain Yield (lb/ac)
AAC Comfort	56	17.3	22.4	63.9	2095
Aragorn	50	13.4	22.9	63.8	1251
CDC Greenwater	55	20.1	21.9	64.5	2053
Hampton	55	15.7	25.3	63.2	1556
Majoret	54	16.5	23.6	64.3	1381
PS0877MT457	50	18.5	25.4	63.4	1329
PSO826MT190	55	18.5	23.8	63.6	1822
PSO877MT076	52	17.3	22.1	63.3	2000
Mean	51	17.3	22.9	64.6	1686
P-Value	<0.0001	0.0154	0.0016	0.0003	0.0019
LSD (0.05)	1.1	3.9	1.8	0.69	394
CV (%)	1.27	13.71	4.88	0.66	14.34

Dryland Yellow Dry Pea Variety Evaluation - MSU **EARC, Sidney, MT 2018**

Yellow Dry Pea Variety	Days to Flower DAP[1]	Plant Height (in)	Protein (%)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
AAC Carver	51	20.5	20.6	64.5	2299
AC Earlystar	51	20.1	20.5	64.2	1687
Agassiz	50	19.3	23.1	64.0	2105
CDC Amarillo	55	17.3	23.2	64.8	1866
CDC Inca	55	21.7	24.0	64.5	2321
CDC Saffron	54	16.9	22.9	65.0	2124
CDC Spectrum	55	16.9	24.5	64.3	1965
Delta	50	13.8	23.4	64.0	1384
DS Admiral	51	16.1	22.5	65.3	1753
Jetset	51	16.5	23.3	65.1	1767
Navarro	50	16.1	22.8	64.5	1676
Nette 2010	50	15.0	22.7	65.9	1951
PSO826MT460	50	15.4	22.7	64.3	1642
PSO826MT492	50	15.4	23.2	64.6	1829
PSO877MT632	50	18.1	25.4	64.1	1938
Mean	51	17	22.9	64.6	1887
P-Value	<0.0001	0.0154	0.0016	0.0003	0.0075
LSD (0.05)	1.1	3.9	1.83	0.69	421
CV (%)	1.3	13.7	4.9	0.7	13.7

Location: Sidney, MT — Previous crop: Wheat
Planted: April 25, 2018 — Harvested: July 25, 2018
Applied fertilizers in lb/a: None — Soil type: Williams Clay Loam
Yield adjusted to 13% moisture content — Rain fall (Apr-Aug) = 9.43"
Irrigation = None

Herbicide Prowl H2O, Roundup and Outlook at 2.5 pt/ac, 22 oz/ac and 21 oz/ac, respectively.
DAP[1] = Days after planting

Irrigated Green Dry Pea Variety Evaluation - MSU **EARC, Sidney, MT 2018**

Green Dry Pea Variety	Days to Flower DAP[1]	Plant Height (in)	Protein (%)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
AAC Comfort	55	24.0	20.1	64.23	3260
Aragorn	47	20.5	17.8	63.67	2184
CDC Greenwater	52	24.4	18.3	64.83	3166
Hampton	50	20.9	19.0	64.17	3179
Majoret	51	20.9	18.0	64.20	2442
PS0877MT457	47	20.1	21.2	63.73	2682
PSO826MT190	51	23.2	18.6	64.33	2925
PSO877MT076	50	21.7	16.2	64.60	3094
Mean	50	22.0	18.7	64.22	2866
P-Value	<0.0001	0.2309	0.0029	0.0756	0.0015
LSD (0.05)	1.5	NS	1.8	NS	435
CV (%)	1.79	10.46	5.93	0.68	9.29

Irrigated Yellow Dry Pea Variety Evaluation - MSU **EARC, Sidney, MT 2018**

Yellow Dry Pea Variety	Days to Flower DAP[1]	Plant Height (in)	Protein (%)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
AAC Carver	49	22.8	16.9	64.83	2299
AC Earlystar	49	23.6	15.3	64.23	1687
Agassiz	49	22.0	16.1	64.27	2105
CDC Amarillo	51	24.8	16.3	65.23	1866
CDC Inca	52	23.2	16.9	64.83	2321
CDC Saffron	50	21.7	16.0	65.30	2124
CDC Spectrum	51	23.2	18.7	65.17	1965
Delta	47	18.1	16.7	63.87	1384
DS Admiral	48	19.7	15.9	64.77	1753
Jetset	48	21.3	19.0	64.53	1767
Navarro	47	3.1	18.1	64.37	1676
Nette 2010	47	20.9	18.2	65.20	1951
PSO826MT460	47	18.5	16.6	63.23	1642
PSO826MT492	48	22.0	16.7	64.97	1829
PSO877MT632	49	22.0	18.3	64.23	1938
Mean	49	22	17.1	64.59	1887
P-Value	<0.0001	0.0496	0.0363	<0.0001	0.0075
LSD (0.05)	0.8	10	2.16	0.67	421
CV (%)	0.99	11.18	7.78	0.64	13.66

Location: Sidney, MT — Previous crop: Wheat
Planted: April 27, 2018 — Harvested: July 30, 2018
Applied fertilizers in lb/a: None — Soil type: Williams Clay Loam
Yield adjusted to 13% moisture content — Rain fall (Apr-Aug) = 9.43"
Irrigation = 2.68"

Herbicide Prowl H2O, Roundup and Outlook at 2.5 pt/ac, 22 oz/ac and 21 oz/ac, respectively.
DAP[1] = Days after planting

Green Dry Pea Variety Evaluation - MSU **Richland, MT 2018**

Green Dry Pea Variety	Plant Height (in)	Protein (%)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
AAC Comfort	28	20.3	64.1	3230
Aragorn	26	21.8	63.6	2519
Bluemoon	27	20.2	64.4	2671
CDC Dakota	29	22.1	64.7	2161
CDC Greenwater	30	20.3	63.9	2723
Empire	36	20.7	64.2	2576
Ginny	25	21.5	64.2	2649
Hampton	24	22.7	63.4	3102
Majoret	25	21.9	64.6	1937
Pro 121-7126	24	21.3	63.7	2710
Pro 121-7127	30	19.5	63.7	3281
Pro 131-7123	26	20.9	63.8	2678
PS0877MT457	27	22.6	64.2	2906
PSO826MT190	32	21.3	63.9	2507
PSO877MT076	26	20.2	63.4	3107
Shamrock	30	20.5	64.8	2707
SW Arcadia	21	20.7	64.2	2371
Mean	27.6	21.08	64.0	2696
P-Value	<0.0001	<0.0001	0.0408	<0.0001
LSD (0.05)	3.3	0.54	0.86	486
CV (%)	8.5	1.8	1.0	12.8

Yellow Dry Pea Variety Evaluation - MSU **Richland, MT 2018**

Yellow Dry Pea Variety	Plant Height (in)	Protein (%)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
AAC Asher	23	21.0	64.7	3142
AAC Carver	30	19.7	64.8	2632
AAC Chrome	27	19.3	64.0	3253
AAC Profit	31	22.1	64.5	2816
AC Earlystar	32	19.1	64.1	2834
Agassiz	32	20.6	63.3	3242
Bridger	27	20.6	63.8	2728
CDC Amarillo	30	21.1	64.0	2110
CDC Inca	31	21.3	63.6	2148
CDC Saffron	23	21.8	64.5	3238
CDC Spectrum	25	22.5	64.6	2818
Delta	23	22.1	64.5	2995
DS Admiral	28	21.4	64.8	2195
Durwood	32	21.1	64.4	2616
Hyline	28	19.6	64.5	2834
Jetset	29	21.8	65.0	2303

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Yellow Dry Pea Variety Evaluation - MSU **Richland, MT 2018**

Yellow Dry Pea Variety	Plant Height (in)	Protein (%)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)
Korando	26	21.7	63.9	2878
LG Amigo	27	21.0	63.6	2644
LG Sunrise	31	19.5	64.8	2372
LL-1	31	20.3	64.7	2660
LL-2	30	21.2	64.2	2484
Majestic	31	21.4	64.1	2925
Navarro	26	21.9	64.0	2851
Nette 2010	28	20.2	65.2	3191
Pro 093-7410	26	18.4	64.6	3143
Pro 133-6243	25	21.2	63.9	3010
Pro 143-6230	25	23.0	63.3	2480
Pro 143-6236	23	20.3	64.7	2908
Pro 153-7405	27	21.9	63.3	2714
PSO7100925	22	21.3	63.5	2703
PSO8101022	25	20.9	64.4	2673
PSO826MT460	26	20.9	64.0	2710
PSO826MT492	25	21.7	64.1	2579
PSO877MT632	26	23.0	64.3	3076
Salamanca	28	21.5	64.0	2362
Spider	29	21.3	64.2	2348
Mean	27.56	21.03	64.2	2739.0
P-Value	<0.0001	<0.0001	<0.0001	<0.0001
LSD (0.05)	3.4	0.77	0.77	555
CV (%)	8.7	2.6	0.9	14.3

Location: Richland, MT Previous crop: Canola

Planted: May 7, 2018 Harvested: Aug. 15, 2018

Yield adjusted to 13% moisture content

Chickpea Dryland Variety Trial - NDSU **WREC, Williston, ND 2018**

Variety	Days to Flower	Days to Mature	Plant height	Seed Size				1000 Seed Weight	Test weight	Yield		
				<8mm	>8mm	>9mm	>10mm			2018	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(DAP[1])	(in)	(%)	(%)	(%)	(%)	(g)	(lb/bu)		(lb/a)	
Desi												
CDC ANNA	39	82	13	99.2	0.9	0.0	0.0	211.2	60.3	1774.0	1178	1489
Kabuli												
CDC FRONTIER	44	88	14	59.3	37.1	3.6	0.2	351.5	61.3	1513.0	1297	1563
CDC LUNA	40	86	14	46.4	46.8	6.8	0.1	373.0	61.7	1929.7	1081	1347
CDC ORION	38	86	12	24.3	49.7	24.9	1.1	428.4	61.2	1763.7	-	-
NASH	43	88	14	8.5	28.4	47.4	19.2	550.6	60.0	1336.7	-	-
ROYAL	44	86	13	14.0	36.4	39.6	10.1	512.5	60.1	1433.0	-	-
SAWYER	39	85	14	43.1	38.2	24.4	2.0	416.9	62.0	1663.7	987	1244
SIERRA	42	88	14	22.3	47.3	32.3	2.9	457.3	60.5	1239.7	712	983
CDC Palmer	38	84	13	31.0	55.5	13.7	0.0	403.2	60.8	1888.7	-	-
CDC Leader	38	83	11	40.9	49.1	9.9	0.1	392.8	61.4	1956.7	-	-
B14	40	88	16	14.6	47.4	35.3	2.3	466.9	60.6	1707.0	-	-
Mean	41	86	13	36.7	39.7	21.6	3.5	414.9	60.9	1655.1	-	-
CV (%)	2.3	1.9	8.5	11.0	9.9	13.0	36.5	2.4	1.3	9.0	-	-
LSD (5%)	1.5	2.7	1.9	6.1	6.2	5.5	2.5	17.3	1.3	231.3	-	-
LSD (10%)	1.3	2.3	1.6	5.1	5.2	4.6	2.1	14.4	1.1	192.6	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft — Previous crop: Spring Wheat
Planted: 05/10/2018 — Harvested: 08/21/2018
Soil test (0-6"): P=43 ppm; K=332 ppm; pH=6.3; OM=2.0% — Soil type: Williams-Bowbells loam
(0-24"): NO3-N=35 lb/a
Applied fertilizers in lb/a: none; seed inoculated with a peat-based inoculant at planting
[1]DAP= Days after planting
*Averages of years 2016 and 2017. **Averages of years 2015, 2016, and 2017
Note: Trial received heavy rain, wind, and hailstorms that damaged the crop and adversely affected yield:
06/23/2018: Wind speed=46 mph; Precipitation=1.53".
06/28/2018: Wind speed=61 mph; Precipitation=0.94"; Hail.
07/09/2018: Wind speed=48 mph; Precipitation=1.67".

"Family farm children learn respect:
Respect for animals, for the weather, for their elders.
And, above all, respect for the land."
Jerry Apps

Dryland Chickpea Variety Evaluation - MSU **EARC, Sidney, MT 2018**

Chickpea Variety	Plant Height (in)	Grain Yield (lb/ac)	Percent above 22/64
CDC Frontier	16.8	397	40.1
CDC Leader	14.4	448	42.1
CDC Orion	14.6	192	28.5
CDC Palmer	14.3	565	49.2
Myles	13.9	547	0.0
Nash	15.1	8	39.9
Royal	18.1	32	20.9
Sawyer	17.6	150	39.0
Sierra	15.7	14	25.3
Mean	15.6	261	31.7
P-Value		0.2424	<0.0001
LSD (0.05)		NS	10.4
CV (%)		14.1	23.3

Location: Sidney, MT — Previous crop: Wheat
Planted: April 27, 2018 — Harvested: Aug. 25, 2018
Applied fertilizers in lb/a: None — Rain fall (Apr-Aug) = 9.43"
Soil type: Williams Clay Loam — Irrigation = none

Test Weight: not enough seed to measure test wt.

Herbicide Prowl H2O, Roundup and Outlook at 2.5 pt/ac, 22 oz/ac and 21 oz/ac, respectively.

Irrigated Chickpea Variety Evaluation - MSU **EARC, Sidney, MT 2018**

Chickpea Variety	Plant Height (in)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)	Percent above 22/64
CDC Frontier	23.9	61.4	3445	16.4
CDC Leader	20.1	62.2	3422	31.4
CDC Orion	22.4	60.8	3701	49.7
CDC Palmer	24.0	61.2	3428	32.7
Myles	18.9	59.7	2584	0.0
Nash	21.5	60.5	2037	66.2
Royal	20.1	60.4	1993	35.8
Sawyer	20.3	61.6	2346	12.6
Sierra	21.8	60.4	2012	34.9
Mean	21.5	60.9	2774	31.1
P-Value	0.3949	0.0840	0.0009	<0.0001
LSD (0.05)	NS	NS	809	13
CV (%)	13.5	1.4	17.9	25.7

Location: Sidney, MT — Previous crop: Sugarbeet
Planted: April 27, 2018 — Harvested: Aug. 25, 2018
Applied fertilizers in lb/a: None — Soil type: Williams Clay Loam
Yield adjusted to 13% moisture content — Rain fall (Apr-Aug) = 9.52"
Irrigation = 2.68"

Herbicide Prowl H2O, Roundup and Outlook at 2.5 pt/ac, 22 oz/ac and 21 oz/ac, respectively.

Chickpea Variety Evaluation - MSU **Richland, MT 2018**

Chickpea Variety	Plant Height (in)	Test Weight (lb/bu)	Adjusted Grain Yield (lb/ac)	Percent above 22/64
CDC Frontier	15.4	63.3	1581	48.5
CDC Leader	15.2	63.4	1275	58.5
CDC Orion	14.8	62.9	1290	72.4
CDC Palmer	16.0	63.2	1342	67.0
GNC-18010	20.1	65.2	1287	14.1
Myles	15.2	60.8	1036	0.0
Nash	16.3	62.2	908	79.3
Royal	16.8	62.2	627	61.2
Sawyer	16.7	63.1	937	80.7
Sierra	16.4	62.4	706	63.9
Mean	16.3	62.8	1099	54.5
P-Value	0.0870	0.0001	<0.0001	<0.0001
LSD (0.05)	NS	0.96	227	18
CV (%)	10.4	1.1	14.4	22.7

Location: Richland, MT Previous crop: Canola

Planted: May 8, 2018 Harvested: Aug. 16, 2018

Yield adjusted to 13% moisture content Soil type: Williams Clay Loam

EARC summer students, Bridger Larson &
Aaron Entz. Photo by Calla Kowatch-Carlson

Dryland Crop Performance Comparisons – Williston, ND 2018

Gautam Pradhan, Jerald Bergman, Kyle Dragseth

Crop	Type	Variety	Yield 3 Year Avg*	Market Price†	Gross Return	+ or - Bolles
			(bu/a)	($/bu)	($/a)	($/a)
HR Spring Wheat		Bolles	33.7	5.39	181.58	0.00
HR Winter Wheat		Jerry	43.9	4.90	215.34	33.77
Durum Wheat		Joppa	30.6	4.90	149.94	-31.64
Barley	(Feed)	Conlon	50.5	2.50	126.28	-55.30
	(Malt)	Hockett	63.5	3.00	190.39	8.82
Oats		Jury	70.2	1.80	126.38	-55.20
Corn		Average	59.6	3.20	190.85	9.27
Flax		Average	20.2	10.00	201.70	20.12
Soybeans	(Conventional)	Average	23.9	7.15	171.03	-10.55
Field Peas	(Green)	Arcadia	32.0	5.50	176.00	-5.58
	(Yellow)	Agassiz	34.1	5.00	170.50	-11.08
			lb/a	$/CWT		
Canola		Star 402	1552	15.21	236.06	54.48
Safflower		MonDak	1774	18.00	319.28	137.70
Sunflower	(Oil)	Cobalt II	2271	16.00	363.36	181.78
Lentils	(Medium green)	Avondale	1671	12.00	200.52	18.94
	(Small green)	ND Eagle	1475	11.50	169.63	-11.95
	(Small red)	CDC Rouleau	1661	8.00	132.88	-48.70
Chickpeas	(Large Kabuli)	CDC Frontier	1563	20.00	312.60	131.02
	(Small Kabuli)	B-90	1323	15.00	198.50	16.92

*Averages from 2015,2016, and 2017. †The market price was obtained in the second week of December 2018 from grain elevators in and around Williston. The Wheat price was adjusted for protein premium by using a linear equation obtained by plotting wheat market prices against percent proteins. In the case of durum, the choice rate was used.

‡Average of several varieties and/or types within the crop.

WREC drone demonstration

Drone-based High Throughput Phenotyping in Support of Cereal Breeding

Gautam Pradhan[1], Joel K. Ransom[2], Jerald W. Bergman[1]

[1]WREC, Williston, ND; [2]NDSU, Fargo, ND

(Funded by NDAES Precision Agriculture Grant)

In North Dakota, about 99% of field crops are non- irrigated, and drought is the single most important abiotic factor affecting yield and quality of dryland crops. It is imperative to develop stress tolerant varieties to mitigate the effect of drought stress on field crops. Plant physiological traits such as the normalized difference vegetation index (NDVI), normalized difference red edge (NDRE), and canopy temperature (CT) are directly related to crop growth and yield; a stress tolerant crop usually has higher NDVI/NDRE and low CT as compared to susceptible crop. These traits, when measured frequently during the growing season, may help in the identification of high yielding drought tolerant genotypes. Thus, there is a need of an application of PRECISION AGRICULTURE; i.e., an application of high throughput phenotyping system comprising of geographic information systems, remote sensing, and geographic positioning system that enable the measurement of physiological/canopy data from thousands of plots quickly (within minutes), frequently (6-7 times during the growing season), and accurately (georeferenced).

Objective

The objective of this project is to evaluate the usefulness of high-resolution geotagged data collected by using an unmanned aircraft system (UAS, drone) equipped with multispectral, thermal, and RGB cameras/sensors in quantifying plant stand; plant height, plant health (NDVI, NDRE, CT) and heading date of cereal breeding nursery plots efficiently and accurately.

Materials and Methods

In the spring of 2018, a newly purchased drone (DJI MATRICE 600 PRO), a multispectral camera (Micasense RedEdge-M), and RGB camera (DJI Zenmuse Z3) were assembled, calibrated, and tested. The UAS system, thus built, was flown over the barley and durum breeding nurseries using Pix4D Capture App installed in an iPad. The images (~1000 photos) thus collected were processed in Agisoft Photoscan to generate DEM and orthophoto; which were subsequently used in QGIS to create raster images of NDVI, NDRE, and canopy height. Ultimately, the ArcGIS software along with python script was used to calculate and quantify plot wise mean NDVI, NDRE, and Maximum canopy height plot.

Picture 1. DJI MATRICE 600 PRO.

Picture 2. Micasense RedEdge-M.

Picture 3. DJI Zenmuse Z3.

Results

We have successfully generated RGB, NDVI and NDRE raster images of entire barley and durum breeding nurseries (Fig. 1a, b, and c, respectively). The mean NDVI, NDRE, and maximum canopy height of each barley breeding plot were quantified, and the plots were classified into 5 to 11 categories (Fig. 2, 3, 4). The illustrated images were generated from aerial photos collected on July 10, 2018.

Summary

The results showed that an unmanned aircraft system may be successfully used in quantifying plant health (NDVI, NDRE) and plant height of thousands of breeding nursery plots efficiently and quickly. The system will be tested again in the spring of 2019 to quantify above mention traits along with canopy temperature, plant stand, and heading dates.

a) RGB Raster Image. b) NDVI Raster Image. c) NDRE Raster Image

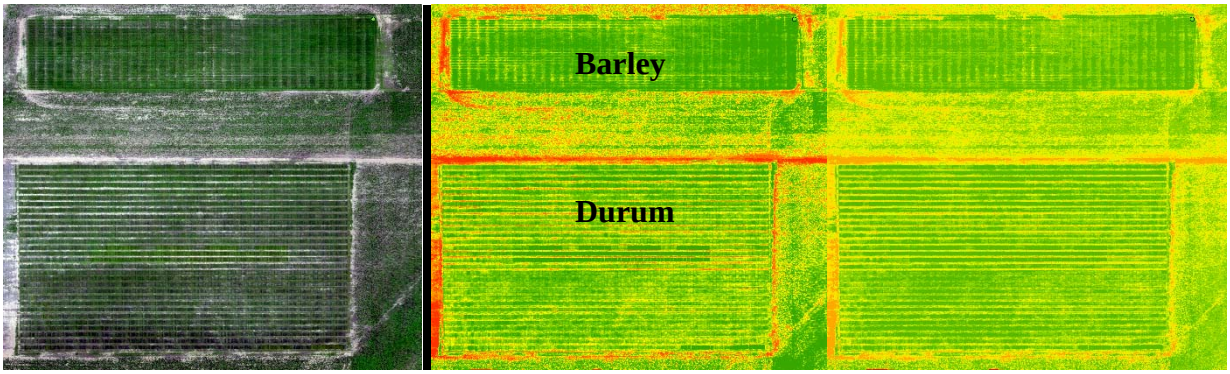

Figure 1. Raster images of barley (top) and durum (bottom) breeding nurseries.

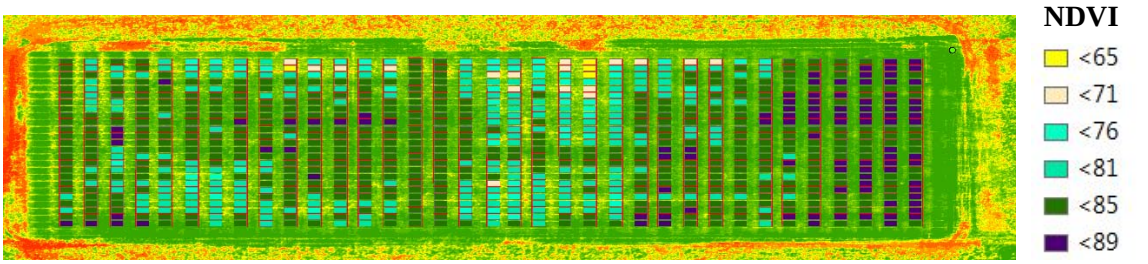

Fig. 2. Mean NDVI of barley breeding plots.

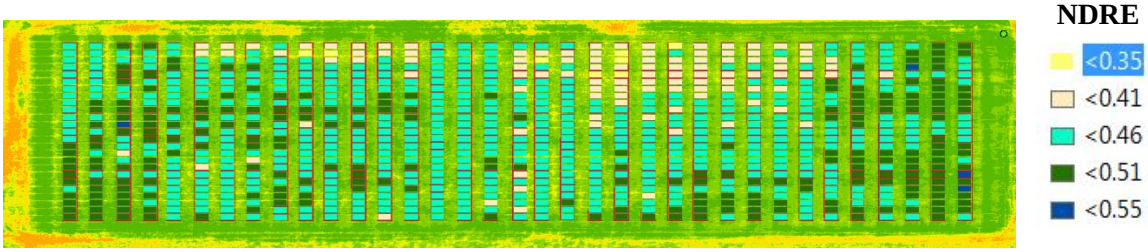

Fig. 3. Mean NDRE of barley breeding plots.

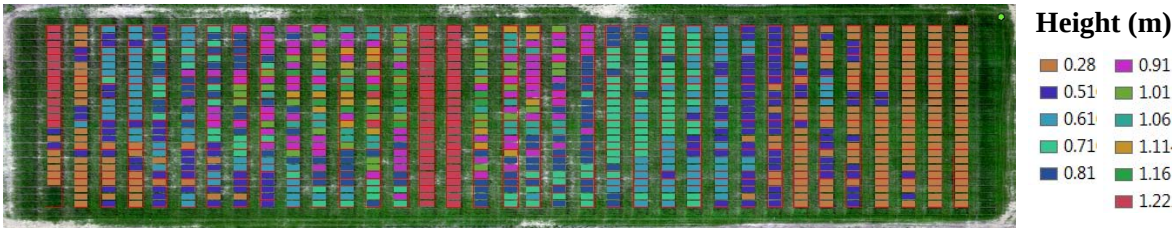

Fig. 4. Maximum canopy height of barley breeding plots.

Sustainable Agroecosystem for Soil Health in the Northern Great Plains (Williston, ND - 2018)

Gautam Pradhan[1], Jim Staricka[1], Audrey Kalil[1], Don Tanaka[1], Jerry Bergman[1], Bart Stevens[2], Upendra Sainju[2], Dimitri Fonseka[1], Kyle Dragseth[1], David Weltikol[1], Cameron Wahlstrom[1], Lyn Soldberg-Rodier[2]

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This long-term dryland research project was initiated in 2013 with the objectives of developing agricultural systems that improve soil health, crop production, precipitation use, and economic sustainability of no-till dryland farming systems in the Northern Great Plains of the USA. In this project, there are five fixed and six dynamic rotations. Every year, each phase of every fixed rotation has been included. The experimental design is randomized complete block with four replications. The plot size is 60 ft. x 200 ft.

Experimental Details

- Treatments:
  - 5 Fixed Rotations and 6 “Dynamic” Rotations.
  - Each phase of every rotation included each year (fixed rotations).
- Field Design:
  - Randomized Complete Block; 4 Replications.
  - Individual plots are 60 by 200 feet. Total area (including roadways and borders) is 40 acres.
- All plots are No-Till.

The 5 Fixed Rotations

2013	2014	2015	2016	2017	2018
Durum	Fallow	Durum	Fallow	Durum	Fallow
Durum	Durum	Durum	Durum	Durum	Durum
Durum	BP1*	Pea	Corn	Safflower	Durum
Durum	WW/ BP2	Pea/BP3	Corn	Safflower	Durum
……...Perennial Grass Mix with Pollinator……..					

* BP1 = Biological primer 1; BP2 = Biological Primer 2; BP3 = Biological Primer 3; WW = Winter Wheat.

What are the Biological Primers?

- Biological Primer 1 (BP1) is a full season cover crop mix, seeded between June 1st and June 20th.
  Pearl millet (3.5)†, Sorghum × Sudan (3.5), Turnip (1.0), Radish (2.0), Berseem clover (1.0), Sunflower (2.0), Soybean (15.0), Cowpea (10.0), Flax (1.0), Hairy vetch (3.0), Mammoth red clover (1.0), Phacelia (2.0), and Italian ryegrass (3.0).
- Biological Primer 2 (BP2) is a cover crop mix seeded after winter wheat but before August 10th.
  Turnip (1.0), Radish (2.0), Kale (1.0) Lentil (5.0), Oats (30.0), Sweet clover (1.0), and Buckwheat (2.0).
- Biological Primer 3 (BP3) is a cover crop mix seeded after pea.
  Triticale (40.0), Hairy vetch (2.0), Common alfalfa (2.0), Mammoth red clover (2.0), Turnip (1.0), and Radish (2.0).

†The numbers in brackets are the seeding rates in lb/a.

"Dynamic" Rotations

- Crops in the dynamic rotations will be determined each year based on weather and market conditions and using the following tools:
  - The USDA-ARS Crop Sequence Calculator (An interactive program for viewing crop sequencing information and calculating returns; www.mandan.ars.usda.gov)
  - The NDSU Projected Crop Budgets for Northwest North Dakota (www.ag.ndsu.edu/publications/farm-economics-management).
- The crops will include a mix of cool-and warm-season grasses and broadleaves.
- Each year durum will be grown in one of the rotations to serve as a comparison.

The Dynamic Rotations

2013	2014	2015	2016	2017	2018
Durum	WW*	Lentil	WW	Chickpea	Durum
Corn	Soybean	Durum	Corn	Soybean	HRSW
Soybean	Sunflower	Barley	Pea	WW	Flax
Safflower	Barley	Pea	Durum	Lentil	WW
Sunflower	HRSW	WW	Lentil	Durum	Sunflower
Pea	Durum	Safflower	Barley	HRSW	Lentil

* SW = Spring Wheat; WW = Winter Wheat.

Measurements

- Crop Performance: leaf chlorophyll, canopy temperature, grain yield, protein or oil content, grain nitrogen and phosphorus, total dry matter, above ground biomass production, carbon and nitrogen ratio of above ground biomass, crop water use.
- Soil Quality: infiltration; aggregate stability; bulk density; organic matter amount, plant-available levels of nitrogen, phosphorus, potassium and other nutrients; pH; salinity.
- Diseases: tan spot, stripe rust, wheat streak mosaic virus and Fusarium head blight in durum.
- Soil microbial parameters: Microbial Biomass Carbon, Potential Carbon Mineralization, Neutral Lipid Fatty Acid analysis (NLFA) to measure beneficial fungi.

Results

Yield, Quality, and Economic Returns from Cash Crops Under Different Crop Rotations

There was a significant effect of treatment (crop rotation) on yield and test weight of durum and winter wheat. The durum yield from Treatment 2 (Durum-Fallow-Durum-Fallow-Durum; 56 bu/a) was statistically on par to the yield from Treatments 3 (Durum-Durum-Durum-Durum-Durum) and 14 (WW-Lentil-WW-Chickpea-Durum), but had 5–11 bushels more yield than from Treatments 4 (BP1-Pea-Corn-Safflower-Durum) and 9 (WW/BP2-Pea/BP3-Corn-Safflower-Durum) (Fig. 1A). The higher durum yield from Treatment 2 was due to Fallow in the previous year; and was consistent to the earlier year's results. The test weight of durum from Treatment 2, 3, and 14 was about 58.7 lb/bu, which was 3 lb/bu higher than from Treatment 4 and 9 (Fig 1B). The winter wheat yield from Treatment 17 (Barley-Pea-Durum-Lentil-WW; 49 bu/a) was 17 bushels higher than from Treatment 10 (Pea/BP3-Corn-Safflower-Durum-WW/BP2) (Fig 2A); and the test weight from Treatment 17 (61.5 lb/bu) was 2.3 lb/bu higher than from Treatment 10.

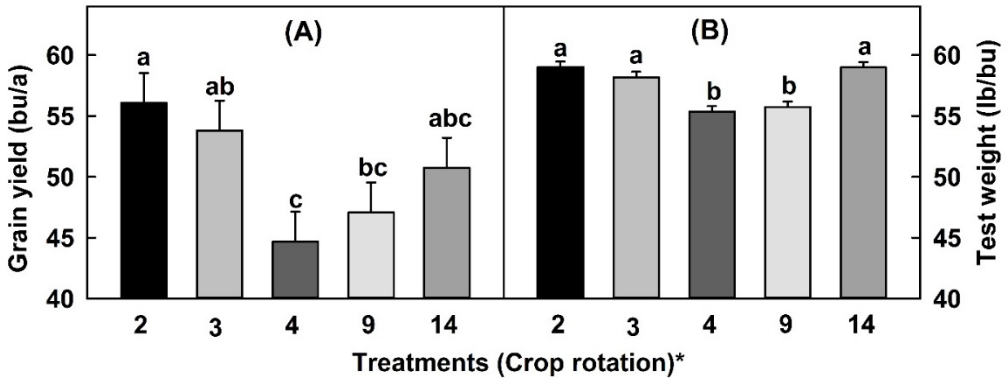


Figure 1. Yield and test weight of durum under different treatments.

*Crop rotations: 2 = Durum-Fallow-Durum-Fallow-Durum; 3 = Durum-Durum-Durum-Durum-Durum; 4 = BP1-Pea-Corn-Safflower-Durum; 9 = WW/BP2-Pea/BP3-Corn-Safflower-Durum; 14 = WW-Lentil-WW-Chickpea-Durum.

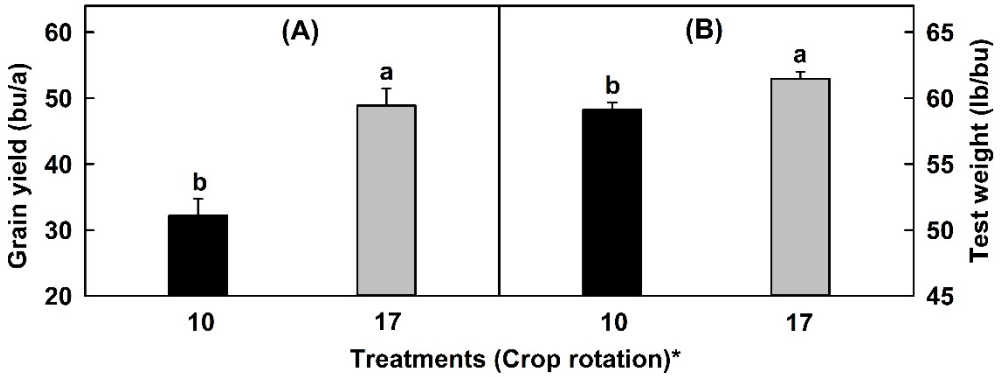


Figure 2. Yield and test weight of winter wheat under different treatments.

*Crop rotations: 10 = Pea/BP3-Corn-Safflower-Durum-WW/BP2; 17 = Barley-Pea-Durum-Lentil-WW.

The effect of crop rotation was not evident on the grain yield of other cash crops. Pea yield, averaged across the Treatments 6 (Corn-Safflower-Durum-BP1-Pea) and 11 (Corn Safflower-Durum-WW/BP2-Pea/BP3), was 45 bu/a; corn yield, averaged across the Treatments 7 (Safflower-Durum-BP1-Pea-Corn) and 12 (Safflower-Durum-WW/BP2-Pea/BP3-Corn), was 71 bu/a; and safflower yield, averaged across the Treatments 8 (Durum-BP1-Pea-Corn-Safflower) and 13 (Durum-WW/BP2-Pea/BP3-Corn-Safflower), was 1618 lb/a.

The grain yield of other cash crops were as follows: sunflower yield from Treatment 18 (HRSW-WW-Lentil-Durum-Sunflower) was 2232 lb/a; lentil yield from Treatment 19 (Durum-Safflower-Barley-HRSW-Lentil) was 1838 lb/a; hard red spring wheat yield from Treatment 15 (Soybean-Durum-Corn-Soybean-HRSW) was 31 bu/a; and flax yield from Treatment 16 (Sunflower-Barley-Pea-WW-Flax) was 31 bu/a.

This year, the biological primer BP2 from Treatment 10 (Pea/BP3-Corn-Safflower-Durum-WW/BP2), and biological primer BP3 from Treatment 11 (Corn-Safflower-Durum-WW/BP2-Pea/BP3) did not produce biomass. The biomass yield of the biological primer (BP1) from Treatment 5 (Pea-Corn-Safflower-Durum-BP1) was 4939 lb/a, and that of perennial mix from Treatment 20 (PM-PM-PM-PM-PM) was 1841 lb/a.

Table 1 shows the economic returns from cash crops in 2014, 2015, 2016, 2017, and 2018 under different crop rotations, and the average net return from each Treatment (crop rotation). The information is a report of observed results and is not intended to be used by producers in making financial decisions.

Table 1. The Economic Returns from Different Crop Rotations.

Rotations		Treatments	2014		2015		2016		2017		2018						
			Crop	Net Return*	Crop	Net Return*	Crop	Net Return*	Crop	Net Return*	Crop	Yield	Price†	Revenue	Direct Cost‡	Net Return*
#	Type	#		($/a)		($/a)		($/a)		($/a)		(bu or lb/a)	($/bu or lb)	($/a)	($/a)	($/a)
I**	Fixed	1	Fallow	-24.58	Durum	125.35	Fallow	-23.35	Durum	52.49	Fallow	0.00	0.00	0.00	23.35	-23.35
	Fixed	2	Durum	255.15	Fallow	-23.09	Durum	176.82	Fallow	-23.49	Durum	56.07	4.75	266.33	139.67	126.66
II	Fixed	3	Durum	202.15	Durum	64.28	Durum	150.13	Durum	57.55	Durum	53.80	4.75	255.55	139.67	115.88
III	Fixed	4	BP1	42.28	Pea	68.62	Corn	-10.81	Safflower	27.51	Durum	44.68	4.75	212.23	139.67	72.56
	Fixed	5	Pea	175.16	Corn	-36.61	Safflower	116.88	Durum	18.91	BP1	4938.95	0.03	133.35	57.37	75.98
	Fixed	6	Corn	30.21	Safflower	-6.08	Durum	121.66	BP1	107.06	Pea	43.71	5.00	218.55	143.28	75.27
	Fixed	7	Safflower	54.89	Durum	8.54	BP1	33.79	Pea	72.36	Corn	74.56	2.89	215.48	219.67	-4.19
	Fixed	8	Durum	145.15	BP1	90.00	Pea	37.34	Corn	-123.75	Safflower	1583.72	0.18	285.07	125.76	159.31
IV	Fixed	9	WW/BP2	64.57	Pea/BP3	71.20	Corn	-14.72	Safflower	38.25	Durum	47.07	4.75	223.58	139.67	83.91
	Fixed	10	Pea/BP3	211.64	Corn	-58.70	Safflower	95.49	Durum	4.39	WW/BP2	32.16	3.91	125.75	140.28	-14.53
	Fixed	11	Corn	14.82	Safflower	-44.11	Durum	110.14	WW/BP2	-7.96	Pea/BP2	47.21	5.00	236.05	143.28	92.77
	Fixed	12	Safflower	42.82	Durum	-10.37	WW/BP2	-15.03	Pea/BP3	-39.01	Corn	67.20	2.89	194.21	219.67	-25.46
	Fixed	13	Durum	145.15	WW/BP2	-29.24	Pea/BP3	82.08	Corn	-119.26	Safflower	1652.28	0.18	297.41	125.76	171.65
V	Dynamic	14	WW	55.72	Lentil	496.99	WW	8.39	Chickpea	269.46	Durum	50.76	4.75	241.11	139.67	101.44
	Dynamic	15	Soybean	16.64	Durum	98.17	Corn	-13.30	Soybean	-59.71	SW	30.78	4.90	150.82	137.57	13.25
	Dynamic	16	Sunflower	121.10	Barley	7.55	Pea	87.28	WW	8.92	Flax	30.89	10.00	308.92	106.28	202.64
	Dynamic	17	Barley	108.56	Pea	88.12	Durum	171.13	Lentil	38.41	WW	48.87	3.91	191.08	140.28	50.80
	Dynamic	18	SW	-36.48	WW	-22.49	Lentil	490.85	Durum	48.11	Sunflower	2232.25	0.15	340.42	177.05	163.37
	Dynamic	19	Durum	226.15	Safflower	23.82	Barley	125.22	SW	48.73	Lentil	1838.15	0.13	238.96	157.62	81.34
VI	Fixed	20	Per. Mix	105.89	Per. Mix	-8.26	Per. Mix	85.15	Per. Mix	74.51	Per. Mix	1841.70	0.03	49.73	8.26	41.47

†The market prices were obtained from grain elevators in and around Williston on November 29, 2018. ‡The direct costs were calculated from the estimations given in the 'North Dakota 2018 Projected Crop Budgets - North West' by Andrew Swenson. *Net Return = Revenue - Direct cost. **This rotation has a Fallow component, therefore the durum yield was consistently high. ***BP1 = Biological Primer 1; BP2 = Bio. Primer 2, BP3 = Bio. Primer 3; Yield and economic return from BP2 and BP3 are not included. #Per=Perennial; in 2013, 2014, and 2015, the hay production from Perennial Mix were not estimated that resulted into a negative net return. SW = Spring Wheat; WW = Winter Wheat.

Water Use Efficiency of Durum

Durum is included in five of the different cropping sequences. The soil wetness at the time of durum planting varies depending on the water use characteristics of the preceding crop. This provides an opportunity to determine the effect of water availability on durum yield. Beginning in 2015, we measured soil water during the entire growing season at one- to two- week intervals. Thus, data from four years are available for this analysis.

This year, the soil was slightly wetter than the 4-yr average conditions at both planting and at harvest (Table S1). The soil water extraction was less than the 4-yr average. Rainfall during the 2018 growing

season was greater than any of the previous three years, consequently, the fraction of water from rain was at a 4-yr high. This year, durum yields averaged 50.5 bu/a, which was a 4-yr high, and water use efficiency, defined as the bushels produced per inch of water used, was also at a 4-yr high.

A more realistic view of the relationship between crop water use and yield is to determine the amount of water required to grow the plant separately from the amount of water required to produce grain. The first value is termed the “initial yield point” and the second is termed the “yield increment”. These values can be calculated by a statistical procedure called “linear regression”. Because the initial yield point value cannot be determined accurately if the data set is too small, data from all 4 years were combined, resulting in a data set of 20 points (i.e., 4 years × 5 treatments). The values determined from this data set were 2.6 inches of water for the initial yield point and 5.2 bushels per inch of water for the yield increment. This initial yield point value is near the lower end of values found in previous studies, whereas this yield increment value is quite typical. The reason these values are so favorable is not completely determined, however improved management practices including no-till is likely a major cause.

Table S1: Relationship of durum yield and crop water use.

	2015	2016	2017	2018	4-yr avg
Soil water at planting *(inches in top 4 ft)*	8.69	10.25	11.31	10.34	10.15
Soil water at harvest *(inches in top 4 ft)*	5.69	6.33	5.91	6.80	6.18
Soil water extracted *(inches)*	3.00	3.93	5.40	3.54	3.97
Rainfall, planting to harvest *(inches)*	6.94	7.67	2.31	8.49	6.35
Total crop water use *(inches)*	9.94	11.60	7.71	12.03	10.32
Fraction of water from rain	70%	66%	30%	71%	59%
Durum yield *(bu/a)*	36.6	45.6	27.5	50.5	40.03
Durum WUE *(bu/in)*	3.64	3.92	3.56	4.20	3.83

Soil Health Data

Background

Potential Carbon Mineralization (PCM) is a measure of soil respiration – microbial breakdown of soil carbon. It is measured by wetting the soil and measuring the amount of carbon released after a 10 day incubation. High PCM is associated with high microbial activity in the soil, which is necessary to make nutrients available to plants. Microbial Biomass Carbon (MBC) is a measurement of the carbon contained within the living component of soil organic matter (i.e. bacteria and fungi). High levels of MBC is generally considered desirable and associated with a “healthy” soil.

Experimental Methods

Soil samples were collected from a depth of 2-4 inches at 5 locations within each plot after crop harvest in the fall of 2016 and 2017. For PCM and MBC, the soil was air dried, sieved and stored at -4°F until analysis. PCM and MBC were measured by incubating wet soil and measuring amount of CO2 generated before and after treatment with chloroform.

Results

Soil collected from durum plots different significantly by rotation in microbial biomass carbon, where durum cropped in a durum-fallow rotation had significantly lower soil microbial biomass carbon than a 5 year diverse rotation sown to a cover crop one out of five years - Dur/BP1/Pea/Corn/Saff (Fig SH1). Continuous cropping of durum (Dur-Dur) or a diverse crop rotations without cover crops (Dur/WW/Pea/Corn/Saff) was not sufficient to improve soil microbial biomass carbon from the levels in a durum-fallow rotation (Fig SH1).

Potential mineralizable carbon (PMC) was highest under the perennial grass treatment which has been undisturbed for five years (Fig SH2). PMC in cover crop, safflower and pea plots were not significantly different from the perennial grass plots, however (Fig SH2). Corn, durum, winter wheat and fallow plots had significantly lower PMC than the perennial grass mix (Fig SH2).

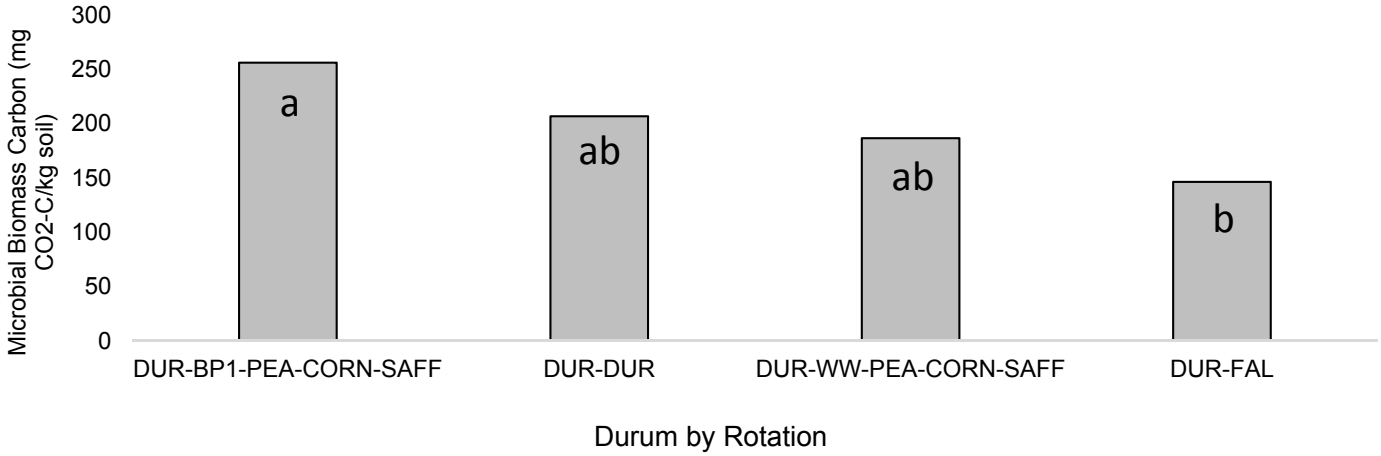


Figure SH1. Microbial Biomass Carbon measured under plots cropped to durum by rotation. Statistically significant differences are indicated by different letters as determined by Student's t test. (α<0.05). Dur = durum, WW = winter wheat, FAL = fallow, SAFF = Safflower, BP1 = cover crop mix. Data is combined results from 2017 and 2016.

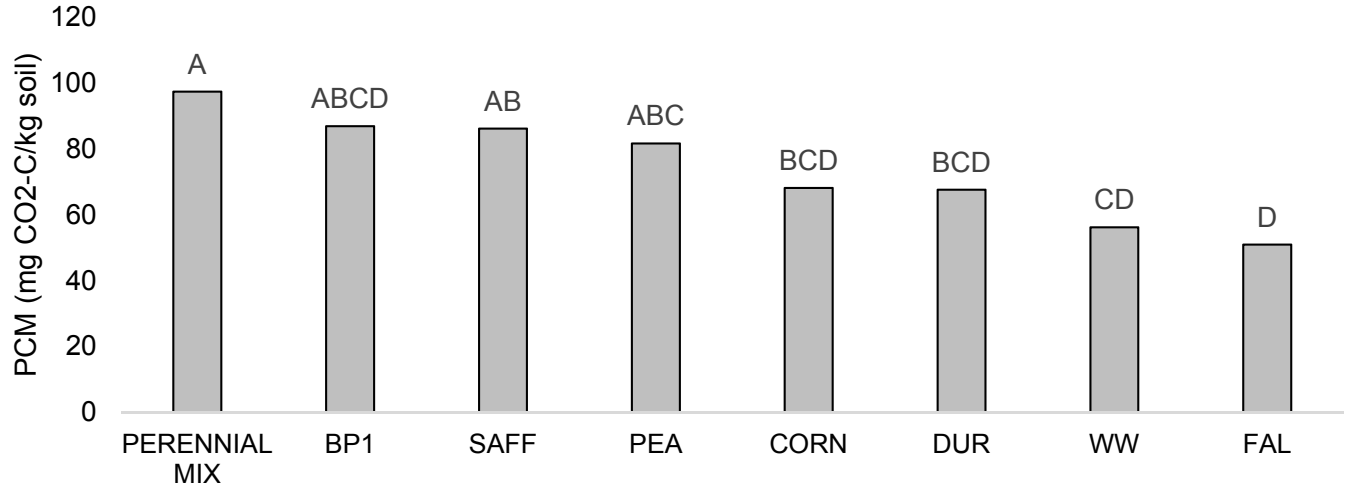


Figure SH2. Potentially Carbon Mineralization measured under different crops. Statistically significant differences are indicated by different letters as determined by Student's t test. (α<0.05). Dur = durum, WW = winter wheat, FAL = fallow, SAFF = Safflower, BP1 = cover crop mix. Data is combined results from 2017 and 2016.

Conclusions

Full season cover crops within a diverse rotation can benefit growers by increasing soil microbial biomass carbon. Microbial biomass is an early indicator of changes in organic matter in the soil. These rotations have only been in place for five years – one full cycle. Thus, in the long term, inclusion of full season cover crops within a rotation may increase soil organic matter more quickly.

Potential carbon mineralization was highest in the perennial grass mixture. This soil has been undisturbed for 5 years and has not received any fertilizer. Thus, these results suggest that the high microbial activity is associated with the presence of the living plant cover. The full season cover crop, safflower and pea had similar levels of PCM as the perennial grass mixture, indicating that these treatments stimulate soil microbial activity. As expected, the fallow treatment had the lowest PCM and corn, durum and winter wheat were not significantly different from fallow. In an annual cropping system, it is important to note that soil respiration also represents a loss of soil carbon to the atmosphere as carbon dioxide – so while PCM is high in the perennial mix treatment – carbon is also going back into the soil via plant roots and plant residue breakdown. Where residue is being consistently removed through baling high PCM may result in net soil loss of carbon. Thus, it is important to balance crops that spur much microbial activity (pea/safflower) with those that have more recalcitrant crop residues (ex. wheat) and to leave sufficient crop residue in the field.

"Always do your best. What you plant now, you will harvest later."
Og Mandino

Reduced Irrigation Amounts on Durum and Barley

Jim Staricka and Tyler Tjelde, NDSU Williston Research Extension Center

Introduction: An ongoing research project has been investigating the effects of reduced irrigation amounts on durum and barley grain yield and quality. This project has been conducted at the Nesson Valley Research and Development site since 2010. Four irrigation amounts are being investigated: 100%, 67%, 33%, and 0% of the amount recommended by the NDAWN checkbook method (Table 1). The irrigation amounts were fine-tuned based on weekly soil moisture measurements. These differing irrigation amounts were applied throughout the growing season via a linear-move overhead sprinkler system equipped with a GPS-regulated variable rate irrigation control system.

Table 1: Amount of water (9-year average) received via irrigation and rain.

	Durum		Barley	
Irrigation amount	Irrigation	Irrigation + rain	Irrigation	Irrigation + rain
	---------- inches ----------			
100%	6.4	14.3	5.5	13.4
67%	4.3	12.2	3.7	11.6
33%	2.1	10.0	1.8	9.7
0%	0.0	7.9	0.0	7.9

Rain amounts (May 15 to August 15) varied from year to year and ranged from 5.2 inches in 2017 to 11.3 inches in 2011. The 9-year average was 7.9 inches, which was very close to the 30-year normal value of 8.0 inches. Irrigation amounts also varied from year to year. For the durum 100% treatment, the amounts ranged from 3.2 inches in 2013 to 11.3 inches in 2017, and averaged 6.4 inches. For the barley 100% treatment, the amounts ranged from 3.5 inches in 2018 to 9.5 inches in 2015, and averaged 5.5 inches. The proportion of water from irrigation in the 100% treatments averaged 44% for durum and 41% for barley.

Results: Reduced amounts of irrigation decreased durum yields and test weights but increased protein levels (Table 2). Although an increase in durum protein is economically beneficial, the price premium for increased protein content may not compensate for the revenue loss from the decreased yield.

Table 2: Durum yield, protein, and test weight achieved with various irrigation amounts.

Irrigation amount	Yield	Protein	Test Wt.
	bu/a	*%*	*lb/bu*
100%	79	15.7	60.3
67%	71	16.2	59.8
33%	63	16.9	59.2
0%	49	17.7	58.2

Table 3: Number of years out of nine when durum yield, protein, and test weight were not affected by reduced irrigation amounts.

Irrigation amount	Yield	Protein	Test Wt.
	---------- *years* ----------		
67%	5	7	8
33%	3	5	6
0%	0	2	5

The magnitude and frequency of reduced yields, test weights, and plumpness and increased protein content were directly related to the reduced irrigation percentages (Tables 2 & 3).

The effect of reduced irrigation on barley was similar: reduced irrigation decreased yield, test weight, and kernel plumpness and increased protein (Table 4). Note that because high-protein content is undesirable in malt barley, increased protein levels in barley may be disadvantageous.

Table 4: Barley yield, protein, test weight, and kernel plumpness achieved with various irrigation amounts.

Irrigation amount	Yield	Protein	Test Wt.	Plump kernels
	bu/a	*%*	*lb/bu*	*%*
100%	96	12.1	52.0	89.4
67%	91	12.5	51.7	87.9
33%	83	12.7	51.0	88.5
0%	73	13.1	50.4	86.0

Table 5: Number of years out of nine when barley yield, protein, test weight, kernel plumpness were not affected by reduced irrigation amounts.

Irrigation amount	Yield	Protein	Test Wt.	Plump kernels
	---------- *years* ----------			
67%	8	7	9	8
33%	5	6	8	7
0%	1	4	5	4

As with durum, the magnitude and frequency of the effects of reduced irrigation on barley increased as the size of the irrigation reduction increased (Tables 4 & 5).

Discussion: Reducing irrigation amount by one-third (i.e., to the 67% rate) had a modest effect on durum yield and a near-negligible effect on durum quality and barley yield or quality. Durum yield, protein, and test weight were unaffected 5, 7, and 8 years out of 9, respectively. Barley yield, protein, test weight, and kernel plumpness were unaffected 8, 7, 9, and 8 years out of 9, respectively. Durum yields were reduced by 10% and barley yields were reduced by 5%. Protein, test weight, and kernel plumpness all were changed by less than 3%. Water savings achieved by reducing irrigation amounts by one-third may help farmers comply with water restrictions or expand irrigated acreage without increasing total water demand. This project will be continued to more fully understand why reduced irrigation affects yield, protein, test weight, and kernel plumpness some years and not others.

"A dream doesn't become reality through magic; it takes sweat, determination and hard work."
Colin Powell

Determining Optimal Planting Date and Soil Temperature for Enhanced Growth and Yield of Soybean under No-till Semi-arid Condition

Gautam Pradhan, James Staricka and Jerald Bergman
(Funded by North Dakota Soybean Council)

Planting date plays significant role in field crop production. Early or late planting may decrease grain yield and quality of a crop due to increased biotic (insect, disease, weed, and bird incidence), and/or abiotic stress (frost, drought, and high temperature). Northwestern North Dakota has a cool semi-arid climate with annual precipitation of <13 inches. The long-term weather data shows that, in this region, the last spring freeze may occur in the last week of April and the first fall freeze in October. There is a need of determining an optimal soybean planting dates and soil temperature for Northwestern ND that provide optimal growing period, decrease chances of frost and/or drought damage, and enhance grain yield.

Materials and methods

Soybean was seeded at Williston Research Extension Center, Williston, ND on 3rd, 10th, 16th, and 25th of May, and 3rd, 9th, and 15th of June 2018 using a 7 rows no-till plot planter. Soil moisture and temperature data at 4 inches depth were continuously recorded from April 26, 2018 to October 2018. Canopy temperature and normalized difference vegetation index (NDVI) were measured weekly with a FLIR® E60 Thermal Imaging camera and a modified NDVI Sony camera; respectively.

Results and discussion

The trial received heavy rain, wind and hailstorms that damaged the crop and adversely affected yield (June 23: wind speed=46 mph, precipitation = 1.53"; June 28: wind speed = 61 mph, precipitation = 0.94", hailstorm; July 9: wind speed = 48 mph, precipitation = 1.67"). There was a significant effect of planting date on plant stand and grain yield. Soybean planted on and after July 9 had the highest plant stand of ~93000/a, which was on an average 20 to 40 thousand more plants than earlier planting dates (Fig.1). Soybean planted on May 16 and 25 had a maximum grain yield of ~17 bu/a, which was on an average 3 to 6 bushels more grain than other planting dates (Fig.2).

Figure 1. Effect of planting date on plant stand.

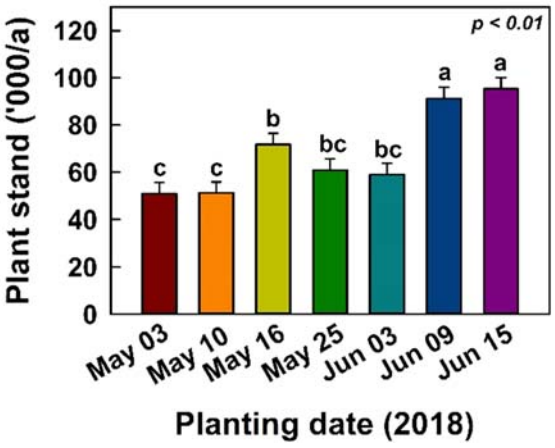
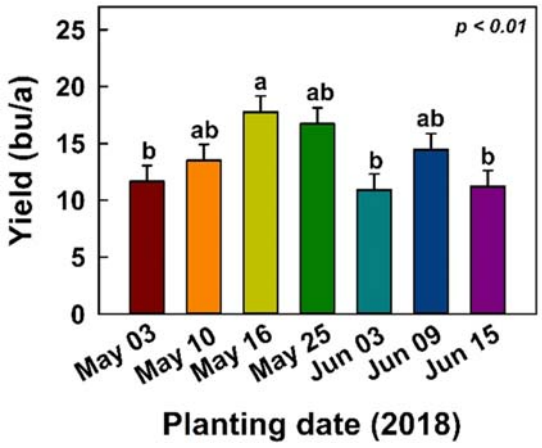


Figure 2. Effect of planting date on grain yield.



Effect of Plant Population and Row Spacing on Physiology, Water Use Efficiency, and Yield of No-till Dryland Soybean

Gautam Pradhan, James Staricka and Jerald Bergman

(Funded by North Dakota Soybean Council)

Soybean acreage has been steadily increasing in North Dakota including in the western part of the state, which has exceptionally drier climate (<13 inches of rain) than the eastern part. Drought is the main abiotic stress affecting soybean yield in western ND, and there is a lack of a soybean production management guide suitable for this region. It is a well-established fact that an optimum planting geometry for a given niche ensures higher radiation, water, and nutrient use efficiency resulting in enhanced per acre crop yield and quality.

Objectives

To find out suitable dryland soybean plant population and row spacing that has (a) higher grain yield, quality, and farm income, (b) favorable morpho-physiological traits such as greater NDVI, canopy temperature depression, and biomass, and (c) higher water use efficiency.

Materials and methods

A RR2Y soybean variety (LS03R22) with a maturity group of 0.3 was planted at WREC on May 30, 2018 using a SRES (Seed Research Equipment Solutions) precision planter. Row spacings of 7½, 15, 22½, and 30 inches were maintained as main plots and plant populations of 90, 120, 150, and 180 thousand per acre were considered as sub-plots. Canopy temperature and normalized difference vegetation index (NDVI) were measured weekly with a FLIR® E60 Thermal Imaging camera and a modified NDVI Sony camera; respectively. Soil moisture was recorded from each plot using a neutron moisture meter.

Results and discussion

The trial received heavy rain, wind and hailstorms that damaged the crop and adversely affected yield (June 23: wind speed=46 mph, precipitation = 1.53”; June 28: wind speed = 61 mph, precipitation = 0.94”, hailstorm; July 9: wind speed = 48 mph, precipitation = 1.67”).

Figure 1. Effect of row spacing on biomass.

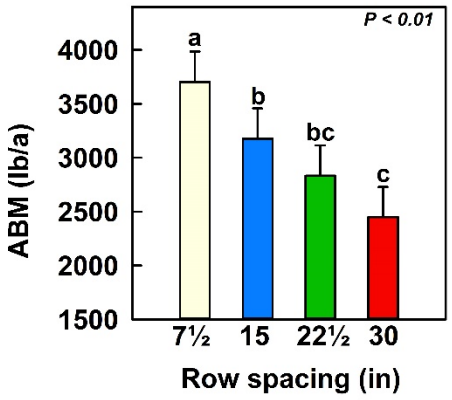
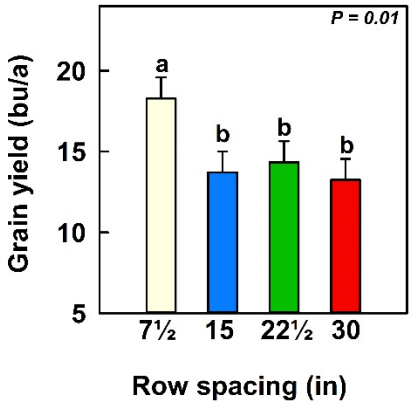


Figure 2. Effect of row spacing on grain yield.



There was no effect of plant population and row spacing on plant height and test weight. The plant height and test weight, averaged across plant population and row spacing, was 17 inches and 58 lb/bu, respectively. There was no effect of plant population on the above ground biomass (ABM) and grain yield, however, a significant effect of row spacing was evident. The 7½ inches row spacing produced about 3700 lb/a of biomass, which was 525 to 1200 more pounds of biomass than wider row spacing (Fig. 1). The row spacing of 7½ inches had the highest grain yield of 23 bu/a, which was 4 to 5 more bushels of grain than the wider row spacing (Fig. 2).

Effects of Cropping Sequence, Ripping, and Manure on Pipeline Reclamation in Western North Dakota (Williston, ND - 2017)

Austin Link[1], Tom DeSutter[2], Jim Staricka[1], Kevin Sedivec[3], Jerry Bergman[1], Chris Augustine[4], Kevin Horsager[2], Kyle Dragseth[1], Meridith Ramsey[1], Cameron Wahlstrom[1],

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Funding provided by the ND Industrial Commission – Oil & Gas Research Program

Summary

Soil disturbance during the construction of pipelines, roadways, and well pads has become a serious issue in western North Dakota. Within cropland, soil health and yields need to be restored during the reclamation process. Reclamation of pipelines in a cropland setting has not been extensively researched and little is known about the best management practices for restoring crop yields. During the spring of the 2015, installation of a 36” water pipeline was completed at the Williston-REC. We took advantage of this opportunity by planting a long-term experiment with five annual crop rotations and two perennial covers in pipeline, roadway, and undisturbed (control) areas. In addition to cropping sequence, ripping/manure is being tested as the subplot in a split plot design in efforts to decrease compaction and add organic matter. This study is designed to address barriers to successful pipeline reclamation. More specifically, this study aims to provide long-term management strategies for landowners to restore productivity to cropland. If economical reclamation options are available to stakeholders, more effective reclamation plans can be composed and more efficient pipeline installations will be possible. Preliminary results indicate soil compaction and crop yields are significantly different between disturbance areas. Additional soil and plant data collection will determine differences between ripping, ripping/manure, and no-till subplots.

Design

Sequence	2015	2016	2017	2018
	Min. till	Min. till	M	Min. till
1	Durum	Durum	Durum	Durum
2	Durum	Peas	Barley	Safflower
3	Peas	Barley	Safflower	Durum
4	CC Mix*	Durum	CC Mix*	Durum
5	Durum	CC Mix*	Durum	CC Mix*
6	Alfalfa	Alfalfa	Alfalfa	Alfalfa
7	Per. Grass	Per. Grass	Per. Grass	Per. Grass

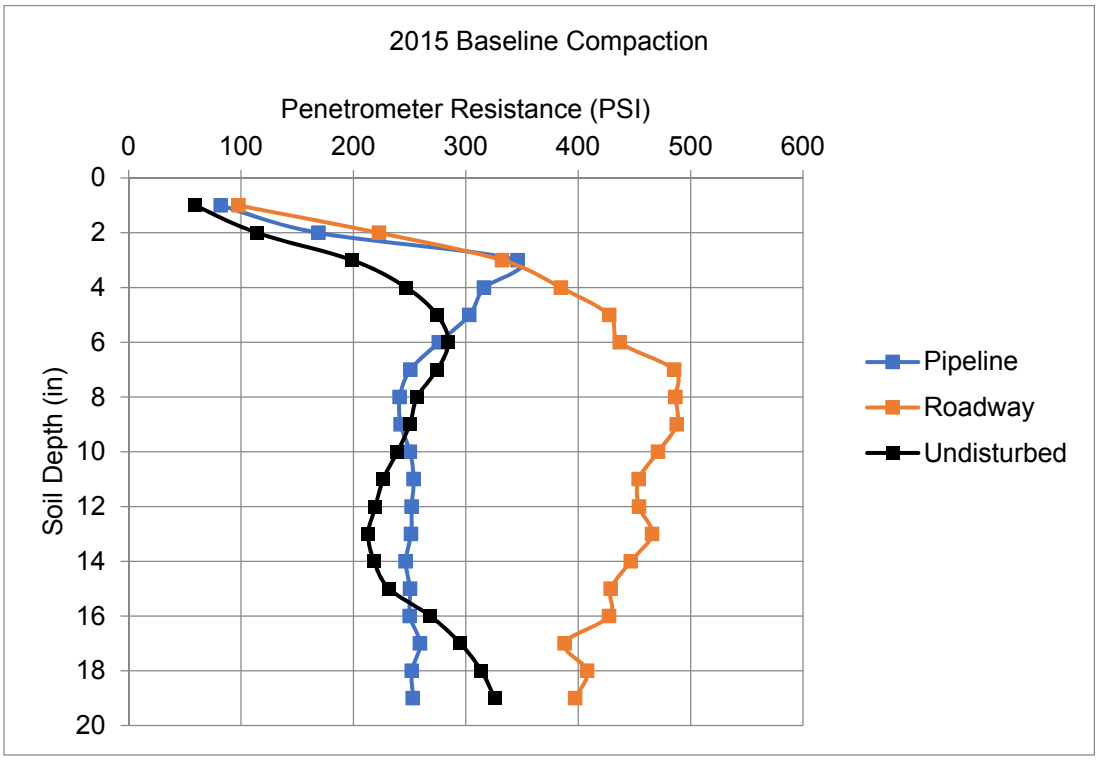
*CC Mix = Pearl Millet, Sorghum, Sudan, Turnip, Radish, Burseem Clover, Sunflower, Soybean, Cow Pea, Flax, Hairy Vetch, Phacelia, Mammoth Red Clover, Italian Ryegrass.

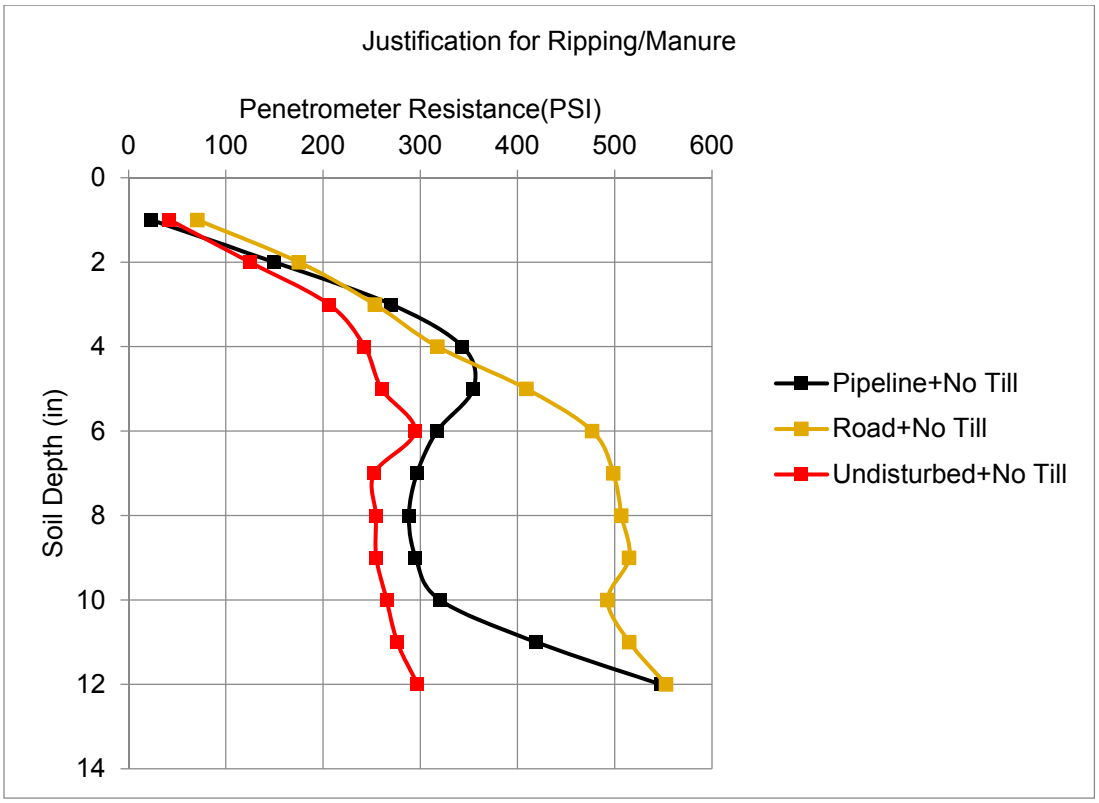
Undisturbed - Ripped	Road - Ripped	Pipeline - Ripped
Undisturbed – Ripped+Manure	Road – Ripped+Manure	Pipeline – Ripped+Manure
Undisturbed – No Till	Road – No Till	Pipeline- No Till

Design of each cropping sequence.

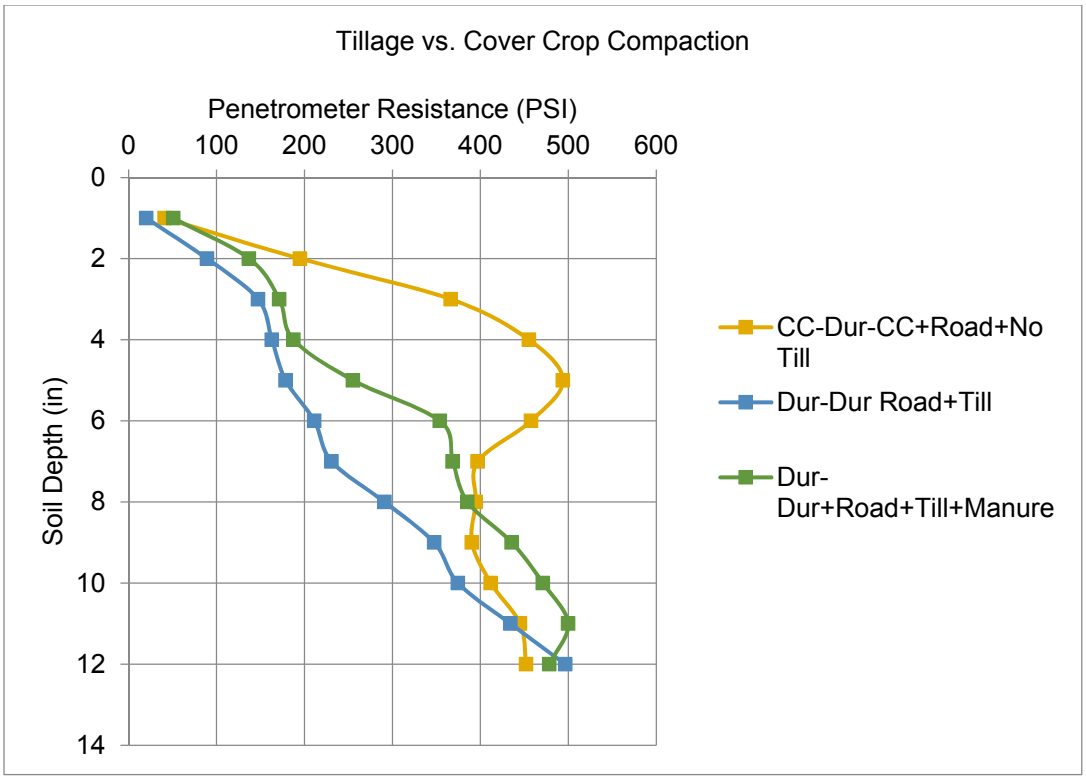
Manure application and tillage methods.

Results

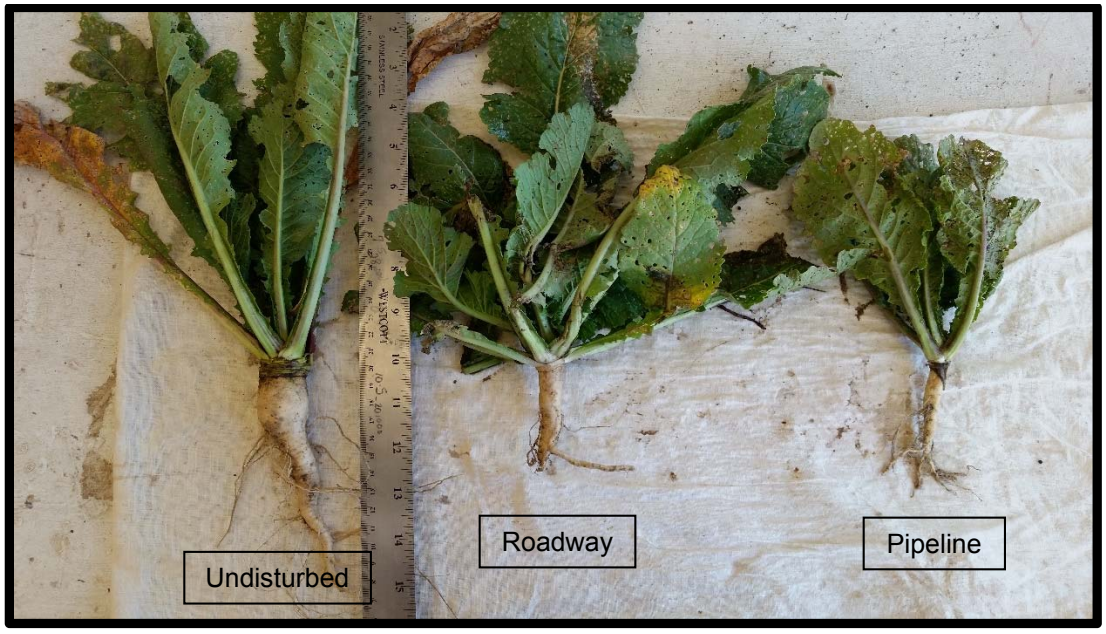




Between years one and three, no significant compaction improvement was observed. This data motivated the installation of ripping/manure treatments to further address excess compaction.



Ripping provided a greater reduction in compaction than a full season tap-rooted cover crop grown two of three years.



Subsidence occurred along portions of the pipeline in the project area.

In June and July 2018 (year 4), there were multiple large storm events that impacted annual crop yields. The July 9, 2018 event led to subsidence along portions of the pipeline, as pictured above.

23-Jun-18	Wind speed=46 mph; Precipitation=1.53".
28-Jun-18	Wind speed=61 mph; Precipitation=0.94"; Hail.
9-Jul-18	Wind speed=48 mph; Precipitation=1.67".

Conclusions

- In years one and two, annual crops yielded significantly less in road and pipeline areas ($P \leq .05$).
- In year two, alfalfa yielded significantly higher in the pipeline area ($P \leq .05$).
- In year three, alfalfa did not yield significantly different between disturbance areas ($P \leq .05$).
- DCP data trends suggests tillage treatments reduce compaction initially more effectively than deep-rooted annual cover crops; however, additional years of sampling will be conducted.

DON Accumulation in Durum Varieties

Dimitri Fonseka, Taheni Jbir, Austin Link, Joseph Effertz, Eric Eriksmoen, Audrey Kalil

Funding provided by the ND Wheat Commission

Introduction

Fusarium Head Blight (FHB), or scab, is a disease of durum wheat (*Triticum durum*) caused by the fungal pathogen *Fusarium graminearum*. This pathogen produces a toxin, Deoxynivalenol (DON), which contaminates wheat grain. Durum varieties are all generally considered susceptible to FHB compared to Hard Red Spring Wheat. FHB disease levels and DON can vary greatly across North Dakota in a given season due to differences in humidity, amount of rainfall and timing of rainfall. The goal of this project was to assess DON levels in the harvested grain of durum varieties grown at several locations in western and central North Dakota to identify the varieties that consistently accumulate the least DON under different environmental conditions.

Methods

Variety trials were conducted at eight locations in 2018. Trials were set up in a randomized complete block design, with 5 x 14 ft. plots and three replicated plots per variety. No fungicides were applied. Grain from each plot was analyzed for DON using the Reveal Q+ mycotoxin extraction kit and AccuScan II GOLD reader (Neogen). Results presented are an average of data from three replications per variety.

Results

Average DON in harvested grain for each variety across sites (Table 1). DON was highest at the Rugby site. There was no DON detected in any durum varieties at the Williston and Wilton locations.

	Scab Rating*	DON (ppm)							
Variety	(1-9)	Garrison	Minot	Mohall	Nesson	Rugby	Williston	Wilton	ALL
Alkabo	6	0.50 *ab*	0.23	0.50 *ab*	0.47 *ab*	0.93	< 0.3	< 0.3	0.42
Carpio	5	0.35 *ab*	0.32	0.38 *ab*	**0.15 *b***	0.97	< 0.3	< 0.3	0.35
Divide	5	**0.15 *b***	0.50	**0.15 *b***	**0.15 *b***	0.93	< 0.3	< 0.3	0.31
Grenora	6	**0.70 *a***	0.23	0.73 *ab*	**0.15 *b***	1.93	< 0.3	< 0.3	0.58
Joppa	5	0.47 *ab*	0.45	0.4 *ab*	**0.73 *a***	1.10	< 0.3	< 0.3	0.49
Lebsock	6	0.38 *ab*	0.42	**0.97 *a***	0.4 *ab*	1.03	< 0.3	< 0.3	0.50
Mountrail	8	**0.23 *b***	0.65	0.53 *ab*	0.37 *ab*	2.23	< 0.3	< 0.3	0.62
ND Grano	6	**0.25 *b***	0.43	0.38 *ab*	0.43 *ab*	1.57	< 0.3	< 0.3	0.48
ND Riveland	5	**0.25 *b***	0.37	**0.15 *b***	**0.15 *b***	0.80	< 0.3	< 0.3	0.29
Tioga	6	0.47 *ab*	0.40	**1.1 *a***	**0.15 *b***	1.77	< 0.3	< 0.3	0.59
All		0.38	0.40	0.53	0.32	1.33	< 0.3	< 0.3	0.46
p - value (α < 0.05)		0.0011	NS	0.0013	0.0015	NS	NS	NS	NS

*Scab rating scores from 1-9, with 1 = resistant and 9 = very susceptible.

Table 1. Average DON in durum varieties across sites in 2018. Different letters within columns (sites) indicate treatments that are significantly different. Treatments with significantly higher DON (red-a) than treatments with lower DON (green-b) are highlighted. NS = varieties are not significantly different. Detection threshold was 0.3 ppm. For statistical analysis, treatments with no detectable DON were assigned a value of 0.15.

Conclusions

Varieties did not perform consistently across all locations in terms of DON accumulation. Grenora, Joppa, Lebsock and Tioga accumulated significantly greater DON than other varieties at one location each. ND Riveland and Divide accumulated significantly less DON than another variety at three sites each. More work is needed to determine performance of these varieties across locations and growing seasons in terms of DON accumulation.

Durum Fusarium Head Blight Fungicide Trial EARC, Sidney, MT

Frankie Crutcher and Amber Ferda

Objective: Test the ability of different foliar fungicides to control Fusarium head blight caused by *Fusarium graminearium* on durum.

Materials and Methods:

Irrigated

Variety: Alzada
Location: Sidney, MT
Planted: 04/27/2018
Harvested: 08/15/2018
Plot Size: 5' x 10'
Seeding Rate: 90 lbs/A
Soil Type: Clay Loam
Previous Crops: Wheat
Residual Soil N to 3 ft: 75 lbs
Residual Soil P to 6 in: 15.7 ppm
Applied Fertilizer: None
Irrigated (sprinkler) on 06/14, 06/15, 06/23, 06/26, 06/27
Chemical Applications: LV6
Precipitation April – September, 2018: 11.38 in.
Vigor Observation Date: 05/30/2018
Disease Assessments: 07/20/2018
Treatments: Prosaro, Miravis Ace, Caramba
Corn spawn application: 06/06/2018
Date of first application: 06/19/2018

Comments: Seed treated with Foothold.
Spray applications at 15 GPA with Teejet AI3070-15 air induction dual patter flat spray nozzles.
NIS used was Activator 90.
Plot 404 missing most of 1st row.

Results: No significant differences between treatments were measured for incidence, severity and yield. Significant differences were observed for percent FDK with the negative control having the greatest amount of FDK.

Table 1: Fungicide Evaluation for Control of Fusarium Head Blight on Durum

Treatment #	Incidence 1 (%)[a]	Severity 1 (%)[b]	% FDK[c]	Adjusted Yield (Bu/A) (13.5%)
1	34.17 A	2.63 A	24.25 A	30.12 A
2	34.17 A	2.04 A	19.00 B	23.44 A
3	21.67 A	1.25 A	16.00 BC	25.41 A
4	33.33 A	2.13 A	15.00 C	23.46 A
Mean	30.83	2.01	18.56	25.61
CV (%)	48.59	60.35	22.94	27.49
LSD (0.05)	24.02	1.90	3.60	11.11

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Pest Incidence: Percent of 30 plants with FHB.
[b]Pest Severity: Average percent area of 30 plants covered by disease.
[c]Fusarium Diseased Kernels.

Table 2: Fungicide Treatments for Fusarium Head Blight on Durum

Treatment #	Fungicide	Rate
1	Untreated Control	None
2	Prosaro	6.5 fl oz/A
3	Miravis Ace	13.7 fl oz/A
4	Caramba	15 fl oz/A
All treatments contain 0.125% v/v (NIS) Activator 90.		

Planting Scabby Seed

Effect of DON and Fungicide Seed Treatment on Durum Establishment and Yield

Audrey Kalil, Dimitri Fonseka, Taheni Gargouri-Jbir, and Kyle Dragseth

Introduction

Fusarium head blight (head scab) of wheat, durum and barley is caused by the fungal pathogens *Fusarium graminearum, F. culmorum, and F. avenaceum.* These fungi infect the seed and, with the exception of *F. avenaceum*, produce a mycotoxin called deoxynivalenol (DON). The result is "scabby" seed which can potentially contain high levels of both pathogenic *Fusarium* species and DON. Planting such seed can result in poor stands due to low germination rates and seedling blight, however, recommendations on what levels of DON in the seed results in yield loss were not available. The objective of this research was to determine 1) how DON and *Fusarium* contamination in the seed effects establishment and yield and 2) if a seed applied fungicide can improve establishment and yield.

Experimental Design

1. Obtained Joppa durum with different levels of DON: < 0.3ppm, 1.1 ppm, 2.8 ppm, 6.4 ppm and 9.1 and 17.5 ppm.
2. Durum lots were split and each received a different fungicide treatment. One lot (control) did not receive fungicide seed treatment for control of *Fusarium*, and the other lot was treated with tebuconazole. Germination was assessed after fungicide treatment.
3. Plots were planted 4/26/2018 using a no-till planter at a seeding rate of 1.6 million live seeds/ac. Stand count was performed 5/24/2018. Plots were harvested 8/17/2018.

Results

Treatment	DON (ppm)	Fungicide Seed Treatment†	Germination
1	< 0.3	Control	93%
2		Tebuconazole	96%
3	1 .1	Control	87%
4		Tebuconazole	83%
5	2.8	Control	85%
6		Tebuconazole	83%
7	6.4	Control	72%
8		Tebuconazole	70%
9	9.1	Control	58%
10		Tebuconazole	62%
11	19.9	Control	37%
12		Tebuconazole	42%

Table 1. Germination rates of DON contaminated seed. † Both control and tebuconazole treatments received metalaxyl seed treatment for control of *Pythium*.

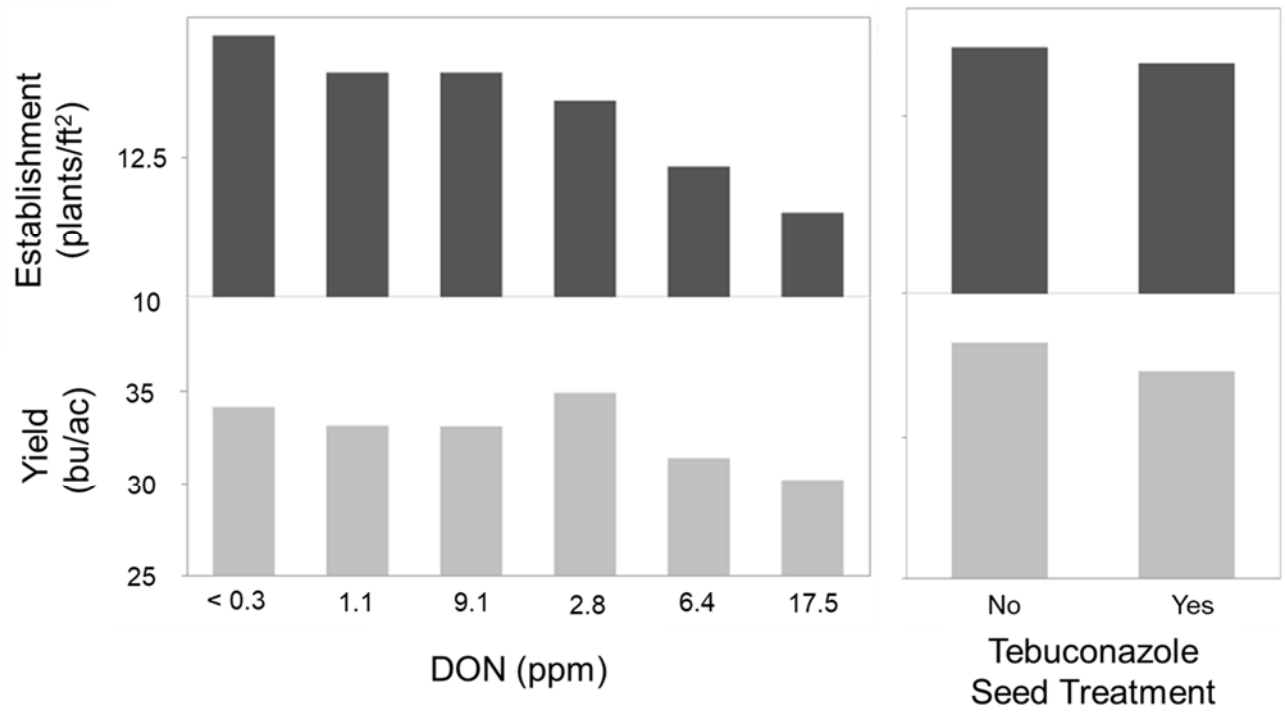


Figure 1. Establishment (plants/ft^2) and yield in decreasing order of yield by levels of DON (ppm) in grain used for seed and by seed treatment with tebuconazole (no/yes). Significance was assessed by ANOVA. There was no significant difference among treatments.

Conclusions

As expected, higher levels of *Fusarium*/DON contamination in the seed greatly reduced germination rates (Table 1). Seed treatment with fungicides did not improve germination. Plots were seeded so that all treatments received 1.6 million live seeds/ac, to account for the poor germination rates of contaminated seed.

In 2017, stand count was slightly reduced when seed with 10.2 ppm DON was planted and reduced by half when seed with 19.9 ppm DON was planted. Yield was reduced only when the highest level of DON contaminated seed was planted (19.9 ppm). In 2018, there was no difference in establishment or yield among the different DON treatments (Fig 1). These data combined suggest that moderate levels of DON (1 – 6 ppm) in seed used at planting will not negatively affect yield. Higher levels than that may result in yield reduction. This trial will be repeated, however, to confirm these results. In both years, there was no DON present in harvested grain and there was no effect of the DON treatments on protein or test weight.

In both 2017 and 2018, use of tebuconazole seed treatment for control of *Fusarium* did not significantly improve durum establishment or yield. Therefore, it does not seem likely that fungicide seed treatment can act as a rescue for highly contaminated seed.

Despite these findings, seeding large quantities of DON contaminated seed may have implications for Fusarium root rot in peas and lentils. *Fusarium avenaceum* is a causal agent of both Fusarium Head Blight in wheat and Fusarium root rot in peas and lentils. To assess the effect of planting scabby seed on pulse crops, peas will be seeded onto these plots in 2019 and yield data will be collected.

Durum Varieties Response to Fusarium Head Blight EARC, Sidney, MT

Frankie Crutcher, Mike Giroux, Amber Ferda, Samantha Hoesel

Objective: Test the resistance of different durum varieties to exposure to Fusarium head blight.

Materials and Methods:

Irrigated

Variety: Misc.
Location: Sidney, MT
Planted: 04/27/2018
Harvested: 08/16/2018
Plot Size: 5' x 10'
Seeding Rate: 90 lbs/A
Soil Type: Clay Loam
Previous Crops: Wheat

Residual Soil N to 3 ft: 75 lbs
Residual Soil P to 6 in: 15.7 ppm
Applied Fertilizer: None
Irrigated (sprinkler) on 06/14, 06/15, 06/23, 06/26, 06/27
Chemical Applications: LV6
Precipitation April – September, 2018: 11.38 in.
Observation dates: Vigor: 05/30/2018, disease assessment: 07/20/2018

Comments: Corn spawn applied 06/06/2018. Two reps only. Seed treatment applied by breeder.

Results: A lot of variation was observed for the different lines of durum. Alkabo overall performed the best with the lowest DON measurements and better than average incidence and severity. The experimental line MTD16010 performed the worst with the highest DON and severity and above average incidence and FDK. All samples with average DON of 2.0 ppm or higher do not meet minimum requirements for sale and would be rejected. This is the first year and only location of this study. More research is needed before specific recommendations can be made.

Table 1: Durum Variety Reponses to Fusarium Head Blight

Variety	[a]Incidence (%)	[b]Severity (%)	[c]% FDK	[d]DON (ppm)	Yield (lbs/A)
Alkabo	30.00 C	2.50 D	9.58 BCD	0.30 F	35.90 AB
Alzada	41.00 ABC	4.30 CD	13.33 ABCD	1.10 DEF	26.70 AB
Carpio	34.00 BC	2.80 CD	16.25 ABC	0.90 DEF	22.89 B
Divide	40.00 BC	3.55 CD	12.08 ABCD	1.25 DEF	38.24 AB
Dynamic	63.00 A	6.15 ABCD	9.58 BCD	2.25 ABCDE	45.01 A
Fortitude	43.00 ABC	5.50 BCD	12.08 ABCD	1.95 BCDEF	30.68 AB
Grenora	36.00 BC	2.65 CD	10.83 ABCD	1.10 DEF	43.51 A
Joppa	41.00 ABC	4.50 CD	9.17 BCD	0.95 DEF	28.38 AB
Mountrail	30.00 C	4.15 CD	10.00 ABCD	2.00 ABCDEF	35.87 AB
MT112219	35.00 BC	3.70 CD	11.25 ABCD	2.75 ABCD	40.88 AB
MTD16001	40.00 BC	4.05 CD	6.67 D	1.10 DEF	30.76 AB
MTD16002	43.00 ABC	9.25 AB	16.67 ABC	3.45 ABC	36.56 AB
MTD16003	32.00 C	2.70 CD	9.58 BCD	0.95 DEF	30.26 AB
MTD16004	52.00 ABC	5.05 BCD	10.42 ABCD	1.20 DEF	42.64 A
MTD16005	46.00 ABC	4.45 CD	16.25 ABC	1.95 BCDEF	41.56 AB
MTD16006	48.00 ABC	7.30 ABC	12.92 ABCD	2.20 ABCDE	32.89 AB
MTD16007	44.00 ABC	5.00 BCD	8.33 CD	1.10 DEF	40.94 AB
MTD16008	45.00 ABC	5.10 BCD	15.42 ABCD	0.80 EF	39.61 AB
MTD16009	33.00 C	4.75 BCD	17.08 ABC	1.50 DEF	31.80 AB
MTD16010	56.00 AB	10.55 A	17.50 AB	3.85 A	39.35 AB
MTD16011	44.00 ABC	4.10 CD	11.67 ABCD	1.80 BCDEF	35.55 AB
Precision	48.00 ABC	4.40 CD	18.75 A	1.60 CDEF	39.90 AB
Tioga	37.00 BC	3.75 CD	14.12 ABCD	2.75 ABCD	41.41 AB
Vivid	48.00 ABC	5.95 ABCD	15.42 ABCD	36.0 AB	30.13 AB
Mean	42.04	4.84	12.71	1.77	35.77
CV (%)	26.56	52.10	35.52	1.88	24.42
LSD (0.05)	22.27	4.70	8.93	64.56	18.90

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Pest Incidence: Percent of 50 plants with FHB.
[b]Pest Severity: Average percent area of 50 plants covered by disease.
[c]Fusarium Diseased Kernels.
[d] Concentration of DON (vomitoxin) in ppm.

Spring Wheat Varieties Response to Fusarium Head Blight

EARC
Sidney, MT

Frankie Crutcher, Luther Talbert, Amber Ferda, Samantha Hoesel

Objective: Test the resistance of different spring wheat varieties to Fusarium head blight caused by *Fusarium graminearum*.

Materials and Methods:

Irrigated

Variety: Misc.
Location: Sidney, MT
Planted: 04/27/2018
Harvested: 08/16/2018
Plot Size: 5' x 10'
Seeding Rate: 90 lbs/A
Soil Type: Clay Loam

Previous Crops: Wheat
Residual Soil N to 3 ft: 75 lbs
Residual Soil P to 6 in: 15.7 ppm
Applied Fertilizer: None
Irrigated (sprinkler) on 06/14, 06/15, 06/23, 06/26, 06/27
Chemical Applications: LV6
Precipitation April – September, 2018: 11.38 in.
Observation dates: Vigor: 05/30/2018, disease assessment: 07/20/2018

Comments: Seed treatment applied by breeder. Corn spawn infested with *Fusarium graminearum* applied 06/06/2018.

Results: Each of the experimental lines showed lower incidence, severity and FDK than the susceptible control McNeal. There were significant differences in yield, however, these did not appear to be due to FHB resistance. These results will need to be confirmed with data collected from other locations.

Table 1: Spring Wheat Variety Reponses to Fusarium Head Blight

Variety	Incidence (%)[a]	Severity (%)[b]	% FDK[c]	Yield (Bu/A)
MT 1621	16.00 BC	2.77 B	10.28 CDE	41.99 AB
MT 1673	12.00 BC	0.87 B	13.33 BCDE	38.56 B
MT 1716	12.00 BC	0.97 B	10.00 DE	46.38 A
MT 1731	6.67 C	0.57 B	14.72 BCDE	42.71 AB
MT 1812	10.67 C	0.90 B	16.94 ABCD	38.57 B
MT 1813	17.33 BC	1.33 B	15.00 BCDE	35.66 B
MT 1827	16.67 BC	1.73 B	8.89 E	46.70 A
MT 1833	10.67 C	1.67 B	12.50 BCDE	40.92 AB
MT 1834	19.33 BC	2.17 B	17.78 AB	36.16 B
McNeal	55.33 A	12.63 A	22.50 A	42.35 AB
Vida	28.67 B	3.60 B	17.50 ABC	47.81 A
Lanning	16.67 BC	2.20 B	11.39 BCDE	48.10 A
Mean	18.5	2.62	14.24	42.16
CV (%)	82.51	142.62	36.95	13.41
LSD (0.05)	17.83	3.98	7.27	7.57

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Pest Incidence: Percent of 50 plants with FHB.
[b]Pest Severity: Average percent area of 50 plants covered by disease.
[c]Fusarium Diseased Kernels.

Pulse Disease and Insect Pest Scouting Results

Shawn Postovit, Graysyn Kitts, Honggang Bu, Dr. Audrey Kalil, Dr. Janet Knodel, Dr. Julie Pasche, Dr. Kim Zitnick-Anderson, Dr. Travis Prochaska

Introduction

In the 2018 growing season a pea, lentil and chickpea scouting program funded by the Northern Pulse Growers Association was conducted. The goals of the program were:

1. Scout farmer fields for diseases and insect pests of lentil, pea and chickpea

2. Provide information of pest populations and disease outbreaks in the weekly *Crop and Pest Report* published by the NDSU Extension Service and maps on the NDSU IPM website.

Methods

Pea, chickpea and lentil fields were scouted for diseases including root rots, bacterial blight, ascochyta blight, downy mildew, white mold, powdery mildew, among others, and insect pests. Insect pests scouted for were cutworms, grasshoppers, pea leaf weevil and pea aphids. Fields were located in northwest, north central and southwest North Dakota pulse crop producing counties. A total of 37 pea fields, 198 chickpea fields and 61 lentil fields were scouted. The scouts used standard scouting practices developed by ND Extension Specialists. This involves walking a "W" pattern in the field, and examining 10 plants at 5 sites in the field for diseases and insects. Scouts use visual counts for cutworms, pea aphids and pea leaf weevil damage, and a 15-inch sweep net for grasshoppers. Diseases were measured based on the number of plants affected (incidence) and the percent of the crop canopy exhibiting disease symptoms (severity).

Results

The results presented here reflect a small fraction of the data collected. To view all the mapped data collected during this survey please visit the NDSU IPM website: https://www.ag.ndsu.edu/ndipm and click on the "Lentil," "Pea" and "Chickpea " links near the center of the page. *Crop and Pest Report* articles on the scouting efforts are also available at this website: https://www.ag.ndsu.edu/cpr

Insect Pests

Cutworms were observed in all three pulse crops surveyed but only present early in the crop growing season from late May to mid-June. The overall percentage of fields infested with cutworms was low – 8% of lentils fields (Fig 1), 3% of field pea fields and <1% of chickpea fields. Economic thresholds were reached in three chickpea fields.

Pea aphids were most common later in the field season; late July into early August, and were only economic in 10% of the lentils scouted (Fig 1) and <1% of the chickpea field scouted. The hot spot for pea aphids was in Williams and Burke Counties.

Pea leaf weevil (*Sitona lineatus*) is a new insect pest of field pea that was first discovered in the fall of 2016 near Beach, ND. In 2018, pulse crop scouts and the IPM scout (Marc Michaelson, DREC) looked for feeding injury (leaf notching) of pea leaf weevil by examining 100 plants per field. In 2018, Pea leaf weevil was found for the first time in Billings, Bowman, Hettinger, Slope and Mercer Counties and found again in Williams County (Fig 1). When the number of leaf notches are greater than 9 notches per plant (yellow square or red triangle on map), yield loss in that field can be significant next season (2019) if conditions are favorable for pea leaf weevil in the spring (warm springs, > 68°F). Only Billings and Slope Counties had fields where leaf notching was greater than 9 notches per plant (Fig 1).

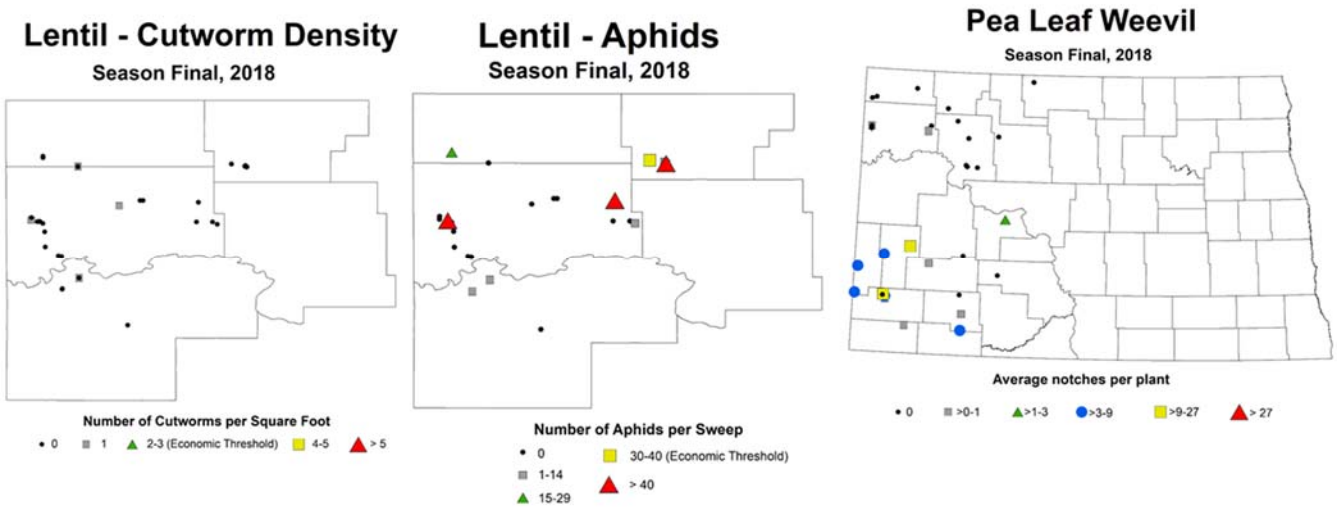


Figure 1. Cutworm (number of cutworms per square foot), aphid (number of aphids per sweep) and pea leaf weevil (average leaf notches per plant) data from lentil and pea fields respectively.

Diseases

Lentil: Anthracnose and white mold were the primary foliar diseases observed in lentils this growing season. Anthracnose onset was in mid-July when the fields scouted were at the early pod growth stage. Incidence of diseased plants reached up to 18% in some fields. White mold was present in fields scouted from mid-July to early August with incidence ranging from 1-50% (Fig 2).

Peas: Bacterial blight symptoms were observed in field pea beginning in early June when the crop was at late vegetative to early reproductive growth stages. Incidence reached 40-50% in some fields with 2-18% of the crop canopy exhibiting symptoms (Fig 2). White mold was not observed in pea fields.

Chickpeas: Onset of Ascochyta blight was in mid-June, when the crop was at mid to late vegetative growth stages. In some fields, the percent of plants showing symptoms stayed below 4% throughout the survey, while in others incidence reached 100% by mid-July. Percent of the crop canopy exhibiting symptoms generally stayed below 15%, indicating successful suppression of disease with fungicide applications (Fig 2).

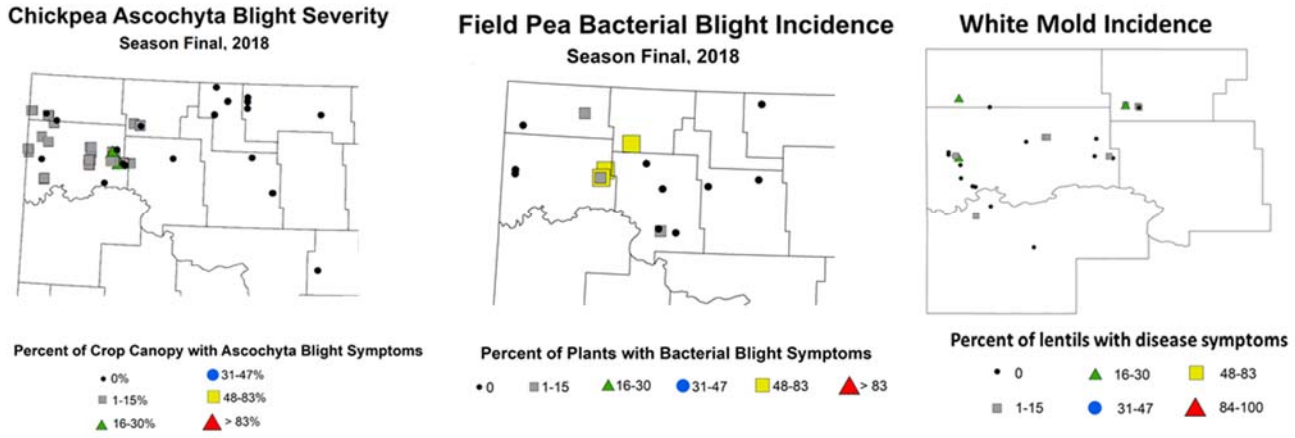


Figure 2. Chickpea Ascochyta blight severity (percent of crop canopy affected by disease). Field pea bacterial blight incidence (number of plants per field exhibiting bacterial blight symptoms). Lentil white mold incidence (number of plants per field exhibiting white mold symptoms).

Intercropping Chickpea and Flax

Clair Keene

High input costs and low crop prices are driving the need for farmers to find innovative strategies to reduce production costs. A promising strategy for reducing input costs is intercropping, also known as interseeding or companion cropping. Intercropping is the planting of multiple, usually two, crops in the same field. While this practice has been common in forage production, e.g., oats and pea for hay, intercropping cash grain crops has not been widely attempted.

A cash grain intercrop with high potential for success in the MonDak is chickpea and flax. Chickpea is a challenging crop to grow due to its susceptibility to ascochyta blight. Typically, 2-3 foliar fungicide applications are needed, and up to 5 sprays can be warranted when weather conditions are favorable for pathogen development. With costs of $20-30/ ac per application, reducing fungicide use is the easiest way to reduce chickpea production cost. By growing chickpea and flax together, flax modifies the chickpea canopy making its microclimate less favorable for ascochyta infection and spread. The goal of my research is to determine if there is an optimal flax seeding rate planted with chickpea that maintains chickpea yield while reducing ascochyta incidence; the flax is considered a bonus, adding dollars per acre in a chickpea crop.

This trial was conducted in 2018 at the WREC dryland farm. Orion chickpea was seeded at 120 lb/ ac in all treatments with CDC Glas flax at various rates. The trial was planted May 25 with chickpea and flax in alternating rows using a single row seeder. Plots had 4 rows, 2 of each crop. Proline™ fungicide applications (product cost $28/ ac) were made on June 25 and July 12. The trial was not desiccated and harvested September 10.

Ascochyta incidence and severity

Table 1. Ascochyta incidence (number of chickpea plants out of 10 with lesions).

Treatment	Jun-25	Jul-17	Jul-31
Pure chickpea	1.5	8.0 A	10.0
Chickpea + 5 lb flax	2.0	5.0 AB	9.5
Chickpea + 10 lb flax	1.0	4.0 B	9.0
Chickpea + 15 lb flax	3.5	6.0 AB	9.5
Chickpea + 20 lb flax	1.0	5.5 AB	9.5
Chickpea + 40 lb flax	1.0	6.0 AB	8.5
	NS	P<0.05	NS

Table 1 shows there was a trend for lower ascochyta incidence in intercropped treatments than pure chickpea; however, there was only a significant difference in incidence observed on July 17th.

Table 2. Severity of Ascochyta infection (scale of 0-10 with 0 = no lesions and 10 lesions present throughout canopy).

Treatment	Jul-17	Jul-31
Pure chickpea	3.0	7.3 A
Chickpea + 5 lb flax	2.3	5.3 AB
Chickpea + 10 lb flax	2.5	4.0 B
Chickpea + 15 lb flax	2.8	3.5 B
Chickpea + 20 lb flax	3.0	3.3 B
Chickpea + 40 lb flax	2.8	3.0 B
	NS	P<0.05

Table 2 shows that there was no difference in severity of Ascochyta infection on July 17, but that on July 31, there was more infection in the monoculture chickpea plots than in treatments seed with 10 or more lbs flax.

Chickpea dry down

Pure chickpea

Chickpea + 10 lbs flax

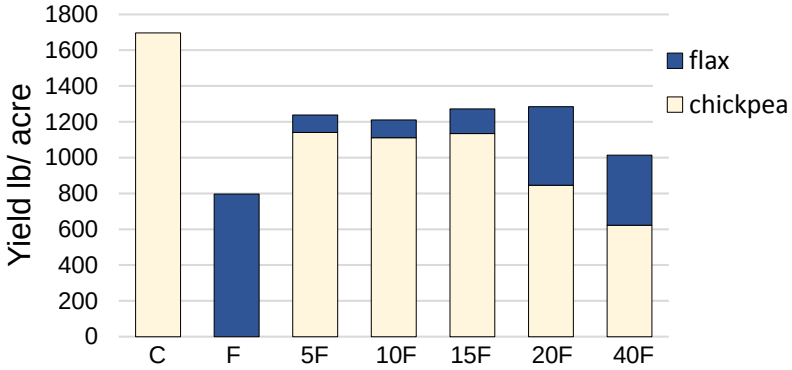
Chickpea + 40 lbs flax

Photos above were taken on August 14, 2018. Chickpea exhibited more mature color in the 40 lbs flax treatment. The trial was harvested without chemical desiccation on September 10 without any threshing problems.

Chickpea dry down ratings, % of chickpea plants mature color.

Treatment	Aug-2	Aug-14	Aug-24	Sep-5
Pure chickpea	0 B	15 B	65 BC	89 B
Chickpea + 5 lb flax	0 B	15 B	60 C	90 AB
Chickpea + 10 lb flax	0 B	15 B	70 ABC	91 AB
Chickpea + 15 lb flax	1 AB	20 AB	75 AB	95 AB
Chickpea + 20 lb flax	1 AB	15 B	80 A	96 A
Chickpea + 40 lb flax	5 A	30 A	80 A	95 AB
	P<0.05	P<0.01	P<0.01	P<0.05

Yield



The graph at left shows chickpea (C) and flax yields. The x-axis indicates flax seeding rate (F) in lbs/ ac. Monocultures of chickpea and flax yielded 1700 and 800 lb/ ac, respectively. Chickpea yield was 1140, 1130, 1110, 850, 620 lbs/ ac in the 5, 10, 15, 20, and 40 lbs of flax treatments. The 20 and 40 lbs flax treatments substantially reduced chickpea yield compared to the monoculture chickpea.

Chickpea quality

Treatment	Test wt lb/bu
Pure chickpea	61.9 B
Chickpea + 5 lb flax	61.7 B
Chickpea + 10 lb flax	62.0 AB
Chickpea + 15 lb flax	63.1 A
Chickpea + 20 lb flax	62.6 AB
Chickpea + 40 lb flax	62.2 AB
	P<0.05

Chickpea seed was tested for the following quality characteristics: green, discolored, or shriveled seed, size, and test weight. All treatments green and discolored seed was <0.5%, and shriveled seed ranged from 0.5-2%, meeting the US food-grade No. 1 standards. There were no differences in size among the treatments but we note that seed size was generally small with 85-90% of seed smaller than 9 mm. There was a slight difference in test weight, shown in the table at left. These data indicate that intercropping did not negatively affect chickpea seed quality.

Micro-Nutrient Fertilization of Dry Pea EARC, Sidney, MT 2018

Yesuf Assen Mohammed, Chengci Chen, Thomas Gross

Table 1: The Effect of Boron (lb/Ac) Application on the Grain Yield of Dry Pea at Richland and Sidney dryland, MT In 2018.

Treatment	Adjusted Grain Yield (lb/ac)	
	Richland	Sidney
Control	2375	1263
0.5	2261	1170
1.0	2472	1274
1.5	2225	1348
Mean	2333	1264
P-Value	0.4470	0.4814
LSD (0.05)	NS	NS
CV (%)	9.79	10.35

Table 2: The Effect of Copper (lb/Ac) Application on the Grain Yield of Dry Pea at Richland and Sidney dryland, MT in 2018.

Treatment	Adjusted Grain Yield (lb/ac)	
	Richland	Sidney
Control	2375	1263
0.5	2314	1529
1.0	2348	1484
1.5	2331	1575
Mean	2342	1463
P-Value	0.9557	0.2864
LSD (0.05)	NS	NS
CV (%)	6.83	12.98

Table 3: The Effect of Iron (lb/Ac) Application on the Grain Yield and Grain Iron Content of Dry Pea at Richland and Sidney dryland, MT in 2018.

Treatment	Adjusted Grain Yield (lb/ac)		Fe in Grain (ppm)	
	Richland	Sidney	Richland	Sidney
Control	2375	1263	54	47
1.0	2396	1078	58	50
2.0	2334	1483	59	53
3.0	2171	1475	63	56
Mean	2319	1325	59	52
P-Value	0.3191	0.1467	0.0004	0.0236
LSD (0.05)	NS	NS	2.6	3.7
CV (%)	7.56	15.69	3.22	5.12

Table 4: The Effect of Molybdenum (lb/Ac) Application on the Grain Yield of Dry Pea at Richland and Sidney dryland, MT in 2018.

Treatment	Adjusted Grain Yield (lb/ac)	
	Richland	Sidney
Control	2375	1263
0.5	2310	1225
1.0	2246	1446
1.5	2417	1484
Mean	2337	1354
P-Value	0.6831	0.6558
LSD (0.05)	NS	NS
CV (%)	8.93	19.84

Table 5: The Effect of Manganese (lb/Ac) Application on the Grain Yield of Dry Pea at Richland and Sidney dryland, MT in 2018.

Treatment	Adjusted Grain Yield (lb/ac)	
	Richland	Sidney
Control	2375	1263
1.0	2338	1641
2.0	2320	1557
3.0	2172	1623
Mean	2301	1521
P-Value	0.4086	0.1355
LSD (0.05)	NS	NS
CV (%)	7.48	12.10

Table 6: The Effect of Zinc (lb/Ac) Application on the Grain Yield and Grain Zinc Content of Dry Pea at Richland and Sidney dryland, MT in 2018.

Treatment	Adjusted Grain Yield (lb/ac)		Zn in Grain (ppm)	
	Richland	Sidney	Richland	Sidney
Control	2375	1263	47.5	36.7
0.5	2178	1218	53.8	37.3
1.0	2341	1327	54.3	39.0
1.5	2229	1375	57.5	40.0
Mean	2280	1296	53.3	38.3
P-Value	0.2968	0.7219	<0.0001	0.088
LSD (0.05)	NS	NS	1.79	NS
CV (%)	6.78	13.73	2.38	3.67

Miriam Backhaus, EARC summer student, working at Sidney dryland farm. Photo by Calla Kowatch-Carlson.

Efficacy of Seed Treatments for Control of Seed-Borne *Ascochyta* of Chickpea

Frankie Crutcher and Amber Ferda **EARC, Sidney, MT**

Objective: Test the efficacy of different seed treatments for control of seed-borne Ascochyta blight on chickpea.

Materials and Methods:

Not Irrigated
Variety: Supplier reported Sierra
Location: Sidney, MT
Planted: 05/09/2018
Harvested: 09/29/2018
Plot Size: 5' x 20'
Seeding Rate: 4 LS/ft²
Soil Type: Clay Loam
Previous crop: Peas

Residual Soil N to 3 ft: 28.7 lbs
Residual Soil P to 6 in: 15.7 ppm
Applied Fertilizer: None
Irrigated (sprinkler): None
Chemical Applications: Proline, Miravis Top, Endura, Prosaro, Roundup
Precipitation April – September, 2018: 11.38 in.
Vigor and stand counts: 05/25/2018, 06/05/2018, 06/19/2018
Treatments: Apron Maxx RTA, Vibrance Maxx, Mertect, Cruiser Maxx
Vibrance Pulse, Evergol Energy, Obvius, Obvius Plus, Gaucho, BAS 750

Comments: Seed was supplied by a farmer from western Montana. Seed was confirmed as having 16% infestation with QoI resistant *Ascochyta pisi*. Samples collected for root analysis on 06/06/2018. Plot 304 missing 50%. Plot 404 not planted due to planter problems. Plot 105 missing part of plot. Sprayed foliar fungicides at 15 GPA with Teejet 80015VS even flat spray nozzles with Induce as the NIS. Used 63 lbs/Bu as the standard to calculate yield. Plots 101 and 102 were harvested on 09/27/2018, and due to high seed moisture were not analyzed for yield. All others treatments were harvested on 09/29/2018.

Results: Because the study used *A. pisi* infested seed, disease pressure was very high. To prevent this from overwhelming the field and causing 100% losses, four foliar fungicide applications were applied throughout the season. All treatments performed better than the negative control except for measurement of disease lesions. We suspect this is due to larger, coalesced lesion formation on the plants that had no seed treatment. When this is repeated next year, percent of root (severity) will be measured in addition to number of lesions. Additionally, in next year's trial more than one repetition of the root evaluation will be performed.

Table 1: Seed Treatment Evaluation Control of *Ascochyta* on Chickpea

Treatment #	*Ascochyta* stem lesions (%)[a]	*Rhizoctonia* root lesions (%)[b]	Plants/A #[c]	Yield (Bu/A)
1	5.75 B	5.0 B	47552 B	50.4 B
2	8.25 AB	0.0 B	68779 AB	64.1 AB
3	13.67 A	13.3 AB	68779 AB	73.4 A
4	9.25 AB	0.0 B	72846 A	62.2 AB
5	6.50 B	0.0 B	55646 AB	51.4 B
6	10.00 AB	12.5 AB	58681 AB	59.6 AB
7	7.00 B	30.0 A	76893 A	63.0 AB
8	8.75 AB	0.0 B	59693 AB	66.2 AB
9	8.00 AB	0.0 B	57669 AB	70.3 A
10	8.75 AB	0.0 B	58681 AB	72.9 A
11	9.25 AB	12.5 AB	68799 AB	66.0 AB
12	8.25 AB	0.0 B	61716 AB	67.8 A
Mean	8.5	6.0	62858	64.0
CV (%)	43.5	285.8	24.5	19.2
LSD (0.05)	6.1	23.7	21553	17.9

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Number of lesions per stem for 10 plants per plot.
[b]Percent of 10 plants per plot that had visible root necrosis (one replication only).
[c]Number of plants per acre calculated from stand counts.

Table 2: Seed Treatments for *Ascochyta* on Chickpea

Treatment #	Seed Treatment	Rate
1	Untreated Control	None
2	Apron Maxx RTA	5 oz/cwt
3	Vibrance Maxx	5 total oz/cwt (3.46 oz H2O/cwt + 1.54 oz/cwt V.M.)
4	Vibrance Maxx + Mertect	5 total oz/cwt (V.M. @ 1.54 oz + Mertect @ 2.04 oz + H2O @ 2.44 oz)
5	Cruiser Maxx Vibrance Pulse	5 oz/ cwt
6	Cruiser Maxx Vibrance Pulse and Mertect	CM. V.P. 5 oz/cwt; Mertect 1.57 oz/cwt
7	Evergol Energy	1 oz/cwt
8	Obvius	4.6 oz/cwt
9	Evergol and Gaucho	1 oz/cwt + 1.6 oz/cwt
10	Obvius	4.6 fl oz/cwt
11	Obvius Plus	1.5 fl oz/cwt
12	Obvius + BAS 750	4.6 fl oz/cwt

Dr. Yesuf Mohammed presenting at the MSU-EARC/Extension Annual Field Day held July 17, 2018.

Irrigated Chickpea Foliar Fungicide Trial EARC, Sidney, MT

Frankie Crutcher and Amber Ferda

Objective: Test the efficacy of different fungicide combinations for control of *Ascochyta rabiei* on chickpea under irrigation.

Materials and methods:

Variety: Sierra
Location: Sidney, MT
Planted: 05/03/2018
Harvested: 09/28/2018
Plot Size: 5' x 20'
Seeding Rate: 4 LS/ft²
Soil Type: Clay Loam
Previous Crop: Sugarbeet
Residual Soil N to 3 ft: 26.7 lbs
Residual Soil P to 6 in: 16 ppm
Applied Fertilizer: None

Irrigated (sprinkler) on 06/14, 06/15, 06/23, 06/26, 06/27
Chemical Applications: Tough 5EC, Gramoxone SL + Hel-fire
Precipitation April – September, 2018: 11.38 in.
Vigor: 06/07/2018
Disease assessments: 07/10/2018, 07/25/2018
Treatments: Aprovia Top, Proline, Miravis Top, Bravo Weather Stik, Delaro, Miravis Neo, Priaxor, Propulse, BAS 751 and BAS 753
Date of first application: 06/25/2018
Date of second application: 07/09/2018
Date of third application: 07/24/2018

Comments: Seed treated by supplier. Spray applications made at 15 GPA with Teejet 80015VS even flat spray nozzles. NIS used was Activator 90. All plots had 5 rows instead of 6 due to wet soils during planting. Desiccated on 09/13/2018. GPS Coordinates: 47°43'39.4"N 104°08'55.3"W Plot 413 is 16.5 ft long.
Used 63 lbs/Bu as the standard to calculate yield. Had problems with combine which resulted in lost samples for plots 101, 109, 201, 209, 301, 309.

Results: Disease pressure was very high during the season and ideally more than 3 applications would have been necessary to completely control the disease. Additionally, weeds were a problem this year with the excessive rainfall, thus having a negative impact on the final yield. All treatments controlled disease when compared with the negative control (treatment 1).

Table 1: Effect of Fungicide Treatments on Chickpeas to control Ascochyta Blight

Treatment #	Incidence 1 (%)[a]	Severity 1 (%)[b]	Incidence 2 (%)[a]	Severity 2 (%)[b]	Yield (Bu/A)
	07/10/2018	07/10/2018	07/25/2018	07/25/2018	
1	90.00 A	19.13 A	100.00 A	27.13 A	22.13 AB
2	85.00 A	5.88 B	100.00 A	7.75 B	18.17 B
3	80.00 A	6.88 B	100.00 A	13.25 B	14.71 B
4	75.00 A	4.75 B	100.00 A	11.88 B	19.48 AB
5	82.50 A	5.00 B	100.00 A	9.63 B	15.82 B
6	77.50 A	4.13 B	100.00 A	7.88 B	17.33 B
7	62.50 A	3.38 B	100.00 A	5.88 B	30.63 A
8	80.00 A	4.75 B	100.00 A	7.88 B	20.82 AB
9	85.00 A	6.63 B	100.00 A	7.63 B	16.63 B
10	77.50 A	4.75 B	100.00 A	8.50 B	18.49 AB
11	87.50 A	8.25 B	100.00 A	12.50 B	16.35 B
12	85.00 A	6.88 B	100.00 A	12.75 B	17.97 B
13	82.50 A	4.88 B	97.50 B	7.63 B	12.82 B
14	82.50 A	5.63 B	100.00 A	9.13 B	11.97 B
15	85.00 A	5.88 B	100.00 A	14.25 B	15.48 B
16	77.50 A	7.85 B	100.00 A	10.38 B	14.32 B
Mean	80.94	6.54	99.84	10.88	17.79
CV (%)	23.48	89.10	1.25	71.99	47.95
LSD (0.05)	29.24	7.55	1.78	9.99	12.14

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Pest Incidence: Percent of 10 plants with *A. rabiei*
[b]Pest Severity: Average percent area of 10 plants covered by disease

Table 2: Fungicide Treatments for Irrigated Chickpeas

Treatment #	Fungicide	Application Timing	Rate
1	Untreated Control	None	None
2	Aprovia Top	A, B, C	11 fl oz/A
3	Proline	A, B, C	5.7 fl oz/A
4	A) Aprovia Top B) Miravis Top C) Bravo Weather Stik	A, B, C	A) 11 fl oz/A B) 13.7 fl oz/A C) 1.5 pt/A
5	A) Propulse B) Delaro C) Bravo Weather Stik	A, B, C	A) 10.3 fl oz/A B) 12 fl oz/A C) 1.5 pt/A
6	Miravis Top	A, B, C	13.7 fl oz/A
7	Miravis Neo	A, B, C	13.7 fl oz/A
8	Priaxor	A	6 fl oz/A
9	BAS 753	A	8 fl oz/A
10	Priaxor	A, B	6 fl oz/A
11	BAS 753	A, B	8 fl oz/A
12	A) Bravo B) BAS 753 C) Priaxor	A, B, C	A) 1.5 pt/A B) 8 fl oz/A C) 6 fl oz/A
13	BAS 751	A	7 fl oz/A
14	BAS 751	A, B	7 fl oz/A
Above treatments contained 0.25% v/v (NIS) Activator 90 except Bravo Weather Stik.			
15	A) Delaro B) Proline	A, B	A) 12 fl oz/A B) 5.7 fl oz/A
16	A) Delaro B) Propulse	A, B	A) 12 fl oz/A B) 10.3 fl oz/A
Above treatments contained 0.125% v/v (NIS) Activator 90.			

Farmer's Wife
Yes, he's working
No, I don't know when he'll be home
Yes, we're still married
No, he's not imaginary

Seed Treatment Evaluation to Control *Rhizoctonia* Damping-off and Root Rot of Lentil EARC, Sidney, MT

Frankie Crutcher and Amber Ferda

Objective: Test the efficacy of different seed treatments for control of *Rhizoctonia solani* on lentil.

Materials and Methods:

Non-irrigated
Variety: Richlea
Location: Sidney, MT
Planted: 05/25/2018
Harvested: 09/27/2018
Plot Size: 5' x 20'
Seeding Rate: 12 LS/ft²
Soil Type: Clay Loam
Previous Crops: Peas

Residual Soil N to 3 ft: 28.7 lbs
Residual Soil P to 6 in: 15.7 ppm
Applied Fertilizer: None
Irrigated (sprinkler) None
Chemical Applications: Roundup
Precipitation April – September, 2018: 11.38 in.
Stand counts and vigor: 06/12/2018, 06/25/2018, 07/10/2018
Treatments: Apron Maxx RTA, Vibrance Maxx, Cruiser Maxx Vibrance Pulse, Obvius, Evergol Energy, BAS 750, Cruiser 5FS, Gaucho

Comments: Originally planted 05/09/2018 with barley inoculated with *R. solani*. Replanted (with barley inoculum) due to uneven distribution of seeds from planter, thus study contained two times the amount of inoculum. Plots 111, 211, 311 and 411 planted on uneven surface. The fourth rep was collected for root analysis on 06/27/2018. Plot 407 disease ratings were out of 9 plants. Row spacing is 9 inches. Lentils were hand harvested and dried. Used 60 lbs/Bu as the standard to calculate yield.

Results: Because very high disease within the trial, yields were very low. The two treatments (1 and 4) that were not inoculated with *R. solani* performed best overall.

Table 1: Seed Treatment Evaluation Control of *Rhizoctonia* on Lentil

Treatment #	[a]Rhizoctonia Root Severity (%)	[b]Rhizoctonia Root Incidence (%)	Plants/A 3	Yield (Bu/A)
1	22.5	70	99152 AB	6.5 A
2	35	90	31364 BC	0.3 C
3	32	80	66776 ABC	0.3 C
4	37	89	32376 BC	5.4 AB
5	19	70	30353 BC	1.1 C
6	45	90	17200 C	1.1 C
7	27	80	17200 C	1.7 C
8	20	80	112304 A	2.5 BC
9	46	90	94093 AB	0.9 C
10	43	100	19223 C	1.8 C
11	51	100	36423 BC	1.5 C
Mean	34.3	85.4	50588	2.1
CV (%)	32.6	12.1	112.5	128.2
LSD (0.05)	-	-	74210	3.07

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]% of root surface necrosis of 10 roots. Only rep 4 was evaluated.
[b]% of 10 roots sampled with lesions. Only rep 4 was evaluated.

Table 2: Seed Treatments for *Rhizoctonia* on Lentil

Treatment #	Seed Treatment	Rhizoctonia Added	Rate
1	Untreated	No	5 oz/cwt
2	Untreated	Yes	30.0 ga/100kg; 6.25 ga/100kg
3	ApronMaxx RTA	Yes	1.54 oz/cwt
4	Apron Maxx RTA	No	5 oz/cwt
5	Vibrance Maxx	Yes	4.6 oz/cwt
6	CruiserMaxx Vibrance Pulse	Yes	1 oz/cwt
7	Obvius	Yes	4.6 fl oz/cwt
8	Evergol Energy	Yes	4.6 fl oz/cwt
9	Obvius; Cruiser 5FS	Yes	1 oz/cwt; 1.6 oz/cwt
10	Obvius; BAS 750; Cruiser 5FS	Yes	5 oz/cwt
11	Evergol Energy; Gaucho	Yes	30.0 ga/100kg; 6.25 ga/100kg

2018 MSU-EARC/Extension Annual Field Day

Irrigated Lentil Foliar Fungicide Trial EARC, Sidney, MT

Frankie Crutcher and Amber Ferda

Objective: Test the efficacy of different fungicide combinations for control of Ascochyta Blight and other foliar pathogens on lentil.

Materials and Methods:

Irrigated

Variety: Richlea
Location: Sidney, MT
Planted: 05/03/2018
Harvested: 09/04/2018
Plot Size: 5' x 20'
Seeding Rate: 12 LS/ft²
Soil Type: Clay Loam
Previous Crop: Sugarbeet
Applied Fertilizer: None
Chemical Applications: None

Precipitation April – September, 2018: 11.38 in.
Residual Soil N to 3 ft: 26.7 lbs
Residual Soil P to 6 in: 16 ppm
Observation dates: Vigor: 06/07/2018
Disease Assessments: 07/26/2018
Treatments: Miravis Top, Aprovia Top, Proline, Delaro, Priaxor, Bravo Weather Stik, BAS 751, BAS 753
Date of first application: 06/26/2018
Date of second application: 07/09/2018
Date of third application: 07/24/2018
Irrigated on: 06/14, 06/15, 06/23, 06/26, 06/27

Comments: Conidia spray on 07/06/2018. NIS used was Induce. Spray applications applied at 15 GPA with Teejet 80015VS even flat spray nozzles. Seed treatment was Obvius and Cruiser 5FS. Plots 114 and 407 overlapped at harvest, so harvest data for both plots was not used in the final analysis. Used 60 lbs/Bu as the standard to calculate yield.

Results: There were no significant differences in yield, however there were some observed for severity and incidence. *Ascochyta lentis* inoculum was applied to the border of the trial at flowering, however, the pathogen was not observed within the trial itself. Ratings for incidence and severity were taken for foliar leaf lesions caused by an unidentified pathogen.

Table 1: Fungicide Evaluation Control of Ascochyta on Lentil

Trt #	Incidence (%)[a]	Severity (%)[b]	Yield (lbs/A)
1	0.73 AB	6.25 AB	23.0 A
2	0.68 B	5.00 B	22.1 A
3	0.63 B	5.00 B	21.5 A
4	0.88 A	5.00 B	24.6 A
5	0.65 B	6.25 AB	25.8 A
6	0.75 AB	5.00 B	21.8 A
7	0.65 B	6.25 AB	26.7 A
8	0.73 AB	7.50 A	24.3 A
9	0.75 AB	5.00 B	21.4 A
10	0.70 AB	5.00 B	21.5 A
11	0.65 B	6.25 AB	22.7 A
12	0.75 AB	5.00 B	22.7 A
13	0.65 B	5.00 B	21.5 A
14	0.70 AB	5.00 B	21.1 A
Mean	0.71	5.54	23.0
CV (%)	19.39	28.19	21.9
LSD (0.05)	0.20	2.20	7.8

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Pest Incidence: Percent of 10 plants with foliar symptoms.
[b]Pest Severity: Average percent area of 10 plants covered by disease.

Table 2: Fungicide Treatments on Lentil

Trt #	Fungicide	Application Timing	Rate
1	Untreated Control	None	None
2	Miravis Top	A, B, C	13.7 oz/A
3	Aprovia Top	A, B, C	11 oz/A
4	Proline	A, B, C	5.7 oz/A
5	Delaro	A, B, C	12 oz/A
6	Priaxor	A, B, C	6 oz/A
7	A. Miravis Top + Select Max B. Miravis Top C. Bravo Weather Stik	A, B, C	A. M.T. @ 13.7 fl oz/A + S.M. @ 12 fl oz/A B. 13.7 fl oz/A C. 1.5 pt/A
8	Priaxor	A	4 oz/A
9	BAS 753	A	8 oz/A
10	BAS 751	A	7 oz/A
Above treatments contain (NIS) Induce 0.25% v/v except Bravo Weather Stik			
11	Delaro	A	12 oz/A
12	Proline	A	5.7 oz/A
13	Propulse	A	8 oz/A
14	Propulse	A	10.3 oz/A
Above treatments contain (NIS) Induce 0.125% v/v			

Forage pea field at EARC

Treatment Evaluation for Control of *Rhizoctonia* Root Rot of Sugarbeet
EARC, Sidney, MT

Frankie Crutcher, Jessica Rupp, Myron Bruce and Amber Ferda

Objective: Test the ability of different seed treatments to control *Rhizoctonia* root rot on sugarbeet.

Materials and Methods

Irrigated
Variety: BS39RR8N
Location: Sidney, MT
Planted: 05/09/2018
Harvested: 09/28/2018
Plot Size: 6' x 30'
Seeding Rate: 90 seeds/30 ft row
Soil Type: Clay Loam
Previous Crops: Barley
Residual Soil N to 3 ft: 13 lbs
Residual Soil P to 6 in: 12 ppm
Applied Fertilizer: 11-52-0 and Urea
Irrigated (flood) on 07/13, 07/14, 07/24, 07/25, 08/07, 08/08, 08/21, 08/22, 09/05
Chemical Applications: Roundup
Precipitation April – September, 2018: 11.38 in.
Stand counts: 05/30/2018, 06/12/2018, 06/27/2018, 07/12/2018
Seed Treatments: Kabina, Metlock, Rizolex, Stamina, Systiva 2.5 and 5.0, Vibrance.
Foliar Treatments: Quadris, Priaxor, Elatus.
Date of application: 06/13/2018

Comments: Rhizoctonia inoculum applied 05/08/2018.

Results: Disease pressure was lower this than last year for two reasons. First, we applied inoculum to the surface of the soil instead of planting with the seed. Second, evening temperatures were very cool throughout the season, stunting disease development.

Table 1: Seed Treatment and Foliar Application Evaluations for *Rhizoctonia* on Sugarbeet

Foliar Fungicide	Seed Treatment	Disease Index (0-100)[a]	% Ruppel class 0-3	Yield (tons/acre)	% Pre-emergence damping off	% Post-emergence damping off
Untreated Control (none)	None (w/o *Rhizoc)*	53.2 A	35.4 A	34.9 A	35.0 A	20.8 A
	None (w/ *Rhizoc*)	63.7 A	46.3 A	31.7 A	35.0 A	36.8 A
	Kabina 14	60.6 A	38.7 A	34.5 A	38.7 A	28.9 A
	Vibrance	56.6 A	42.6 A	32.7 A	36.7 A	23.5 A
	Stamina + Systiva 2.5	58.3 A	40.9 A	36.2 A	38.3 A	25.9 A
	Stamina + Systiva 5.0	60.5 A	38.5 A	33.4 A	43.0 A	19.9 A
	Metlock + Rizolex	57.2 A	41.9 A	36.8 A	35.4 A	23.7 A
Priaxor	None (w/o *Rhizoc)*	53.4 A	46.3 A	37.2 AB	37.2 AB	19.0 A
	None (w/ *Rhizoc*)	54.7 A	44.8 A	33.0 B	40.9 A	17.2 A
	Kabina 14	47.3 A	52.0 A	38.6 A	31.9 B	16.9 A
	Vibrance	54.9 A	44.6 A	35.4 AB	40.4 AB	19.7 A
	Stamina + Systiva 2.5	57.5 A	41.7 A	33.1 B	39.1 AB	22.4 A
	Stamina + Systiva 5.0	56.6 A	43.0 A	37.1 AB	37.5 AB	24.8 A
	Metlock + Rizolex	49.8 A	50.2 A	37.2 AB	34.3 AB	19.4 A
Quadris	None (w/o *Rhizoc)*	46.8 A	53.1 A	36.9 A	36.3 ABC	14.5 AB
	None (w/ *Rhizoc*)	52.1 A	47.8 A	37.6 A	43.3 A	13.2 B
	Kabina 14	55.9 A	43.9 A	39.1 A	43.3 AB	17.9 AB
	Vibrance	51.5 A	48.1 A	35.4 A	36.3 ABC	19.2 AB
	Stamina + Systiva 2.5	55.2 A	44.1 A	37.3 A	33.7 BC	24.9 AB
	Stamina + Systiva 5.0	52.9 A	47.4 A	39.5 A	31.9 AB	27.7 A
	Metlock + Rizolex	48.9 A	50.7 A	38.2 A	36.9 ABC	16.8 AB

Table 1: Seed Treatment and Foliar Application Evaluations for *Rhizoctonia* on Sugarbeet – continued

Foliar Fungicide	Seed Treatment	Disease Index (0-100)[a]	% Ruppel class 0-3	Yield (tons/acre)	% Pre-emergence damping off	% Post-emergence damping off
Elatus	None (w/o *Rhizoc)*	49.9 A	50.4 A	36.0 A	40.6 A	14.7 A
	None (w/ *Rhizoc*)	47.1 A	53.0 A	37.2 A	34.4 A	18.3 A
	Kabina 14	49.2 A	50.8 A	34.9 A	37.2 A	16.6 A
	Vibrance	58.1 A	42.0 A	37.0 A	40.7 A	26.2 A
	Stamina + Systiva 2.5	55.0 A	45.0 A	34.4 A	36.3 A	28.8 A
	Stamina + Systiva 5.0	52.8 A	47.4 A	38.1 A	43.9 A	15.6 A
	Metlock + Rizolex	51.6 A	48.3 A	38.1 A	38.1 A	20.3 A

Letters in common within treatment grouping and column did not differ significantly according to a t-test at a significance level of 5%.
[a]Calculated based on Ruppel Scale (0-7), where 0% is no disease and 100% is completely rotten roots.

Table 2: Effect of Seed Treatments on *Rhizoctonia* Root Rot

Seed Treatment	Disease Index	% Ruppel 0-3	Yield (ton/A)	Pre-emergence damping off (%)	Post-emergence damping off (%)
None	50.8 A	49.0 A	36.2 A	37.3 A	17.2 B
None + *Rhizoc*	54.4 A	45.2 A	34.9 A	38.0 A	21.4 A
Kabina 14	53.2 A	46.3 A	36.8 A	37.8 A	20.0 AB
Vibrance	55.3 A	44.4 A	35.1 A	38.5 A	22.2 AB
Stamina + Systiva 2.5	56.5 A	42.9 A	35.2 A	36.9 A	25.5 A
Stamina + Systiva 5.0	55.7 A	44.1 A	37.0 A	39.0 A	22.0 AB
Metlock + Rizolex	51.9 A	47.8 A	37.6 A	36.2 A	20.0 AB
Mean	54.0	45.7	36.1	37.7	21.2
CV (%)	21.9	26.5	15.7	20.9	61.1
LSD (0.5)	6.8	6.9	3.2	4.5	7.4

Letters in common within treatment grouping and column did not differ significantly according to a t-test at a significance level of 5%.
[a]Calculated based on Ruppel Scale (0-7), where 0% is no disease and 100% is completely rotten roots.

Table 3: Fungicide Treatments for Rhizoctona on Sugarbeet

Treatment #	Fungicide	Rate
1	None	None
2	Priaxor	0.37 fl oz/1000 ft row
3	Quadris	0.38 fl oz/1000 ft row
4	Elatus	0.547 oz wt/1000 ft row

Optimization of Nitrogen Fertilizer in Sugarbeet under No-till Management

Chengci Chen, Reza Keshavarz Afshar, Abdelaziz Nilahyane **EARC, Sidney MT**

Objectives: The main objective of this project is to optimize nitrogen rate in sugarbeet production when shifting from CT to NT system.

Materials and Methods: A field experiment was conducted in 2016, 2017, and 2018 on EARC irrigated farm located at Sidney MT to evaluate the response of sugarbeet to nitrogen rate (0, 50, 100, 150, and 200 lb. N/ac supplied with urea 46-0-0) under conventional tillage (CT), strip tillage (ST), and no-till (NT). Soil at this location is containing 2.3% organic matter and pH of 8.3.

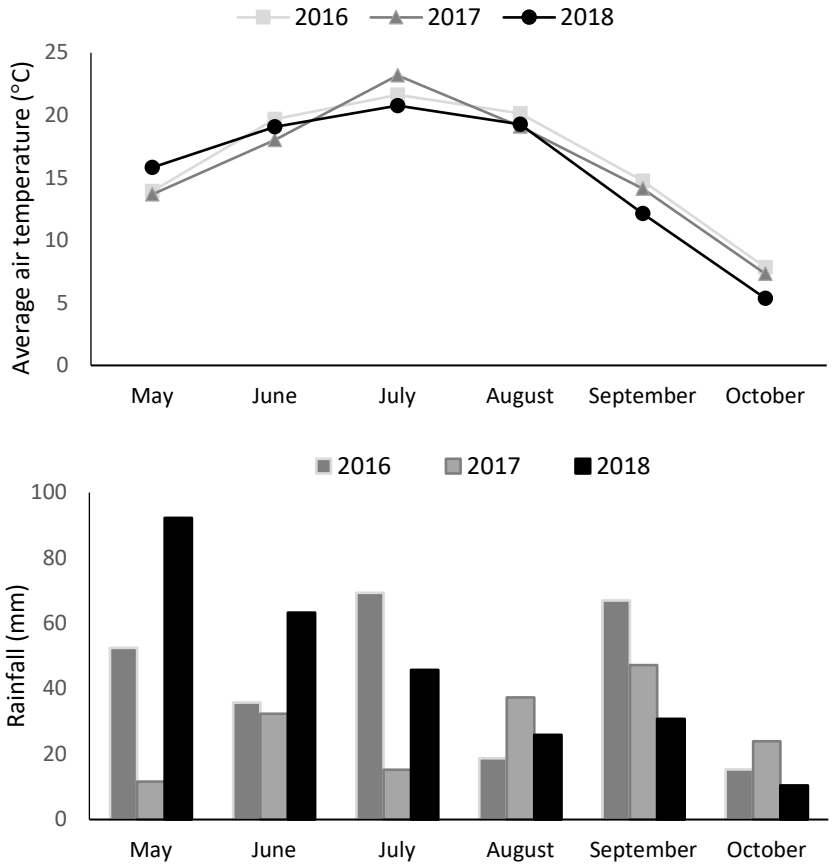


Fig. 1: Average monthly air temperature (a) and total monthly rainfall during sugarbeet growing season in 2016-2018 in Sidney, Montana (source: https://ndawn.ndsu.nodak.edu/weather-data-monthly.html)

The experiment was conducted in a split plot arrangement based on a randomized complete block design with four replications. Main plots were tillage systems and subplots were nitrogen rate. Weather data during the sugarbeet growth period are shown in Fig. 1.

Conventional tillage was performed in the fall consisted of three passes to deep disking and two passes of mulch packing. Strip tillage was performed at the same time as conventional tillage. Strip tillage was performed with specialized equipment described in detail by Evans et al. (2009). In no-till treatment, seeds were planted directly into wheat stubble. Sugarbeet (cv. American Crystal S360) was planted in early May at a rate of 1.09 seed/ft^2 (5.5 inches between plant and 24 inches between rows). All tillage treatments were flat-planted (no furrow created). All plots received an equal amount of phosphorus (20

lb./ac 11-52-0) and potassium (40 lb./ac potash) which were broadcasted on soil surface three days before seeding. One application of Minerva-Duo fungicide was also used to control fungal disease. Sugarbeet roots were harvested in late September, and root yield, sucrose concentration, and impurity value were measured.

The results of this 3-year field study revealed that sugarbeet stand, root yield, sucrose concentration, and recoverable sucrose yield were statistically similar in NT, ST, and CT systems (Table 1). In fact, reduced tillage produced similar yield at a significantly lower production cost. Therefore, NT in this environment could be a win-win scenario for farmers by increasing their profit while minimizing the adverse effect of agricultural activities on the soil and environment. Sugarbeet root yield linearly increased in response to increasing rate of N, however, sucrose concentration decreased and root impurities increased with increasing N input. Therefore, the recoverable sucrose yield did not significantly increased with increasing rate of N.

Sugarbeet Harvest: Chengci Chen walking in field; Becky Garza, Thomas Gross and Doug Hettich in plot harvester; and Ron Brown driving tractor.

Project Results:

Table 1: Main Effect of Year, Tillage, and Nitrogen Rate on Sugarbeet Measured Variables.

Experimental Factor		Plant Stand per ha	Root Yield ton ha^{-1}	Sucrose Concentration %	Gross Sucrose Yield kg ha^{1}	Recoverable Sucrose Yield kg ha^{-1}	Sodium	Potassium	Amino-N	Impurity Value	SLM %
							Concentration in juice (mg L^{-1})				
Year	2016	57282^{b}	63.4^{c}	17.4^{a}	11168^{c}	10540^{c}	26.3^{b}	230.2^{a}	17.8^{a}	0.66^{a}	0.98^{a}
	2017	78363^{a}	97.3^{a}	16.6^{b}	16066^{a}	15283^{a}	26.0^{b}	198.5^{b}	9.7^{b}	0.53^{b}	0.80^{b}
	2018	47247^{c}	82.3^{b}	17.6^{a}	14404^{b}	13551^{b}	34.7^{a}	228.4^{a}	19.0^{a}	0.69^{a}	1.03^{a}
Tillage	CT	62122	77.6	17.3a	13652	12921	28.3	219.0	15.1	0.62	0.93
	ST	57835	83.1	16.9b	14145	13353	30.0	219.7	16.0	0.63	0.95
	NT	61456	82.9	17.2b	14208	13443	28.9	219.8	15.8	0.63	0.94
Nitrogen Rate (kg ha^{-1})	56	61889	73.2	17.6	13149	12499	27.3	216.4	13.7	0.60	0.90
	112	61634	79.4	17.4	13773	13057	27.7	218.3	14.0	0.61	0.91
	168	60187	83.1	16.8	14089	13274	30.6	221.0	17.0	0.64	0.97
	224	58652	88.3	16.9	14845	13995	30.6	222.3	17.8	0.65	0.98
	Trend		L	L					L	L	L

Means with similar letters are not statistically different at $P < 0.05$.

Saline Seep Reclamation Research Project

Clair Keene, Jim Staricka, Kyle Dragseth, Jerry Bergman, and
Jane Holzer (Montana Salinity Control Association)

The goal of this on-going research project is to reclaim and remediate a saline seep present in one of the Williston Research Extension Center's dryland fields.

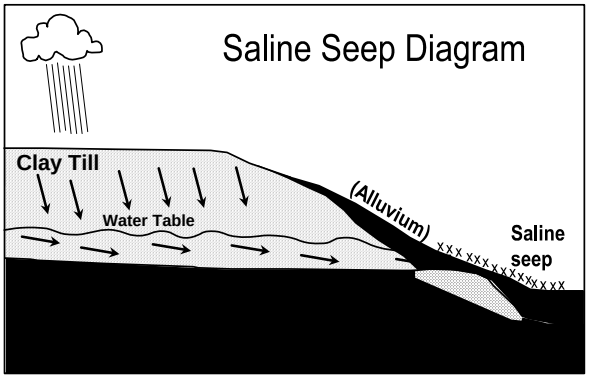
Background

This reclamation project is a partnership between the WREC and Montana Salinity Control Association (MSCA) to conduct a saline seep investigation on land operated by WREC. The project is located in T154N R102W Section 36 of the Fifth Principle Meridian Public Land Survey System (PLSS).

The saline area currently appears as wet and weedy areas in the field; however, in dry years ground water and salts will wick upwards to evaporate and form a white salt-encrusted layer on the soil surface. Currently approximately one acre is noticeable; however, a larger area of crop growth has reduced production.

Monitoring Wells*:* On August 18, 2014, ten shallow ground water monitoring wells were installed - nine recharge identification wells and one discharge area well. All of the wells were cased at the time of drilling with 2-inch PVC well casing, backfilled with pea gravel in the saturated zone and sealed with bentonite within the top five feet of the ground surface. Each well was surveyed for surface elevation in relation to the other wells. Ground surface elevations and well measurements to the water table are used to determine the direction of ground water flow and the location of the recharge area.

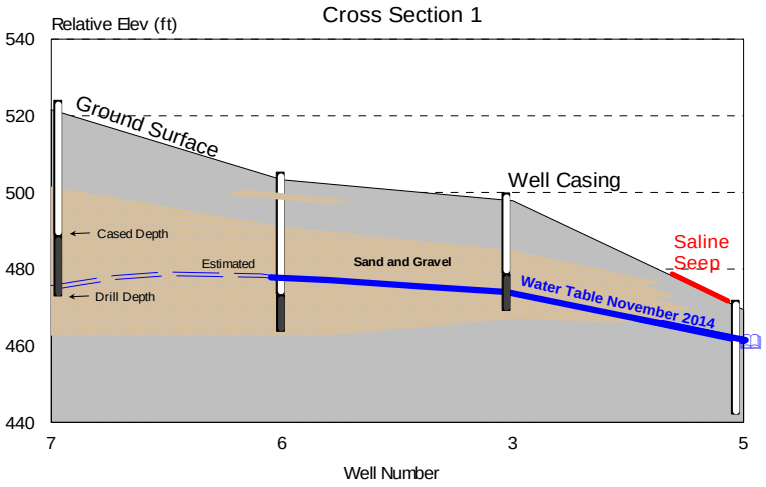
Soils: In the investigated area, the soil texture in the upper 0- to 5-foot soil profile is predominantly Clay or Sandy Clay Loam derived from Glacial Till left behind from the previous glacial periods. Glacial till in this area is mainly clay and clay loam soils.



Clay and Sandy Clay Loam have a water holding capacity of 2.0-2.2 inches of Plant Available Water (PAW) per foot of soil. Cereal grains and other annual crops typically root four feet deep or shallower. The total PAW can be estimated based on the soil type in the recharge area by using the average of 2.0 in. PAW/foot of moist soil for Clay soil multiplied by the four feet of rooting depth. Therefore, the top four feet of soil can store about 8 inches of water that is available to plants. When the soil profile is recharged or at moisture capacity, any excess soil moisture will leach below the rooting zone and recharge the water table. The sand and gravel layers hold less than one inch of PAW.

Geology: In this area, bedrock is the Bullion Creek Formation, also known as the Fort Union Formation in Montana. It is a clay shale, siltstone, and sandstone formation with numerous lignite layers. This formation extends hundreds of feet deep and is the semi-impermeable layer that perches, or holds, shallow ground water from local recharge and contributes salt to the ground water system (See Saline Seep Diagram). Bedrock was not encountered in any of the shallow wells installed at this site, but it would be present at a deeper depth. Lignite was also not found in the soil profile at this site.

Ground Water: The ground water flow direction at this site is south. Cropland north of the saline seep is contributing to the elevated water table causing the saline seeps. The difference in water table elevation from one well to another indicates the pressure-gradient influencing ground water flow (See Cross Section 1).



Investigation

In order to reclaim saline seeps, land-use changes in the recharge area must be made. In June 2016, an area of approximately 40 acres was planted to perennial forages in an attempt to lower the water table and reclaim the salt-affected area.

To assist area producers with future forage variety selection and evaluate currently available alfalfa varieties side-by-side in northwestern North Dakota, WREC partnered with forage seed company Alforex Seeds to establish a salt-tolerant forage variety trial of four alfalfa and two perennial grass varieties in the worst part of the saline seep. Alfalfa varieties are AFX 457, PGI 427, Magnum Salt, and Rugged. Perennial grasses are Garrison creeping foxtail and AC Saltlander.

This on-going research and extension project is reclaiming acres lost to a saline seep on the dryland farm at the Williston Research Extension Center. In 2014, shallow ground water monitoring wells were installed to identify the recharge and discharge areas associated with a saline seep that had been growing for approximately 15 years. In June 2016, an area of approximately 40 acres was planted to salt-tolerant alfalfa varieties and perennial grasses to lower the water table and allow salts concentrated at the soil surface to be washed down into the soil profile and, eventually, deeper than the plant rooting zone. Over the worst part of the saline seep, we planted a variety trial to evaluate the salt tolerance of four alfalfa varieties and two perennial grasses. Alfalfa varieties are AFX 457, PGI 427, Magnum Salt, and Rugged. Perennial grasses are Garrison creeping foxtail and AC Saltlander.

Stand evaluations in May 2017 estimated all alfalfa varieties at 80-90% ground cover with the stand in good to very good condition. The perennial grasses did not establish as well as the alfalfa and had poor to fair stands due to difficulty establishing in the no-till, heavy-residue conditions. In May 2018, all alfalfa varieties had very good stands and 90-95% ground cover, demonstrating good winter hardiness in Northwest North Dakota. Grass stands improved somewhat in 2018 and started to fill in, but in plots where establishment was very poor, little desirable grass is present. Garrison foxtail and AC Saltlander yielded 0.6 and 0.5 Ton/ acre, respectively, at the first cutting in 2018. Regrowth was not sufficient to merit a second cutting. Consideration will be given to plant another grass species in the Garrison foxtail plots as the water table is too low not to sustain that species.

The variety trial plots were cut once in the establishment year 12 weeks after planting (September, 2016), twice in 2017, and twice in 2018. In 2017, the region experienced a severe drought and less than 1” of precipitation fell between early May and mid-July. Despite the lack of rain, second cutting alfalfa in the saline seep yielded well, demonstrating that it was able to take advantage of the shallow

Cover Crops and Snow Capture

Jim Staricka, NDSU Williston Research Extension Center

The Current Scenario

Many producers use cover crops to improve soil health. However, in areas where water is often limited like western North Dakota, concerns regarding soil water depletion has slowed the adoption of cover crops. Enhanced snow capture by cover crops increases the amount of water available to crops, but data on this seems to be scarce or non-existent.

Data Source

In 2013, the Williston Research Extension Center started a research project investigating the use of diverse crop rotations to improve soil health and crop production. In this project, soil water content was measured weekly or biweekly, generally from mid-April to mid-October. Over-winter soil water recharge was determined by calculating the change in soil water content that occurred between the end of one growing season and the start of the next. Data for these calculations were available for four winters. Four different experimental treatments, having different cropping treatments during the antecedent summer and thus different types of ground cover at the onset of winter, were chosen for this presentation (see Table 1).

Table 1: Ground cover conditions at the start of fall.

Antecedent crop	Resultant ground cover
Fallow	Minimal ground cover
Durum	Short stubble
Perennial mix	Tall standing plant material
Cover crop mix	Tall standing plant material

Results

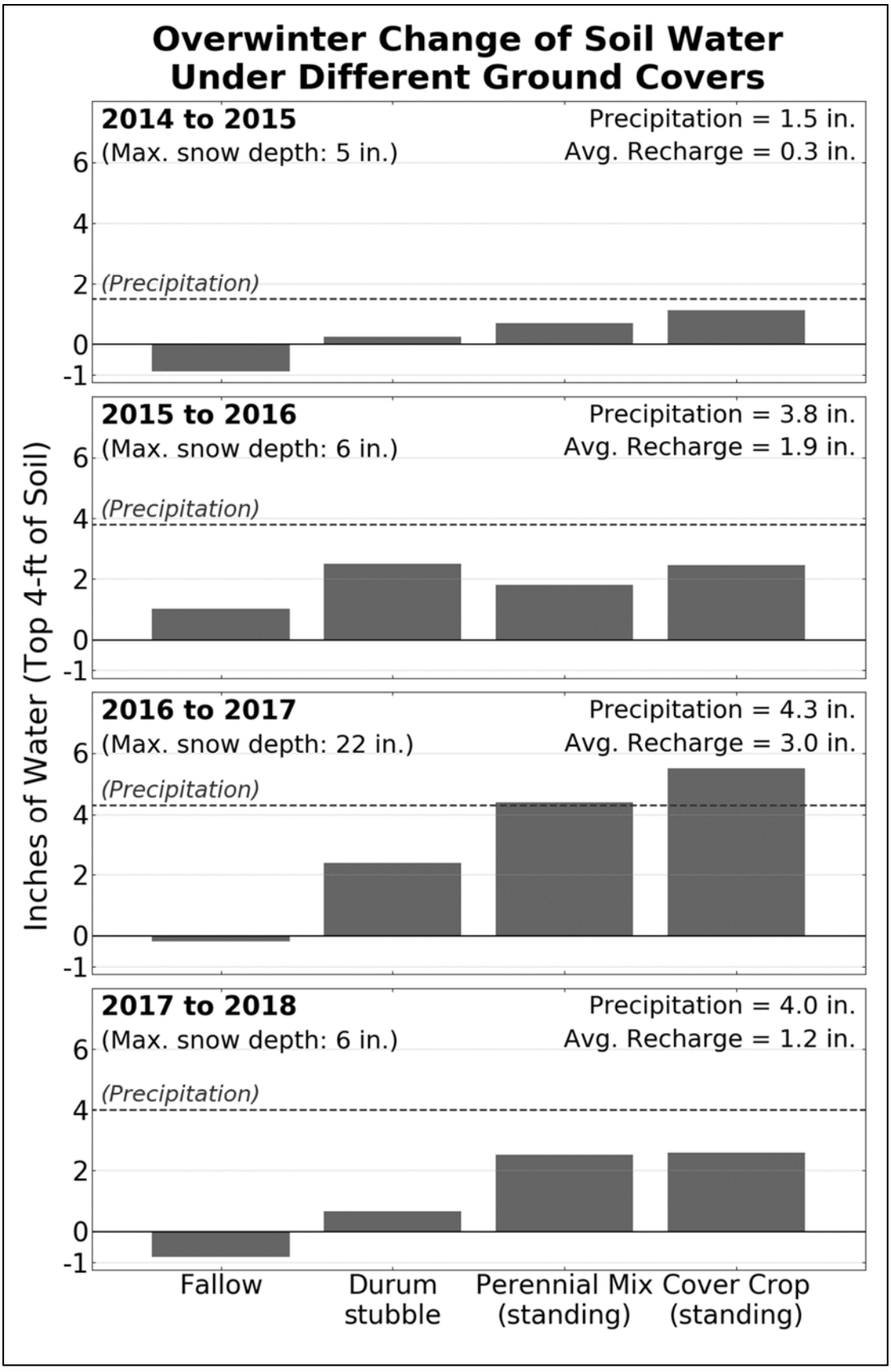
Over-winter precipitation amount (including both rain and snowmelt water) and maximum snow depth for each winter are listed on the graphs (see next page). The over-winter recharge that occurred in each winter × treatment combination is indicated by the bars.

Precipitation ranged from 1.5 to 4.3 inches and maximum snow depth ranged from 5 to 22 inches. Soil water recharge was generally much less than precipitation.

Averaged across all winters and treatments, the soil retained 43% (1.6 inches) of the over-winter precipitation. The fallow treatment lost water three of the four winters with an average over-winter precipitation retention of -14% (-0.2 inches). Durum retained 39% (1.5 inches) of the over-winter precipitation, the perennial mix retained 65% (2.4 inches), and the cover crop mix retained 83% (2.9 inches). During the winter of deep snow cover (2016-2017), soil water recharge exceeded over-winter precipitation in the cover crop mix. This water resulted from enhanced snow capture.

Discussion

This project will continue to monitor the frequency and magnitude of snow capture by cover crops to help answer the question “Do producers adequately consider the possibility of snow capture when making decisions on cover crops?”


Overwinter Change of Soil Water
Under Different Ground Covers
2014 to 2015
(Max. snow depth: 5 in.)
Precipitation = 1.5 in.
Avg. Recharge = 0.3 in.
(Precipitation)
2015 to 2016
(Max. snow depth: 6 in.)
Precipitation = 3.8 in.
Avg. Recharge = 1.9 in.
(Precipitation)
2016 to 2017
(Max. snow depth: 22 in.)
Precipitation = 4.3 in.
Avg. Recharge = 3.0 in.
(Precipitation)
2017 to 2018
(Max. snow depth: 6 in.)
Precipitation = 4.0 in.
Avg. Recharge = 1.2 in.
(Precipitation)
Inches of Water (Top 4-ft of Soil)
6
4
2
0
-1
Fallow
Durum stubble
Perennial Mix (standing)
Cover Crop (standing)

Irrigation Research at Nesson Valley 2018

Justin Jacobs, NDSU – Williston Research Extension Center

Weather Summary - Nesson Valley, ND[+]

	Precipitation		Temperature		
Month	2018	Avg	2018	Avg	Days above 89^0
	-inches-		-degrees F^0-		
Oct-Dec. 2017	1.87	1.10	35.25	36.1	-
January-March	-	-	11.00	27.6	-
April	0.40	0.71	33.00	41.5	-
May	1.54	2.30	59.00	53.5	1
June	4.67	2.98	66.00	62.8	0
July	2.27	2.10	68.00	69.5	3
August	0.98	1.25	67.00	67.3	10
September	1.22	1.35	53.00	57.3	0
April-July	8.88	2.04	56.50	57.0	4
April-Sept	11.08	1.79	57.67	58.8	14
Total- Oct 2017 - September 2018	12.95	-	49.03	-	14

Last Spring Frost - April 24, 2018 (25.0^0 F)

First Fall Frost - September 28, 2018 (24.0^0 F)

[+] NDAWN Hofflund site

Two-thousand and eighteen has come and gone, and with it many new changes and challenges. For starters, we hired a new Research Technician, Ken Burback. A new Variable Rate Irrigation panel was purchased to replace an existing panel on one of the linear systems. The International Harvester 1460 was replaced by a Case International Harvester 1666. However, with all the new changes, several things remained the same. Important and ground-breaking research continues to take place.

The weather was the largest variable factor for 2018, but in North Dakota, the weather can be the biggest constant as well. There is no way of predicting what will happen, whether we will have a wet, rainy year or a drought. It is also impossible to tell when we will get into the field, or out of the field for the year. This was one of those years for sure. We made it into the field late, and naturally did not finish until late. We wrapped up harvest this year with corn on November 22.

In 2018 we had a total of 19 variety trials in 13 crops. This was an average year for several of the trials. The growing season started off wet, and as a result we encountered a lot of early problems. For instance, because of the excessive moisture, herbicide damage was seen in spring wheat, durum, barley, and oat. The plots eventually pulled out of the injury, however, the initial injury was crucial to the eventual yield. The excessive moisture also caused emergence problems in the canola and intercrop trials. However, I am still happy with the results from this year's varietal trials.

This year marked the first year of, hopefully, a several year project. I am talking about my trial looking at intercropping field pea with canola and chickpea with flax. There were several challenges that faced us with this trial. The first challenge was with planting. It was not certain how we would plant two different crops in the same plot with the planter we had available. However, we were able to figure out a system to plant As mentioned previously the excessive moisture caused some emergence problems in the canola. As a result the canola had reduced yields in the peaola (pea and canola) plots. Weeds were a major problem in the intercropping trial this year. Unfortunately a pre-emergent herbicide was not applied as a result of un-timely rains. The only in-season herbicide applied was Section 3 for grass control. Unfortunatley the weed problem consisted primarily of Kochia. As result of the problems experienced this year, several changes will be made for the 2019 season. The canola planting rate will be reduced from 8 pounds per acre to 4 pounds per acre. Two additional ratios will be added; 75 / 25, and 67 / 33. The addition of a lentil / canola mix is also being discussed. The chickpea / flax will have some changes in the disease scouting and management. The initial results have shown that research needs to continue, potentially increasing crop production efficiency.

Two-thousand and nineteen looks bright as we approach the future. The mission and vision at Nesson Valley remains the same as it did in 2011 when Tyler Tjelde wrote, "Our vision at the Nesson Valley site is to further advance irrigation practices, improve crop production within an irrigated system and develop alternative cropping systems to improve water, nutrient, and pest management." Please remember to join us this coming year, July 11, 2019 for our Nesson Valley field tour.

Dryland and Irrigated Horticultural Crops

Research Update

By: Kyla Splichal

Horticulture in 2018

"The love of gardening is a seed once sown that never dies."

-Gertrude Jekyll

Horticulture staff from left to right: Rojee Pradhan, Ann Reinke, Tayder Jones and Kyla Splichal.

Every season at the Williston Research Extension Center brings new life as well as a new set of challenges. The 2018 season was no different in that respect, however, it marked a special milestone in my career. This past March marked my fifth year since moving across the entire state from Wahpeton to Williston to start on a new adventure. It has truly been a pleasure being a part of the Williston Research Extension Center and I can't imagine life without these gardens! I look forward to many more seasons, but first a glance at the summer of 2018.

Spring seemed to take its sweet time arriving in North Dakota with the minimum air temperatures barely staying in the 40s for most of May, threatening the gardens with a late spring frost and taunting the gardeners who just wanted to plant their tomatoes! From May 1st through September 30th the gardens accumulated 2272 growing degree days, which made the cucumbers, peppers and various annual flowers happy. In fact, the gardens produced among other things 152 pounds of cucumbers, 160 pounds of squash and 176 pounds of peppers! The total vegetable and fruit production for the season was just under 860 pounds. The season ended right on the average predicted first fall killing frost date which is September 21st, just in time for fall. The seasonal rainfall was just below average with 11.06 inches recorded during the period of April 1st to October 31st according to NDAWN.

"One of the most delightful things about a garden is the anticipation it provides."
W.E. Johns

Dryland

All-America Selection Garden

All-America Selection hot pepper, 'Flaming Flare' F1. Photo taken by Kyla Splichal.

The All-America Selections this year did not disappoint! We enjoyed a bumper harvest of hot peppers, cucumbers, cherry tomatoes and squash. WREC has been a public display garden for nearly a decade and each season keeps us looking forward to the selections in which AAS has deemed winners and top performers in their class. Keep All-America Selections in mind as you begin receiving seed catalogs for next year's garden. Visit their website for more cultivar information as well as recipes and landscape ideas-you won't be disappointed!

https://all-americaselections.org/

Haskap

Figure 1. Haskap shrub. Photo taken by Kyla Splichal.

Last year's report mentioned a newly funded trial, the haskap variety trial. Haskaps or Honeyberry (*Lonicera caerulea*) is an exciting new fruit crop for North America. It belongs to the Honeysuckle family and the name Haskap is a Japanese term for edible blue Honeysuckle. The fruits are oblong in shape, bluish to purple in color and about 1 cm in diameter (see Figure 3.). The plant is a deciduous shrub that can grow 3-6 feet tall (Figure 1.). The flowers are yellowish-white in color and are produced in pairs (see Figure 2.). Haskap is a circumpolar species native to the northern boreal forests of Asia, Europe and North America. It can be found in low lying wet areas or high in the mountains. In Canada, it can be found in the wild in every province except BC.

Figure 2. Haskap flower. Photo taken by Kyla Splichal.

Figure 3. Haskap fruit. Photo taken by Kyla Splichal.

Next season, the haskap trial will be conducted at the Williston REC dryland station as well as the NDSU Research Arboretum in Absaraka, ND in collaboration with High Value Crop Specialist, Dr. Harlene Hatterman-Valenti. We will be testing 12 different commercially available cultivars in each location.

Hops

Figure 1. Hop training date trial. Photo taken by Kyla Splichal

In the fall of 2016, WREC was awarded a continuation grant through the Specialty Crop Block program to look at management practices on the established hop yards. Early, mid and late spring stringing dates were evaluated in 2017-2018. The p values of this 2-year study are found in Table 1. Significance was found in cultivar, training date and year by training date for the measured bine length. Significance was found in the cultivar and training date for the yields (kg/plant and pounds/acre).

Table 1. P values of bine length, kg and pounds per acre for hop training date study conducted in 2017 and 2018.

		Bine length	Kg	Lbs/A
Sources of variation	df	--------Probability > F ---------		
Year	1	0.1099	0.1611	0.1611
Cultivar	11	0.0009*	<.0001*	<.0001*
Year*cultivar	11	0.1667	0.0469	0.0469
Training date	2	<.0001*	<.0001*	<.0001*
Year*training date	2	0.0243*	0.0787	0.0787
Cultivar*training date	22	0.6044	0.1803	0.1803
Year*Cultivar*Training date	22	0.6001	0.6169	0.6169

* Denotes significant main effects and interactions at P<0.05.

Figure 2 indicates the highest yielding cultivar regardless of training date which was ‘Zeus’ followed by ‘Challenger’ and ‘Galena’. The poorest yielding cultivar is ‘Spalt Select’.

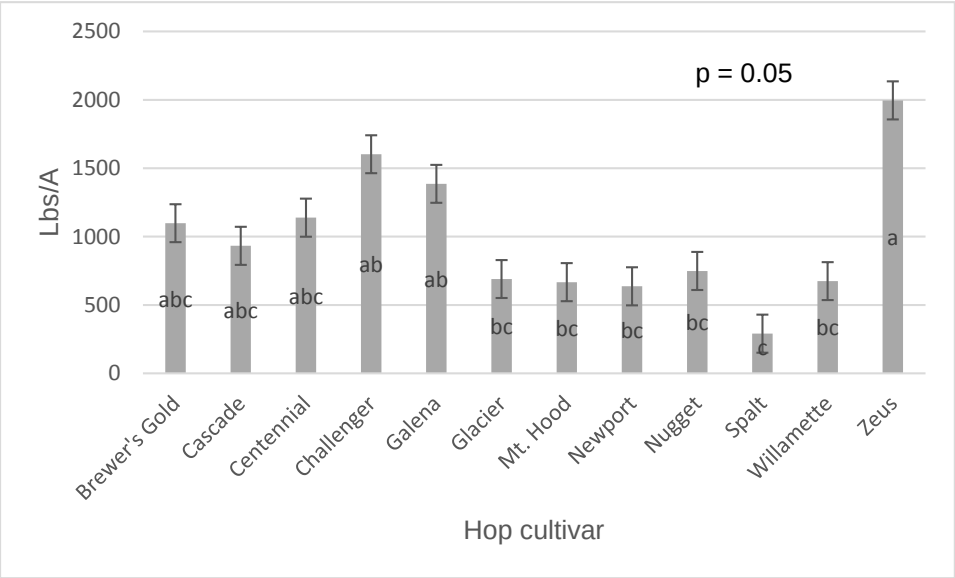


Figure 2. Mean hop yields per cultivar from the training date study conducted in 2017 and 2018.

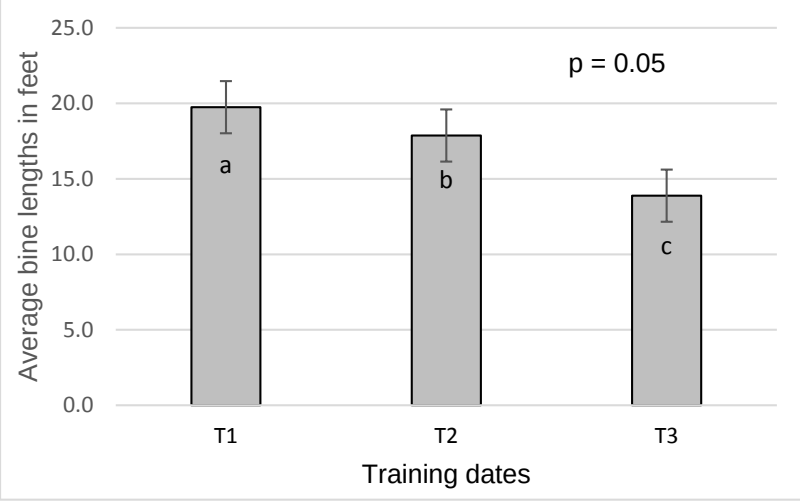


Figure 3. Average bine length in feet per training date.

Figure 3 indicates significant differences between training dates 1, 2 and 3 on bine length regardless of the cultivar. Training dates were as follows:

Year	T1	T2	T3
2017	5/1	5/16	6/7
2018	5/9	5/24	6/6

During the growing season, hops can grow up to 1 foot a day, reaching a height of 25’ tall. The taller the hop bine, the more internodes the plant will have. It is at these internodes that the hop cones are formed on side-arm shoots that begin forming in late June and early July. Hop plants are day length sensitive and need to reach their maximum height before the summer solstice (June 22nd) when the days become shorter. The shorter day lengths trigger a physiological response within the plant to begin reproducing. Delaying the training date, by not allowing the plant to reach its maximum height reduces the amount of cones produced and thus yield. Training date 1 produced 2.7 times more hops than training date 3. Training date 1 produced 1.3 times more hops than training date 2.

Table 2 summarizes information on the varieties tested.

Table 2. Cultivar information, alpha acid, hop storage index and harvest moistures.

Cultivar	Origin[1]	Brew Usage[2]	Typical Beer Style	Typical Alpha Acid Ranges	2017 Tested Alpha Acid[3]	2018 Tested Alpha Acid[3]	2017 Hop Storage Index[4]	2018 Hop Storage Index[4]	2018 Harvested Moisture
				---------- % ----------					---%---
Brewer's Gold	UK	B	Ale	8-10	2.2	3.3	0.25	0.22	75
Cascade	DM	A	American Pale Ale	5-7	3.4	5.0	0.21	0.34	74
Centennial	DM	D	American Pale Ale	9.5-11	12.4	8.1	0.23	0.25	75
Challenger	UK	D	English Ale	6.5-9	4.5	6.2	0.24	0.20	75
Galena	DM	B	English Ale	10-15	9	6.7	0.20	0.10	76
Glacier	DM	D	American Pale Ale	5.5	3	2.6	0.21	0.16	74
Mt. Hood	DM	A	Lager	4-7	--	2.2	--	0.17	78
Newport	DM	B	Barley Wine	13-17	3.7	6.2	0.23	0.24	69
Nugget	DM	B	Barley Wine	12-14	4.7	9.1	0.22	0.21	72
Spalt Select	GE	A	Bock	3-6.5	--	2.7	--	0.26	71
Willamette	DM	A	English Style Ale	4-6	2.1	2.9	0.22	0.28	75
Zeus	DM	B	Pale Ale	20	0.7	3.0	0.27	0.15	79

[1]DM = Domestic, UK = United Kingdom, GE = German as reported by Hopunion LLC

[2]A = Aroma, B = Bittering, D = Dual purpose as reported by Hopunion LLC

[3]Alpha acids ajusted to 10% moisture by sample weight. Missing values indicates insufficient sample size.

[4]HSI is a non-dimensional number calculated by measuring the adsorption of an alkaline methanolic hop extract at two different wavelengths using UV spectrophotometric analysis. Normal range is from 0.25 for fresh hops and 2.5 for fully oxidized hops.

Master Gardener Pollinator Garden

Master Gardener Certified Pollinator Garden sign on display at the WREC gardens. Photo taken by Kyla Splichal.

Williams County and WREC again received additional funds through the Extension Master Gardener Pollinator Garden Grants. The purpose of these gardens is to provide Master Gardeners with volunteer opportunities, build a habitat that will nourish pollinators, and create a public teaching garden that can be jointly utilized by Master Gardeners and Extension Agents to encourage members of the general public to build home pollinator gardens. The garden is really starting to shape up, thanks to the tireless efforts of volunteers.

Perennial Trials

Figure 1. Heuchera cultivars from top left to bottom right: Apple Crisp, Autumn Leaves, Berry Smoothie, Caramel, Cherry Cola, Crimson Curls, Fire Alarm, Frosted Violet, Lime Marmalade, Marmalade, Midnight Rose, Miracle, Obsidian, Plum Pudding, Stainless Steel and Zipper.

In 2015, WREC along with NDSU Extension Horticulturist, Dr. Esther McGinnis and Dr. Hatterman-Valenti planted 16 heuchera cultivars in three locations across the state, NDSU campus in Fargo, Horticulture Research Arboretum near Absaraka and WREC in Williston. (See Figure 1 for cultivar names).

Heuchera is a genus of herbaceous perennial plants commonly referred to as coral bells or American alumroot. They are native to North America with more than 70 known species, but have been heavily hybridized between 5 species *H. americana*, *H. micrantha, H. sanguinea*, *H. villosa*, and *H. cylindrical*.

After two years of data collection on winter survival and ornamental value, results indicate that ‘Crimson Curls’ had the highest average survival with 100% across three locations as well as the highest landscape ornamental rating. Other cultivars with 100% winter survival included ‘Cherry Cola’, ‘Midnight Rose’ and ‘Obsidian’. In contrast, the variety ‘Fire Alarm’ died over the winter in all trial locations. Other varieties of poor survival included ‘Caramel’, ‘Marmalade’ and ‘Autumn Leaves’ all of which scored less than 60% on winter survival. Cultivars that scored 80% or higher on ornamental landscape rating included ‘Crimson Curls’, ‘Obsidian’, ‘Midnight Rose’, ‘Marmalade’, ‘Stainless Steel’, and ‘Plum Pudding’.

Tree Trial

Under the direction of Dr. Todd West, with the NDSU Woody Plant Improvement program, Williston REC and the cities of Dickinson, Bismarck, Minot and Williston received funding from a USDA Specialty Crop Block Grant to study the hardiness of commercially available tree species which may or may not be suitable for planting in western North Dakota. In the spring of 2016, '17 and '18, WREC along with the NDSU Woody Plant research team planted a total of 50 different tree species as part of the Western Tree Trial. The 2016 trial was planted at the WREC, while the 2017 and '18 trials were planted at Nesson Valley.

The purpose of this project is to provide updated tree species and/or cultivar information to North Dakota commercial nursery crop producers and retailers by evaluating potential woody species to enhance, diversify and increase the inventory of usable landscape plants for USDA hardiness zones 3-4. This trial will also help enhance and expand the North Dakota Tree Selector website (http://www.ag.ndsu.edu/tree-selector/).

North Dakota Western Tree Trial cultivars

Bailey Nursery:
Silver Queen silver maple*
Northwood red maple
Hot Wings® Tartarian maple*
Firefall™ freeman maple*
Red Baron crabapple*
Swamp white oak*
Boulevard American linden
Unity sugar maple
Fall Fiesta® sugar maple
Regal Prince® hybrid oak
Valley Forge American elm*
Princeton Gold® Norway maple*
Spring Wonder™ Sargent cherry*
Majestic Skies™ northern pin oak*
Mountain Frost® pear
Autumn Gold ginko biloba

Carlton Plants:
Royal Red Norway maple*
Sutherland caragana*
Street Keeper® honeylocust*
Pink Spires crabapple*
Purple Robe black locust
Ivory Pillar™ Japanese tree lilac*
Princeton American elm*
New Horizon hybrid elm*
Homestead buckeye
Ironwood (Ostrya)

J. Frank Schmidt Nursery:
Red November™ Amur maple*
Prairie Stature™ hybrid oak
Prairie Gold® aspen*
Prairie Dream® paper birch*
Heartland® catalpa
Chinkapin oak
Espresso™ Kentucky coffee tree
Marilee® crabapple*
Urban Pinnacle® bur oak
Crimson Spire® hybrid oak
His Majesty™ cork tree
Prairie Sentinel® hackberry*
Commemoration® sugar maple
MaacNificent® maaackia*
Mountain Sentinel® aspen*
Patriot elm*
Eye Stopper™ phellodendron*
Ivory Spear™ crabapple*

Speer&Sons Nursery:
Northern Acclaim® honeylocust*

Swedberg Nursery:
Gladiator™ crabapple*
Harvest Gold Mongolian linden
Prairie Expedition® elm*
Amur maackia

(*) Indicates survival as of summer 2018.

Irrigated

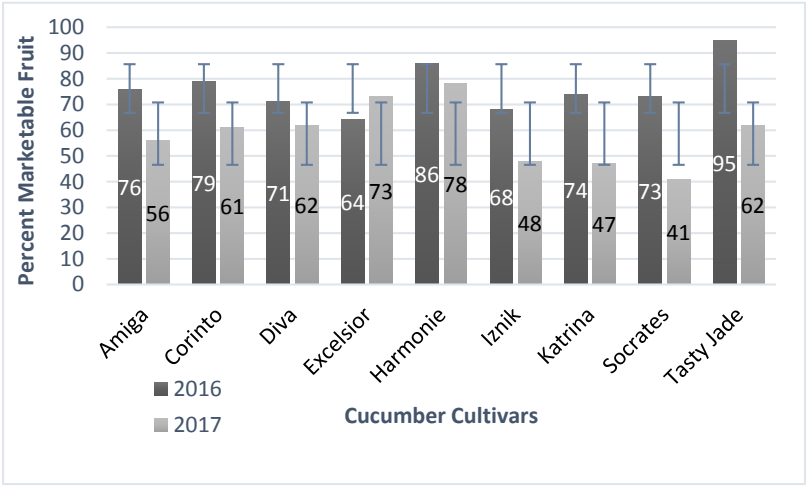
High Tunnel

High tunnel at Nesson Valley. Photo taken by Tyler Tjelde.

In the fall of 2015, WREC along with NDSU High Value Crop Specialist, Dr. Harlene Hatterman-Valenti and Extension Horticulturist, Dr. Esther McGinnis were awarded a USDA Specialty Crop Block Grant through the North Dakota Department of Ag to look at high tunnels for season extension. One of the objectives was to evaluate traditional high tunnel vegetables tomatoes, peppers and cucumbers; and to evaluate non-traditional high value crops, cut flowers.

Locally grown, fresh-cut flowers were considered non-traditional crops for this trial (data not shown). There were nine cultivars of slicing tomatoes, nine cultivars of bell peppers and nine cultivars of cucumbers, each set up in their own experiment and carried out at two trial locations, Williston and Absaraka, ND. The experiments conducted inside the high tunnel were also facilitated in a field adjacent to each high tunnel.

Cucumber trial



The cucumber trial consisted of nine cultivars of cucumbers, three of which were considered pickling varieties. The percent marketability of each cultivar can be seen in Figure 1. The cultivars 'Tasty Jade', 'Harmonie' and 'Corinto' are well adapted to high tunnel production and produced the highest marketable yields in 2016. A heavier disease pressure in 2017, reduced marketability across all cultivars except 'Harmonie' which may indicate disease resistance.

Figure 1. Marketability of high tunnel grown cucumbers by cultivar two-year results from Nesson Valley.

Pepper trial

There were nine cultivars grown in the pepper trials, however due to seed discontinuation only eight cultivars are represented in the data. The 2016 and 2017 high tunnel yields are shown in Table 1. The cultivar 'Islander' produced the most fruit per plant, followed by the cultivar 'Ace'. Both 'Ace' and 'Islander' consistently produced the highest total weight in both years as well. The poorest yielding cultivar was the only non-hybrid cultivar, 'California Wonder'.

Table 1. Pepper yields in 2016 and 2017 grown under high tunnel protection.

Cultivar	Total number	Total weight (kg)	Fruit weight (g)	Total number	Total weight (kg)	Fruit weight (g)
	Average †					
	2016			2017		
Ace	19	2.1	106.3	9	0.7	89.3
California Wonder	9	1.6	172.0	5	0.4	93.2
Flavorburst	11	1.6	149.7	6	0.6	94.4
Intruder	13	1.9	150.3	4	0.4	88.1
Islander	24	2.1	86.4	7	0.7	107.9
King Arthur	13	2.1	159.9	3	0.4	95.2
Sprinter	11	1.8	172.0	5	0.5	105.3
X3R Red Knight	9	1.7	192.8	4	0.5	122.5
Mean	14	1.9	148.7	5	0.5	99.5
LSD (5%)	24	1.7	54.6	7	0.7	66.9
LSD (10%)	20	1.3	43.8	6	0.2	53.6

† Data collected from one plant per block averaged across locations Nesson Valley and Absaraka, ND.

Peppers from the high tunnel. Left to right: 'Flavorburst' and 'Islander'. Photos taken by Kyla Splichal.

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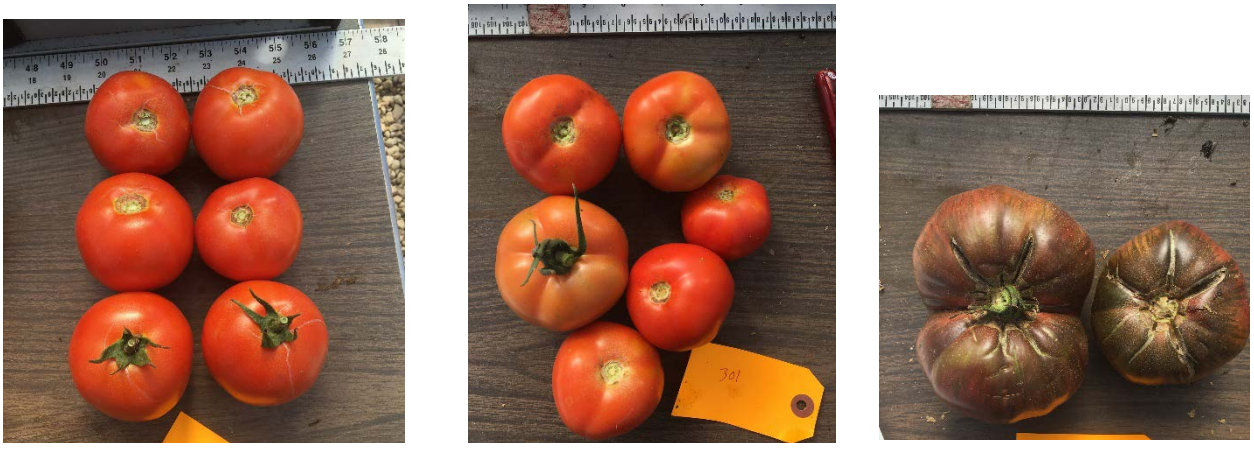
Tomato Trial

The tomato trial consisted of nine cultivars. A yield comparison of high tunnel to field for the year 2016 can be seen in Table 2. The cultivars 'New Girl' and 'Tomimaru Muchoo' are extremely well adapted to high tunnel production with the highest fruit harvested per plant at 29 and 28, respectively. The poorest adapted to high tunnel production was the only heirloom selection, 'Pink Berkeley Tie Dye'. The cultivar 'Tomimaru Muchoo' is not well adapted for field tomato production with only 3 fruits per plant harvested. The highest yielding cultivar for field production was 'Bigdena' with an average of 10 fruits per plant. Other cultivar performance to note was 'Cobra' with an average of 18 fruits per plant under high tunnel production and 9 fruits per plant in the field.

Table 2. Nesson Valley tomato yields per plant in 2016.

Cultivar	Fruit harvested	Total weight (kg)	Total weight (lbs)	Fruit harvested	Total weight (kg)	Total weight (lbs)
	---------- Average † ----------					
	--------- High Tunnel ----------			---------- Field ----------		
Arbason	14	2.6	5.7	5	1.1	2.4
Best Boy	9	1.6	3.5	5	0.5	1.2
Bigdena	11	4.6	10.1	10	1.1	2.4
Cobra	18	4.6	10.0	9	1.3	2.8
New Girl	29	4.6	10.1	8	0.9	1.9
Pink Berkeley	7	2.8	6.2	5	1.1	2.3
Pink Wonder	12	3.5	7.7	8	1.6	3.5
Tomimaru Muchoo	28	6.1	13.5	3	0.4	1.0
Trust	16	5.1	11.1	8	1.7	3.7
Mean	16	3.9	8.7	7	1.1	2.3
LSD (5%)	13	2.9	6.5	7	1.0	2.1
LSD (10%)	18	4.0	8.8	10	1.3	3.0

† Data collected from one plant per block averaged across replications.



Tomatoes harvested from the high tunnel from left to right: 'Arbason', 'New Girl' and 'Pink Berkeley Tie Dye'. Photos taken by Tyler Tjelde.

WREC Foundation Seed Increase Update

Kyle Dragseth, David Weltikol, Cameron Wahlstrom, Kelly Stehr, NDSU Williston Research Extension Center

NDSU has released 2 new durum varieties, ND Riveland & ND Grano, both with outstanding yields, low cadmium uptake, good quality, and good straw strength. Both ND Riveland and ND Grano have shown the highest yields and lowest Fusarium head blight and DON accumulation in variety testing plots across the state.

NDSU is also releasing 2 glyphosate tolerant soybean varieties. ND17009GT is a 00.9 maturity, high yield potential, and is the first soybean variety where you can keep your own seed and replant it following years. By allowing this not only is your seed cost the first year on average 30% cheaper then private industry varieties, every year thereafter is just the cost to clean your own seed. So thanks to NDSU the breakeven price for soybean production is considerably less than the private industry varieties.

The other NDSU glyphosate tolerant soybean variety is ND18008GT. This is another early maturing variety, 00.8 and also has aphid tolerance. So if you've had soybean aphid issues, this is a great variety to try out. However, do to this trait, it is a CSO variety. Meaning you need to buy new certified seed every year and cannot plant back you own seed. The seed price is still around 30% less than private industry soybean varieties and has shown strong yields to compete with other soybean varieties.

The last new release to highlight is ND Eagle lentil. This variety is a small green lentil with excellent agronomic performance and high seed quality. ND Eagle seed size is smaller than CDC Richlea and slightly larger than CDC Viceroy. ND Eagle has shown a slight yield advantage based on the last 7 years of trial data.

Listed below are the varieties available for sale. Please contact either the WREC at 701-774-4315 or Kyle Dragseth at 701-770-1652 with any questions, availability, and prices.

HRSW	Durum	Lentils	Soybeans
Bolles	ND Riveland	ND Eagle	ND17009GT
ND Vit-pro	ND Grano		ND18008GT
	Lebsock		
	Carpio		
	Tioga		
	Divide		

Save the Dates!

2019 Field Day Schedule

USDA-ARS/MSU-EARC/Extension Dryland Tour

ARS farm site: 4 miles North on Hwy 16, left on County Road 129, 2nd left on County Road 346.

Tuesday, June 18th (tentative) 9:00 am – 12:00 pm (MST)

9:00 am – Registration

12:30 pm - Lunch

Williston Research Extension Center Dryland Tour

0.6 miles West of Hwy 2 and 85 Junction

Wednesday, July 10th 3:00 pm – 7:00 pm (CST)

3:00 pm – Registration

4:00 pm – Dryland Tour begins

7:00 pm – Dinner

Nesson Valley Irrigation Tour

23 miles East of Williston on Hwy 1804

Thursday, July 11th 8:30 am – 12:00 pm (CST)

8:30 am – Coffee and Rolls

9:00 am – Irrigation Tour

12:00 – Lunch

Eastern Agricultural Research Center/Extension Field Day

1 mile North of Sidney on Hwy 200

Tuesday, July 16th 8:00 am – 12:30 pm (MST)

8:00 am – Coffee and Rolls

9:00 am – Field Tour

12:30 - Lunch

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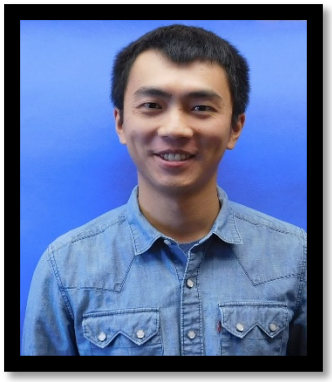

Andy Zhou
Research Associate

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