2019 Agricultural Research Update

NDSU Williston Research Extension Center

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MSU Eastern Agricultural Research Center

Serving the MonDak Region

NDSU North Dakota State University ND Agricultural Experiment Station

Regional Report No. 25 – December 2019

MONTANA STATE UNIVERSITY Montana Agricultural Experiment Station

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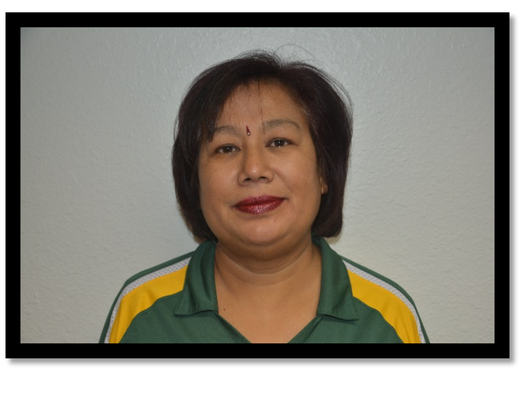

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Horticulture Technician

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Irrigation Research Specialist

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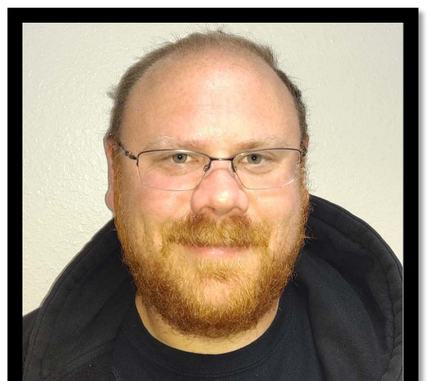
Part-Time Seed Processing Technician



Scott Fedorenko
Seed Processing Technician

Nick Birkhimer
Graduate Research Assistant

Current Vacant Positions:
Irrigation Technician
Irrigation Technician-Mechanic

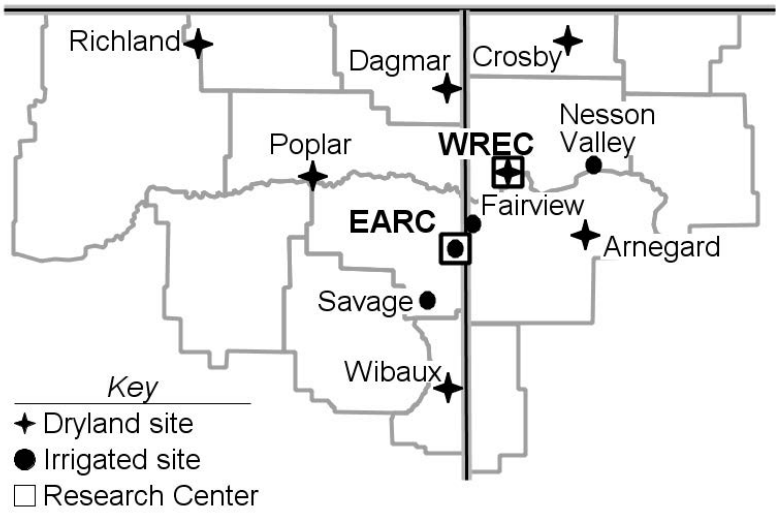
Table of Contents

Off-Station Cooperators – Producers – CES Agents

MONTANA
SMALL GRAIN--PULSES:
Dagmar - Brian Kaae - Agent Colleen Buck
Poplar - Mark Swank - Agent Jeff Chilson
Richland - Richard Fulton - Agent Shelley Mills
Wibaux - Rick Miske - Agent Danielle Harper
SUGARBEET:
Culbertson - Dana Berwick
East Fairview - Texas-Red Enterprises, Inc.
Savage - Conradsen Land & Livestock, Inc.
Savage - Jeff Jorgensen
Sidney - Don Steinbeisser, Jr.

NORTH DAKOTA
SMALL GRAIN--PULSES--OIL SEEDS:
Crosby - Robert Kostek - Agent Brandon Biwer
Arnegard - Beau Wisness - Agent Devon Leo

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 2019	Precipitation Avg	Temperature 2019	Temperature Avg	*
	- inches -		- degrees F -		
Oct-Dec. 2018	1.35	1.74			
January-March	1.94	1.19			
April	0.52	1.16	43.4	46.0	0
May	1.35	2.23	51.7	57.0	0
June	3.67	2.70	64.3	65.0	3
July	2.03	2.23	69.0	72.0	3
August	2.36	1.57	67.4	71.0	3
September	6.92	1.48	59.1	60.0	0
April-July	7.57	8.32			
April-Sept	16.85	11.37			
Total-Oct 18-Sept 19	20.14	14.30			

*Number of Days over 89° F

Last Spring Frost – May 12, 2019 (32° F)

First Fall Frost – October 10, 2019 (31° F)

Weather Summary Sidney, MT

Month	Precipitation 2019	Precipitation Avg	Temperature 2019	Temperature Avg	*
	- inches -		- degrees F -		
Oct-Dec. 2018	1.88	1.85			
January-March	1.25	1.30			
April	1.12	1.15	44.5	44.5	0
May	1.78	2.16	50.3	56.0	0
June	2.39	2.73	63.4	64.6	2
July	3.28	2.08	68.3	70.2	6
August	1.52	1.46	67.1	68.7	4
September	9.28	1.39	58.2	58.0	2
April-July	8.57	8.12			
April-Sept	19.37	10.97			
Total- Oct 18-Sept 19	22.50	14.12			

*Number of Days over 89° F

Last Spring Frost – May 17, 2019 (31.8° F)

First Fall Frost – October 2, 2019 (31.9° F)

Off-Station Precipitation* North Dakota

Site	April	May	June	July	Aug	Sept	Total
Beach	1.59	2.53	2.86	3.51	1.65	6.75	18.89
Crosby	0.92	0.65	3.23	3.10	3.33	6.92	18.15
Nesson Valley	0.89	0.88	2.90	3.46	2.17	10.04	20.34
Watford City	0.49	1.50	1.77	4.25	2.32	5.77	16.10

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

Off-Station Precipitation* Montana

Site	April	May	June	July	Aug	Sept	Total
Dagmar	0.55	0.25	3.39	2.15	2.69	5.55	14.58
E Fairview	1.30	2.05	2.05	4.66	1.61	10.27	21.94
Poplar	1.64	1.88	4.50	2.73	1.59	6.32	18.66
Richland	1.15	0.79	4.72	0.38	1.64	3.81	12.49
Savage	1.37	2.26	2.57	2.38	2.41	10.30	21.29
Wibaux	1.16	3.85	2.72	2.73	2.47	7.55	20.48

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

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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
CP 3100	Croplan	2016	MEDIUM	MEDIUM	MR	R	MR/MS	NA	MS	NA	NA	NA
CP 3419	Croplan	2014	M SHORT	LATE	MR	NA	MR	MR	MR	NA	M HIGH	MEDIUM
CP 3504	Croplan	2015	M SHORT	MEDIUM	MR	R	R	NA	MS	NA	NA	NA
CP 3530	Croplan	2015	TALL	LATE	MR	NA	NA	NA	NA	NA	M HIGH	HIGH
CP 3616	Croplan	2016	MEDIUM	MEDIUM	MR	NA	NA	NA	NA	NA	NA	NA
CP 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
NS Presser CLP	MT	2016	MEDIUM	MEDIUM	NA	NA	NA	NA	NA	S	MEDIUM	MEDIUM
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	2018	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-Heartland	21st C gen.	2019	M SHORT	M Early	MR	NA	R	NA	M	NA	NA	HIGH
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
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.

Hard Red Spring Wheat Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Days to heading	Plant height	Protein†	Test weight	Yield#		
					2019	2-Yr Avg	3-Yr Avg*
	(DAP)	(in)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
TCG-Spitfire	55	28.9	14.4	61.8	68.9	65.2	53.3
Elgin-ND	54	31.6	14.8	61.7	71.2	65.3	53.1
SY Rockford	54	29.1	14.7	61.3	69.8	62.6	52.8
Shelly	56	27.7	13.8	61.9	68.1	62.9	51.4
Surpass	52	31.6	15.2	61.1	69.9	61.1	50.8
SY Valda	53	26.5	14.3	61.3	69.3	61.2	50.6
LCS Trigger	60	29.5	12.4	62.1	68.1	64.5	50.1
MS Chevelle	53	28.5	13.7	61.8	71.7	60.2	50.0
LCS Rebel	52	27.8	14.7	63.0	68.3	58.8	48.4
NDVitPro	53	28.6	15.7	64.0	60.5	58.7	48.4
MS Camaro	53	24.5	16.5	62.5	62.3	57.2	48.2
Glenn	53	30.2	14.5	64.7	59.8	57.2	47.9
Faller	56	30.1	14.6	60.7	64.5	59.1	47.8
SY Soren	53	26.9	16.2	62.5	61.1	55.2	46.9
LCS Breakaway	52	25.7	15.5	63.1	61.9	56.0	46.8
Barlow	52	31.1	14.6	62.6	59.6	56.0	46.7
Linkert	54	25.9	15.8	62.0	55.9	54.9	45.8
TCG-Climax	58	28.0	17.0	63.1	57.7	55.2	45.3
Boost	56	30.6	15.0	60.9	63.6	51.1	43.8
Bolles	56	30.3	16.7	61.4	61.5	52.4	43.5
Lang-MN	54	27.8	15.5	61.8	62.8	51.2	43.3
SY Ingmar	52	24.7	14.5	62.6	60.0	50.8	43.2
Lanning	54	26.4	15.5	61.7	62.2	62.6	-
AAC Brandon	53	28.0	15.3	62.4	69.2	59.7	-
Prevail	52	30.4	13.7	61.4	64.1	59.5	-
AAC Penhold	52	26.5	13.6	61.7	65.5	59.1	-
AAC Goodwin	54	28.3	14.5	62.3	66.9	58.9	-
LCS Cannon	51	25.1	15.0	62.6	60.8	55.8	-
MS Barracuda	52	24.8	14.2	61.9	61.4	52.9	-
CP3504	54	27.0	13.7	60.6	69.4	-	-
SY McCloud	53	28.9	16.8	63.2	67.6	-	-
Dyna-Gro Commander	53	25.5	15.2	62.2	67.5	-	-
CP3910	52	25.2	15.1	62.5	67.5	-	-
Dyna-Gro Ambush	52	28.0	14.9	62.8	67.2	-	-
TCG-Stalwart	53	27.3	16.7	60.8	66.0	-	-
SY Longmire	52	26.5	15.6	63.0	65.7	-	-
CP3616	53	27.2	16.9	61.6	64.5	-	-
CP3915	53	27.0	15.9	62.6	64.0	-	-
Mott	54	32.9	16.1	61.9	63.5	-	-
TCG-Heartland	52	25.2	16.0	63.5	61.3	-	-
CP3530	54	31.0	14.5	61.4	60.8	-	-
CP3888	53	26.8	15.5	61.2	59.6	-	-
CP3939	53	29.0	14.8	62.7	58.6	-	-
MN Washburn	54	26.4	14.6	61.7	58.3	-	-
Mean	53	28.1	15.2	62.1	64.3	-	-
CV (%)	1.3	5.2	5.7	0.5	7.0	-	-
LSD (5%)	1.1	2.4	1.4	0.5	7.3	-	-
LSD (10%)	0.9	2.0	1.2	0.4	6.1	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation Previous crop: Soybeans

Planted: 5/8/2019 Harvested: 08/21/2019

Soil test to 6" in ppm: OM=2% pH=5.7 Soil type: Williams-Bowbells loam

Soil test to 24" in lb/a:

Applied fertilizers in lb/a: (60 lbs of MESZ with seed, 135 lbs of Urea broadcast at planting)

†Protein adjusted to 12% moisture

*Average of years 2017, 2018, and 2019

Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ;
Supremacy @ 5 oz/a with Axial XL @ 16 oz/a (6/13/2019)

Spring Wheat Dryland Off-Station Variety Trial - NDSU **Divide County, ND 2019**

Variety	Protein†	Test weight	Yield#		
			2019	2-Yr Avg	3-Yr Avg
	(%)	(lb/bu)	----------(bu/a)----------		
SY Soren	13.4	61.4	44.2	38.2	34.2
Elgin-ND	11.9	60.8	47.6	35.4	33.6
Barlow	11.9	60.8	42.5	35.4	33.1
Mott	12.8	61.1	47.0	35.2	30.2
Bolles	13.5	60.9	42.9	33.3	30.1
SY Ingmar	13.6	61.5	37.7	32.8	29.5
Glenn	12.5	63.8	37.4	28.2	28.5
ND-Vitpro	12.9	63.2	41.4	32.6	-
ND828	12.7	62.3	46.8	-	-
Lanning	13.2	60.3	43.8	-	-
Prestige	12.4	60.4	41.7	-	-
NDHRS16-13-97	12.6	61.5	40.3	-	-
Mean	12.88	61.60	42.78	-	-
CV (%)	4.02	0.40	11.36	-	-
LSD (5%)	0.88	0.42	8.23	-	-
LSD (10%)	0.73	0.34	6.81	-	-

Location: Crosby, ND; Latitude 48° 8' N; Longitude 103° 18' W; Elevation 2044 ft.

Planted: 05/6/2019 Previous crop: HRSW

Soil test to 6" in ppm: P=14 ppm; K=362; OM=3% Harvested: 8/21/19

Soil test to 24" in lb/a: N=14 lb/a Soil type: Farnuf-Alkabo.

Applied fertilizers in lb/a: N=77; P=24; K=0; S=6; Zn=0.6 (60 lbs of MESZ with seed, 152 lbs of Urea broadcast)

†Protein adjusted to 12% moisture.

#Yield reported on a 13.5% moisture basis.

Herbicide Application: Bison @ 1.5 pts/a with Tacoma @ 10 oz/a (6/25/2019)

Spring Wheat Dryland Off-Station Variety Trial - NDSU **McKenzie County, ND 2019**

Variety	Protein†	Test weight	Yield#
			2019
	(%)	(lb/bu)	(bu/a)
Lanning	16.1	60.5	52.4
Prestige	16.6	59.6	50.0
Mott	16.6	60.3	49.8
Elgin-ND	16.7	60.1	49.4
SY Ingmar	17.3	60.9	48.9
Glenn	17.2	63.1	48.7
Barlow	16.7	61.3	48.1
SY Soren	17.3	60.7	47.8
Bolles	19.1	60.2	45.9
ND828	17.2	61.3	45.1
ND-Vitpro	18.1	62.1	44.8
NDHRS16-13-97	16.7	60.9	40.1
Mean	17.1	60.9	47.6
CV (%)	4.3	0.4	4.5
LSD (5%)	1.3	0.4	3.6
LSD (10%)	1.0	0.4	3.0

Location: Arnegard ND, Lat. 47 48'N; Long. 103 25'W Previous crop: lentils

Planted: 5/13/2019 Harvested: 8/21/19

Soil test to 6" in ppm: P=11 ppm; K=324; OM=2% Soil type: Dooley-Zahl complex

Soil test to 24" in lb/a: N=8 lb/a

Applied fertilizers in lb/a: N=85; P=24; K=0; S=6; Zn=0.6 (60 lbs of MESZ with seed, 184 lbs of Urea broadcast)

†Protein adjusted to 12% moisture.

#Yield reported on a 13.5% moisture basis.

Herbicide Application: Bison @ 1.5 pt/s with Parity @ 8 oz/a (6/18/2019)

Spring Wheat Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9⁺)	Protein† 2019 (%)	Protein† 2-Yr Avg (%)	Protein† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2019 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
TCG-Spitfire	34	68	0	14.0	14.1	14.0	57.7	96.4	99.9	105.3
SY Ingmar	33	66	0	14.9	15.2	15.2	61.8	105.0	94.9	100.4
Redstone	34	60	1	14.4	14.4	14.7	59.4	93.1	91.5	97.6
SY Soren	33	63	0	14.6	15.4	15.3	60.9	104.6	90.4	97.3
LCS Trigger	37	70	0	13.0	13.1	13.3	57.3	92.1	91.6	97.3
Faller	35	66	1	13.6	14.0	14.2	58.4	90.8	87.3	97.2
MS Chevelle	33	62	0	13.5	14.1	14.2	58.3	94.1	91.1	97.2
SY Valda	34	65	0	13.8	14.3	14.4	59.0	94.0	89.4	97.1
Prestige	36	69	0	13.8	14.0	14.1	57.5	90.5	92.0	96.4
Prosper	37	66	0	14.5	14.9	14.8	59.6	94.9	87.5	96.3
CP3504	32	66	0	13.9	14.4	14.4	57.3	99.9	92.7	96.2
CP3419	35	75	0	13.8	14.0	14.1	55.8	89.1	90.6	95.5
Surpass	35	62	0	14.5	15.0	14.9	59.9	99.2	87.4	95.0
SY Rockford	36	67	0	15.6	15.4	15.2	56.7	79.5	84.5	94.8
LCS Rebel	37	61	1	14.6	15.3	15.6	61.1	97.5	92.7	94.8
Velva	37	65	1	14.5	14.9	15.0	58.3	92.3	89.0	93.2
Linkert	31	64	0	15.4	15.9	15.8	59.7	89.7	83.7	92.9
Bolles	35	67	0	16.3	17.0	17.0	58.7	93.6	85.5	92.9
Reeder	36	65	0	15.5	15.9	15.8	59.0	84.4	84.5	92.6
Mott	39	66	0	14.9	15.6	15.8	59.1	87.0	87.2	92.3
CP3530	37	67	1	14.4	15.0	15.1	58.2	86.1	86.2	92.1
Elgin-ND	38	65	1	15.3	15.6	15.5	59.1	85.2	83.6	90.3
Barlow	37	62	2	15.2	15.8	15.8	61.5	91.9	84.2	90.1
TCG-Climax	37	69	0	16.6	16.8	16.9	59.9	87.5	84.3	89.8
Glenn	38	61	0	15.3	15.6	15.9	62.9	88.4	85.6	89.8
Steele-ND	36	64	2	14.5	15.2	15.3	58.8	77.8	80.2	89.1
MS Camaro	32	63	0	14.9	15.9	15.9	60.0	91.9	79.9	89.1
ND-VitPro	35	62	0	15.0	15.6	15.6	62.1	84.4	80.5	87.9
Boost	37	67	0	14.5	15.2	15.4	57.9	84.9	81.9	86.6
Lanning	34	63	0	15.3	15.7	-	57.3	88.9	89.0	-
LCS Cannon	33	59	1	14.6	15.1	-	62.1	102.4	87.8	-
SY Rowyn	34	65	2	14.2	14.6	-	58.7	91.7	86.0	-
LCS Breakaway	33	62	0	13.8	15.1	-	61.4	98.0	84.8	-
Dyna-Gro Commander	34	62	0	14.4	-	-	60.8	107.0	-	-
SY McCloud	35	62	0	14.9	-	-	61.8	106.1	-	-
MS Barracuda	32	61	0	15.2	-	-	60.4	102.5	-	-
Dyna-Gro Ambush	34	63	0	14.6	-	-	61.5	102.0	-	-
CP3888	34	64	0	14.4	-	-	59.5	99.6	-	-
TCG-Heartland	32	62	0	15.1	-	-	61.3	99.2	-	-
SY Longmire	33	65	0	14.9	-	-	60.7	93.7	-	-
TCG-Stalwart	33	63	0	17.0	-	-	56.1	74.2	-	-
MEAN	34.8	64.4	0.3	14.71	15.10	15.14	59.45	92.95	87.50	94.03
C.V. (%)	3.3	4.0	-	3.46	-	-	2.29	8.73	-	-
LSD (5%)	1.6	3.6	0.8	0.71	-	-	1.91	11.37	-	-
LSD (10%)	1.4	3.0	0.7	0.60	-	-	1.60	9.52	-	-

* 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 in.): P=22 ppm; K=177 ppm; pH=7.9 ; OM=2.2% Previous crop: Field Pea

(0-24 in.): NO3-N=25 lb/a Planted: 4/24/2019

Yield goal: 90 Bu/a Harvested: 8/22/2019

Planting population: 1.5 million seeds/a Soil type: Lihen Loamy Fine Sand

Applied fertilizer: 385 lb/a of Urea (46-0-0) [4/18] Plot size: 92 ft^2

Herbicides applied: 2,4-D 1.5 pt/a, Talinor 14 oz/a, Tacoma 0.66 pt/a, and Goldsky 1 pt/a (6/5) Rainfall: 9.6 inches (4/24 - 8/22)

Fungicides applied: Tilt 4 oz/a (6/5), Prosaro 421 8 oz/a (7/2)

Dryland Advanced Yield Spring Wheat - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
AGRIPR 141	29.5	175	64.8	15.4	83.4
AGRIPR 151	29.8	175	63.6	14.2	88.4
AGRIPR 161	32.4	176	62.5	13.2	97.1
BZ 92413R	29.5	174	63.8	13.8	73.1
BZ 996434	31.5	172	63.1	14.0	79.6
CI 10003	40.9	179	61.5	14.3	77.6
CI 13596	36.5	175	62.8	13.5	70.4
CP3888	30.8	175	62.9	13.8	84.3
CP3939	31.4	172	63.7	13.4	80.3
CPx36619	26.6	171	63.2	13.7	82.3
LIMAGR 171	30.8	172	64.3	14.2	84.4
LIMAGR 191	29.4	174	63.7	13.3	83.4
LIMAGR 192	30.7	172	63.2	14.3	89.2
MT 1621	29.1	172	63.5	13.3	79.8
MT 1673	30.7	171	62.0	14.8	84.7
MT 1716	30.3	171	63.1	13.2	90.4
MT 1736	31.6	177	61.4	12.9	80.4
MT 1742	30.2	171	63.2	12.4	84.7
MT 1743	31.1	176	62.1	12.8	93.0
MT 1748	36.9	178	62.3	13.9	84.8
MT 1750	32.3	172	63.9	13.0	89.9
MT 1756	31.1	173	61.8	13.8	89.4
MT 1767	30.6	172	62.2	13.5	90.9
MT 1775	32.7	177	62.1	14.3	88.8
MT 1807	32.3	172	62.3	13.4	92.0
MT 1809	30.3	175	62.4	13.5	93.5
MT 1811	33.5	175	63.3	14.0	81.2
MT 1815	33.1	176	62.9	13.1	90.1
MT 1818	33.1	175	63.4	14.6	91.5
MT 1819	31.6	173	63.6	13.6	85.8
MT 1821	31.8	176	64.4	14.2	83.0
MT 1824	30.3	175	63.0	13.1	93.8
MT 1826	31.5	175	60.9	14.2	87.1
MT 1837	29.0	174	63.2	13.4	74.0
MT 1838	29.7	172	62.0	13.1	87.9
MT 1840	30.6	175	65.0	13.2	85.6
MT 1846	31.9	174	63.8	14.7	83.4
MT 1853	30.1	173	63.9	13.5	88.2
MT 1855	35.2	176	63.3	13.9	93.0
MT 1856	32.5	175	62.9	13.6	86.6
MT 1857	32.0	175	64.2	13.6	98.5
MT 1861	32.2	175	64.3	13.3	85.0
MT 1862	31.6	172	63.0	13.3	86.7
MT 1863	29.9	173	62.9	13.8	88.4
MT 1865	31.8	175	62.4	13.4	90.7
MT 1866	31.4	175	63.5	13.3	93.3
MT 1867	31.1	174	63.8	13.2	86.9
MT 1868	31.0	175	62.3	12.4	87.8
MT 1870	30.7	172	63.1	13.8	85.9
MT 1871	31.1	176	63.1	12.6	90.1
MT 1872	31.5	172	63.1	14.5	93.9
ND 695	33.7	173	63.6	13.5	85.2
PI 574642	32.7	177	63.2	12.6	87.7

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Dryland Advanced Yield Spring Wheat - MSU					EARC, Sidney, MT 2019
Variety	**Plant Height** (inch)	**Days to Heading** (Julian*)	**Test Weight†** (lb/bu)	**Protein** (%)	**Grain Yield†** (bu/ac)
PI 633974	30.2	175	62.5	13.4	91.1
PI 642366	30.3	175	62.6	13.0	85.1
PI 660981	30.6	171	62.6	12.8	87.4
PI 671855	30.2	176	62.6	14.2	80.6
PI 676978	29.7	171	63.0	15.3	82.8
PI 679964	33.5	178	62.1	13.7	93.9
SYN 181	29.0	172	64.4	15.2	78.7
SYN 182	29.1	175	64.6	13.3	82.3
SYN 183	28.2	173	64.9	13.0	86.3
WB 143	25.7	170	63.1	15.9	72.6
WB 171	26.5	172	63.5	13.7	83.8
WB 173	30.3	176	66.5	13.5	98.3
WB 9879 CLP	30.8	175	62.8	12.8	85.8
WSCIA	31.5	175	64.0	13.0	89.9
Mean	31.2	174	63.2	13.6	86.4
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.15	0.46	0.44	5.89	6.27
LSD (0.05)	2.09	1.28	0.45	1.30	8.75

Planted: 4/18/19
Harvested: 8/19/19
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 39
N added (lb/ac): 60

Previous crop: Fallow
Soil Type: William Clay Loam
Plot Width: 5 ft.
Precipitation (2019): 21.5”
Soil Test P_2O_5 (ppm): 31
P_2O_5 added (lb/ac): 20

Ron Brown, EARC Farm Manager and Bill Franck, EARC Research Scientist

EARC: Summer students, Zava Zupan and Emily Skogen, assisting Samantha Hoesel, EARC Research Assistant

Irrigated Advanced Yield Spring Wheat - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
AGRIPR 141	31.5	183	64.4	14.9	102.9
AGRIPR 151	32.3	183	63.7	14.9	96.6
AGRIPR 161	33.5	184	61.0	14.7	98.9
BZ 92413R	31.4	183	62.6	14.7	77.5
BZ 996434	32.5	181	62.4	15.7	81.5
CI 10003	41.7	186	60.8	16.2	65.7
CI 13596	37.0	180	61.2	15.5	67.4
CP3888	32.7	182	62.1	14.7	98.4
CP3939	33.2	182	62.8	15.6	94.8
CPx36619	27.4	180	61.9	14.6	93.8
LIMAGR 171	34.1	179	63.5	15.6	89.1
LIMAGR 191	31.5	181	63.2	14.5	98.6
LIMAGR 192	31.9	181	62.3	15.7	94.2
MT 1621	32.3	180	62.4	15.8	96.0
MT 1673	32.0	178	60.6	16.3	84.0
MT 1716	33.3	179	63.0	15.6	90.2
MT 1736	31.6	183	60.5	16.0	79.1
MT 1742	32.8	178	62.1	15.7	86.7
MT 1743	33.9	183	60.7	15.6	84.0
MT 1748	37.5	184	60.9	16.1	93.9
MT 1750	34.1	178	63.3	14.9	93.3
MT 1756	33.1	181	60.1	15.1	93.8
MT 1767	32.9	180	61.0	15.6	97.7
MT 1775	34.6	283	60.4	16.1	87.7
MT 1807	31.2	182	61.4	16.0	91.2
MT 1809	33.1	182	61.2	16.3	93.9
MT 1811	35.7	184	62.2	15.8	87.6
MT 1815	34.0	183	61.6	15.4	92.4
MT 1818	35.0	184	61.6	16.1	93.0
MT 1819	34.4	183	62.3	15.1	97.9
MT 1821	33.1	183	62.7	16.6	72.4
MT 1824	32.0	182	61.9	14.7	100.0
MT 1826	34.1	183	59.5	17.0	81.5
MT 1837	29.9	183	60.9	16.4	81.8
MT 1838	32.3	181	60.4	15.8	87.8
MT 1840	32.0	182	63.3	14.6	86.2
MT 1846	34.6	182	63.0	16.9	89.8
MT 1853	34.0	183	62.8	15.7	95.9
MT 1855	35.8	184	62.5	15.1	92.5
MT 1856	33.7	183	61.1	16.6	83.6
MT 1857	33.7	182	63.0	14.6	101.3
MT 1861	32.0	183	63.4	16.1	92.1
MT 1862	33.2	182	61.2	15.1	86.5
MT 1863	32.9	183	61.7	16.5	90.5
MT 1865	34.4	183	61.6	15.5	83.9
MT 1866	34.0	181	62.7	15.5	97.8
MT 1867	33.6	180	62.8	15.0	95.2
MT 1868	33.2	183	61.1	14.4	95.4
MT 1870	31.1	180	61.5	15.7	75.5
MT 1871	33.7	183	62.6	15.6	91.8
MT 1872	32.7	178	62.3	14.8	95.4
ND 695	35.4	183	62.5	15.6	95.4

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Irrigated Advanced Yield Spring Wheat - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
PI 574642	34.0	183	61.4	15.8	92.1
PI 633974	32.5	182	61.5	15.1	83.4
PI 642366	32.3	183	62.0	15.4	96.9
PI 660981	32.5	179	61.5	15.1	87.7
PI 671855	32.4	183	61.7	15.7	88.2
PI 676978	32.5	181	61.4	16.0	96.3
PI 679964	34.1	184	61.2	15.2	89.0
SYN 181	32.7	180	63.7	15.6	91.0
SYN 182	31.0	182	63.2	15.3	99.3
SYN 183	29.4	181	63.9	14.8	106.4
WB 143	26.2	178	62.3	17.5	79.9
WB 171	29.1	179	62.5	15.8	93.9
WB 173	31.0	183	65.1	15.1	97.3
WB 9879 CLP	32.2	183	61.0	15.8	80.9
WSCIA	32.9	182	63.0	15.0	84.6
Mean	33.0	183	62.0	15.5	90.1
P-Value	<0.0001	0.43	<0.0001	<0.0001	<0.0001
CV (%)	3.48	11.6	0.55	3.04	4.62
LSD (0.05)	1.85	34.3	0.55	0.76	6.79

Planted: 5/6/99 Previous crop: Sugarbeet
Harvested: 8/27/19 Soil Type: William Clay Loam
(Julian*) is a continuous count of days since January 1 Plot Width: 5 ft.
† Test weight and grain yield adjusted to 12.0% moisture Precipitation (2019): 22.5"
Soil Test N Avail (lb/ac): 25 Soil Test P2O5 (ppm): 25
N added (lb/ac): 100 P2O5 added (lb/ac): 30

Recrop Spring Wheat Evaluation - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Brennan	28.5	171	64.5	16.8	60.3
Choteau	29.5	175	63.2	14.6	60.5
Corbin	29.1	172	63.8	15.3	64.7
CP3888	30.6	174	63.3	14.6	79.1
CP3939	31.1	172	64.5	15.6	74.7
CPX36619	25.6	171	64.3	16.2	62.2
Duclair	32.7	172	63.1	14.8	66.6
Egan	30.7	176	62.3	17.1	71.9
Lanning	28.3	172	64.1	16.2	72.2
MT 1617	31.4	175	63.4	14.3	77.2
MT 1621	30.3	172	64.1	15.4	69.9
MT 1716	29.5	174	64.3	14.9	71.6
MT 1749	30.7	175	63.6	16.2	66.1
NS Presser CLP	31.0	175	63.3	14.6	79.2
Reeder	31.0	175	64.5	15.1	64.3
SY Soren	29.4	173	65.0	15.8	68.4
Vida	33.5	175	63.9	14.0	79.7
Mean	30.2	173	63.8	15.4	69.9
P-Val	0.0003	<0.0001	<0.0001	0.001	0.02
CV (%)	4.99	0.53	0.53	5.34	10.9
LSD (0.05)	2.50	1.53	0.56	1.37	12.4

Planted: 4/19/19 Previous crop: Pea
Harvested: 8/22/19 Soil Type: William Clay Loam
(Julian*) is a continuous count of days since January 1 Plot Width: 5 ft.
† Test weight and grain yield adjusted to 12.0% moisture Precipitation (2019): 21.5"
Soil Test N Avail (lb/ac): 22 Soil Test P_2O_5 (ppm): 29
N added (lb/ac): 60 P_2O_5 added (lb/ac): 20

Roosevelt County Dryland Spring Wheat - MSU **Poplar, MT 2019**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Brennan	27.7	64.7	15.4	76.5
Choteau	29.3	61.9	14.3	84.4
Corbin	28.0	62.5	14.2	68.3
CP3888	29.7	62.0	14.2	81.5
CP3939	30.1	63.8	14.5	82.2
CPX36619	24.3	63.7	14.3	59.6
Duclair	29.7	62.9	13.4	81.8
Egan	30.7	61.2	15.5	78.7
Lanning	29.1	62.8	15.5	84.0
MT 1617	32.8	62.1	13.6	86.5
MT 1621	30.2	64.0	15.1	92.4
MT 1716	30.2	63.2	14.3	87.7
MT 1749	31.2	62.8	14.6	86.0
NS Presser CLP	32.9	60.3	14.5	88.9
Reeder	32.9	63.0	14.7	83.6
SY Soren	27.6	63.7	15.1	77.5
Vida	31.0	61.2	14.5	93.6
Mean	29.8	62.7	14.6	82.0
P-Value	0.0007	<0.0001	<0.0001	<0.0001
CV (%)	0.61	0.80	1.73	4.2
LSD (0.05)	3.28	0.83	0.42	5.69

Planted: 4/23/19 Previous crop: Fallow
Harvested: 8/28/19 Plot Width: 5 ft.
(Julian*) is a continuous count of days since January 1 Fertilizer: MESZ @ 80 lbs/ac
† Test weight and grain yield adjusted to 12.0% moisture 10-40-0-10sulfur-1Zn

Sheridan County Dryland Spring Wheat - MSU **Dagmar, MT 2019**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Brennan	29.5	64.6	15.4	70.1
Choteau	34.4	62.3	15.3	71.3
Corbin	32.0	62.8	14.9	67.5
CP3888	30.4	62.8	14.8	80.5
CP3939	32.5	63.8	15.3	75.7
CPX36619	23.6	62.1	13.9	56.3
Duclair	31.2	61.9	14.5	64.6
Egan	32.5	61.8	16.2	67.7
Lanning	29.0	62.3	16.2	67.5
MT 1617	34.8	62.8	13.9	77.8
MT 1621	31.0	62.6	15.5	72.8
MT 1716	32.2	64.1	14.2	74.4
MT 1749	32.7	62.3	15.6	67.2
NS Presser CLP	35.0	61.2	14.6	78.0
Reeder	36.0	63.2	14.6	73.3
SY Soren	31.0	64.4	15.2	74.7
Vida	34.3	62.4	14.1	75.0
Mean	31.9	62.8	15.0	71.4
P-Val	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.36	0.73	2.93	6.20
LSD (0.05)	2.31	0.77	0.73	7.36

Planted: 4/24/19 Previous crop: Lentil
Harvested: 8/29/19 Plot Width: 5 ft.
(Julian*) is a continuous count of days since January 1 N added (lb/ac): 60
† Test weight and grain yield adjusted to 12.0% moisture P_2O_5 added (lb/ac): 20

Wheat Variety Comparisons, Williston, ND 2019

Gautam Pradhan, Jerald Bergman, Kyle Dragseth

The gross return per acre was based on three-year average yield of spring wheat (2016, 2017, 2019) and two-year average yield of durum wheat (2017, 2019) from dryland varietal trials, and the market price obtained in the second week of December 2019 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 case of durum, the choice rate was used. There were several episodes of high wind, heavy rain, and hailstorm that affected crops in 2018. So, the data from 2018 was not included.

Spring Wheat

Variety	3 Yr Avg. Yield	3 Yr Avg. Protein	Gross Return	+ or - Barlow
	bu/a	%	$/a	$/a
MS Chevelle	53.0	15.2	258.26	31.01
Elgin-ND	52.4	15.9	255.09	27.83
Prevail	51.9	15.1	252.78	25.52
SY Valda	51.2	15.2	249.54	22.29
Faller	49.4	15.2	240.66	13.40
Mott	48.1	17.0	234.41	7.15
SY Ingmar	47.6	15.5	231.67	4.42
Glenn	47.0	15.4	228.67	1.42
SY Soren	46.8	16.3	228.07	0.82
Barlow	46.7	15.9	227.26	0.00
Linkert	46.4	16.1	226.17	-1.09
LCS Breakaway	46.4	16.2	225.84	-1.42
ND VitPro	45.3	17.4	220.84	-6.42
Bolles	43.0	17.5	209.52	-17.74

Durum

Variety	2 Yr Avg. Yield	2 Yr Avg. Protein	Gross Return	+ or - Joppa
	bu/a	%	$/a	$/a
ND Riveland	48.0	17.5	288.19	21.16
Tioga	47.3	17.1	283.76	16.73
Grenora	46.6	16.9	279.71	12.68
Maier	45.8	18.4	274.64	7.60
Mountrail	45.7	17.3	274.39	7.35
VT Peak	45.6	17.2	273.40	6.37
Alkabo	45.3	16.9	272.00	4.96
Divide	45.3	17.7	271.62	4.58
AC Commander	45.1	18.0	270.45	3.42
ND Grano	44.9	17.9	269.12	2.09
Ben	44.8	17.4	268.86	0.00
Rugby	44.7	17.5	268.45	1.41
Joppa	44.5	17.1	267.03	0.00
CDC Verona	44.2	18.8	265.14	-1.89
Strongfield	44.1	18.3	264.58	-2.45
Pierce	44.0	17.2	263.92	-3.11
Carpio	43.3	17.5	259.52	-7.51
Normanno	41.7	17.4	249.98	-17.05
Alzada	40.9	17.4	245.43	-21.60

Kyra Candee, WREC Irrigation Technician

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 FORTITUDE	CANADA	2014	M TALL	MEDIUM	R	R	R	NA	M	MEDIUM	MEDIUM	M HIGH	GOOD
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
TCG-BRIGHT	TCG	2019	MEDIUM	M EARLY	M	R	M	NA	S	HIGH	MEDIUM	MEDIUM	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; TCG = 21st Century Genetics; 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.

Groundbreaking ceremony for the new seed conditioning facility at WREC

Durum Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Days to heading	Plant height	Protein†	Test weight	Yield#		
					2019	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(in)	(%)	(lb/bu)	----------(bu/a)----------		
Tioga	57.3	24.1	15.5	62.6	66.1	51.5	43.9
AC Commander	55.3	16.9	17.2	61.6	63.4	50.5	42.6
Alkabo	55.3	20.6	16.1	62.5	63.0	49.2	42.0
Strongfield	57.0	23.4	17.4	61.9	63.4	50.4	41.9
VT Peak	56.3	21.8	16.8	63.1	64.3	49.2	41.7
Mountrail	56.7	21.4	16.4	61.9	67.6	50.6	41.7
Joppa	57.3	23.2	15.8	62.0	61.4	48.5	41.5
ND Riveland	56.3	21.8	16.6	61.7	68.5	48.4	41.4
Maier	56.3	22.4	16.9	62.3	65.4	49.1	41.4
Divide	57.0	22.5	16.6	62.1	63.6	48.3	41.2
CDC Verona	58.0	23.2	17.2	61.0	65.4	49.6	40.7
Grenora	56.0	22.0	15.8	61.4	67.6	49.8	40.6
Carpio	58.3	21.8	16.5	62.1	59.8	47.0	40.2
ND Grano	57.0	21.8	16.6	62.6	63.7	46.5	39.7
Pierce	56.3	21.7	16.6	62.4	61.6	46.1	39.5
Ben	56.3	22.1	16.6	62.9	63.0	45.9	39.5
Alzada	54.3	16.7	16.9	61.3	54.2	44.7	39.0
Rugby	55.7	25.4	16.3	62.3	64.4	45.8	38.9
Normanno	54.3	16.6	15.8	60.7	57.0	45.0	38.7
AAC Cabri	57.3	24.0	17.6	61.9	63.2	-	-
TCG-Bright	56.3	21.9	15.0	62.7	67.6	-	-
TCG-Webster	53.7	16.9	15.5	62.5	60.6	-	-
Mean	56.7	22.4	16.6	62.1	64.7	-	-
CV (%)	1.5	5.5	4.7	0.5	9.8	-	-
LSD (5%)	1.4	2.0	1.3	0.5	10.2	-	-
LSD (10%)	1.1	1.7	1.1	0.4	8.6	-	-

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

Planted: 5/7/2019 Harvested: 8/20/2019

Soil test to 6" in ppm: P=24 ppm K=363 ppm OM=2% pH=5.7 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=37.5 lb/a

Applied fertilizers in lb/a: N=70; P=24; K=0; S=6; Zn=0.6 (60 lbs of MESZ applied with seed, 136 lbs of Urea broadcast)

†Protein adjusted to 12% moisture.

#Yield reported on a 13.5% moisture basis.

*Averages of years 2018 and 2019. **Averages of years 2017, 2018, and 2019.

[1]DAP = Days after planting.

Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ; Bison @ 1.5 pts/a with Parity @ 8 oz/a (6/13/2019)

Durum Dryland Off-Station Variety Trial - NDSU **Divide County, ND 2019**

Variety	Protein†	Test weight	Yield#		
			2019	2-Yr Avg	3-Yr Avg
	(%)	(lb/bu)	----------(bu/a)----------		
Tioga	14.3	60.5	52.4	43.5	37.5
ND Riveland	14.1	61.1	51.1	39.0	36.6
Mountrail	14.1	60.8	53.9	40.2	36.2
ND Grano	13.6	60.6	51.1	37.9	34.7
Carpio	13.9	60.9	51.2	37.4	34.1
Divide	14.0	60.6	52.1	37.5	34.1
Joppa	14.6	60.4	48.9	36.9	33.6
Lebsock	13.4	60.7	49.9	35.3	32.7
Alkabo	13.7	60.1	46.9	34.6	32.6
Grenora	13.6	60.3	52.1	35.0	-
VT Peak	13.5	61.4	49.6	-	-
DG Max	14.1	60.8	42.8	-	-
Mean	13.91	60.69	50.43	-	-
CV (%)	4.79	0.93	9.07	-	-
LSD (5%)	1.13	0.96	7.74	-	-
LSD (10%)	0.94	0.79	6.41	-	-

Location: Crosby, ND; Latitude 48° 8' N; Longitude 103° 18' W; Elevation 2044 ft.

Planted: 05/6/2019 Previous crop: HRSW

Soil test to 6" in ppm: P=14 ppm; K=362; OM=3% Harvested: 8/21/19

Soil test to 24" in lb/a: N=14 lb/a Soil type: Farnuf-Alkabo.

Applied fertilizers in lb/a: N=77; P=24; K=0; S=6; Zn=0.6

(60 lbs of MESZ with seed, 152 lbs of Urea broadcast)

†Protein adjusted to 12% moisture.

#Yield reported on a 13.5% moisture basis.

Herbicide Application: Bison @ 1.5 pts/a with Tacoma @ 10 oz/a (6/25/2019)

Durum Dryland Off-Station Variety Trial - NDSU **McKenzie County, ND 2019**

Variety	Protein†	Test weight	Yield#
			2019
	(%)	(lb/bu)	(bu/a)
Tioga	17.0	60.8	53.9
ND Riveland	17.0	60.8	52.9
DG Max	18.5	60.9	51.1
ND Grano	17.3	61.2	51.0
VT Peak	17.9	61.0	50.1
Lebsock	17.1	61.2	47.8
Mountrail	17.8	60.3	46.2
Divide	17.8	60.6	44.2
Joppa	17.5	60.4	42.9
Carpio	17.1	60.7	42.6
Alkabo	17.8	59.6	37.3
Grenora	17.6	59.5	34.7
Mean	17.5	60.6	46.2
CV (%)	3.6	1.0	6.9
LSD (5%)	1.1	1.0	5.4
LSD (10%)	0.9	0.9	4.5

Location: Arnegard ND, Lat. 47 48'N; Long. 103 25'W Previous crop: lentils

Planted: 5/13/2019 Harvested: 8/21/19

Soil test to 6" in ppm: P=11 ppm; K=324; OM=2% Soil type: Dooley-Zahl complex

Soil test to 24" in lb/a: N=8 lb/a

Applied fertilizers in lb/a: N=85; P=24; K=0; S=6; Zn=0.6

(60 lbs of MESZ with seed, 184 lbs of Urea broadcast)

†Protein adjusted to 12% moisture.

#Yield reported on a 13.5% moisture basis.

Herbicide Application: Bison @ 1.5 pt/s with Parity @ 8 oz/a (6/18/2019)

Durum Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Plant Height	Days to Head	Lodging	Protein†			Test Weight	Yield		
				2019	2-Yr Avg	3-Yr Avg		2019	2-Yr Avg	3-Yr Avg
	(in)	(DAP*)	(0 - 9⁺)	(%)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
ND Riveland	38	69	0	14.7	15.6	15.9	58.2	72.4	68.9	83.4
Carpio	35	71	0	14.5	15.3	15.8	59.6	70.0	67.3	80.3
Joppa	36	70	0	13.6	14.7	15.1	59.7	79.0	68.6	80.0
Alkabo	34	67	0	14.6	15.0	15.1	59.7	73.1	67.7	79.0
ND Grano	36	68	0	14.4	15.1	15.5	60.3	75.8	65.8	79.0
Divide	36	68	0	14.5	15.6	16.0	59.1	76.6	68.8	78.5
Grenora	34	67	0	14.4	15.2	15.5	58.4	72.6	68.1	78.4
Tioga	38	70	0	14.6	15.4	15.8	59.3	75.7	68.1	77.9
Mountrail	34	68	0	14.3	15.1	15.6	58.9	76.2	66.6	77.5
Maier	33	69	0	15.3	16.2	16.7	59.8	70.2	61.9	74.6
Strongfield	35	70	0	14.8	16.2	16.7	59.5	73.5	66.5	74.4
CDC Verona	37	71	0	15.7	16.9	17.0	57.4	58.9	59.6	72.9
AC Commander	29	67	0	14.1	15.0	15.3	58.1	80.4	66.0	72.9
Pierce	36	68	0	14.6	15.3	15.6	59.7	71.6	61.3	72.2
Rugby	37	66	0	15.0	15.8	16.1	59.0	69.9	62.5	71.5
Lebsock	32	65	0	14.8	15.5	15.8	59.9	69.5	62.6	71.3
Alzada	29	64	0	14.7	15.1	15.5	57.1	66.8	60.3	70.3
Ben	35	65	0	15.1	15.8	16.0	59.8	70.6	62.6	70.1
Normanno	26	64	0	16.3	16.1	16.3	55.5	65.7	57.8	70.0
VT Peak	35	67	0	14.7	14.7	14.7	60.0	72.9	72.9	-
AAC Cabri	36	71	0	15.0	15.0	15.0	59.9	73.8	-	-
MEAN	34.2	67.6	0.1	14.74	15.52	15.86	58.89	72.03	64.79	75.48
C.V. (%)	4.0	1.8	-	5.55	-	-	1.45	9.14	-	-
LSD (5%)	2.0	1.8	ns	1.16	-	-	1.21	9.33	-	-
LSD (10%)	1.6	1.5	ns	0.97	-	-	1.01	7.79	-	-

* 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 (0-6 in.): P=22 ppm; K=177 ppm; pH=7.9 ; OM=2.2% Previous Crop: Soybean

(0-24 in.): NO3-N=25 lb/a Planted: 4/23/2019

Yield goal: 90 bu/a Harvested: 8/21/2019

Planting population: 1.5 million seeds/a Soil Type: Lihen Loamy Fine Sand

Applied fertilizer: 385 lb/a of Urea (46-0-0) [4/18] Plot size: 92 ft^2

Herbicides applied: 2,4-D 1.5 pt/a, Talinor 14 oz/a, Tacoma 0.66 pt/a, and Goldsky 1 pt/a (6/5) Rainfall: 9.6 inches (4/23 - 8/21)

Fungicides applied: Tilt 4 oz/a (6/5) and Prosaro 421 8 oz/a (7/2)

Statewide Dryland Durum - MSU **EARC, Sidney, MT 2019**

Variety	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alkabo	177	65.1	12.8	91.5
Alzada	175	64.0	13.4	71.0
Carpio	179	65.6	12.0	68.0
Divide	177	64.9	11.1	80.4
Dynamic	180	65.0	12.1	82.1
Fortitude	177	65.3	12.0	83.4
Grano	178	66.2	12.8	84.7
Grenora	177	64.2	13.1	84.6
Joppa	176	65.1	12.4	73.5
Mountrail	177	65.1	11.7	80.6
MTD16001	178	64.2	10.9	68.4
MTD16002	179	65.0	13.0	88.5
MTD16004	178	65.8	12.6	78.0
MTD16005	178	64.9	12.5	92.8
MTD16006	177	64.9	12.7	77.8
MTD16007	177	65.2	12.6	80.5
MTD16008	177	64.0	12.4	81.5
MTD16009	178	62.6	12.4	75.7
MTD16010	178	65.8	13.1	74.9
MTD16011	178	64.6	12.4	85.8
Precision	177	65.1	13.1	79.6
Riveland	178	65.0	12.8	73.5
Tioga	178	64.7	14.0	78.8
Vivid	178	65.6	13.6	93.8
Mean	178	64.9	12.6	80.4
P-Value	<0.0001	<0.0001	<0.0001	0.12
CV (%)	0.54	0.49	6.45	12.5
LSD (0.05)	1.57	0.53	1.33	16.5

Planted: 4/18/19 Previous crop: Fallow
Harvested: 8/21/19 Soil Type: William Clay Loam
(Julian*) is a continuous count of days since January 1 Plot Width: 5 ft.
† Test weight and grain yield adjusted to 12.0% moisture Precipitation (2019): 21.5"
Soil Test N Avail (lb/ac): 39 Soil Test P2O5 (ppm): 31
N added (lb/ac): 60 P2O5 added (lb/ac): 20

Statewide Irrigated Durum - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alkabo	37.1	183	62.3	15.8	90.0
Alzada	29.5	180	61.2	15.6	70.6
Carpio	38.8	186	62.9	16.1	94.6
Divide	37.4	185	62.4	16.4	84.1
Dynamic	38.7	186	63.2	16.8	92.8
Fortitude	34.6	184	61.4	16.4	88.8
Grano	38.2	186	63.3	15.9	95.7
Grenora	34.9	183	61.6	16.0	85.9
Joppa	38.1	184	62.4	16.0	81.4
Mountrail	38.6	184	62.2	16.3	92.3
MTD16001	37.1	186	61.4	15.7	81.9
MTD16002	40.6	186	61.8	16.5	80.4
MTD16004	38.5	183	61.4	15.6	83.5
MTD16005	38.2	186	62.3	16.3	90.0
MTD16006	39.2	184	60.9	16.3	83.4
MTD16007	37.9	185	62.2	16.1	87.9
MTD16008	37.8	183	61.0	15.9	95.1
MTD16009	39.8	185	60.3	16.1	91.3
MTD16010	39.1	185	62.4	16.4	84.5
MTD16011	39.4	185	62.0	15.6	92.3
Precision	36.9	183	62.1	16.2	91.1
Riveland	40.0	184	63.1	15.6	94.6
Tioga	39.4	183	61.9	16.5	85.0
Vivid	36.2	184	62.9	16.5	92.9
Mean	37.8	188	62.0	16.1	87.9
P-Value	<0.0001	0.46	<0.0001	0.11	0.0016
CV (%)	2.39	18.8	0.62	3.06	7.11
LSD (0.05)	1.49	58.2	0.64	0.81	10.3

Planted: 5/6/19 Previous crop: Sugarbeet
Harvested: 8/26/19 Soil Type: William Clay Loam
(Julian*) is a continuous count of days since January 1 Plot Width: 5 ft.
† Test weight and grain yield adjusted to 12.0% moisture Precipitation (2019): 22.5"
Soil Test N Avail (lb/ac): 25 Soil Test P2O5 (ppm): 25
N added (lb/ac): 100 P2O5 added (lb/ac): 30

Evaluation of Recrop Durum - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alkabo	36.5	178	65.1	11.9	73.6
Alzada	33.7	177	64.2	12.4	64.6
Carpio	30.7	177	64.0	12.4	66.3
Divide	33.7	181	65.9	11.8	75.5
Dynamic	32.5	178	62.3	14.6	64.5
Fortitude	33.9	179	65.6	13.9	63.5
Grano	33.5	179	64.6	11.7	60.3
Grenora	36.7	179	65.1	13.0	65.9
Joppa	34.6	178	65.5	12.1	67.6
Mountrail	34.4	177	65.5	12.7	62.5
MTD16001	34.1	181	66.4	12.9	67.4
MTD16002	26.5	175	63.4	13.2	39.7
MTD16004	32.4	180	64.9	13.6	50.3
MTD16005	32.3	177	64.8	13.3	62.2
MTD16006	31.2	177	65.1	13.5	52.3
MTD16007	32.7	178	64.2	11.7	59.0
MTD16008	32.7	178	65.6	13.1	56.6
MTD16009	37.6	179	65.6	11.1	74.7
MTD16010	34.6	179	65.6	12.0	68.0
MTD16011	36.5	181	64.7	11.6	68.5
Precision	31.9	179	65.1	14.6	62.5
Riveland	34.5	177	65.0	11.6	64.7
Tioga	34.3	178	64.7	12.5	64.8
Vivid	30.1	179	65.0	14.3	59.6
Mean	33.4	178	64.9	12.8	62.9
P-Value	0.0047	<0.0001	<0.0001	0.0021	0.29
CV (%)	7.62	0.75	0.64	8.09	18.90
LSD (0.05)	4.27	2.24	0.69	1.73	20.0

Planted: 4/19/19
Harvested: 8/22/19
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 22
N added (lb/ac): 60

Previous crop: Pea
Soil Type: William Clay Loam
Plot Width: 5 ft.
Precipitation (2019): 21.5"
Soil Test P_2O_5 (ppm): 29
P_2O_5 added (lb/ac): 20

EARC Field Day attendees loading on trailers for the morning field tour

Dryland Uniform Regional Durum - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
ALKABO	33.1	179	65.1	13.4	92.7
CARPIO	34.1	180	66.2	13.1	94.5
D09555	32.8	177	65.8	13.3	92.2
D111068	32.4	180	66.3	12.7	102.6
D13500	34.4	179	65.8	13.4	94.6
D13720	38.1	180	65.9	13.4	103.7
D13750	36.7	179	65.6	13.4	90.2
D13899	37.5	180	66.0	13.1	98.9
D14053	36.0	179	65.5	13.8	99.9
D14056	35.3	177	65.6	13.2	83.6
D141103	36.2	179	66.2	14.5	97.6
D14115	34.8	179	66.1	13.6	92.0
D14935	34.1	179	65.4	12.0	97.3
D15051	33.5	178	65.9	13.6	93.9
D151012	33.1	177	65.5	13.5	97.9
D15115	34.1	180	65.1	13.4	89.7
D151190	35.7	179	65.6	13.1	95.4
D15262	36.4	179	65.7	14.3	83.4
D15428	35.3	179	65.3	14.0	89.0
D15574	37.0	178	64.8	13.3	98.3
D15677	33.2	178	64.7	13.2	95.9
D15739	33.7	179	66.3	13.2	88.2
D15838	35.6	178	65.0	13.5	94.6
D15841	35.4	179	65.5	14.2	100.4
D15935	36.4	179	65.5	11.9	100.6
D15937	33.2	179	65.3	13.0	85.3
D15946	33.2	179	66.0	13.0	94.7
DIVIDE	35.0	177	65.4	13.1	92.0
JOPPA	32.5	179	65.4	13.3	89.0
MOUNTRAIL	33.7	178	65.7	12.9	98.1
NDGRANO	32.0	179	66.1	13.4	92.4
NDRIVELAND	35.3	179	65.0	14.3	92.2
Mean	34.7	179	65.6	13.3	94.1
P-Value	<0.0001	<0.0001	<0.0001	<0.0004	<0.0022
CV (%)	4.29	0.34	0.59	4.41	6.20
LSD (0.05)	2.43	1.16	0.63	0.96	9.60

Planted: 4/19/19
Harvested: 8/21/19
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 39
N added (lb/ac): 60

Previous crop: Fallow
Soil Type: William Clay Loam
Plot Width: 5 ft.
Precipitation (2019): 21.5"
Soil Test P_2O_5 (ppm): 31
P_2O_5 added (lb/ac): 20

Roosevelt County Dryland Durum - MSU **Poplar, MT 2019**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alkabo	32.9	64.9	12.6	76.3
Alzada	24.8	62.4	12.9	53.5
Carpio	34.5	64.4	13.4	86.3
Divide	31.1	64.1	14.0	75.8
Dynamic	34.3	63.3	13.8	81.8
Fortitude	30.8	62.8	13.6	80.3
Grano	35.2	64.9	13.2	81.4
Grenora	28.2	63.4	12.0	69.3
Joppa	32.8	64.8	12.9	78.6
Mountrail	31.6	64.1	13.1	78.0
MTD16001	32.7	62.5	13.0	78.4
MTD16002	34.6	63.8	13.6	79.7
MTD16004	32.2	65.4	13.2	78.8
MTD16005	33.9	63.4	13.6	78.7
MTD16006	34.1	64.7	13.2	71.7
MTD16007	32.4	64.2	13.1	74.2
MTD16008	32.8	62.7	14.0	82.1
MTD16009	32.5	59.4	14.8	72.5
MTD16010	33.7	64.7	13.5	76.0
MTD16011	32.7	63.0	13.9	75.4
Precision	32.2	63.8	13.8	81.1
Riveland	35.3	63.9	13.5	84.2
Tioga	36.1	64.3	12.9	78.9
Vivid	34.9	64.1	14.0	88.0
Mean	32.8	63.7	13.4	77.5
P-Value	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.92	0.84	2.67	7.74
LSD (0.05)	2.65	0.88	0.59	9.87

Planted: 4/23/19 Previous crop: Fallow
Harvested: 8/28/19 Plot Width: 5 ft.
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture

Sheridan County Dryland Durum - MSU **Dagmar, MT 2019**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alkabo	37.4	64.3	13.4	64.8
Alzada	26.4	61.5	13.1	37.9
Carpio	36.1	64.2	13.0	65.2
Divide	34.4	63.4	14.1	57.0
Dynamic	37.7	63.7	15.3	65.6
Fortitude	36.1	62.9	14.6	64.0
Grano	36.6	64.2	13.7	62.2
Grenora	33.2	62.8	14.6	57.7
Joppa	37.3	63.9	13.4	61.7
Mountrail	35.6	63.4	13.9	60.4
MTD16001	32.9	62.2	13.9	52.4
MTD16002	38.1	63.5	14.0	66.8
MTD16004	31.4	64.6	13.7	60.8
MTD16005	35.3	63.3	14.1	62.6
MTD16006	36.5	63.3	12.8	50.9
MTD16007	34.5	64.4	14.0	63.4
MTD16008	37.7	62.7	14.4	65.1
MTD16009	34.3	59.8	15.0	50.5
MTD16010	33.7	64.1	13.8	50.5
MTD16011	36.7	63.6	14.1	59.4
Precision	35.6	63.8	15.1	66.1
Riveland	36.2	64.2	13.3	61.2
Tioga	38.8	63.7	14.2	64.4
Vivid	37.9	63.7	14.7	67.8
Mean	35.5	63.4	14.0	60.2
P-Value	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.51	0.90	2.24	7.69
LSD (0.05)	2.72	0.96	0.53	7.93

Planted: 4/24/19 Previous crop: Lentil
Harvested: 8/29/19 Plot Width: 5 ft.
(Julian*) is a continuous count of days since January 1 N added (lb/ac): 60
† Test weight and grain yield adjusted to 12.0% moisture P2O5 added (lb/ac): 20

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
FOUROSIX	MT	2018	MEDIUM	MEDIUM	**FAIR**	NA	MR	MR	NA	M HIGH	M HIGH
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
RAY**	MT	2019	M TALL	M LATE	GOOD	MR	R	NA	NA	MEDIUM	MEDIUM
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
TCG BOOMLOCK	TCG	2019	MEDIUM	MEDIUM	FAIR	NA	NA	NA	NA	MEDIUM	M HIGH
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; TCG = 21ST CENTURY GENETICS; 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. **DUAL PURPOSE-GRAIN/FORAGE

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 2019**

Variety	Plant height	Days to heading	Protein†	Winter Survival	Test weight	Yield#		
						2019	2-Yr Avg	3-Yr Avg
	(in)	(julian)	(%)	(%)	(lb/bu)	----------(bu/a)----------		
Peregrine	21.3	162.7	16.0	73.3	60.8	63.4	54.8	54.8
Ideal	23.1	163.7	16.0	61.7	60.3	63.7	52.2	52.2
Jerry	22.0	163.7	16.6	66.7	59.8	57.2	49.5	49.5
Loma	22.3	166.0	15.9	61.7	60.4	63.5	48.4	48.4
SY Monument	19.3	160.7	16.8	76.7	60.4	57.6	48.1	48.1
Northern	19.4	163.3	16.8	68.3	60.8	59.0	46.1	46.1
AC Emerson	26.9	163.7	16.5	68.3	61.3	55.6	45.5	45.5
Keldin	20.7	161.0	16.1	71.7	61.4	59.3	44.9	44.9
SY Wolf	20.7	161.0	17.7	70.0	61.7	57.3	39.4	39.4
Oahe	20.3	161.3	17.3	70.0	61.0	57.3	39.3	39.3
Overland-Fhb1	21.5	160.0	18.6	73.3	59.0	50.0	37.4	37.4
Thompson	20.9	161.0	17.7	74.2	60.1	56.9	52.1	-
NHH1444913-3	20.1	159.7	18.5	68.3	59.1	49.8	46.7	-
WB4595	22.8	162.7	16.7	68.3	62.7	61.6	-	-
14Nord-01	21.9	162.3	16.3	70.0	61.2	59.9	-	-
Ray	24.3	165.0	16.0	76.7	59.6	53.8	-	-
WB4462	23.2	159.0	16.7	70.0	61.1	54.2	-	-
Decade-Fhb1	20.1	160.5	18.6	70.0	60.8	53.0	-	-
TCG-Boomlock	17.1	161.3	18.5	46.7	60.7	44.5	-	-
Mean	21.5	162.0	17.0	69.4	60.7	57.5	-	-
CV (%)	8.2	0.8	6.9	10.7	0.9	8.7	-	-
LSD (5%)	2.9	2.1	1.9	12.3	0.9	8.3	-	-
LSD (10%)	2.4	1.7	1.6	10.2	0.8	6.9	-	-

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

Planted: 09/26/2018 Harvested: 8/14/2019

Soil test to 6" in ppm: P=23 ppm K=369 ppm OM=2.8% pH=5.1 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=96 lb/a

Applied fertilizers in lb/a: N=7.2; P=24; K=0; S=6; Zn=0.6 (60 lbs. of MESZ with seed)

†Protein adjusted to 12% moisture. #Yield reported on a 13.5% moisture basis. [1]DAP = Days after planting.

Herbicide Application: Goldsky @ 1 pt/a (5/19/2019)

Winter Wheat Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Winter Survival	Days to Head	Plant Lodge	Plant Height	Protein†			Test Weight	Yield		
					2019	2-Yr Avg‡	3-Yr Avg¥		2019	2-Yr Avg‡	3-Yr Avg¥
	(%)	(julian+)	(0 - 9*)	(in)	(%)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
Peregrine	97	165	1	34	12.2	11.2	11.7	62.6	113.3	123.6	119.3
Accipiter	96	167	0	31	12.4	11.2	11.7	62.3	112.5	124.4	117.2
Decade	80	164	0	28	15.0	12.7	12.9	61.8	98.0	117.0	111.0
Northern	94	168	1	30	13.2	11.9	12.4	61.7	112.2	112.7	109.3
Jerry	98	164	0	33	14.4	12.0	12.5	61.3	97.8	102.9	99.7
Oahe	99	163	0	27	15.0	13.1	-	60.9	97.6	115.9	-
Ideal	92	164	1	26	13.6	11.5	-	62.7	95.7	115.2	-
SY Wolf	99	164	0	28	13.9	12.6	-	61.7	94.7	112.6	-
AC Broadview	84	164	1	29	13.6	11.8	-	62.2	81.2	106.7	-
WB Matlock	99	166	0	31	15.0	13.8	-	62.1	103.2	104.7	-
AC Gateway	68	168	0	29	13.9	12.8	-	62.2	81.7	100.7	-
Yellowstone	95	165	1	31	12.8	-	-	61.1	113.1	-	-
CDC Chase	85	166	1	34	13.0	-	-	62.8	108.5	-	-
FourOsix	98	164	0	28	14.0	-	-	61.3	105.5	-	-
Loma	94	167	1	28	13.4	-	-	59.5	103.0	-	-
AAC Wildfire	97	168	1	31	13.4	-	-	61.2	100.3	-	-
SY Monument	98	164	0	27	13.3	-	-	60.9	99.5	-	-
AAC Goldrush	96	168	0	32	12.9	-	-	61.9	96.9	-	-
Redfield	99	162	1	27	14.1	-	-	62.7	96.7	-	-
SY Sunrise	98	163	1	21	15.4	-	-	61.4	60.5	-	-
MEAN	93.3	169.2	0.4	29.3	13.72	12.24	12.22	61.71	98.60	112.40	111.31
C.V. (%)	14.5	0.7	-	4.9	6.95	-	-	1.32	16.43	-	-
LSD (5%)	19.1	1.5	0.8	2.0	1.35	-	-	1.16	22.94	-	-
LSD (10%)	16.0	1.3	0.7	1.7	1.13	-	-	0.96	19.15	-	-

+ Days after January 1, 2018 * 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 12% moisture

‡ 2-Yr average from 2017 and 2019 ¥ 3-Yr average from 2016, 2017, and 2019

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

Soil test (0-6 in.): P=22 ppm; K=177 ppm; pH=7.9 ; OM=2.2% — Previous crop: Field Pea

(0-24 in.) NO3-N=25 lb/a — Planted: 9/11/2018

Yield goal: 100 bu/a — Harvested: 8/2/2019

Planting population: 1.5 million seeds/a — Soil type: Lihen Loamy Fine Sand

Applied fertilizer: 385 lb/a of Urea (46-0-0) [4/18] — Plot size: 92 ft^2

Herbicides applied: 2,4-D 1.5 pt/a, Talinor 14 oz/a, Tacoma .66 pt/a, and Goldsky 0.5 pt/a (6/5) — Rainfall: 8.2 in (1/1 - 8/2)

Fungicides applied: Tilt 4 oz/a (6/5) and Prosaro 421 8 oz/a (7/2)

Dryland Intrastate Winter Wheat Evaluation-MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
08BC379-40-1	24.3	160	61.7	15.3	25.2
AAC Wildfire	30.1	168	64.5	13.1	87.8
ASC107	21.0	162	N/A	14.9	5.4
ASC116	23.9	157	59.2	17.9	20.4
ASC122	22.0	164	61.3	15.4	15.3
Brawl CLP	26.1	157	63.4	15.8	35.3
Byrd CL Plus	28.9	161	63.0	12.8	50.6
Canvas	26.5	161	64.9	13.9	46.2
Decade	30.4	162	63.3	14.6	68.0
FourOsix	27.0	163	62.8	14.1	63.9
Incline AX	27.2	164	60.9	12.9	47.7
Judee	28.9	162	65.2	13.9	80.1
Keldin	29.3	164	64.0	14.2	66.0
LCS Chrome	29.0	162	63.3	15.0	50.1
LCS Jet	23.6	164	59.5	13.0	74.7
LCS Mint	24.9	161	62.2	15.5	45.3
Loma	26.2	167	62.1	13.7	71.0
Long Branch	25.9	157	63.6	13.4	50.2
LWW14-73915	24.7	163	58.0	13.8	50.1
MT1564	27.0	159	64.1	13.7	65.8
MT1642	29.7	165	61.5	13.3	67.6
MT1683	29.8	164	62.4	13.2	78.0
MT1745	28.7	164	63.8	12.9	86.9
MT1746	25.3	163	64.1	13.4	69.3
MT1747	25.7	162	63.3	13.8	52.2
MT1750	25.6	164	62.7	13.8	45.6
MT1773	26.2	163	63.7	13.2	69.9
MT1782	28.3	163	64.0	15.1	59.1
MT1787	24.3	165	63.0	14.3	67.8
MT1793	28.7	161	63.3	15.1	64.4
MT1796	28.3	161	63.4	16.4	62.8
MTCL1732	26.2	164	62.9	12.9	64.2
MTCL1737	25.9	165	62.6	13.4	75.3
MTCS1601	28.7	165	64.5	14.0	78.5
MTS1588	26.2	165	64.2	13.4	64.5
MTS1731(w)	26.1	162	63.7	14.3	67.3
MTW1491	31.1	164	63.6	12.6	86.3
Northern	28.2	166	63.3	13.7	85.6
Oahe	30.1	161	62.8	14.8	38.2
Ray	31.1	169	60.1	14.0	63.9
SY 517 CL2	24.3	157	63.5	16.0	26.0
SY Clearstone 2CL	28.2	164	63.0	13.3	72.9
SY Legend CL2	26.0	162	63.0	14.3	38.2
SY Monument	24.0	161	60.9	14.1	38.2
Warhorse	28.7	165	62.7	15.8	52.8
WB4269	22.7	160	63.2	14.2	33.5
WB4311	24.0	161	63.0	15.7	44.8
WB4418	25.6	158	62.6	13.1	40.2
Yellowstone	29.1	165	62.3	13.6	72.5
Mean	26.8	163	62.8	14.2	56.9
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	5.94	0.66	1.53	3.35	17.7
LSD (0.05)	2.58	1.74	1.57	0.77	16.3

Planted: 9/27/2018
Harvested: 8/6/2019
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 39
N added (lb/ac): 73

Previous crop: Fallow
Soil Type: William Clay Loam
Plot Width: 5 ft.
Precipitation (2019): 21.5”
Soil Test P_2O_5 (ppm): 31
P_2O_5 added (lb/ac): 21

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 Bow	Canada	M	2019	Medium	Late	MR	R	MS	MS	MR	High	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
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.

WREC Staff seeding Cropping Sequence Study

Barley Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Days to heading	Plant height	Plumps	Thins	Protein†	Test weight	Yield#		
							2019	2-Yr Avg*	3-Yr Avg**
	(DAP[1])	(in)	(%)	(%)	(%)	(lb/bu)	----------(bu/a)----------		
Two-Row									
ABI Balster	63.3	25.7	87.3	1.6	10.1	52.6	106.4	83.9	75.0
ND Genesis	61.3	26.4	92.8	0.5	9.9	52.6	109.5	82.0	74.4
Pinnacle	63.0	27.8	95.9	0.5	10.0	54.0	109.4	83.6	73.2
Explorer	60.7	19.9	89.0	1.4	9.1	52.2	105.7	79.0	71.8
Hockett	63.0	28.0	86.7	1.6	10.0	54.2	99.0	74.1	70.3
AAC Synergy	62.5	25.7	94.5	0.7	11.5	52.2	75.7	71.3	66.6
Conlon	58.3	26.0	96.0	0.5	11.5	54.1	92.6	70.8	62.0
CDC Bow	61.0	25.0	93.5	0.7	10.3	53.0	97.9	-	-
AAC Connect	61.0	23.6	85.1	2.0	10.8	51.8	95.2	-	-
Six-Row									
Lacey	59.3	25.7	87.6	0.6	11.9	52.9	85.6	65.8	62.8
Tradition	62.0	24.8	88.7	0.7	11.9	52.6	73.4	63.5	61.1
Mean	60.8	25.0	91.9	0.9	10.7	52.9	99.2	-	-
CV (%)	3.1	6.9	1.5	23.1	6.4	1.0	8.9	-	-
LSD (5%)	3.1	2.9	2.2	0.4	1.1	0.9	14.7	-	-
LSD (10%)	2.6	2.4	1.8	0.3	0.9	0.7	12.2	-	-

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

Planted: 4/26/2019 Harvested: 8/9/2019

Soil test to 6" in ppm: P=24 ppm K=363 OM=2.0 pH=5.7 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=37.5 lb/a

Applied fertilizers in lb/a: N=57.2; P=24; K=0; S=6; Zn=0.6 (60 lbs of MESZ with seed, 108 lbs of Urea broadcast)

†Protein adjusted to 0% moisture.

#Yield reported on a 13.5% moisture basis.

*Averages of years 2018 and 2019. **Averages of years 2017, 2018, and 2019.

[1]DAP = Days after planting.

Herbicide applications: Valor @ 3 oz/a with LV6 @ 1 pt/a (10/22/18) ; Supremacy @ 5 oz/a with Axial XL @ 16 oz/a (6/13/2019)

Jerry Bergman, WREC Director

Chengci Chen, EARC Superintendent

Barley Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9⁺)	Protein† 2019 (%)	Protein† 2-Yr Avg (%)	Protein† 3-Yr Avg (%)	Test Weight (lb/bu)	Plump % >6/64	Yield 2019 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
Six Row											
Tradition	35	62	1	14.6	14.6	14.6	51.0	81	143.4	126.3	137.5
Lacey	37	61	0	15.1	14.8	14.7	52.3	82	142.7	126.0	134.7
Celebration	36	60	3	15.6	15.8	15.5	51.3	79	137.1	127.7	133.1
Innovation	36	71	4	14.5	14.8	14.8	51.9	91	127.4	123.6	-
Two Row											
ABI Balster	32	67	3	14.5	14.6	14.4	50.6	82	133.8	119.5	132.5
AAC Synergy	34	69	4	15.1	14.8	14.5	50.2	82	121.4	113.4	124.1
Pinnacle	36	62	2	13.6	13.5	13.3	52.3	92	139.8	120.0	122.9
ND Genesis	26	63	1	13.4	13.1	13.1	52.6	97	132.5	115.3	120.6
Explorer	29	66	1	14.2	14.6	14.6	50.7	84	138.5	106.9	119.4
Hockett	29	64	5	15.0	14.3	14.4	51.3	78	123.4	109.5	117.7
Conlon	32	59	1	14.3	14.4	14.6	53.8	98	111.6	99.5	111.8
AAC Connect	34	65	0	14.4	14.4	14.4	51.9	91	141.0	-	-
MEAN	32.9	64.0	2.0	14.54	14.49	14.42	51.64	86.0	131.97	117.07	125.43
C.V. (%)	13.6	2.1	99.9	4.08	-	-	2.22	8.4	9.28	-	-
LSD (5%)	6.4	2.0	2.7	0.85	-	-	1.65	10.4	17.72	-	-
LSD (10%)	5.4	1.6	2.2	0.71	-	-	1.37	8.7	14.74	-	-

* 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 (0-6 in.): P=22 ppm; K=177 ppm; pH=7.9 ; OM=2.2% — Previous crop: Field Pea

(0-24 in.): NO3-N=25 lb/a — Planted: 4/24/2019

Yield goal: 120 bu/a — Harvested: 8/14/2019

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

Applied fertilizer: 265 lb/a of Urea (46-0-0) [4/18] — Plot size: 92 ft^2

Herbicides applied: 2,4-D 1.5 pt/a, Talinor 14 oz/a, and Tacoma .66 pt/a (6/5) — Rainfall: 9.4 inches (4/24 - 8/14)

Fungicides applied: Tilt 4 oz/a (6/5) and Prosaro 421 8 oz/a (7/2)

Dryland Intrastate Barley Evaluation - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
2IM14-8212	28.0	171	96.7	3.1	52.8	11.2	128.6
Bow	31.2	176	97.8	2.2	53.5	12.0	125.8
Ellinor	24.9	175	95.9	3.7	50.0	10.3	131.6
Fraser	27.8	172	98.3	1.7	52.2	11.1	126.7
Genie	25.1	173	91.7	7.2	54.0	11.6	130.6
Hockett	28.2	172	96.0	3.6	54.7	12.1	125.4
IK14-8413	29.8	172	96.9	2.7	53.9	12.1	137.7
Leandra	24.1	176	96.4	3.3	52.1	11.2	143.7
Merit 57	31.2	175	94.4	5.0	51.7	11.2	135.0
Metcalfe	29.4	172	95.4	2.1	52.8	12.6	128.6
MT090202	28.3	173	95.2	4.2	53.4	11.2	121.4
MT124112	28.0	172	96.7	3.0	52.8	11.4	123.5
MT16M00209	29.1	169	99.0	1.0	50.4	11.5	135.5
MT16M00305	26.4	169	95.3	4.2	50.9	11.8	120.3
MT16M00406	30.3	174	97.8	2.1	52.5	11.5	137.6
MT16M00407	29.5	171	98.4	1.5	51.5	12.5	109.9
MT16M00408	31.0	172	99.2	0.7	51.0	12.3	110.2
MT16M00504	30.4	169	98.5	1.4	51.9	12.0	127.4
MT16M00603	27.4	171	98.4	1.4	51.5	12.1	139.1
MT16M00610	28.9	169	98.2	1.7	53.5	12.1	109.8
MT16M00707	32.0	173	97.8	2.0	53.6	11.6	123.4
MT16M00709	31.0	172	97.6	2.2	53.5	10.6	131.3
MT16M00806	29.4	172	97.0	2.7	52.7	12.1	128.0
MT16M00807	31.1	169	99.0	0.9	51.2	12.0	121.2
MT16M01204	26.5	168	97.3	2.6	51.5	11.4	107.5
MT16M01405	28.7	170	98.2	1.7	53.3	11.1	118.5
MT16M01705	29.4	168	95.4	4.1	53.7	12.1	116.8
MT16M01801	31.2	173	93.4	5.5	52.5	10.8	129.2
MT16M01803	27.7	169	95.5	4.1	53.5	11.9	118.6
MT16M01806	30.1	171	95.1	4.3	53.4	10.9	123.3
MT16M01819	28.6	169	98.5	1.4	53.0	12.3	109.3
MT16M01901	27.0	171	98.1	1.8	52.5	11.4	109.0
MT16M01902	31.1	170	91.4	7.5	50.9	11.8	113.8
MT16M02003	27.4	171	93.7	5.6	52.9	11.6	105.0
MT16M02008	30.8	169	99.3	0.7	52.2	11.6	109.9
MT16M02101	29.1	169	93.2	5.7	50.3	11.3	127.0
MT16M02106	29.5	170	95.7	4.0	52.1	11.3	110.7
MT16M02107	29.4	169	97.0	2.7	54.6	11.5	118.6
MT16M02201	28.2	169	97.4	2.3	50.9	11.5	133.6
MT16M05403	29.8	176	93.3	5.6	54.2	11.4	124.1
MT16M05610	29.0	175	96.1	3.5	53.3	11.1	116.5
MT16M05902	27.0	168	98.0	1.7	54.0	11.7	105.7
MT16M06110	29.4	172	95.8	3.8	53.5	11.0	123.2
MT16M06404	28.1	172	98.4	1.5	55.2	11.6	108.9
MT16M07806	30.1	174	97.6	2.3	54.4	11.7	129.7
MT16M09602	25.7	169	96.7	2.9	53.7	11.3	123.5
MT16M10204	33.5	174	91.2	7.2	N/A	N/A	107.5
Odyssey	24.8	175	95.4	4.0	51.5	10.7	142.9
Opera	23.5	176	92.8	5.7	49.8	10.6	132.3
Mean	28.7	172	96.4	3.2	52.6	11.5	122.8
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
CV (%)	5.83	0.55	1.14	29.0	1.13	3.7	9.51
LSD (0.05)	2.72	1.52	1.78	1.49	0.97	0.69	18.9

Planted: 4/16/2019 Previous crop: Fallow

Harvested: 8/9/2019 Soil Type: William Clay Loam

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

† Test weight and grain yield adjusted to 12.0% moisture Precipitation (2019): 21.5"

Soil Test N Avail (lb/ac): 39lb/ac Soil Test P2O5 (ppm): 31lb/ac

N added (lb/ac): 60lb/ac P2O5 added (lb/ac): 20lb/ac

Dryland Intrastate Barley Evaluation - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
2IM14-8212	28.0	171	96.7	3.1	52.8	11.2	128.6
Bow	31.2	176	97.8	2.2	53.5	12.0	125.8
Ellinor	24.9	175	95.9	3.7	50.0	10.3	131.6
Fraser	27.8	172	98.3	1.7	52.2	11.1	126.7
Genie	25.1	173	91.7	7.2	54.0	11.6	130.6
Hockett	28.2	172	96.0	3.6	54.7	12.1	125.4
IK14-8413	29.8	172	96.9	2.7	53.9	12.1	137.7
Leandra	24.1	176	96.4	3.3	52.1	11.2	143.7
Merit 57	31.2	175	94.4	5.0	51.7	11.2	135.0
Metcalfe	29.4	172	95.4	2.1	52.8	12.6	128.6
MT090202	28.3	173	95.2	4.2	53.4	11.2	121.4
MT124112	28.0	172	96.7	3.0	52.8	11.4	123.5
MT16M00209	29.1	169	99.0	1.0	50.4	11.5	135.5
MT16M00305	26.4	169	95.3	4.2	50.9	11.8	120.3
MT16M00406	30.3	174	97.8	2.1	52.5	11.5	137.6
MT16M00407	29.5	171	98.4	1.5	51.5	12.5	109.9
MT16M00408	31.0	172	99.2	0.7	51.0	12.3	110.2
MT16M00504	30.4	169	98.5	1.4	51.9	12.0	127.4
MT16M00603	27.4	171	98.4	1.4	51.5	12.1	139.1
MT16M00610	28.9	169	98.2	1.7	53.5	12.1	109.8
MT16M00707	32.0	173	97.8	2.0	53.6	11.6	123.4
MT16M00709	31.0	172	97.6	2.2	53.5	10.6	131.3
MT16M00806	29.4	172	97.0	2.7	52.7	12.1	128.0
MT16M00807	31.1	169	99.0	0.9	51.2	12.0	121.2
MT16M01204	26.5	168	97.3	2.6	51.5	11.4	107.5
MT16M01405	28.7	170	98.2	1.7	53.3	11.1	118.5
MT16M01705	29.4	168	95.4	4.1	53.7	12.1	116.8
MT16M01801	31.2	173	93.4	5.5	52.5	10.8	129.2
MT16M01803	27.7	169	95.5	4.1	53.5	11.9	118.6
MT16M01806	30.1	171	95.1	4.3	53.4	10.9	123.3
MT16M01819	28.6	169	98.5	1.4	53.0	12.3	109.3
MT16M01901	27.0	171	98.1	1.8	52.5	11.4	109.0
MT16M01902	31.1	170	91.4	7.5	50.9	11.8	113.8
MT16M02003	27.4	171	93.7	5.6	52.9	11.6	105.0
MT16M02008	30.8	169	99.3	0.7	52.2	11.6	109.9
MT16M02101	29.1	169	93.2	5.7	50.3	11.3	127.0
MT16M02106	29.5	170	95.7	4.0	52.1	11.3	110.7
MT16M02107	29.4	169	97.0	2.7	54.6	11.5	118.6
MT16M02201	28.2	169	97.4	2.3	50.9	11.5	133.6
MT16M05403	29.8	176	93.3	5.6	54.2	11.4	124.1
MT16M05610	29.0	175	96.1	3.5	53.3	11.1	116.5
MT16M05902	27.0	168	98.0	1.7	54.0	11.7	105.7
MT16M06110	29.4	172	95.8	3.8	53.5	11.0	123.2
MT16M06404	28.1	172	98.4	1.5	55.2	11.6	108.9
MT16M07806	30.1	174	97.6	2.3	54.4	11.7	129.7
MT16M09602	25.7	169	96.7	2.9	53.7	11.3	123.5
MT16M10204	33.5	174	91.2	7.2	N/A	N/A	107.5
Odyssey	24.8	175	95.4	4.0	51.5	10.7	142.9
Opera	23.5	176	92.8	5.7	49.8	10.6	132.3
Mean	28.7	172	96.4	3.2	52.6	11.5	122.8
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
CV (%)	5.83	0.55	1.14	29.0	1.13	3.7	9.51
LSD (0.05)	2.72	1.52	1.78	1.49	0.97	0.69	18.9

Planted: 4/16/2019 Previous crop: Fallow

Harvested: 8/9/2019 Soil Type: William Clay Loam

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

† Test weight and grain yield adjusted to 12.0% moisture Precipitation (2019): 21.5"

Soil Test N Avail (lb/ac): 39lb/ac Soil Test P2O5 (ppm): 31lb/ac

N added (lb/ac): 60lb/ac P2O5 added (lb/ac): 20lb/ac

Evaluation of Early Yield of Barley - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Hockett	29.5	172	93.4	5.4	55.0	12.2	133.4
Merit 57	29.8	176	92.6	6.2	52.3	12.2	137.6
Metcalfe	29.7	171	94.3	5.2	53.3	13.0	131.2
MT124112	27.6	172	95.9	3.5	53.0	54.3	124.8
MT16M01303	30.4	172	97.4	2.3	52.9	12.8	124.0
MT16M01820	26.5	171	93.9	4.6	51.9	11.6	120.8
MT16M06007	27.3	168	95.6	3.9	53.7	13.4	129.2
MT16M06402	29.0	172	94.9	4.4	54.1	12.5	143.2
MT16M07910	27.3	172	88.3	9.2	53.8	11.8	127.3
MT16M08502	27.0	175	94.8	4.7	54.6	12.4	117.8
MT17M00210	30.1	168	97.8	1.8	52.7	13.6	119.8
MT17M00301	29.1	174	97.5	2.2	51.9	12.3	127.8
MT17M00302	29.8	175	95.1	4.2	54.1	11.3	149.9
MT17M00502	29.1	169	97.7	2.1	51.6	12.5	132.5
MT17M00504	29.0	169	95.7	3.8	52.2	12.6	135.7
MT17M00710	29.7	170	98.8	1.1	53.0	11.8	130.8
MT17M01302	27.2	168	96.8	2.9	52.2	12.8	134.5
MT17M01306	29.1	170	97.5	2.1	52.3	12.9	142.2
MT17M01710	27.2	169	94.5	4.8	53.7	11.9	122.8
MT17M01711	28.5	171	89.6	7.1	50.7	12.2	114.3
MT17M01801	31.0	171	95.9	3.6	54.0	11.5	126.6
MT17M01808	25.2	169	93.8	5.1	52.6	12.8	123.9
MT17M01906	28.1	171	94.9	4.3	51.3	12.5	130.3
MT17M01908	29.4	169	97.9	1.9	52.4	11.6	121.4
MT17M01912	32.4	172	98.4	1.5	53.3	10.9	134.1
MT17M02003	29.4	170	97.9	1.5	51.4	12.5	117.7
MT17M02009	30.3	172	96.8	2.9	51.4	11.6	125.8
MT17M02106	26.9	169	93.6	5.2	52.0	12.6	120.3
MT17M02507	29.8	173	96.4	3.2	53.7	10.8	136.3
MT17M02510	25.3	169	96.9	2.8	53.7	11.6	129.7
MT17M04801	28.9	172	95.2	4.1	53.8	11.8	144.6
MT17M04808	30.6	174	93.2	5.7	53.4	11.2	124.3
MT17M04904	28.1	176	95.0	4.4	53.1	12.0	134.0
MT17M05106	31.4	172	89.5	9.0	54.0	11.9	140.4
MT17M05201	27.3	170	95.1	4.3	51.3	13.3	110.2
MT17M05312	31.1	175	94.1	5.2	52.7	11.7	147.4
MT17M05416	27.8	174	92.4	6.3	52.3	11.7	116.2
MT17M05502	31.2	174	96.2	3.4	53.8	11.8	139.3
MT17M05508	32.3	172	95.7	3.8	53.9	11.3	140.3
MT17M05609	31.9	173	95.1	4.3	52.6	11.8	122.7
MT17M05808	28.3	171	93.7	5.2	53.0	12.0	117.9
MT17M05812	31.5	171	95.1	4.2	53.8	13.0	127.4
MT17M06010	25.6	168	97.8	2.1	53.8	12.6	136.3
MT17M07605	25.7	169	91.0	7.0	53.0	11.9	129.6
MT17M07704	29.3	170	94.3	5.0	54.0	12.3	141.9
MT17M07901	28.6	173	91.7	6.3	51.9	11.0	133.6
MT17M07902	29.9	172	91.2	7.6	53.3	12.0	129.5
MT17M07904	29.3	172	89.5	8.9	53.1	11.4	140.2
MT17M08001	27.0	169	96.3	3.2	54.0	12.8	127.0
MT17M08016	29.5	169	96.6	3.0	53.5	12.6	133.7

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Evaluation of Early Yield of Barley - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
MT17M08208	24.7	174	92.1	7.0	52.7	13.9	123.2
MT17M08213	27.3	175	97.1	2.6	54.0	12.3	137.8
MT17M08403	29.4	175	91.7	7.2	53.2	12.6	147.8
MT17M08404	28.9	176	92.5	6.2	53.7	12.3	131.6
MT17M08501	25.2	171	93.5	5.4	54.5	11.8	126.3
MT17M08509	28.5	174	95.4	4.2	54.2	12.8	124.0
MT17M08702	27.6	171	92.3	6.0	53.6	11.0	130.0
MT17M08804	26.0	168	96.3	3.1	53.5	12.5	123.2
MT17M08806	26.8	169	98.3	1.5	53.9	11.9	133.6
MT17M08808	28.0	169	96.7	2.9	53.4	11.1	144.7
MT17M09010	30.1	175	95.6	3.7	53.3	10.9	135.3
MT17M09011	30.3	174	95.5	4.1	53.8	11.8	135.4
MT17M09602	28.6	172	94.1	5.1	52.7	10.5	132.8
Odyssey	25.3	175	96.5	3.1	51.9	11.5	130.7
Mean	28.6	172	94.9	4.4	52.9	12.7	131
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	0.0014	0.56	0.02
CV (%)	6.57	0.63	1.83	31.1	3.74	73.7	9.22
LSD (0.05)	3.04	1.75	2.81	2.19	3.20	15.2	19.5

Planted: 4/16/2019
Harvested: 8/8/2019
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 39
N added (lb/ac): 60

Previous crop: Fallow
Soil Type: William Clay Loam
Plot Width: 5 ft.
Precipitation (2019): 21.5"
Soil Test P_2O_5 (ppm): 31
P_2O_5 added (lb/ac): 20

Forage Barley Evaluation - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Hays		174	49.4	13.1	119
Lavina	26.8	171	48.6	13.6	134
MT16F01601	27.6	171	48.6	14.2	132
MT16F01602	28.6	169	46.8	12.3	127
MT16F01603	26.6	171	46.4	14.2	130
MT16F02406	31.0	172	49.7	13.2	132
MT16F02408	29.0	172	50.5	14.7	140
MT16F02410	28.3	171	49.4	14.1	133
MT16F02902	30.7	172	49.9	13.6	140
MT16F02903	33.1	171	50.6	13.5	125
MT16F02910	34.0	171	47.3	14.0	129
MT17F01606	29.0	171	46.3	12.6	230
MT17F01616	28.3	171	47.0	14.3	124
MT17F02401	30.4	172	47.3	13.5	117
MT17F02902	33.9	172	51.5	13.5	136
MT17F02908	29.4	174	51.8	13.6	135
Mean	29.6	172	48.8	13.6	137
P-Val	<0.0001	0.0027	<0.0001	0.0006	0.39
CV (%)	4.61	0.64	1.48	3.95	31.0
LSD	2.27	1.82	1.21	0.90	71.0

Planted: 4/16/19
Harvested: 8/14/19
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 22
N added (lb/ac): 60

Previous crop: Pea
Soil Type: William Clay Loam
Plot Width: 5 ft.
Precipitation (2019): 21.5"
Soil Test P_2O_5 (ppm): 29
P_2O_5 added (lb/ac): 20

Dryland Hulless Barley Evaluation - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
09WA-265.12	27.1	175	62.4	11.1	99.1
Havener	26.8	176	62.4	11.5	92.8
MT16H09210	26.6	174	59.1	11.7	92.7
MT16H09302	30.4	174	60.4	12.3	101.4
MT16H09308	29.1	171	60.9	11.8	88.1
MT16H21503	27.7	175	62.9	13.1	64.1
MT16H22201	27.1	169	61.8	12.9	72.8
MT17H09304	29.0	171	61.1	12.4	84.2
MT17H09402	30.3	173	58.5	13.9	54.4
OR23-B	28.3	173	60.9	11.8	89.3
OR27-1-C	29.0	178	62.8	12.0	92.7
OR29-2-B	26.8	176	59.8	12.3	97.2
OR29-3-C	24.8	172	63.2	13.6	86.5
OR29-4-B	25.7	172	63.0	13.0	89.4
OR33-3-A	27.4	175	62.5	12.7	88.5
OR45-1-B	31.2	176	61.8	11.6	86.7
Mean	27.9	174	61.5	12.3	86.9
P-Value	0.0012	<0.0001	<0.0001	0.0006	0.007
CV (%)	5.77	0.71	0.97	5.20	13.5
LSD (0.05)	2.69	2.07	1.0	1.09	19.9

Planted: 4/16/19
Harvested: 8/9/19
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac):22
N added (lb/ac): 60

Previous crop: Pea
Soil Type: William Clay Loam
Plot Width: 5 ft
Precipitation (2019): 21.5”
Soil Test P_2O_5 (ppm): 29
P_2O_5 added (lb/ac): 20

Irrigated Hulless Barley Evaluation **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
09WA-265.12	34.5	178	61.7	13.9	145
Havener	30.3	179	62.4	13.4	129
MT16H09210	32.5	177	58.9	14.3	127
MT16H09302	33.5	178	59.5	13.4	125
MT16H09308	31.1	174	60.7	12.1	118
MT16H21503	29.5	180	62.5	15.0	116
MT16H22201	28.6	172	59.7	14.3	97
MT17H09304	33.3	173	61.5	13.1	133
MT17H09402	34.6	177	58.4	16.0	104
OR23-B	35.4	178	58.4	14.8	115
OR27-1-C	34.4	183	61.5	14.7	116
OR29-2-B	30.3	178	59.0	13.8	137
OR29-3-C	33.6	176	61.0	16.3	121
OR29-4-B	29.8	175	62.7	15.3	125
OR33-3-A	35.6	177	61.5	15.2	115
OR45-1-B	35.6	179	61.9	15.1	118
Mean	32.7	177	60.7	14.4	122
P-Value	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	5.78	0.60	1.30	2.40	7.05
LSD (0.05)	3.15	1.78	1.31	0.58	14.6

Planted: 4/26/19
Harvested: 8/16/19
(Julian*) is a continuous count of days since January 1

† Test weight and grain yield adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 25
N added (lb/ac): 60

Previous crop: Sugarbeet
Soil Type: William Clay Loam
Plot Width: 5 ft.
Precipitation (2019): 22.5”
Irrigation (sprinkler): 1.8”
Soil Test P_2O_5 (ppm): 25
P_2O_5 added (lb/ac): 20

Recrop Barley Evaluation - MSU **EARC, Sidney, MT 2019**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Balster	26.2	176	97.2	2.5	51.2	12.0	100
Champion	30.4	174	93.3	5.9	52.6	11.5	105
Conrad	24.3	177	97.1	2.7	51.4	13.1	101
Copeland	31.9	178	96.5	3.1	51.8	12.1	108
Craft	28.3	175	96.5	3.2	52.4	13.5	74
Expedition	24.1	176	97.7	2.1	52.2	11.6	105
Fraser	25.3	176	98.1	1.8	49.8	12.1	90
Genie	24.7	175	92.0	6.7	52.2	11.9	120
Growler	27.2	177	96.8	3.0	50.8	11.9	105
Haxby	29.5	174	95.3	4.2	53.8	12.7	112
Haybet	31.5	174	68.4	27.7	47.6	14.6	59
Hays	29.5	175	79.6	15.9	48.0	13.1	82
Hockett	25.5	174	96.6	3.0	53.1	12.0	108
Lavina	30.4	174	79.1	18.5	46.9	13.7	89
Merit 57	27.6	177	91.7	7.0	50.8	12.0	104
Metcalfe	29.7	175	95.5	4.0	51.9	13.6	103
MT124112	25.5	175	97.0	2.8	50.4	11.4	74
MT124113	27.3	169	97.9	1.9	51.1	11.8	82
MT124128	24.8	169	97.8	1.9	51.3	11.8	82
MT124134	25.5	171	98.0	1.7	51.5	11.9	78
MT124664	26.2	174	98.0	1.8	51.5	12.6	81
Odyssey	25.2	178	96.6	3.0	50.0	11.3	104
Opera	23.4	180	95.6	3.8	48.7	10.9	98
Synergy	30.2	177	96.7	3.1	51.2	13.0	92
Voyager	27.3	174	98.0	1.8	50.5	12.9	82
Mean	27.3	175	93.9	5.33	50.9	12.4	93.6
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.02
CV (%)	7.09	0.81	2.6	34.1	1.48	5.94	19.0
LSD (0.05)	3.17	2.31	3.97	2.98	1.24	1.21	29.5

Planted: 4/19/19 Previous crop: Pea
Harvested: 8/14/19 Soil Type: William Clay Loam
(Julian*) is a continuous count of days since January 1 Plot Width: 5 ft.
† Test weight and grain yield adjusted to 12.0% moisture Precipitation (2019): 21.5”
Soil Test N Avail (lb/ac): 22 Soil Test P_2O_5 (ppm): 29
N added (lb/ac): 60 P_2O_5 added (lb/ac): 20

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
ORE3541M	CANADA	2018	WHITE	MEDIUM	LATE	R	S	R	MS	HIGH	M HIGH
ORE3542M	CANADA	2019	WHITE	MEDIUM	LATE	R	S	R	S	M 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.

EARC Postdoc Research Associate, Fatemeh Etemadi speaking at EARC field day

Oats Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Days to heading	Plant height	Test weight‡	Yield#		
				2019	2-Yr Avg	3-Yr Avg
	(DAP[1])	(in)	(lb/bu)	----------(bu/a)----------		
Killdeer	54	34.6	42.2	194.7	136.5	113.5
CS Camden	56	37.8	40.5	195.0	136.2	113.4
Jury	57	36.0	42.2	183.5	135.3	112.2
Legget	55	38.6	43.9	190.7	136.7	112.2
CDC Dancer	55	38.3	44.6	186.1	134.1	111.5
Deon	56	38.6	43.4	176.7	128.7	109.4
AC Pinnacle	54	42.8	44.8	166.3	125.0	107.6
Hayden	55	37.4	44.6	176.3	124.1	106.7
Otana	56	38.3	42.7	171.0	125.5	106.5
Rockford	55	38.2	45.0	184.6	128.1	106.3
CDC Minstrel	56	36.5	42.7	172.8	124.0	104.1
HiFi	56	37.3	43.5	164.0	121.1	101.3
Souris	54	36.1	44.2	162.2	117.4	100.0
Newburg	55	40.0	43.7	147.7	116.6	99.4
Stallion	55	38.6	42.9	156.6	120.3	97.0
Beach	54	36.7	45.3	138.0	110.7	92.6
Hytest	54	37.3	45.7	127.1	92.5	78.3
Paul	57	41.9	51.8	120.1	87.7	72.7
ORe3542M	55	33.6	41.7	164.4	-	-
ORe3541M	54	33.3	44.1	146.8	-	-
Warrior	55	32.7	43.4	166.0	-	-
Mean	55	37.9	44.3	163.4	-	-
CV (%)	1.5	6.6	1.4	10.8	-	-
LSD (5%)	1.4	4.1	1.0	28.8	-	-
LSD (10%)	1.1	3.4	0.8	24.1	-	-

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

Planted: 5-7-2019 Harvested: 8-21-2019

Soil test to 6" in ppm: OM=2.0% pH=5.2 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a:

Applied fertilizers in lb/a:

†Protein adjusted to 12% moisture.

#Yield reported on a 13.5% moisture basis.

[1]DAP = Days after planting.

Herbicide Application: Bison @ 1.5 pts/a (6/13/2019)

Oat Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Plant Height	Days to Head	Lodging	Test Weight	Yield		
					2019	2-Yr Avg	3-Yr Avg
	(in)	(DAP*)	(0 - 9+)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
Deon	46	71	7	42.5	175.4	199.3	170.4
Hayden	47	70	5	42.2	182.1	185.7	164.5
Killdeer	42	69	8	37.6	148.3	170.3	150.4
Rockford	47	71	9	42.5	165.9	168.2	149.4
Jury	47	73	9	39.7	150.3	168.4	148.2
Beach	47	69	7	43.7	154.1	163.4	146.0
CS Camden	44	69	2	38.3	187.8	188.3	-
ORe3541M	46	70	6	41.7	183.9	-	-
ORe3542M	46	70	3	36.6	169.9	-	-
Hytest	45	68	7	42.8	142.7	-	-
Paul	50	72	5	49.5	112.2	-	-
MEAN	46.1	70.1	6.2	41.55	161.15	177.66	154.83
C.V. (%)	3.6	2.0	-	7.02	15.68	-	-
LSD (5%)	2.4	2.0	3.7	ns	36.21	-	-
LSD (10%)	2.0	1.7	3.0	3.49	30.10	-	-

* 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 (0-6 in.): P=22 ppm; K=177 ppm; pH=7.9 ; OM=2.2% Previous crop: Field Pea

(0-24 in.): NO3-N=25 lb/a Planted: 4/24/2019

Yield goal: 200 bu/a Harvested: 8/19/2019

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

Applied fertilizer: 208 lb/a of Urea (46-0-0) [4/18] Plot size: 92 ft^2

Herbicides applied: Aim 0.5 oz/a, Rhonox 1 pt/a, and Moxy 1 pt/a (6/5) Rainfall: 9.6 in (4/24 - 8/19)

Fungicides applied: None applied

Flax Variety Descriptions

Variety[1]	ORIGIN[2]	YEAR RELEASED	RELATIVE MATURITY[3]	SEED COLOR	PLANT HEIGHT[3]	RESISTANCE TO WILT[4]
ACC Bright	Canada	2016	LATE	YELLOW	M TALL	MR
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	NDSU	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
Webster	SDSU	1998	LATE	BROWN	TALL	MR
York	NDSU	2002	LATE	BROWN	MEDIUM	R

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

Flax Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Stand	Days to Flowering	Days to Maturity	Plant height	Oil†	Test weight	Yield		
							2019	2-Yr Avg	3-Yr Avg
	(%)	(DAP)	(DAP)	(in)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
OMEGA	64	56	94	27.3	43.4	53.2	21.8	21.2	17.4
CDC GLAS	69	55	94	28.0	44.4	47.8	21.3	18.3	16.4
CDC NEELA	40	56	97	24.4	43.0	51.3	16.2	16.6	15.0
YORK	70	54	94	27.2	43.7	51.0	16.2	17.1	14.6
PRAIRIE THUNDER	58	55	95	27.7	43.1	51.1	19.3	15.2	14.0
GOLD ND	59	55	95	28.1	44.7	52.2	14.0	15.1	13.6
BISON	66	54	94	27.6	43.1	52.1	12.6	14.1	13.5
CARTER	63	53	95	25.3	42.9	51.9	13.9	14.9	13.3
WEBSTER	66	54	97	28.2	44.4	51.5	13.2	13.4	12.2
ND HAMMOND	63	54	96	25.9	42.3	50.3	15.9	13.8	-
CDC BURYU	76	53	94	27.0	43.4	52.3	26.8	-	-
CDC MELYN	60	56	94	26.4	45.3	46.0	15.3	-	-
CDC PLAVA	73	55	95	26.5	44.7	47.7	28.8	-	-
CDC BRIGHT	76	54	94	25.9	45.9	45.3	21.5	-	-
Mean	63	55	95	27.1	44.0	51.2	17.4	-	-
CV (%)	23	2	2	6.2	0.8	1.3	21.4	-	-
LSD (5%)	21	2	3	2.3	0.5	1.0	5.2	-	-
LSD (10%)	17	1	2	2.0	0.4	0.8	4.4	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft — Previous crop: German Foxtail Millet
Planted: 5-3-2019 — Harvested: 09-23-2019
†Oil adjusted to 9% moisture — Soil type: Williams-Bowbells loam
Soil test to 6" in ppm: P=26 ppm K=301 ppm OM=1.8% pH=5.9
Soil test to 24" in lb/a: N=106 lb/a
Applied fertilizers in lb/a: N=21; P=24; K=0; S=6; Zn=0.6 (60 lbs/a MESZ applied with seed , 30 lns of Urea broadcast)
Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ; Bison @ 0.9pt/a with Secure EC @ 12 oz/a (6/24/2019)

Flax Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Days to Flower (DAP*)	Days to Maturity (DAP*)	Lodging (0 - 9⁺)	Plant Height (in)	Oil†			Test Weight (lb/bu)	Yield		
					2019 (%)	2-Yr Avg (%)	3-Yr Avg (%)		2019 (bu/a)	2-Yr Avg (bu/a)	3-Yr Avg (bu/a)
Bison	60	94	1	29	38.2	38.2	39.0	52.6	38.7	30.2	33.1
CDC Sanctuary	59	94	0	28	38.6	38.1	38.7	51.9	36.6	29.8	32.4
York	59	95	0	26	39.0	38.4	38.9	52.4	32.8	27.9	30.8
Gold ND	59	97	0	28	40.3	39.2	39.6	53.3	31.2	26.7	30.6
CDC Sorrel	58	95	0	29	38.6	38.7	39.1	52.5	33.9	27.6	29.6
CDC Glas	58	94	0	25	39.9	39.2	39.7	51.8	21.2	22.5	27.5
ND Hammond	58	94	0	28	38.5	38.0	-	52.5	35.2	29.2	-
Prairie Thunder	60	95	0	31	37.4	37.3	-	52.7	38.0	28.8	-
CDC Melyn	58	92	0	26	39.0	39.5	-	53.3	25.2	28.5	-
Pembina	59	95	1	28	38.6	38.5	-	52.7	29.9	26.5	-
Rahab 94	60	94	0	28	38.7	38.3	-	52.1	29.6	26.2	-
CDC Bethume	58	96	0	28	38.7	-	-	52.7	29.2	-	-
MEAN	58.7	94.3	0.2	27.8	38.80	38.49	39.18	52.51	32.02	27.63	30.67
C.V. (%)	2.2	2.6	214.8	6.9	1.77	-	-	1.42	19.26	-	-
LSD (5%)	1.9	3.5	ns	2.8	0.99	-	-	1.08	8.81	-	-
LSD (10%)	1.5	2.9	0.5	2.3	0.82	-	-	0.89	7.33	-	-

* 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 (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% — Previous crop: Corn

(0-24 in.): NO3-N=15 lb/a — Planted: 5/6/2019

Yield goal: 50 bu/a — Harvested: 8/30/2019

Planting population: 1 million seeds/a — Soil type: Lihen Loamy Fine Sand

Applied fertilizer: 141 lb/a of Urea (46-0-0) — Plot size: 61 ft^2

Herbicides applied: Spartan Charge 2 oz/a and Preference 7 oz/a (5/10), — Rainfall: 9.4 in. (5/6 - 8/30)

Section 3EC 5.33 oz/a, 28-0-0 2 at/a, Destiny HC 1.5 pt/a (6/24), Gramaxone SL 2.0 2 pt/a and Destiny HC 2 qt/100 gal (8/28)

Fungicides applied: Priaxor D 8 oz/a (7/12)

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 2019**

Variety	Oil Type	Stand	Days to heading	Plant Height	Oil†	Test weight	Yield		
							2019	2-Yr Avg	3-Yr Avg
		(%)	(DAP[1])	(in)	(%)	(lb/bu)	(lb/a)	(lb/a)	(lb/a)
Chickadee	High Lino	65	83.0	21.2	40.3	40.7	1865	1501	1321
Cardinal	High Lino	71	84.8	23.2	38.4	37.0	1583	1412	1257
Hybrid 1601	High Oleic	59	83.8	25.3	37.3	32.1	1375	1324	1244
Hybrid 446	High Oleic	53	82.8	22.6	39.9	39.8	1375	1340	1221
Hybrid 528	High Oleic	59	82.5	24.4	38.1	31.7	1500	1380	1218
Hybrid 300	High Oleic	54	82.3	23	40.8	40.0	1400	1281	1208
Hybrid 200	High Oleic	22	88.0	23.2	38.3	37.7	1239	1270	1205
Montola 2003	High Oleic	48	86.3	21.1	40.2	37.3	1216	1289	1057
MonDak	High Oleic	49	85.3	22.8	41.8	37.3	1360	1137	1054
Morlin	High Lino	81	85.0	20.2	38.2	34.8	1442	1215	1028
Hybrid 570	High Oleic	56	83.5	23.5	39.4	33.9	1109	1074	1002
Rubis Red	High Lino	43	82.5	21.4	36.7	40.6	1143	1051	966
Hybrid 621	High Oleic	51	83.8	21.9	40.6	29.0	856	928	959
Finch	High Lino	68	82.0	22.5	42.0	36.3	934	930	834
NutraSaff	High Lino	59	83.5	22.6	41.1	31.0	986	1040	825
STI 1201	High Oleic	55	84.3	19.6	39.3	31.8	938	912	821
Baldy	High Lino	44	82.5	22.0	38.8	37.1	741	893	818
Montola 2000	High Oleic	58	83.0	21.2	38.7	36.2	1452	-	-
Mean		55	83.8	22.3	39.4	35.8	1251	-	-
CV (%)		16.1	1.2	7.9	6.7	2.5	18	-	-
LSD (5%)		12.6	1.4	2.5	3.8	1.2	314	-	-
LSD (10%)		10.5	1.2	2.1	3.1	1.0	262	-	-

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

Planted: 05/02/2019 Harvested: 09/19/2019

Soil test to 6" in ppm: P=26 ppm K=301 ppm OM=1.8% pH=5.9 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=106 lb/a

Applied fertilizers in lb/a: N=21; P=24; K=0; S=6; Zn=0.6 (60 lbs/a MESZ applied with seed , 30 lns of Urea broadcast)

Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18)

†Oil adjusted to 10% moisture. [1]DAP = Days after planting.

Safflower Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Plant Height	Oil†		Test Weight	Yield	
		2019	3-Yr Avg		2019	3-Yr Avg
	(in)	(%)	(%)	(lb/bu)	(lb/a)	(lb/a)
Hybrid 446	32	38.3	31.5	37.6	1623	1886
Montola 2003	30	42.2	36.5	35.3	1187	1838
MonDak	31	41.3	34.9	36.9	1463	1820
Hybrid 200	31	38.7	31.6	35.7	1528	1819
Hybrid 300	33	39.7	31.9	39.0	1869	1796
Hybrid 1601	33	42.9	35.3	29.4	1104	1793
Cardinal	32	40.9	34.9	34.5	1292	1629
Rubis Red	33	37.7	30.7	40.7	1133	1607
STI 1201	29	43.7	40.7	31.2	1183	1433
Baldy	31	36.9	29.8	34.7	973	1432
Finch	32	40.4	35.1	32.2	987	1244
Morlin	30	38.1	35.7	31.9	944	1222
STI1401	31	46.6	44.4	27.7	842	996
NutraSaff	33	45.1	44.5	28.4	773	887
Chickadee	28	42.3	-	38.6	1350	-
Montola 2000	27	42.5	-	34.0	1394	-
Montola 2001	32	34.9	-	28.4	1006	-
MEAN	31.1	40.70	35.54	33.90	1214.8	1528.8
C.V. (%)	5.7	1.27	-	2.11	15.9	-
LSD (5%)	3.0	0.86	-	1.19	320.8	-
LSD (10%)	2.5	0.72	-	0.99	266.8	-

* Days after planting ˚ 0: no lodging - 9: plants lying flat on the ground † oil content reported on oven dried basis

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

Soil test (0-6 in.): P=17 ppm; K=182 ppm; pH=7.6 ; OM=1.6% Previous Crop: Durum

(0-24 in.): NO3-N=48 lb/a Planted: 5/7/2019

Yield goal: 2,000 lb/a Harvested: 10/8/2019

Planting population: Conventional 20 lb/a PLS, Hybrid 18 lb/a PLS Soil type: Lihen Loamy Fine Sand

Applied fertilizer: 68 lb/a of Urea (46-0-0) [5/13] Plots size: 40 ft^2

Herbicides applied: Prowl H2O 1 pt/a (5/10) Rainfall: 20.0 inches (5/7 - 10/8)

Fungicides applied: Priaxor D 8 oz/a (7/17), and Priaxor D 8 oz/a (7/30)

Safflower Irrigated Variety Trial - EARC **EARC, Sidney, MT 2019**

Variety	Stand	Days to Flowering	Plant height	Oil	Test weight	Yield
						2019
	(%)	(DAP[1])	(in)	(%)	(lb/bu)	(lb/a)
Montola 2003	99	77	30	41.1	34.3	3193
Hybrid 300	96	73	31	38.0	36.0	3135
MonDak	97	77	31	40.9	32.6	3011
Chickadee	99	76	28	41.3	33.4	2652
Hybrid 200	89	75	30	37.6	35.8	2521
Rubis Red	98	73	29	36.0	34.6	2442
Hybrid 1601	99	76	32	42.0	28.7	2363
Hybrid 446	95	74	31	36.4	32.5	2360
STI 1201	99	76	28	41.5	30.2	2204
STI 1401	97	77	31	45.6	28.3	2187
Morlin	100	77	30	36.8	32.1	2115
Montola 2000	98	75	28	38.7	27.5	2100
NutraSaff	98	66	32	45.6	29.1	1799
Cardinal	100	76	31	38.5	30.3	1710
Montola 2001	97	76	29	34.9	26.0	1707
Finch	88	74	31	39.6	29.5	1365
Baldy	99	71	30	35.1	32.0	927
Mean	97	75	30	39.4	30.9	2146
CV (%)	3.5	4.3	3.9	5.1	6.4	10.2
LSD (5%)	5.6	5.3	1.9	3.3	3.3	360.4
LSD (10%)	4.7	4.4	1.6	2.8	2.7	300.4

Location: EARC, Sidney, MT Previous crop: sugar beets

Planted: 5/15/2019 Harvested: 10/16/2019

Soil test (0-6"): P=25 ppm; K=350 ppm; pH=5.9; OM=2.6%. Soil type: Savage Silty Clay

(0-24"): NO3-N=25 lb/a.

Applied fertilizers in lb/a: N=100; P_2O_5=38; K_2O=0.

†Oil adjusted to 0% moisture. [1]DAP = Days after planting.

Precipitation: 22.5" Irrigation (sprinkler): 5.99"

Herbicide applications: Sonalin & Eptam (3 pints/ac) on 5/8/2019.

Fungicide applications: Priaxor (8 oz/ac) on 7/26/2019 and 8/14/2019.

Sunflower Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Company	Hybrid Type	Oil Type	Days to Flowering	Days to Maturity	Height	Oil†	Test Weight	Yield		
									2019	2-Yr Avg	3-Yr Avg
				(DAP[1])	(DAP[1])	(in)	(%)	(lb/bu)	(lb/a)	(lbs/a)	
N4HM354	Nuseed	Clearfield	Nusun	70	130	46	42.3	32.59	1002	1743	1868
Camaro II	Nuseed	Clearfield	Nusun	67	131	44	42.9	32.49	1052	1782	1856
Falcon	Nuseed	Express	Nusun	70	131	45	42.3	32.37	987	1765	1803
E-362436	Proseed	Conventional	Nusun	69	133	52	41.7	34.65	1196	-	-
E-91 E	Proseed	Express	Nusun	69	131	52	37.0	29.23	862	-	-
E-92 E	Proseed	Express	Nusun	73	132	59	40.2	29.99	923	-	-
N4H470 CL Plus	Nuseed	Clearfield	High Oleic	71	133	46	48.3	33.85	1428	-	-
N4H302 E	Nuseed	Express	High Oleic	69	132	46	44.7	30.45	1138	-	-
H42HO18CL	Dyna-Gro	Clearfield	High Oleic	68	130	39	45.2	31.86	807	-	-
H44HO12CL	Dyna-Gro	Clearfield	High Oleic	66	133	44	43.5	32.51	1340	-	-
H45HO10EX	Dyna-Gro	Express	High Oleic	70	133	46	42.1	30.80	686	-	-
H45NS16CL	Dyna-Gro	Clearfield	Nusun	67	132	43	43.9	34.70	1397	-	-
H48HO15CL	Dyna-Gro	Clearfield	High Oleic	72	133	49	48.4	31.68	1329	-	-
H49HO19CL	Dyna-Gro	Clearfield	High Oleic	71	131	48	46.2	32.05	1294	-	-
H49NS14CL	Dyna-Gro	Clearfield	Nusun	70	133	45	43.5	33.86	1247	-	-
CP450E	Windfield	Express	High Oleic	71	133	42	37.9	30.56	1189	-	-
CP455E	Windfield	Express	High Oleic	70	133	43	42.3	32.27	989	-	-
Mean				69	131.8	47.0	41.8	31.9	1127	-	-
CV (%)				1.5	0.7	4.4	4.4	2.1	14.5	-	-
LSD (5%)				1.4	1.3	2.9	2.6	1.0	231.7	-	-
LSD (10%)				1.2	1.1	2.4	2.2	0.8	193.5	-	-

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

Planted: 5/28/2019 Harvested: 10/8/2019

Soil test to 6" in ppm: P=26 ppm; K=301 ppm; OM=1.8%; pH=5.9 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=106 lb/a

Applied fertilizers in lb/a: N=36; P_2O_5=26; K_2O=0.

† Oil adjusted to 10% moisture. [1]DAP = Days after planting.

Sunflower Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Company / Brand	Hybrid Type	Oil Type	Days to Flower	Plant Height	Oil†	Test Weight	Harvest Moisture	Yield‡
				(DAP*)	(in)	(%)	(lb/bu)	(%)	(lb/a)
Falcon	Nuseed	Express	Nusun	75	46	40.3	32.3	12.4	3078
N4H470 CL Plus	Nuseed	Clearfield	High Oleic	76	45	41.8	28.2	15.2	2830
H49NS14CL	Dyna-Gro	Clearfield	Nusun	76	41	38.2	31.2	15.8	2674
Camaro II	Nuseed	Clearfield	Nusun	75	46	40.0	31.3	13.7	2605
N4H302 E	Nuseed	Express	High Oleic	73	51	38.2	26.2	12.6	2513
H48HO15CL	Dyna-Gro	Clearfield	High Oleic	76	46	43.0	29.0	15.1	2379
H45NS16CL	Dyna-Gro	Clearfield	Nusun	70	47	38.6	31.3	12.2	2365
H49HO19CL	Dyna-Gro	Clearfield	High Oleic	76	42	38.1	28.3	15.9	2358
H42HO18CL	Dyna-Gro	Clearfield	High Oleic	71	44	38.8	30.8	12.4	2289
H45HO10EX	Dyna-Gro	Express	High Oleic	73	49	39.5	28.5	12.7	2241
E-362436	Proseed	Conventional	Nusun	71	51	36.5	31.2	13.6	2154
H44HO12CL	Dyna-Gro	Clearfield	High Oleic	68	46	40.1	30.3	12.8	2109
E-91 E	Proseed	Express	Nusun	75	56	35.6	30.0	11.8	2095
E-31 CL	Proseed	Clearfield	Nusun	75	49	33.6	29.0	12.3	1954
N4HM354	Nuseed	Clearfield	Nusun	71	46	40.0	31.8	12.1	1870
E-92 E	Proseed	Express	Nusun	77	62	35.8	26.5	12.4	1755
MEAN				73.5	47.9	38.63	29.74	13.30	2329.3
C.V. (%)				1.1	10.0	4.35	5.33	6.17	19.5
LSD (5%)				1.2	6.8	2.40	2.26	1.17	648.2
LSD (10%)				5.7	5.7	2.00	1.88	0.97	540.5

* Days after planting + 0: no lodging - 9: plants lying flat on the ground † Oil content adjusted to 10% moisture ‡ Yield adjusted to harvest moisture

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

Soil test (0-6 in.): P=20 ppm; K=191 ppm; pH=7.7 ; OM=2% Previous crop: Soybean

(0-24 in.): NO3-N=34 lb/a Planted: 5/21/2019

Planting population: 26,000 seeds/a Harvested: 11/26/2019

Applied fertilizer: 265 lb/a of Urea (46-0-0) [5/8] Soil type: Lihen Loamy Fine Sand

Herbicides applied: Prowl H2O 1.5 pt/a (5/23) and Section 3EC 5.33 oz/a (6/24) Plot size: 260 ft^2

Fungicides applied: none applied Rainfall: 19.5 inches (5/21 - 11/26)

Canola-Clearfield Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Company/ Brand	Flower Duration	Days to Maturity	Plant height	Lodging	Oil†	Test weight	Yield#
								2019
		(days)	(DAP[1])	(in)	(0-9)	(%)	(lb/bu)	(bu/a)
CS2500 CL	Canterra Seeds	28	103.0	36.0	5.5	45.5	51.7	1423.6
5545 CL	BrettYoung	29	103.0	41.0	3.0	45.9	51.3	1339.1
Mean		28	102.2	36.3	3.7	45.3	51.5	1333.8
CV (%)		4.9	1.9	6.8	28.7	4.1	0.5	14.2
LSD (5%)		2.2	3.1	4.0	1.7	3.0	0.4	303.4
LSD (10%)		1.8	2.5	3.2	1.4	2.4	0.3	245.9

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

Planted: 05/07/2019 Harvested: 08/28/2019

Soil test to 6" in ppm: P=24 ppm K=363 OM=2.0 pH=5.7 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=37.5 lb/a

Applied fertilizers in lb/a: N=90; P=24; K=0; S=46; Zn=0.6

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

#Yield reported on a 13.5% moisture basis.

[1]DAP = Days after planting.

Canola-Roundup Ready Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Company/ Brand	Flower Duration	Days to Maturity	Plant height	Lodging	Oil†	Test Weight	Yield#		
								2019	2-Yr Avg	3-Yr Avg
		(days)	(DAP[1])	(in)	(0-9)	(%)	(lb/bu)	----------(bu/a)----------		
6074 RR	BrettYoung	28	102.3	37.6	1.5	48.4	51.2	1471.3	1343.7	1126.8
CP930RR	Croplan	29	101.0	33.7	3.8	48.3	51.3	1235.3	1147.1	1096.4
300 Mag	Proseed	28	101.8	34.4	4.8	46.4	51.7	1048.5	1107.2	1025.5
CP955RR	Croplan	28	102.5	34.1	3.0	47.7	51.5	976.9	973.9	994.3
Star 402	Star	29	102.5	34.5	2.8	50.1	51.0	1015.2	982.1	969.4
PS 5000	Proseed	28	99.5	34.0	5.3	44.9	52.0	878.3	939.7	928.1
4187 RR	BrettYoung	27	103.3	35.4	2.3	48.2	51.2	1083.0	1032.0	-
6090 RR	BrettYoung	28	103.0	36.5	4.3	48.0	47.2	974.5	828.7	-
CS2100	Canterra Seeds	29	102.0	36.4	3.5	45.6	52.0	1173.6	-	-
CS2300	Canterra Seeds	29	104.5	39.1	2.3	47.4	50.2	925.0	-	-
CS2600 CR-T	Canterra Seeds	30	102.8	31.0	3.5	46.9	51.5	882.0	-	-
CP9982RR	Croplan	29	104.8	39.9	3.0	44.8	50.9	930.1	-	-
CP9919RR	Croplan	31	100.8	26.3	6.3	44.9	35.9	255.0	-	-
CP9978TF	Croplan	28	103.5	35.3	2.5	46.2	51.9	1339.5	-	-
Starflex	Star	27	101.3	33.2	2.8	49.0	51.6	1109.8	-	-
Mean		28	102.4	34.7	3.4	47.2	50.2	1019.6	-	-
CV (%)		7.2	1.7	11.2	48.0	3.7	3.7	24.1	-	-
LSD (5%)		2.9	2.5	5.5	2.3	2.5	2.6	350.5	-	-
LSD (10%)		2.4	2.1	4.6	1.9	2.1	2.2	292.3	-	-

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

Planted: 05/07/2019 Harvested: 08/28/2019

Soil test to 6" in ppm: P=24 ppm K=363 OM=2.0 pH=5.7 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=37.5 lb/a

Applied fertilizers in lb/a: N=90; P=24; K=0; S=46; Zn=0.6

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

#Yield reported on a 13.5% moisture basis.

[1]DAP = Days after planting.

RR Canola Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Company / Brand	Days to Flower (DAP*)	Flower Duration (days)	Days to Maturity (DAP*)	Lodging (0 - 9⁺)	Oil† 2019 (%)	Oil† 2-Yr Avg (%)	Oil† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2019 (lb/a)	Yield 2-Yr Avg (lb/a)	Yield 3-Yr Avg (lb/a)
CP930RR	CROPLAN	58	11	100	0	43.6	43.0	42.4	48.4	1979	2246	2805
CP955RR	CROPLAN	57	14	100	0	44.1	42.8	42.2	48.4	2081	2172	2771
6074 RR	BrettYoung	60	12	97	0	43.8	41.6	41.3	48.7	2208	2118	2693
Star 402	Santerra Seed	56	13	99	0	44.4	43.0	43.0	48.9	1821	2125	2662
300 Mag	Proseed	56	16	101	0	42.9	41.8	-	48.9	1959	2882	-
PS 5000	Proseed	58	13	99	0	41.3	40.6	-	49.4	1913	2545	-
4187 RR	BrettYoung	59	14	98	0	43.3	42.1	-	48.6	2131	2191	-
6090 RR	BrettYoung	60	10	98	0	42.4	41.1	-	49.5	1967	2110	-
CP9978TF	CROPLAN	58	12	100	0	41.7	-	-	49.2	1995	-	-
Starflex	Santerra Seed	56	13	98	0	42.6	-	-	49.2	1851	-	-
CP9982RR	CROPLAN	60	13	100	0	42.1	-	-	48.3	1654	-	-
CP9919RR	CROPLAN	55	13	96	0	40.5	-	-	48.9	1631	-	-
MEAN		57.8	12.6	99.0	0.0	42.93	42.01	42.22	48.87	1959.9	2298.6	2732.8
C.V. (%)		4.0	19.1	2.5	-	2.41	-	-	2.19	13.2	-	-
LSD (5%)		3.3	3.4	3.6	ns	1.48	-	-	ns	366.2	-	-
LSD (10%)		2.7	2.9	3.0	ns	1.23	-	-	ns	304.6	-	-

* 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 (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% — Previous crop: Corn

(0-24 in.): NO3-N=15 lb/a — Planted: 5/6/2019

Yield goal: 2,500 lb/a — Harvested: 8/28/2019

Planting population: 260,000 seeds/a — Soil type: Lihen Loamy Fine Sand

Applied fertilizer: 125 lb/a of AMS (21-0-0-24S) and 171 lb/a of Urea (46-0-0) — Plot size: 61 ft^2

Herbicides applied: Sonolan HFP 1.5 pt/a (5/10), Cornerstone 5 Plus 24 oz/a and Class Act 24 oz/a (6/13), Section 3EC 5.33 oz/a, 28-0-0 2 qt/a, and Destiny HC 1.5 pt/a (6/24) — Rainfall: 9.4 in. (5/6 - 8/28)

Fungicides applied: Priaxor D 8 oz/a (7/12)

Soybean Dryland Conventional Variety Trial -NDSU **WREC, Williston, ND 2019**

Variety	Company/Brand	Relative Maturity	Height (in.)	Days to Maturity (DAP)	Protein (%)	Test Weight (lb/bu)	Yield (bu/a)	2-YR Avg Yield (bu/a)
ND Stutsman	NDSU	0.7	25.8	124	31.8	56.7	42.4	-
AG 00835 (RR check)	Asgrow	0.08	21.5	119	31.1	56.3	40.8	-
AG 00937 (RR check)	Asgrow	0.09	23.0	119	33.4	55.2	39.4	-
AG 0835 (RR check)	Asgrow	0.8	26.0	129	30.6	54.7	37.8	-
AG 00632 (RR check)	Asgrow	0.06	23.2	119	33.1	56.7	36.9	28.0
ND Henson	NDSU	0.00	20.3	119	33.1	56.3	36.5	31.7
ND Benson	NDSU	0.4	23.0	129	34.3	56.6	36.0	-
MEAN			22.6	122.1	33.0	56.2	38.6	-
C.V.(%)			9.5	0.8	2.3	1.2	6.2	-
LSD (5%)			3.0	1.3	1.1	0.9	3.4	-
LSD (10%)			2.5	1.1	0.9	0.8	2.8	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft Previous crop: German Foxtail Millet

Planted: 5-14-2019 Harvested: 10-07-2019

Planting population: 140,000 seeds/a Soil type: Williams-Bowbells loam

Soil test to 6" in ppm: P=26 ppm K=301 ppm OM=1.8% pH=5.9

Soil test to 24" in lb/a: N=106 lb/a

Applied fertilizers in lb/a: None

Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ; Roundup @32oz/a (6/27/19)

Soybean Dryland Roundup Ready Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Company/ Brand	Relative Maturity	Height (in.)	Days to Mature (DAP)	Protein (%)	Oil (%)	Test Weight (lb/bu)	Yield (bu/a)
50309N	Integra	0.3	22.9	119	32.1	19.1	56.6	43.8
S03XT29	Dyna-Gro	0.3	24.6	119	31.8	19.3	56.2	43.5
19X03	PFS	0.3	22.8	119	31.9	19.1	56.6	42.6
LGS0111RX	LG Seeds	0.1	23.8	119	33.3	20.3	56.9	42.1
30-20	Proseed	0.2	25.1	120	33.8	19.7	56.3	42.0
S02-F9X	Syngenta NK	0.2	21.6	121	30.9	19.7	57.2	42.0
RX00810	REA hybrids	00.8	17.8	119	32.9	20.4	55.7	41.0
S01-C4X	Syngenta NK	0.1	24.2	119	31.7	19.5	56.9	40.5
XT 60-09	Proseed	00.9	24.8	119	32.8	18.4	56.9	40.0
S009XT68	Dyna-Gro	00.9	25.1	119	32.9	18.5	57.3	39.8
ND14-6120	NDSU	0.1	23.7	119	32.5	19.7	57.8	39.7
RX0520	REA hybrids	0.5	25.2	129	32.4	19.3	56.1	39.1
S007-Y4	Syngenta NK	00.7	21.9	119	31.8	20.1	57.1	39.0
RX0330	REA hybrids	0.3	24.6	125	32.8	19.2	56.4	38.5
ND17009GT	NDSU	00.9	25.6	119	34.4	20.4	58.1	38.5
EL 80-093	Proseed	00.9	21.3	119	30.9	20.4	56.4	38.4
16R01	PFS	0.1	26.1	119	33.5	20.4	56.4	38.3
S006-R7X	Syngenta NK	00.6	19.2	119	33.4	20.3	55.9	37.4
ND18008GT	NDSU	00.8	21.9	119	33.2	20.3	57.0	37.3
LGS00899RX	LG Seeds	00.8	23.5	119	31.9	20.3	56.9	36.9
M06R-614008GT	UM	00.8	18.4	120	32.5	20.4	56.5	36.9
40209 E3	Integra	0.3	22.3	122	32.0	19.5	56.0	36.4
RX00749	REA hybrids	00.7	20.0	119	31.5	19.8	56.0	34.2
20EN02	PFS	0.2	20.4	124	31.3	19.5	55.9	33.3
Mean			22.9	120.0	32.5	19.7	56.7	39.0
CV %			8.3	0.8	1.9	1.3	0.8	7.8
LSD 0.05			2.7	1.4	0.9	0.4	0.7	4.3
LSD 0.1			2.2	1.2	0.7	0.3	0.6	3.6

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft Previous crop: German Foxtail Millet

Planted: 5-14-2019 Harvested: 10-07-2019

Planting population: 140,000 seeds/a Soil type: Williams-Bowbells loam

Soil test to 6" in ppm: P=26 ppm K=301 ppm OM=1.8% pH=5.9

Soil test to 24" in lb/a: N=106 lb/a

Applied fertilizers in lb/a: None

Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ; Roundup @32oz/a (6/27/19)

Soybeans Roundup Ready Dryland Off-Station Variety Trial-NDSU **Divide County, ND 2019**

Variety	Company/ Brand	Relative Maturity	Protein†	Test Weight	Yield 2019
				(lb/bu)	(bu/a)
S03XT29	Dyna-Gro	0.3	36.2	55.8	47.8
30-20	Proseed	0.2	37.2	52.6	41.5
S009XT68	Dyna-Gro	00.9	37.8	56.3	41.3
LGS0111RX	LG Seeds	0.1	36.9	54.0	40.5
S01-C4X	Syngenta NK	0.1	35.1	56.0	40.2
ND14-6120	NDSU	0.1	37.1	57.2	35.0
40209 E3	Integra	0.3	36.9	51.9	35.0
M06R-614008GT	UM	00.8	36.6	53.5	34.9
ND17009GT	NDSU	00.9	37.7	56.6	34.9
ND18008GT	NDSU	00.8	36.2	55.9	34.1
20EN02	PFS	0.2	36.8	52.7	29.1
RX0330	REA Hybrids	0.3	36.9	52.3	27.2
Mean			36.8	54.6	36.8
CV %			1.1	1.7	13.8
LSD 0.05			0.7	1.6	8.6
LSD 0.1			0.6	1.3	7.1

Location: Crosby, ND; Latitude 48° 8' N; Longitude 103° 18' W; Elevation 2044 ft.

Planted: 05/06/2019 Harvested: 10/16/2019

Soil test (0-6"): P=14 ppm; K=362 ppm; OM=3.0%. Previous crop: spring wheat

(0-24"): NO3-N=14 lb/a. Soil type: Farnuf-Alkabo

Applied fertilizers in lb/a: none

†Protein adjusted to 13% moisture.

Herbicide Applications: Spartan Charge @ 4oz/a with RT3 @ 32 oz/a (5/6/2019);

Basagran @ 1pt/a with Secure @ 8 oz/a (6/25/2019)

Soybeans Roundup Ready Dryland Off-Station Variety Trial-NDSU **McKenzie County, ND 2019**

Variety	Company/ Brand	Relative Maturity	Protein†	Test Weight	Yield 2019
				(lb/bu)	(bu/a)
LGS0111RX	LG Seeds	0.1	34.9	54.7	33.0
S01-C4X	Syngenta NK	0.1	34.3	55.9	29.7
RX0330	REA Hybrids	0.3	32.7	53.2	28.3
30-20	Proseed	0.2	35.4	54.2	26.8
ND14-6120	NDSU	0.1	35.7	55.3	24.9
S009XT68	Dyna-Gro	00.9	35.2	55.6	24.6
S03XT29	Dyna-Gro	0.3	34.1	54.7	24.1
ND17009GT	NDSU	00.9	35.9	56.1	23.6
20EN02	PFS	0.2	34.5	55.1	22.5
40209 E3	Integra	0.3	34.8	54.1	21.5
M06R-614008GT	UM	00.8	34.1	55.3	20.5
ND18008GT	NDSU	00.8	35.6	54.8	17.5
Mean			34.8	54.9	24.8
CV %			2.0	1.0	12.0
LSD 0.05			1.2	0.9	5.0
LSD 0.1			1.0	0.8	4.2

Location: Arnegard, ND; Elevation 2254 ft. Previous crop: spring wheat

Planted: 05/13/2019 Harvested: 10/15/2019

†Protein adjusted to 13% moisture. Soil type: Dooley-Zahl complex

Applied Fertiler in lb/a: none

Herbicide Applications: Spartan Charge @ 4 oz/a with RT3 @ 32 oz/a (5/13/2019);

Basagran @ 1 pt/a with Secure @ 10 oz/a (6/18/2019)

Conventional Soybean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Company / Brand	Relative Maturity	Plant Height	Days to Maturity	Protein†		Oil‡		Test Weight	Yield	
					2019	3-Yr Avg	2019	3-Yr Avg		2019	3-Yr Avg
			(in)	(DAP*)	(%)	(%)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)
ND Benson	NDSU	0.4	24	128	35.4	36.0	15.3	14.5	57.5	49.3	56.0
ND Rolette	NDSU	00.9	21	122	36.1	35.7	14.8	14.5	57.8	44.8	51.2
ND Henson	NDSU	0.0	18	122	37.5	36.2	15.3	14.8	58.4	38.9	50.6
ND Stutsman	NDSU	0.7	22	129	36.6	-	15.4	-	58.4	47.8	-
MEAN			21.1	125.4	36.41	35.95	15.19	14.62	58.02	45.22	52.61
C.V. (%)			9.2	1.2	3.11	-	3.74	-	1.62	10.76	-
LSD (5%)			3.1	2.3	1.81	-	ns	-	ns	7.78	-
LSD (10%)			2.5	1.9	1.47	-	ns	-	ns	6.31	-

* Days after planting † Protein content adjusted to 13% moisture ‡ Oil content adjusted to 13% moisture

Lodging not reported for 2019 as no lodging was noted in the trial.

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W — Elevation: 1902 ft
Soil test (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% — Previous crop: Corn
(0-24 in.): NO3-N=15 lb/a — Planted: 5/15/2019
Yield goal: 50 bu/a — Harvested: 10/8/2019
Planting population: 200,000 seeds/a — Soil type: Lihen Loamy Fine Sand
Applied fertilizer: none applied / seed innoculated — Plot size: 61 ft^2
Herbicides applied: Prowl H2O 1.5 pt/a (5/23), Section 3EC 5.33 oz/a, Destiny HC 1.5 pt/a, 28-0-0 2 qt/a (6/24), and Basagran 1 pt/a, Destiny HC 2 pt/a, Varisto 21 oz/a (6/26) — Rainfall: 20.0 in. (5/15 - 10/8)
Fungicides applied: Priaxor D 8 oz/a (7/12)

RR Soybean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Company / Brand	Relative Maturity	Plant Height	Days to Maturity	Protein†		Oil‡		Test Weight	Yield	
					2019	3-Yr Avg	2019	3-Yr Avg		2019	3-Yr Avg
			(in)	(DAP*)	(%)	(%)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)
ND17009GT	NDSU	00.9	16	120	36.7	37.7	15.3	14.6	58.0	29.3	51.3
ND18008GT	NDSU	00.8	14	119	37.9	37.7	14.5	14.4	58.5	21.4	44.1
RX00749	REA	00.7	17	119	36.4	-	14.5	-	58.3	30.8	-
RX0520	REA	0.5	19	131	36.2	-	14.5	-	57.8	43.9	-
50309N	Integra	0.3	18	123	36.3	-	14.8	-	58.2	42.1	-
30-20	Proseed	0.2	20	126	36.6	-	14.7	-	57.9	41.6	-
S02-F9X	NK	0.2	18	121	36.2	-	15.2	-	57.9	41.6	-
19EN02	Peterson Farm Seed	0.2	18	129	37.1	-	14.8	-	57.8	41.2	-
16R01	Peterson Farm Seed	0.1	22	121	36.9	-	15.1	-	58.6	40.8	-
S03XT29	Dyna-Gro	0.3	16	122	36.9	-	15.2	-	58.4	39.6	-
RX0330	REA	0.3	19	127	36.0	-	15.0	-	58.0	38.5	-
M06R-614008GT	U of M	00.8	17	130	36.5	-	15.8	-	57.9	38.4	-
S009XT68	Dyna-Gro	00.9	20	123	36.8	-	15.2	-	57.9	38.2	-
40209 E3	Integra	0.2	19	127	37.0	-	15.0	-	57.9	37.1	-
GH0308X	Golden Harvest	0.3	17	125	44.8	-	15.0	-	57.6	37.1	-
19X03	Peterson Farm Seed	0.3	18	121	36.6	-	15.5	-	58.5	36.5	-
EL 80-093	Proseed	00.9	17	120	35.8	-	14.7	-	57.4	35.7	-
XT 60-09	Proseed	00.9	20	119	35.9	-	15.4	-	57.8	34.7	-
S01-C4X	NK	0.1	18	124	37.3	-	14.9	-	58.1	34.0	-
GH0145X	Golden Harvest	0.1	20	121	36.4	-	15.0	-	57.6	33.2	-
S007-Y4	NK	00.5	18	121	36.5	-	14.9	-	58.3	32.1	-
RX00810	REA	00.8	17	120	37.4	-	14.4	-	57.9	30.3	-
S0006-R7X	NK	00.6	16	120	36.7	-	15.0	-	58.2	26.1	-
MEAN			18.0	122.9	37.00	37.70	14.98	14.50	58.02	35.82	47.70
C.V. (%)			9.5	1.9	9.64	-	4.68	-	1.00	13.42	-
LSD (5%)			2.4	3.3	5.04	-	0.99	-	0.82	9.51	-
LSD (10%)			2.0	2.7	4.21	-	0.83	-	0.68	5.67	-

* 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 (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% — Previous crop: Corn
(0-24 in.): NO3-N=15 lb/a — Planted: 5/15/2019
Yield goal: 50 bu/a — Harvested: 10/8/2019
Planting population: 200,000 seeds/a — Soil type: Lihen Loamy Fine Sand
Applied fertilizer: none applied — Plot size: 61 ft^2
Herbicides applied: Prowl H2O 1.5 pt/a and Spartan Charge 2 oz/a (5/23), Cornerstone 5 Plus 26 oz/a and Class Act 24 oz/a (6/13), and Section 3 EC 5.33 oz/a, Destiny HC 1.5 pt/a, and 28-0-0 2 qt/a (6/24), — Rainfall: 20.0 in. (5/15 - 10/8)
Fungicides applied: Priaxor D 8 oz/a (7/12)

Navy Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Canopy Height	Days to Maturity	Hundred Seed Weight	Seeds / Pound	Test Weight	Yield	
						2019	2-Yr Avg
	(in)	(DAP*)	(g)		(lb/bu)	(lb/a)	(lb/a)
HMS Medalist	13	122	77	589	63.9	1447	1353
T9905	11	124	79	580	61.9	1303	1318
Blizzard	12	122	78	580	62.4	1221	1221
MEAN	12.1	122.3	78.1	583.1	62.75	1323.8	1297.4
C.V. (%)	13.3	1.5	5.6	5.6	1.32	17.4	-
LSD (5%)	ns	ns	ns	ns	1.44	ns	-
LSD (10%) +	ns	ns	ns	ns	1.14	ns	-

* 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 (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% — Previous crop: Corn
(0-24 in.): NO3-N=15 lb/a — Planted: 5/21/2019
Yield goal: 2,500 lb/a — Harvested: 10/7/2019
Planting population: 125,000 seeds/a — Soil type: Lihen Loamy Fine Sand
Applied fertilizer: 265 lb/a of Urea (46-0-0) [6/4] — Plot size: 53 ft^2
Herbicides applied: Prowl H2O 1.5 pt/a (5/23), Section 3EC 5.33 oz/a, Destiny HC 1.5 pt/a, 28-0-0 2 qt/a (6/24), Basagran 1 pt/a, Destiny HC 2 pt/a, Varisto 21 oz/a (6/26), Gramoxone 2.0 SL 2 pt/a, and Destiny HC 1 qt/ 100 gal (9/24) — Rainfall: 19.5 in. (5/21 - 10/7)
Fungicides applied: Priaxor D 8 oz/a (7/12)

Pinto Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Canopy Height	Days to Maturity	Hundred Seed Weight	Seeds / Pound	Test Weight	Yield		
						2019	2-Yr Avg	3-Yr Avg
	(in)	(DAP*)	(g)		(lb/bu)	(lb/a)	(lb/a)	(lb/a)
Monterrey	14	122	36	1256	57.2	1689	2185	3087
LaPaz	14	123	36	1244	55.9	1426	1974	2717
Lariat	12	121	37	1230	57.5	1702	2055	2641
ND-Palomino	15	123	35	1312	59.7	1663	1809	2364
Stampede	13	123	35	1316	58.4	1539	1776	2362
Windbreaker	13	122	36	1251	58.6	1942	1912	2299
ND121315-Pinto	11	123	36	1254	59.0	1896	-	-
Torreon	13	123	37	1229	58.6	1893	-	-
Vibrant	15	125	36	1261	57.3	1873	-	-
ND-Falcon	15	125	37	1245	57.1	1569	-	-
MEAN	13.5	122.8	36.1	1259.7	57.94	1719.3	1951.9	2578.5
C.V. (%)	15.2	1.8	5.7	6.1	2.96	13.7	-	-
LSD (5%)	3.5	3.3	ns	ns	2.49	341.2	-	-
LSD (10%) +	2.9	2.7	ns	ns	2.07	283.2	-	-

* 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 (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% — Previous crop: Corn
(0-24 in.): NO3-N=15 lb/a — Planted: 5/21/2019
Yield goal: 2,500 lb/a — Harvested: 10/7/2019
Planting population: 125,000 seeds/a — Soil type: Lihen Loamy Fine Sand
Applied fertilizer: 265 lb/a of Urea (46-0-0) [6/4] — Plot size: 53 ft^2
Herbicides applied: Prowl H2O 1.5 pt/a (5/23), Section 3EC 5.33 oz/a, Destiny HC 1.5 pt/a, 28-0-0 2 qt/a (6/24), Basagran 1 pt/a, Destiny HC 2 pt/a, Varisto 21 oz/a (6/26), Gramoxone 2.0 SL 2 pt/a, and Destiny HC 1 qt/ 100 gal (9/24) — Rainfall: 19.5 in. (5/21 - 10/7)
Fungicides applied: Priaxor D 8 oz/a (7/12)

Faba Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Days to Maturity	Protein†		Test Weight	Yield		
		2019	2-Yr Avg‡		2019	2-Yr Avg	3-Yr Avg
		(%)	(%)	(lb/bu)	(lb/a)	(lb/a)	(lb/a)
Laura	93	26.7	24.8	62.9	2105	1476	2677
Fabelle	94	26.4	24.1	63.1	2566	1740	2457
Boxer	93	26.6	24.5	62.7	2043	3509	-
FanFare	96	26.5	24.3	62.5	2049	3308	-
LG Cartouche	94	26.7	26.7	62.0	2282	-	-
MEAN	93.9	26.58	24.87	62.65	2209.1	2508.2	2566.7
C.V. (%)	1.8	2.52	-	1.07	11.5	-	-
LSD (5%)	ns	ns	-	1.03	391.7	-	-
LSD (10%) +	2.2	ns	-	0.84	320.4	-	-

* Days after planting 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 16% moisture

‡ 2-Yr average from 2017 and 2019

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

Soil test (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% Previous crop: Corn

(0-24 in.): NO3-N=15 lb/a Planted: 5/6/2019

Yield goal: 2,500 lb/a Harvested: 9/4/2019

Planting population: 195,000 seeds/a Soil type: Lihen Loamy Fine Sand

Applied fertilizer: none / seed innoculated Plot size: 53 ft^2

Herbicides applied: Prowl H2O 2 pt/a and Sharpen 0.5 oz/a (5/10), Section 3EC 5.33 oz/a, Destiny HC 1.5 pt/a, Rainfall: 10.3 inches (5/6 - 9/4)

and 28-0-0 2 qt/a (6/24),Basag Basagran 1 pt/a, and Destiny HC 1 pt/a (6/26), and Gramoxone 2.0SL 2 pt/a, and Destiny HC 1 qt/100 gal (8/28)

Fungicides applied: Priaxor D 8 oz/a (7/12)

Insecticides applied: Mustang Maxx 4 oz/a (7/2)

Misc. Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Market Class‡	Canopy Height	Days to Maturity	Hundred Seed Weight	Seeds / Pound	Test Weight	Yield	
							2019	2-Yr Avg
		(in)	(DAP*)	(g)		(lb/bu)	(lb/a)	(lb/a)
Zorro	BL	10	121	101	490	60.0	1424	2060
Powderhorn	GN	11	123	111	455	60.0	2194	1893
Eclipse	BL	12	121	134	338	57.9	1542	1669
Loreto	BL	11	125	91	542	60.5	1403	1558
Rosetta	PK	13	124	96	502	59.2	1505	1467
Merlot	SR	13	123	77	588	59.6	1980	-
ND112929-Pink	PK	14	120	113	426	58.3	1927	-
ND-Pegasus	GN	16	123	111	452	60.8	1799	-
NDF120287-Black	BL	11	121	104	474	60.0	1798	-
Black Tails	BL	12	124	100	487	56.4	1788	-
Viper	SR	15	122	99	492	60.4	1739	-
MEAN		12.4	122.4	103.3	477.0	59.37	1736.4	1729.4
C.V. (%)		14.5	1.7	31.3	30.4	3.91	24.9	-
LSD (5%)		3.0	2.9	46.7	208.0	3.35	536.0	-
LSD (10%) +		2.5	2.4	38.9	173.1	2.78	445.9	-

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

‡ Market class: BL = Black, GN = Great Northern, SR = Small Red, PK = Pink

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

Soil test (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% Previous crop: Corn

(0-24 in.): NO3-N=15 lb/a Planted: 5/21/2019

Yield goal: 2,500 lb/a Harvested: 10/7/2019

Planting population: 125,000 seeds/a Soil type: Lihen Loamy Fine Sand

Applied fertilizer: 265 lb/a of Urea (46-0-0) [6/4] Plot size: 53 ft^2

Herbicides applied: Prowl H2O 1.5 pt/a (5/23), Section 3EC 5.33 oz/a, Destiny HC 1.5 pt/a, 28-0-0 2 qt/a (6/24), Rainfall: 19.5 in. (5/21 - 10/7)

Basagran 1 pt/a, Destiny HC 2 pt/a, Varisto 21 oz/a (6/26), Gramoxone 2.0 SL 2 pt/a, and Destiny HC 1 qt/ 100 gal (9/24)

Fungicides applied: Priaxor D 8 oz/a (7/12)

Corn Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Company	Days to Silk	Plant Height	Bird Damage‡	Test Weight‡	Yield# 2019
		(DAP[1])	(in)	(%)	(lb/bu)	(bu/a)
1974	Proseed	74	26.6	51.4	54.4	107.0
2B862	REA Hybrids	74	29.3	24.9	49.7	98.6
1980	Proseed	72	29.4	45.0	53.1	95.6
3009 VT2P	Wilbur Ellis	72	27.7	44.8	54.2	95.0
73S84	Peterson Farms Seed	73	29.3	26.7	52.0	92.0
71D83	Peterson Farms Seed	73	29.2	42.5	52.2	91.9
71V81	Peterson Farms Seed	75	27.1	17.7	52.0	91.3
NK8005-3110A	Syngenta	73	26.8	11.6	54.2	90.8
1480VT2P	Proseed	74	29.5	32.2	53.2	89.6
2A872	REA Hybrids	75	30.6	25.1	49.4	88.3
1B780	REA Hybrids	73	29.5	33.6	51.1	87.6
1B720	REA Hybrids	71	25.1	52.1	56.2	87.4
3718 VT2P RIB	Wilbur Ellis	75	27.7	12.6	47.8	86.1
3282 VT2P RIB	Wilbur Ellis	75	33.2	18.7	52.7	85.6
IC2862	Rob-See-Co	73	31.7	30.0	55.5	84.0
NK7837-3220	Syngenta	74	29.0	6.9	53.4	82.8
3537 VT2P RIB	Wilbur Ellis	74	31.2	19.7	49.6	76.2
NK8204-3220	Syngenta	78	31.0	12.4	51.2	73.9
RC3240	Rob-See-Co	74	29.7	25.8	56.1	72.4
NK8519-3220	Syngenta	80	32.7	18.5	48.8	66.6
Mean		74	29.3	27.6	52.3	87.6
CV (%)		2.0	12.7	32.9	1.8	18.3
LSD (5%)		2.1	5.3	19.0	1.3	22.7
LSD (10%)		1.8	4.4	15.7	1.1	18.9

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

Planted: Reps 1 & 2- 5/15/2019, Reps 3 & 4- 5/20/2019 Soil type: Williams-Bowbells loam.

Soil test to 6" in ppm: P=26 ppm; K=301 ppm; OM=1.8%; pH=5.9 Harvested: 10/21/2019

Soil test to 24" in lb/a: N=106 lb/a

Applied fertilizers in lb/a: N=36; P_2O_5=26; K_2O=0.

‡Bird Damage: % of cobs with damage from birds

#Yield adjusted for bird damage

[1]DAP = Days after planting.

Corn Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Company / Brand	Relative Maturity	Days to Silk	Ear Height	Harvest Moisture	Test Weight	Yield 2019‡	Yield 2-Yr Avg	Yield 3-Yr Avg
			(DAP*)	(in)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
2B861	REA	86	78	30	23.0	49.1	168.9	196.4	208.1
3718 VT2P RIB	Integra	87	82	31	24.3	46.3	154.3	182.9	-
1B780	REA	79	77	30	20.7	49.6	160.1	179.2	-
3537 VT2P RIB	Integra	85	82	31	20.3	49.6	135.8	161.5	-
3282 VT2P RIB	Integra	82	82	32	20.7	50.2	133.4	161.2	-
1980	Proseed	80	75	29	19.8	52.1	184.3	-	-
73S84	Peterson Farm Seed	84	78	32	21.1	50.4	168.9	-	-
1978	Proseed	78	77	32	18.3	53.4	164.2	-	-
G85Z56-3220-EZ1	Golden Harvest	85	83	35	21.7	48.1	162.1	-	-
1974	Proseed	74	75	25	19.5	53.5	161.5	-	-
NK8519-3220	NK	85	83	35	20.6	48.5	159.3	-	-
2B862	REA	86	79	28	23.2	48.6	158.1	-	-
71V81	Peterson Farm Seed	81	78	29	20.1	52.6	155.9	-	-
NK8005-3110A	NK	80	76	29	21.0	54.6	152.3	-	-
D22QH42	Dyna-Gro	82	76	29	21.9	54.2	149.0	-	-
NK7837-3220	NK	78	78	31	20.8	53.7	145.4	-	-
71D83	Peterson Farm Seed	83	76	30	20.0	52.1	145.1	-	-
G78C29-3220-EZ1	Golden Harvest	78	75	32	21.5	53.5	142.3	-	-
G82M47-3220-EZ1	Golden Harvest	82	82	32	19.9	49.3	140.0	-	-
NK8204-3220	NK	82	81	33	19.9	50.0	138.7	-	-
1B720	REA	72	73	25	23.2	55.5	137.9	-	-
G80Q01-3110A	Golden Harvest	80	75	29	20.9	54.7	132.0	-	-
MEAN			78.0	30.4	21.00	51.36	152.25	176.24	208.13
C.V. (%)			1.6	9.2	7.80	2.07	11.54	-	-
LSD (5%)			1.8	3.9	2.32	1.50	23.47	-	-
LSD (10%)			1.5	3.3	1.94	1.26	19.61	-	-

* Days after planting † Yield adjusted to harvest moisture

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

Soil test to (0-6 in.): P=20 ppm; K=191 ppm; pH=7.7; OM=2.0% Previous crop: Soybean

(0-24 in.): NO3-N= 34 lb/a Planted: 5/14/2019

Yield goal: 190 bu/a Harvested: 11/26/2019

Planting population: 38,000 seeds/a Soil type: Lihen Loamy Fine Sand

Applied fertilizer in lb/a broadcast: 265 lbs of Urea (46-0-0)[5/8], and 146 lbs of Urea (46-0-0) [7/12] Plot size: 130 ft^2

Herbicides applied: Cornerstone 5 Plus 26 oz/a and Class Act 21 oz/a (6/12) Rainfall: 20.0 inches (5/14 - 11/26)

Fungicides applied: none applied

‡ Heavy rains during growing season caused nitrate leaching. Supplemental N was applied on 7/12.
Yellowing leaves indicated low N levels and negatively impacted yields.

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.

EARC Research Scientist Bill Frank, and MSU/Richland County Extension Agent Tim Fine speaking at EARC Field Day

Lentils Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Days to Flowering	Days to Maturity	Plant height	1000 Kernel Weight	Protein†	Test weight	Yield#		
							2019	2-Yr Avg	3-Yr Avg
	(DAP[1])	(DAP[1])	(in)	(g)	(%)	(lb/bu)	----------(lb/a)----------		
French Green									
CDC LEMAY	58	94	10.1	31.0	24.5	63.0	1828	1379	1095
Medium Green									
AVONDALE	55	95	13.6	47.6	27.0	61.1	2661	1799	1547
CDC RICHLEA	56	95	13.7	46.8	26.0	61.3	2600	1862	1513
Large Green									
CDC GREENLAND	57	95	11.3	60.9	23.7	58.1	2277	1790	1445
RIVELAND	54	95	14.1	70.0	25.2	58.4	2379	1625	1360
PENNELL	57	95	12.1	56.3	25.4	59.4	1537	1124	968
Small Green									
CDC VICEROY	56	94	11.8	31.0	25.5	62.7	2580	1865	1485
ND EAGLE	54	94	12.0	36.2	24.1	62.6	2583	1745	1463
Small Red									
CDC RED RIDER	57	94	12.8	42.7	25.3	62.0	2783	2037	1640
CDC REDBERRY	57	94	14.0	40.1	25.2	62.1	2376	1862	1485
CDC ROULEAU	58	94	12.4	33.2	25.1	61.6	2491	1704	1417
CDC ROSETOWN	58	94	11.4	26.6	24.7	63.1	2259	1681	1345
Spanish Brown									
PARDINA	53	94	9.7	39.5	25.0	63.8	2389	1307	1137
Mean	55.19	94.38	12.02	46.91	25.1	61.59	2403	-	-
CV (%)	1.13	0.53	10.70	4.46	5.6	1.19	11	-	-
LSD (5%)	0.88	0.70	1.81	2.95	2.0	1.03	388	-	-
LSD (10%)	0.74	0.58	1.51	2.47	1.6	0.86	324	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Pervious crop:German Foxtail Millet

Planted: 05/03/2019 Harvested: 8/16/2019

Soil test to 6" in ppm: P=26 ppm K=301 ppm OM=1.8% pH=5.9 Soil type: Williams-Bowbells loam.

Soil test to 24" in lb/a: N=106 lb/a

Applied fertilizers in lb/a: none

†Protein adjusted to 0% moisture.

#Yield reported on a 13.5% moisture basis.

[1]DAP = Days after planting.

Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ; Secure EC @ 12 oz/a (6/24/2019)

WREC Field Day Events

Dryland Lentil Variety Evaluation - MSU **Richland, MT 2019**

Variety	Plant Height (cm)	Test Weight (lb/bu)	1000 Seed Weight (g)	Adjusted Grain Yield (lb/a)
Avondale	33.0	62.5	49.0	2299
CDC Impress	32.4	62.2	50.4	2332
CDC Imvincible	30.5	64.9	30.0	2076
CDC Maxim	30.5	64.4	38.4	2366
CDC Richlea	31.1	61.8	53.5	2355
CDC Viceroy	33.0	65.0	30.8	2371
NDL090185R	34.9	62.8	37.4	2536
NDL090204R	32.4	63.9	40.6	2271
NDL090170L	33.0	61.1	67.8	2283
Sage	26.7	64.6	37.0	1943
Mean	31.8	63.3	43.5	2283
P-Value	0.0002	<0.0001	0.0	<0.0001
LSD	2.87	0.3	17.3	167.0
CV (%)	6.3	0.3	27.3	5.0

Location: Richland, MT
Previous crop: Spring Wheat
Planted: May 9, 2019
Harvested: Aug. 21, 2019
Applied fertilizers in lb/a: None
Soil type: Farnuf Loam
Yield adjusted to 13% moisture content

Herbicide: Valor at 3 fl oz/a fall applied; Sharpen at 0.75 fl oz/a.

Irrigated Lentil Variety Evaluation - MSU **EARC, Sidney, MT 2019**

Variety	Days to Flower DAP[1]	Plant Height (cm)	Test Weight (lb/bu)	1000 Seed Weight (g)	Adjusted Grain Yield (lb/a)
Avondale	54	38.3	61.1	44.9	2751
CDC Impress	56	34.8	59.7	51.8	2371
CDC Imvincible	58	35.0	63.0	33.8	2753
CDC Maxim	54	28.5	63.4	37.5	2864
CDC Richlea	58	32.0	59.6	47.6	2488
CDC Viceroy	57	33.5	63.5	33.3	2729
NDL090185R	56	34.5	60.1	46.6	2531
NDL090204R	54	30.8	61.7	50.9	2273
NDL090170L	54	33.3	59.0	60.0	2110
Sage	54	29.3	63.2	35.8	2758
Mean	55.5	33.0	61.4	44.2	2563
P-Value	<0.0001	0.0086	<0.0001	<0.0001	0.4
LSD	0	4.73	0.6	2.6	692.0
CV (%)	0	9.89	0.7	4.0	18.6

Location: EARC; Sidney, MT
Previous crop: Sugarbeet
Planted: April 24, 2019
Harvested: Aug. 14, 2019
Applied fertilizers in lb/a: None
Soil type: Williams Clay Loam
Yield adjusted to 13% moisture content
Rain fall (Apr-Aug) = 10.1"
Irrigation = 1.8"

Herbicide: Durango and Outlook at 24 oz/ac and 12 oz/ac, respectively.
DAP[1] = Days after planting

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
AAC CHROME	LEGUME LOGIC	SL	NA	MEDIUM	MEDIUM	M LARGE	R
AAC PROFIT	BIRDSALL GRAIN	NA	NA	NA	M LATE	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	BIRDSALL GRAIN	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
HAMPTON	NDCIA	NA	NA	M SHORT	MEDIUM	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
LG SUNRISE	PULSE USA	SL	NA	TALL	MEDIUM	S MEDIUM	R
LGPN4909	LIMAGRAIN	NA	NA	NA	NA	NA	NA
LGPN4913	LIMAGRAIN	NA	NA	NA	NA	NA	NA
LGPN4915 (LG STUNNER)	LIMAGRAIN	NA	NA	NA	NA	NA	NA
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
NDP121587	NDSU	NA	NA	M SHORT	MEDIUM	M SMALL	R
NETTE 2010	PULSE USA	SL	NA	SHORT	M EARLY	M SMALL	NA
PSTSP27	PHOTOSYNTECH	NA	NA	NA	NA	NA	NA
PSTSP34	PHOTOSYNTECH	NA	NA	NA	NA	NA	NA
PSTSPS32	PHOTOSYNTECH	NA	NA	NA	NA	NA	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							
AAC COMFORT	MERIDIAN SEEDS	NA	NA	MEDIUM	MEDIUM	LARGE	R
ARAGORN	PROGENE	SL	SD	M SHORT	M EARLY	M LARGE	NA
ARCADIA	PULSE USA	SL	SD	MEDIUM	EARLY	SMALL	MS
CDC GREENWATER	MERIDIAN SEEDS	NA	NA	M TALL	LATE	MEDIUM	R
CDC STRIKER	CANADA	SL	SD	MEDIUM	MEDIUM	M LARGE	S
CRUISER	WA	SL	SD	MEDIUM	MEDIUM	M SMALL	S
DAYTONA	MERIDIAN	SL	SD	MEDIUM	LATE	MEDIUM	R
GINNY	PROGENE	NA	NA	M SHORT	MEDIUM	SMALL	NA
GREENWOOD	PROGENE	NA	NA	MEDIUM	MEDIUM	SMALL	MR
K-2	LEGUME LOGIC	SL	SD	MEDIUM	EARLY	M SMALL	S
LG KODA	PULSE USA	SL	NA	MEDIUM	MEDIUM	MEDIUM	R
MAJORET	SWEDEN	SL	SD	MEDIUM	M LATE	MEDIUM	S
SHAMROCK	GREAT NORTHERN AG	SL	NA	NA	LATE	NA	S
STIRLING	WA	SL	SD	SHORT	EARLY	MEDIUM	R
VIPER	PULSE USA	SL	SD	M SHORT	M EARLY	MEDIUM	MR

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

Dryland Field Pea Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Flowering Date (DAP)	Maturity Date (DAP)	Height (in.)	Protein (%)	1000 Seed Weight (g)	Test Weight (lb/bu)	Yield (bu/a)	2-YR Avg (bu/a)	3-YR Avg (bu/a)
Yellow Cotyledon Type									
AAC Carver	57	93	24	20.9	260.3	65.1	67.6	49.1	39.8
Agassiz	57	93	23	21.8	267.2	64.9	62.3	47.9	38.9
Jetset	58	95	23	24.5	260.9	65.4	62.4	45.4	37.2
CDC Inca	60	94	27	22.5	239.5	65.3	65.9	46.8	36.9
Hyline	58	94	23	22.7	267.4	65.4	62.5	44.9	36.8
CDC Saffron	59	94	22	21.9	266.4	65.5	60.7	48.5	36.5
Salamanca	57	92	25	23.2	266.0	64.8	58.0	43.6	36.4
Durwood	57	96	28	22.9	258.9	65.2	61.5	44.0	36.2
Korando	54	95	23	24.7	287.1	65.4	57.1	44.7	35.9
DS Admiral	58	94	22	21.9	247.0	65.3	54.6	42.8	34.8
SW Midas	59	92	21	20.5	219.8	65.1	53.4	43.1	34.6
Spider	59	96	26	23.0	253.2	65.2	60.6	46.6	34.4
LG Amigo	57	94	21	24.5	240.4	64.7	54.3	39.0	34.1
CDC Amarillo	60	95	26	22.0	249.0	65.3	59.3	43.0	33.0
AAC Chrome	59	95	23	21.5	273.8	65.8	75.0	54.5	-
AAC Profit	61	95	26	22.9	257.2	65.1	66.1	50.2	-
Bridger	55	94	21	23.4	243.8	65.7	64.2	49.4	-
LG Sunrise	55	94	28	20.3	247.0	66.3	57.5	44.3	-
LGPN4915	55	94	23	26.7	235.4	65.2	56.6	44.2	-
Navarro	53	93	21	22.6	270.2	65.3	55.8	44.0	-
LGPN4909	54	92	20	22.6	228.8	64.9	55.2	41.4	-
LGPN4913	56	92	22	23.5	259.8	65.8	53.2	40.7	-
AC Earlystar	57	93	24	20.2	230.3	65.3	64.6	-	-
CDC Spectrum	59	96	25	23.7	263.8	64.7	63.9	-	-
CDC Treasure	56	93	26	21.1	223.8	65.9	61.9	-	-
DL Apollo	58	92	20	22.8	233.9	65.6	60.0	-	-
Hampton	60	94	20	25.5	244.2	64.9	55.8	-	-
N13022-7	54	94	22	23.4	276.7	65.8	62.0	-	-
N13029-10	54	94	23	21.3	275.2	65.8	60.3	-	-
N13057-4	54	92	21	23.4	239.5	65.1	50.1	-	-
N13057-5	58	95	27	25.0	254.3	65.0	58.7	-	-
N13068-1	57	93	24	22.4	287.3	65.0	64.8	-	-
NDP121587	58	94	23	20.7	243.8	65.1	55.4	-	-
Nette 2010	54	93	24	20.2	239.7	66.3	57.4	-	-
PSTSP27	54	91	22	23.7	275.5	65.4	56.9	-	-
PSTSP34	58	92	27	22.5	219.3	65.5	59.5	-	-
PSTSPS32	59	93	25	22.5	287.1	65.9	68.3	-	-
Green Cotyledon Type									
Arcadia	57	95	21	20.6	219.7	65.3	61.4	46.7	38.6
CDC Striker	57	94	19	20.3	226.8	65.2	64.3	47.8	38.2
AAC Comfort	62	96	23	23.6	270.6	65.2	66.5	44.9	34.1
CDC Greenwater	60	96	27	21.7	252.3	65.3	56.8	42.0	33.2
Viper	56	93	23	22.5	235.8	64.5	53.5	40.3	33.0
Shamrock	60	93	22	22.3	258.1	65.4	62.7	43.0	32.6
Cruiser	56	92	21	21.6	209.9	64.9	48.2	36.5	30.3
Banner	54	91	20	17.6	210.5	65.5	54.6	40.3	-
Empire	58	95	30	22.4	234.1	66.0	55.9	-	-
LN1131	55	90	19	23.3	262.0	64.4	50.4	-	-
N13073-17	59	93	24	23.0	288.1	64.7	59.9	-	-
N13073-19	54	94	23	23.6	281.2	64.9	55.8	-	-
12CP3032	59	94	22	21.2	308.6	65.2	57.4	-	-
Mean	57	93	23	22.4	252.6	65.3	59.4	-	-
CV %	2	1	12	3.6	4.0	0.6	8.3	-	-
LSD 0.05	1	2	4	1.1	13.9	0.6	6.9	-	-
LSD 0.1	1	2	3	0.9	11.7	0.5	5.8	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft Previous crop: German Foxtail Millet

Planted: 4/26/2019 Harvested: 08/01/2019

Soil test to 6" in ppm: P=26 ppm; K=301 ppm; OM=1.8%; pH= 5.9 Soil type: Williams-Bowels loam

Soil test to 24" in lb/a: N=106 lbs/a

Applied fertilizers in lb/a: none

Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ; Secure EC @ 12 oz/a (6/24/2019)

Peas Dryland Off-Station Variety Trial - NDSU **Divide County, ND 2019**

Variety	1000 Kernel Weight	Protein†	Test weight	Yield#		
				2019	2-Yr Avg	3-Yr Avg
	(g)	(%)	(lb/bu)	----------(bu/a)----------		
Yellow Cotelydon Type						
Agassiz	221.0	26.3	62.4	61.8	53.5	46.0
Nette 2010	227.0	24.0	63.9	53.1	43.2	37.0
NDP 121587	221.1	23.6	63.2	53.7	-	-
CDC Saffron	233.5	26.2	63.3	61.2	-	-
CDC Treasure	205.2	24.0	64.4	51.7	-	-
SW Midas	201.3	24.7	63.3	51.2	-	-
Hampton	216.6	26.9	61.8	49.3	-	-
Green Cotelydon Type						
Arcadia	206.2	23.7	62.7	52.2	47.4	42.5
Majoret	226.7	26.7	63.4	56.9	42.5	-
CDC Striker	232.2	26.6	63.7	47.4	-	-
Aragorn	197.9	25.6	62.4	46.1	-	-
Cruiser	185.2	25.1	63.0	45.2	-	-
Mean	214.5	25.3	63.1	52.5	-	-
CV (%)	3.7	1.9	0.7	11.7	-	-
LSD (5%)	13.4	0.8	0.8	10.4	-	-
LSD (10%)	11.1	0.7	0.6	8.6	-	-

Location: Crosby, ND; Latitude 48° 8' N; Longitude 103° 18' W; Elevation 2044 ft.

Planted: 05/06/2019 Previous crop: spring wheat

Soil test (0-6"): P=14 ppm; K=362 ppm; OM=3.0%. Harvested: 8/21/2019

(0-24"): NO3-N=14 lb/a. Soil type: Farnuf-Alkabo

Applied fertilizers in lb/a: none

†Protein adjusted to 0% moisture. #Yield reported on a 13.5% moisture basis.

[1]DAP = Days after planting.

Herbicide Applications: Spartan Charge @ 4oz/a with RT3 @ 32 oz/a (5/6/2019); Basagran @ 1pt/a with Secure @ 8 oz/a (6/25/2019)

Peas Dryland Off-Station Variety Trial - NDSU **McKenzie County, ND 2019**

Variety	1000 Kernel Weight	Protein†	Test weight	Yield#
				2019
	(g)	(%)	(lb/bu)	(bu/a)
Yellow Cotelydon Type				
Agassiz	230.3	25.8	61.3	54.7
CDC Saffron	235.6	25.6	62.7	53.6
NDP 121587	213.8	23.8	62.0	49.4
CDC Treasure	206.1	24.5	63.2	47.5
Nette 2010	222.9	24.2	63.3	46.5
Hampton	219.6	28.3	61.6	43.2
SW Midas	200.7	24.8	61.7	43.0
Green Cotyledon Type				
Arcadia	205.1	23.4	61.7	50.1
Cruiser	180.2	24.8	61.7	37.7
Majoret	232	26.6	62.6	36.8
Aragorn	191.6	23.6	61.4	36.6
CDC Striker	226.2	27.6	62.6	33.2
Mean	213.7	25.2	62.1	44.4
CV (%)	2.3	3.8	0.7	8.7
LSD (5%)	8.5	1.6	0.8	6.5
LSD (10%)	7.0	1.4	0.7	5.4

Location: Arnegard, ND; Elevation 2254 ft. Previous crop: spring wheat

Planted: 05/13/2019 Harvested: 08/21/2019

†Protein adjusted to 0% moisture. Soil type: Dooley-Zahl complex

#Yield reported on a 13.5% moisture basis.

Applied Fertiler in lb/a: none

Herbicide Applications: Spartan Charge @ 4 oz/a with RT3 @ 32 oz/a (5/13/2019); Basagran @ 1 pt/a with Secure @ 10 oz/a (6/18/2019)

Field Pea Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2019**

Variety	Canopy Height (in)	Vine Length (in)	Height Index‡ (%)	Days to Flower (DAP*)	Days to Maturity (DAP*)	Lodging (0 - 9⁺)	Protein† (%)	Test Weight (lb/bu)	Yield 2019 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
YELLOW COTYLEDON											
Agassiz	22	31	69	58	92	5	25.9	61.9	53.4	56.7	55.5
Spider	21	35	61	60	94	6	27.4	62.5	50.8	-	-
DS Admiral	25	30	82	58	91	6	24.2	62.2	45.1	-	-
GREEN COTYLEDON											
CDC Striker	17	29	56	57	90	6	25.1	61.4	50.5	52.6	51.1
Cruiser	11	29	36	57	91	8	25.2	61.0	48.2	-	-
Arcadia	12	29	41	60	90	8	24.9	60.6	47.8	-	-
MEAN	22.4	31.9	70.8	58.4	92.1	5.7	25.80	62.20	49.77	56.68	55.45
C.V. (%)	23.1	5.8	24.2	5.4	2.0	20.0	2.12	1.03	13.64	-	-
LSD (5%)	6.1	2.7	20.9	4.7	2.7	1.9	0.81	0.96	ns	-	-
LSD (10%)	5.0	2.2	17.2	ns	2.3	1.6	0.67	0.79	ns	-	-

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

‡ Percentage of how lodged the plant is. 100% - Plant is standing straight, 0% - Plant is lying flat.

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

Soil test (0-6 in.): P=13 ppm; K=313 ppm; pH=7.6 ; OM=3.1% Previous crop: Corn

(0-24 in.): NO3-N=15 lb/a Planted: 5/3/2019

Yield goal: 50 bu/a Harvested: 9/4/2019

Planting population: 400,000 seeds/a Soil type: Lihen Loamy Fine Sand

Applied fertilizer: none applied Plot size: 61 ft^2

Herbicides applied: Prowl H2O 2 pt/a and Sharpen 0.5 oz/a (5/10), Section 3EC 5.33 oz/a, 28-0-0 2 qt/a, and Destiny HC 1.5 pt/a (6/24), Basagran 1 pt/a and Destiny HC 1.5 pt/a (6/26), and Gramoxone SL 2.0 2 pt/a and Destiny HC 1 qt/ 100 gal (8/28) Rainfall: 10.4 in. (5/3 - 9/4)

Fungicides applied: Priaxor D 8 oz/a (7/12)

Dryland Green Dry Pea Variety Evaluation - MSU **Richland, MT 2019**

Variety	Plant Height (cm)	Test Weight (lb/bu)	Protein (%)	Adjusted Grain Yield (lb/a)
AAC Comfort	67.3	64.7	24.6	2696
Aragorn	64.8	62.5	23.1	2858
Bluemoon	64.1	64.4	22.9	3153
CDC Greenwater	76.8	65.6	23.4	2938
Ginny	59.7	64.0	23.3	2941
Hampton	62.2	64.4	26.2	2441
Keystone	61.6	65.6	25.2	2105
Majoret	64.8	64.8	24.7	2764
MT457	65.4	64.6	25.4	2757
Pro 121-7126	55.9	63.9	23.7	2651
Pro 141-6258	55.9	63.8	21.2	2671
PS0877MT076	57.2	63.8	25.8	2133
SW Arcadia	62.9	63.9	23.7	2930
Mean	63.0	64.3	24.1	2695
P-Value	0.0003	<.0001	<.0001	<.0001
LSD	7.6	0.6	0.7	227.4
CV (%)	8.4	0.6	1.9	5.9

Dryland Yellow Dry Pea Variety Evaluation - MSU **Richland, MT 2019**

Variety	Plant Height (cm)	Test Weight (lb/bu)	Protein (%)	Adjusted Grain Yield (lb/a)
124-7146	60.3	65.8	28.6	2358
154-7207	56.5	65.2	25.3	2091
154-7225	56.5	65.4	29.3	1940
AAC Asher	64.8	64.7	23.5	3531
AAC Carver	72.4	64.7	22.1	3175
AAC Chrome	68.6	64.2	24.0	3597
AAC Profit	71.1	65.0	25.8	2953
AC Agassiz	68.6	63.9	25.2	2939
AC Earlystar	71.8	64.1	23.3	3130
Astronaute	69.2	65.0	25.0	3448
Bridger	66.7	64.3	22.9	3084
CDC Amarillo	78.7	65.5	24.5	2793
CDC Dakota	74.3	65.4	26.6	3359
CDC Inca	81.3	65.4	24.6	3207
CDC Saffron	70.5	65.2	24.1	3516
CDC Spectrum	80.0	64.9	25.5	3062
Delta	59.1	64.2	24.1	3287
DL Apollo	80.0	65.4	25.5	3103
DS-Admiral	71.1	64.3	23.5	3236
Durwood	71.1	64.2	24.1	2823
Hyline	70.5	64.4	24.0	3114
Jetset	64.8	63.9	23.8	3640
Korando	66.7	64.6	24.2	3412
LG Amigo	69.2	63.9	23.5	3359
LG Sunrise	66.7	64.8	22.4	2845
Majestic	73.7	64.8	23.9	3155
Navarro	67.9	64.0	25.2	3215
NDP121587	64.1	63.7	22.3	3436
Nette 2010	61.6	64.7	23.0	2946
Pro 093-7410	59.7	64.7	21.8	3059
Pro 133-6243	66.0	64.8	24.3	3287
Pro 143-6236	56.5	63.9	22.7	2538
PS07100925	62.2	64.5	24.2	3277
PS08101022	51.4	64.4	23.3	3896
PS0877MT632	62.2	64.7	25.9	2567
Salamanca	68.6	64.1	24.8	3132
Spider	71.8	65.4	24.9	2773
Mean	67.5	64.6	24.4	3089
P-Value	<.0001	<.0001	<.0001	<.0001
LSD	9.4	0.5	0.8	279.4
CV (%)	9.9	0.6	2.2	6.5

Location: Richland, MT
Previous crop: Spring Wheat
Planted: May 9, 2019
Harvested: Aug. 20, 2019
Applied fertilizers in lb/a: None
Soil type: Farnuf Loam
Yield adjusted to 13% moisture content

Herbicide: Valor at 3 fl oz/a fall applied; Sharpen at 0.75 fl oz/a.

Irrigated Green Dry Pea Variety Evaluation - MSU **Sidney, MT 2019**

Variety	Days to Flower DAP[1]	Plant Height	Test Weight	1000 Seed Weight	Protein	Adjusted Grain Yield
		(cm)	(lb/bu)	(g)	(%)	(lb/a)
Aragorn	56	66.5	63.4	204.6	21.5	4874
Hampton	59	65.5	64.8	214.3	21.5	4731
Majoret	56	69.8	65.3	234.5	21.1	5050
MT457	56	71.5	64.1	233.1	25.0	4691
PS0877MT076	59	61.8	63.9	175.6	21.9	3414
Mean	57	67.0	64.3	212.4	22.2	4552
P-Value	<0.0001	0.0845	<0.0001	<0.0001	<0.0001	0.0002
LSD	0	7.2	0.5	8.3	0.8	544.5
CV (%)	0	7.0	0.6	2.5	2.3	7.8

Irrigated Yellow Dry Pea Variety Evaluation - MSU **Sidney, MT 2019**

Variety	Days to Flower DAP[1]	Plant Height	Test Weight	1000 Seed Weight	Protein	Adjusted Grain Yield
		(cm)	(lb/bu)	(g)	(%)	(lb/a)
Delta	56	64.0	65.7	236.0	20.6	4994
DS-Admiral	56	78.0	64.8	234.6	20.6	5114
NDP121587	54	76.8	65.1	236.4	20.1	5333
PS07100925	58	64.0	64.7	261.1	20.4	5123
PS08101022	54	65.3	64.4	240.0	20.1	5313
PS0877MT632	54	70.5	64.0	205.9	22.2	4305
Mean	55	69.8	64.8	236.0	20.6	5030
P-Value	<0.0001	0.044	0.005	<0.0001	0.007	0.029
LSD	0	11.1	0.8	6.4	1.1	615.7
CV (%)	0	10.5	0.8	1.8	3.5	8.1

Location: EARC; Sidney, MT — Previous crop: Sugarbeet
Planted: April 24, 2019 — Harvested: Aug. 9, 2019
Applied fertilizers in lb/a: None — Soil type: Williams Clay Loam
Yield adjusted to 13% moisture content

Herbicide: Durango and Outlook at 24 oz/ac and 12 oz/ac, respectively.
DAP[1] = Days after planting

Chickpea Dryland Variety Trial - NDSU **WREC, Williston, ND 2019**

Variety	Brand/ Company	Days to Flower	Days to Mature	Plant height	Seed Size				1000 Seed Weight	Test weight	Yield		
					<8mm	8-9mm	9-10mm	>10mm			2019	2-Yr Avg	3-Yr Avg
		(DAP[1])	(DAP[1])	(in)	(%)	(%)	(%)	(%)	(g)	(lb/bu)	----------(lb/a)----------		
Desi													
CDC ANNA	Meridian Seeds	58	111	18.3	100.0	0.0	0.0	0.0	182.4	62.3	2449	2112	1678
Kabuli													
CDC ORION	Meridian Seeds	57	111	18.0	40.8	46.7	12.4	0.1	400.4	61.4	2466	2115	1701
CDC LUNA	Meridian Seeds	57	112	18.0	74.4	22.2	3.2	0.3	338.7	62.2	2228	2079	1585
CDC FRONTIER	Meridian Seeds	58	107	17.8	78.8	19.4	1.7	0.0	333.2	61.9	2140	1826	1458
SAWYER		58	109	17.4	72.1	22.2	5.6	0.1	366.2	60.4	1987	1825	1411
SIERRA		58	109	17.7	39.5	47.1	12.3	1.1	431.7	61.3	1903	1571	1242
CDC Leader	Meridian Seeds	56	111	18.0	67.6	29.7	2.7	0.0	351.2	62.2	2772	2364	-
CDC Palmer	Meridian Seeds	56	112	18.1	47.1	47.3	5.6	0.0	387.1	61.8	2921	2405	-
BGC090017		57	112	20.1	48.6	44.6	6.9	0.0	394.8	62.6	2555	-	-
MS-19CP1	Meridian Seeds	56	111	16.9	99.2	0.8	0.0	0.0	269.5	63.0	2861	-	-
MS-19CP2	Meridian Seeds	59	110	20.1	98.7	1.3	0.0	0.0	238.6	60.0	2785	-	-
Mean		57	111	19	57.3	30.7	11.3	0.7	367.4	61.2	2340.0	-	-
CV (%)		1.9	2.4	8.4	8.4	12.1	27.1	125.9	3.6	1.3	11.0	-	-
LSD (5%)		1.5	3.8	2.2	6.9	5.3	4.3	1.2	19.0	1.1	365.3	-	-
LSD (10%)		1.3	3.1	1.9	5.7	4.4	3.6	1.0	15.8	0.9	304.8	-	-

Location of the WREC: Latitude 48 8'; Longitude 103 44'W; Elevation 2105 ft — Previous Crop: German Foxtail Millet
Planting Date: 5/3/19 — Harvest Date: 9/4/19
Soil type: Williams-Bowbells loam
Soil test to 6" in ppm: P=26 ppm; K=301 ppm; OM=1.8%; pH=5.9
Soil test to 24" in lb/a: N=106 lb/a
Applied fertilizers in lb/a none
Herbicide Applications: Valor @ 3 oz/a with LV6 @ 1pt/a (10/22/18) ; Secure EC @ 12 oz/a (6/24/2019
[1]DAP = days after planting

Irrigated Chickpea Variety Evaluation - MSU **Sidney, MT 2019**

Variety	Seed sizes greater than 22/64 inches (%)	Adjusted Grain Yield (lb/a)
BGC090017	57.9	3965
CDC Alma	33.5	1249
CDC Frontier	24.0	2605
CDC Leader	49.4	4371
CDC Orion	47.7	2830
Myles	0.0	2573
Nash	51.9	361
Royal	46.1	662
Sawyer	21.7	1585
Sierra	59.2	922
Mean	39.1	2112
P-Value	<0.0001	<0.0001
LSD	0.1	532.8
CV (%)	15.8	17.4

Location: EARC; Sidney, MT
Previous crop: Sugarbeet
Planted: April 23, 2019
Harvested: Sept. 5, 2019
Applied fertilizers in lb/a: None
Soil type: Williams Clay Loam
Yield adjusted to 13% moisture content
Rain fall (Apr-Aug) = 10.1"
Irrigation = 1.8"

Herbicide: Durango and Outlook at 24 oz/ac and 12 oz/ac, respectively.

Fungicide: Proline at 5.7 fl oz/a on 6/27/19, Priaxor @ 8 fl oz/a on 7/13/19, Delaro at 12 fl oz/a on 7/30/19.

Note: Conditions were favorable for development of Ascochyta blight at this location in 2019 and as a result, those varieties lacking resistance to Ascochyta performed poorly

Dryland Chickpea Variety Evaluation - MSU **Richland, MT 2019**

Variety	Seed sizes greater than 22/64 inches (%)	Adjusted Grain Yield (lb/a)
BGC090017	82.0	1713
CDC Alma	48.8	2245
CDC Frontier	62.4	2391
CDC Leader	66.3	2193
CDC Orion	70.7	1705
CDC Palmer	67.0	1811
GNC-18011	4.3	1011
Myles	0.0	1168
Nash	88.9	802
Royal	77.5	924
Sawyer	63.9	1854
Sierra	87.8	996
Mean	60.0	1568
P-Value	<0.0001	<0.0001
LSD	0.1	142.8
CV (%)	14.7	6.3

Location: Richland, MT
Previous crop: Spring Wheat
Planted: May 9, 2019
Harvested: Sept. 4, 2019
Applied fertilizers in lb/a: None
Soil type: Farnuf Loam
Yield adjusted to 13% moisture content

Herbicide: Valor at 3 fl oz/a fall applied; Sharpen at 0.75 fl oz/a.

Dryland Crop Performance Comparisons – Williston, ND 2019

Gautam Pradhan, Jerald Bergman, Kyle Dragseth

Crop	Type	Variety	Yield 3 Year Avg*	Market Price†	Gross Return	+ or - spring wheat
			(bu/a)	($/bu)	($/a)	($/a)
HR Spring Wheat		Bolles	43.00	4.87	209.41	0.00
HR Winter Wheat		Jerry	47.47	3.68	174.68	-34.73
Durum Wheat		Joppa	44.51	6.00	267.03	57.62
Flax		Average‡	17.00	9.00	152.97	-56.44
Soybeans	(Conventional)	Average‡	28.62	7.56	216.39	6.98
Field Peas	(Green)	Arcadia	41.07	5.00	205.36	-4.05
	(Yellow)	Agassiz	42.63	3.75	159.85	-49.56
			lb/a	**$/CWT**		
Canola		Star 402	1398.73	14.91	208.55	-0.86
Safflower		MonDak	1499.46	18.00	269.90	60.49
Lentils	(Medium green)	Avondale	1982.00	14.00±	277.48	68.07

*The average yield of a crop, except durum wheat, was based on three-year average yield (2016, 2017, 2019) from dryland varietal trials. The average yield of durum wheat was based on 2017 and 2019. There were several episodes of high wind, heavy rain, and hailstorm that affected crops in 2018. So, the data from 2018 was not included.

†The market price was obtained in the second week of December 2019 from different grain elevators in and around Williston.

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

±Very limited market in 2019

WREC staff prepare for harvest

Drone Based High Throughput Phenotyping in Support of Cereal Breeding for Drought Tolerance

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Funding Agency: ND Agricultural Experiment Station – Precision Ag Grant Program

Introduction

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. In 2000, drought caused ~223 million dollars of economic losses in North Dakota (Jossi, 2002), and the lost in 2006 was estimated at 425 million dollars (NDDA, 2007). 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. However, breeders seldom use these traits in their breeding programs; because it is highly resources demanding (time and labor). Also, due to time constraints, breeders have been collecting plant height data only once in a season. Thus, to identify drought tolerant cereal genotypes rapidly and accurately from standing crops, 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, which 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). 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 2018, a newly purchased drone (DJI MATRICE 600 PRO, Picture 1), a multispectral camera (MicaSense RedEdge-M, Picture 3), and an RGB camera (DJI Zenmuse X3, Picture 4) were assembled, calibrated, and tested. The UAS system, thus built, was flown over the barley and durum breeding nurseries using the Pix4D Capture App installed on an iPad. The images (~1000 photos) thus collected were processed in Agisoft Photoscan to generate Digital Elevation Model (DEM) and Orthophotos; which were subsequently used in QGIS to create raster images of Normalized Difference Vegetative Index (NDVI), Normalized Difference Red Edge (NDRE), and canopy height. Ultimately, the ArcGIS software along with Python Scripts was used to calculate and quantify plot-wise mean NDVI, NDRE, and Maximum canopy height plot.

In 2019, a drone (DJI MATRICE 600 PRO) equipped with a multispectral camera (MicaSense RedEdge-M) or a thermal camera (DJI Zenmuse XT2, Picture 5) and a newly acquired DJI Mavic 2 PRO (Picture 2) drone equipped with an RGB camera was flown frequently over the barley and winter wheat breeding nurseries and once over the durum nurseries. Altogether, we flew 20 times in the season. Software like DJI Ground Station Pro, DJI GO, DJI GO4, and Atlas Flight in an IPad was used to fly drones based on the type of camera and/or drone. The images were processed in Agisoft Metashape Professional to generate Digital Elevation Model (DEM) and orthophotos. The ArcGIS along with Python Scrips were used to quantify plot-wise canopy height from DEM and mean NDVI, NDRE from orthophotos.

Results

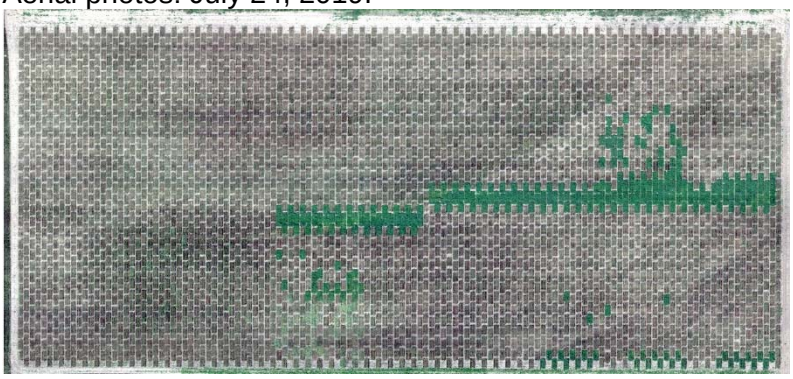
We successfully generated RGB, DEM, NDVI, NDRE, and canopy temperature orthomosaic (raster images) from our flights and quantified plot-wise plant height, NDVI, and NDRE. Figures 1-7 show outcomes of the project from selected dates and nurseries. We are still testing new algorithms and

software like ImageJ, MATLAB to quantify plot-wise plant stand and percent heading from RGB raster images and pixel by pixel temperature information from FLIR raster images.

Conclusions

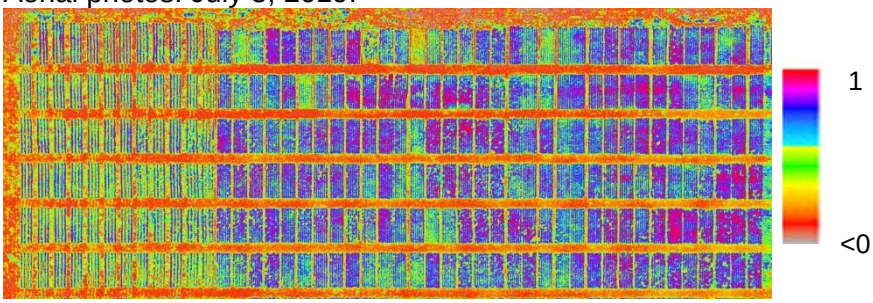
The results showed that a UAV system may be successfully used in quantifying plant health (NDVI, NDRE) and plant height of thousands of breeding nursery plots frequently, efficiently and quickly. These data will provide time-series information on growth and plant health that will help breeders to increase the efficiency of selecting high yielding abiotic and biotic stress tolerant genotypes. There is still a need for finding a way to process raster images that provide plot-wise canopy temperature and percent flowering/heading. The next venture, stepping on this project, will be to determine the UAS based data collection and analyses protocol specific to a crop and trait. The protocol shall include but not limited to suitable stages of plant for data collection, time of the day on each stage, the height of the flight, and sensor to be used to measure the specific traits of ~ 15 crop species. It will also explain the procedure of processing images (stitching and mosaic production) and plot-wise quantification of the traits.

Figure 1. RGB orthomosaic of durum nurseries.
Aerial photos: July 24, 2019.



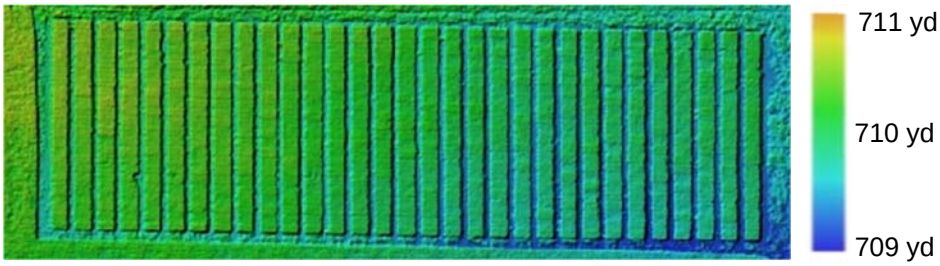
Picture 1. DJI MATRICE 600 PRO.

Figure 2. NDRE orthomosaic of a portion of WW nurseries.
Aerial photos: July 5, 2019.



Picture 2. DJI Mavic 2 PRO.

Figure 3. Digital elevation model (DEM) of barley nurseries.
Aerial photos: July 24, 2019.



Picture 3. MicaSense RedEdge-M – Multispectral Camera.

Figure 4. RGB orthomosaic with polygons identifying plots of barley nursery (“19 EXPT12WIR”). Aerial photos: Jul 24, 2019.

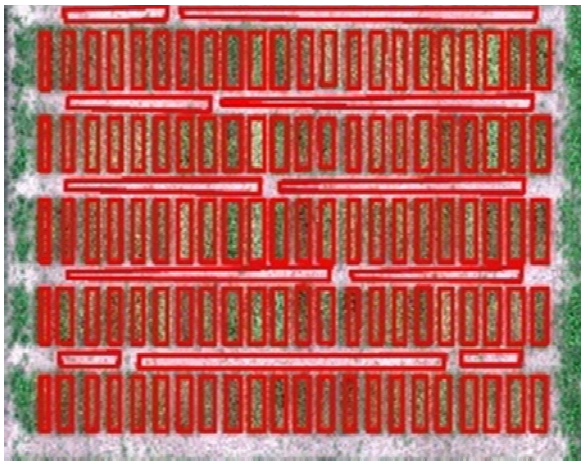


Figure 5. Plot-wise plant heights of barley nursery (“19 EXPT12WIR”) derived from DEM, categorized into eight classes and presented by overlaying on RGB orthomosaic.

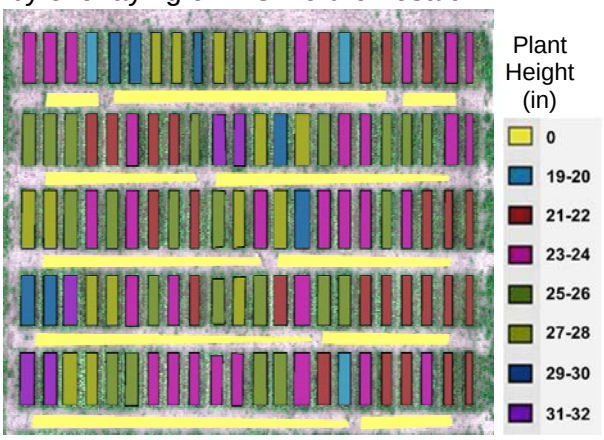


Figure 6. Plot-wise NDVI of barley nursery (“19 EXPT12WIR”) categorized into eleven classes. Aerial photos: July 24, 2019.

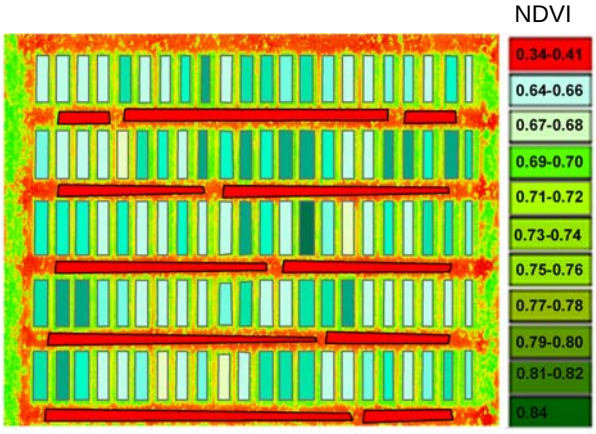
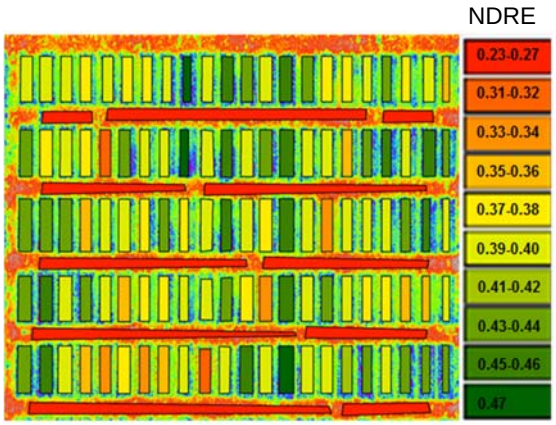


Figure 7. Plot-wise NDRE of barley nursery (“19 EXPT12WIR”) categorized into ten classes. Aerial photos: July 24, 2019.



Picture 4. DJI Zenmuse X3 – RGB Camera.

Picture 5. DJI Zenmuse XT2 – Thermal Camera.

Correlations between Yields of Spring Wheat Varieties and Normalized Difference Vegetation Index (NDVI) from Ground and Aerial Based Systems EARC, Sidney, MT and WREC, Williston, ND

Gautam Pradhan, Shuang Zhou, Apurba Sutradhar, and Chengci Chen

Materials and Methods:

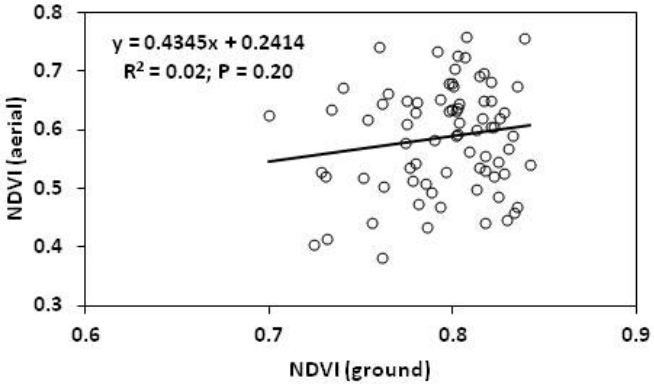
Location: EARC
Planted: 4/18/2019
Tillage: Conventional
Experimental design: Randomized Complete Block
Rainfall: 21.5”
Fertilizers (obtained): 60 lbs N/ac and 30 lbs P_2O_5/ac.

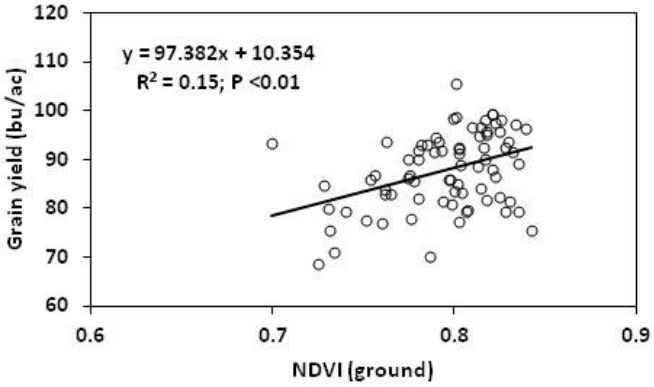
Previous crop: Fallow
Harvested: 8/19/2019
Plot size: 5” x 10”
Replications: 4
Soil type: Williams Clay Loam

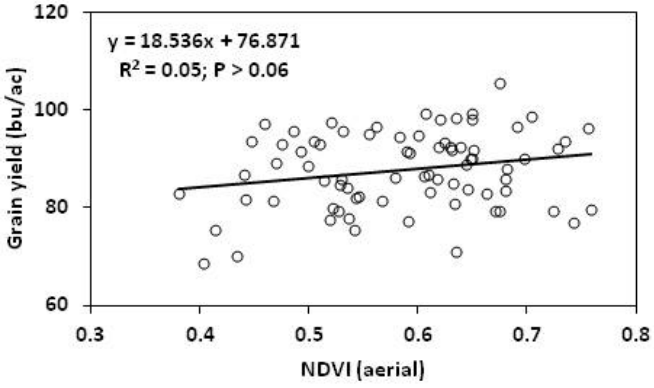
Plotwise NDVI data was extracted from imageries collected on 06-20-2019 using a DJI Matrice 600 Pro system and a Micasense Rededge-M multispectral camera attached. A hand-held GreenSeeker was used to collect ground-based NDVI data on the same day.

In the figure from the top, relationships between NDVI readings extracted from imageries using and unmanned aerial system and a hand-held GreenSeeker, between grain yields and ground based NDVI, and between grain yields and aerial-based NDVI.

Grain yields were adjusted to 12% moisture content.







Sustainable Agroecosystem for Soil Health in the Northern Great Plains (Williston, ND - 2019)

Gautam Pradhan[1], Jim Staricka[1], Audrey Kalil[1], Jerry Bergman[1], Bart Stevens[2], Upendra Sainju[2], Kyle Dragseth[1], Cameron Wahlstrom[1], Meridith Miller[1], Taheni Gargouri Jbir[1], David Weltikol[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 were 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. In 2019, based on the results from previous five years, treatment structure was modified to seven fixed rotations and two dynamic rotations, which are as follows:

Fixed Rotations from 2019

2019	2020	2021	2022	2023
Durum	Fallow	Durum	Fallow	Durum
Durum	Durum	Durum	Durum	Durum
Cover Crop	Pea	Durum	Canola	Safflower
HRWW	Pea	Durum	Canola	Safflower
Durum	Pea	Durum	Lentil	Durum
Durum + SC	Sweet Clover	Durum + SC	Sweet Clover	Durum + SC
Perennial Mix	Perennial Mix	Perennial Grass	Perennial Mix	Perennial Mix

Note: Cover crop is a mixture of turnip, soybean, flax, sorghum sudangrass, and oats. HRWW = hard red winter wheat; SC = sweet clover. SC + Durum = sweet clover is companion cropped with durum.

Dynamic Rotations from 2019

	2019	2020	2021	2022	2018
	Safflower	TBD	TBD	TBD	TBD
	Durum	TBD	TBD	TBD	TBD

- 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).

Methods

Planting date, seeding rate, varieties and harvest dates are indicated in the table below. Rotations were differentially fertilized based on soil test and crop history. Durum, canola and safflower received 50 lbs of MEZ (12-40-0-10S-1Zn). Durum was fertilized based on 110 lb N/ac target minus a 40 lb no-till credit, a 26 lb/ac legume credit, starter and results of soil tests. Treatments 15, 3 and 18 received 102 lbs/ac urea. Treatments 6, 11, 18 and 19 had sufficient N based on soil tests and credits and thus did not receive urea. Canola was fertilized based on a 140 lb N/ac target minus a 40lb no till credit and results of the soil test. Canola plots received 100lbs/ac AMS and 76lbs/ac urea. Safflower plots received 35 lbs/ac urea (95 lb/ac N target minus no-till credit and soil test N). Peas, lentils and sweet clover were not fertilized as soil tests indicated approximately 40lbs/ac N was available. No fungicides were applied to durum, peas, lentils or canola. Safflower was treated with a foliar fungicide (azoxystrobin, 9 oz/ac) at early bloom and mid-bloom for control of Alternaria blight.

Crop	Seeding Rate	Seeding Date	Harvest Date
Durum (ND Riveland)	1 million PLS/ac	5/3/2019	8/21/2019
Canola (CP9919RR)	6 lbs/ac	5/9/2019	8/16/2019
Safflower (Cardinal)	30 lb/ac	5/2/2019	9/20/2019
Peas (Midas)	385,000 PLS/ac	5/3/2019	8/2/2019
Lentils (Richlea)	70 lb/ac	5/9/2019	8/29/2019

Results – Agronomic

There was a significant effect of crop rotation on durum yield and grain protein, but not on test weight. Durum following fallow, pea or sunflower (treatments 1, 6, 11 and 18) produced the highest yield compared with durum grown on durum stubble or grown as a mixture with sweet clover on HRSW stubble (treatments 3 and 15) (Table 1). Durum grown with sweet clover on HRSW stubble had the lowest grain protein. The test weight, averaged across the treatments, was 62.2 lb/bu.

Table 1. Durum yield, test weight, and protein content under different treatments.

Treatment	Crop		Yield	Test Weight	Protein
#	2018	2019	(bu/ac)	(lb/bu)	(%)
1	Fallow	Durum	78.5 A	62.3 A	13.1 A
3	Durum	Durum	57.2 D	62.2 A	11.7 A B C
6	Pea	Durum	70.6 A B	62.1 A	11.7 A B C
11	Pea/BP3	Durum	75.7 A B	62.1 A	11.5 B C
15	HRSW	Durum + SC	54.9 D	62.6 A	10.3 C
19	Lentil	Durum	69.3 B C	62.4 A	12.1 A B
18	Sunflower	Durum	72.2 A B	62.1 A	12.8 A B
21	Small grain	Durum	61.0 C D	61.9 A	12.9 A B

Note: Different letters within a column indicates significant difference at *p* value of 0.0001 for yield and 0.016 for percent protein. HRSW = hard red spring wheat. SC = sweet clover. Small grain indicates either barley or durum in 2018. BP3 = Biological primer 3 (cover crop mixture).

There was a significant effect of crop rotation on pea yield, but not on test weight or grain protein. Pea preceded by HRWW in 2018 produced the highest yield compared pea seeded following BP1 or flax (treatments 5 and 10). The pea test weight and protein averaged across the crop rotation was 64.2 lb/bu and 20.5%, respectively.

Table 2. Pea yield, test weight, and protein content under different treatments.

Treatment	Crop		Yield	Test Weight	Protein
#	2018	2019	(bu/a)	(lb/bu)	(%)
5	BP1	Pea	74.3B	63.8A	20.8A
10	HRWW/BP2	Pea	79.8A	64.5A	20.6A
16	Flax	Pea	73.5B	64.3A	20.1A

Note: BP1 and BP2 are biological primers (cover crop mixtures). Different letters within a column indicates significant difference at *p* value of 0.02 for yield.

The effect of crop rotation was not evident on the grain yield of other cash crops. The average yield of safflower, canola, lentil, and winter wheat were 1904 lb/ac, 1661 lb/ac, 2582 lb/ac, and 38 bu/ac, respectively.

The sweet clover and cover crop were cut for hay July 24th and July 29th respectively. The cover crop plots produced in total 1,900 lbs/ac and the sweet clover plots produced 2,960 lbs/ac.

Results – Plant Pathology

Table 3. Early season foliar fungal leaf spotting disease and Fusarium Head Blight in durum

	Feekes 2		Feekes 11.2	
Rotation (2013 - 2019)	LS INC	LS SV	FHB INC	FHB SV
Fallow - Durum	0	0	22.5	1.1
Durum - Durum	1.5	0.04	22.5	1.6
Pea - Corn -Safflower- Durum – BP1 - Pea - Durum	0	0	29.2	2.0
Pea/BP2- Corn - Safflower - Durum - HRWW/BP3 - Pea/BP2 - Durum	0	0	23.3	1.1
Sunflower - HRSW - HRWW - Lentil - Durum - Sunflower - Durum	0	0	15.8	0.9
Pea - Durum - Safflower - Barley - HRSW - Lentil - Durum	1	0.04	33.3	2.2
	NS	NS	NS	NS

Note: LS = Leaf spotting diseases such as tan spot, Septoria/Stagnospora blotch. FHB = Fusarium head blight (scab). INC = incidence or percent of plants exhibiting disease symptoms. SV = severity or the percent of the plant tissue exhibiting disease. NS = not significant, indicating no difference among the treatments.

Conclusions

Taking the 40 lb/ac no-till credit and a 26 lb/ac legume credit did not seem to reduce durum yield as they were comparable across treatments 1, 6, 11 and 18 (Table 1) with only treatment 18 receiving urea fertilization. The durum crops with the lowest yield were those following durum or HRSW (Table 1). Further studies are needed to determine if the practice of companion cropping durum with sweet clover results in yield and protein loss. Foliar disease levels overall were very low and Fusarium head blight was observed at consistent levels in durum across rotational treatments.

Determining soybean planting date and soil temperature for no-till semi-arid condition of western North Dakota

Gautam P. Pradhan, James Staricka and Jerald W. Bergman
NDSU Williston Research Extension Center
Funding Agency: North Dakota Soybean Council

Introduction

Planting date plays a crucial role in the performance and success of a field crop. Early or late planting may decrease grain yield and quality of a crop due to increased biotic (insect, disease, weed), and abiotic (frost, drought, and high temperature) stress. Kandel (2013) noted that soybean is susceptible to frost and prolonged exposure to near-freezing conditions in the spring and fall; and recommended that soybean be planted in North Dakota and Northwestern Minnesota when the soil temperature is >50°F. Western North Dakota has a cool semi-arid climate with annual precipitation of <15 inches, which is at least 5 inches lower than the eastern part of the state. In this part of the state, the last spring freeze may occur in the last week of April and the first fall freeze in October. Thus, there is a need of determining optimal soybean planting dates and soil temperature for the western part of North Dakota that provide optimum growing period, decrease chances of frost and/or drought damage, and enhance grain yield.

Materials and Methods

Two glyphosate tolerant soybean varieties, 'ND17009GT' and 'ND18008GT' were seeded at Williston Research Extension Center, Williston, using a GPS based autosteered seven rows no-till plot seeder that maintained a row to row distance of 7". The treatments comprised of seven seeding dates: 2nd, 9th, 16th, 23rd, and 30th of May, and 6th and 13th of June 2019 as main plots; two varieties: as subplots, and two seed treatments (treated and not treated) as sub-sub plots. During plant growth, the soil moisture and temperature data at four inches depth were continuously recorded using soil sensors. Unmanned aircraft systems equipped with multispectral, thermal, or RGB cameras were flown over the experimental field to estimate Canopy Temperature (CT), Normalized Difference Vegetation index (NDVI), Normalized Difference Red Edge (NDRE), and plant heights at different growth stages. At maturity, soybean was harvested using a plot combine.

Results

Preliminary results showed that there was a significant effect of planting date and variety but not of seed treatment on seed yield and test weight. Varieties responded differentially to the planting date for these traits. When averaged across the other two treatments, soybean variety 'ND18008GT' produced 4.5 bushels more seeds per acre than variety 'ND17009GT' (Fig. 1); and soybean planted on May 9th had the highest seed yield and one planted on June 13th had the lowest seed yield (Fig. 2). When averaged across seed treatment, the Variety 'ND17009GT' produced higher yield when planted on May 9th and June 6th as compared to all other planting dates; however, the variety 'ND18008GT' produced statistically similar yield when planted in the month of May but had a decline in yield when planting was delayed to June 6th. (Fig. 3). When averaged across the other two treatments, the test weight of the variety 'ND18008GT' was slightly lower than the variety 'ND17009GT' (Fig. 4); and the effect of planting date on the test weight was not evident in soybean planted from May 2nd to 23rd. A sharp decline in test weight was observed when soybean was planted on and after June 6th (Fig. 5). When averaged across seed treatment, the effect of late planting was detrimental to both soybean varieties for the test weight, (Fig. 6). However, the degree of decline in test weight as a result of late planting was higher in 'ND17009GT' than in 'ND18008GT'.

Figure 1. Effect of variety on soybean yield.

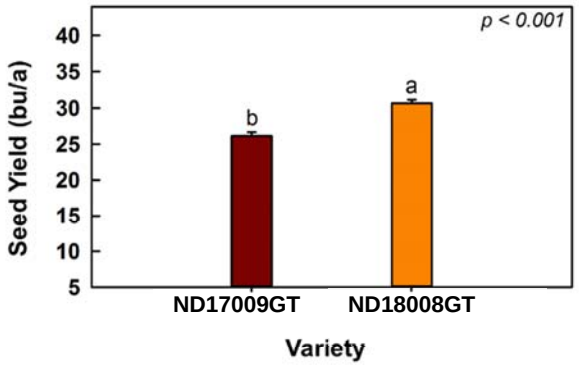


Figure 2. Effect of planting date on soybean yield.

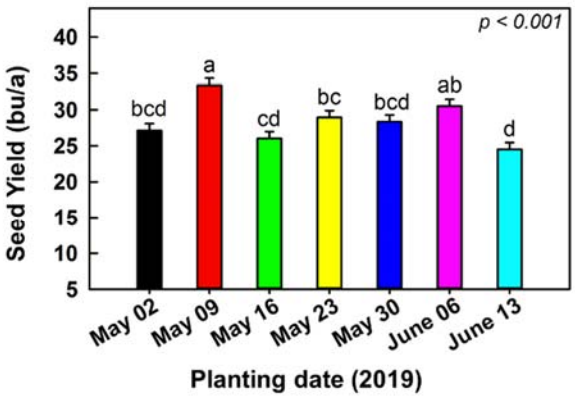


Figure 3. Differential responses of soybean varieties to planting dates for seed yield.

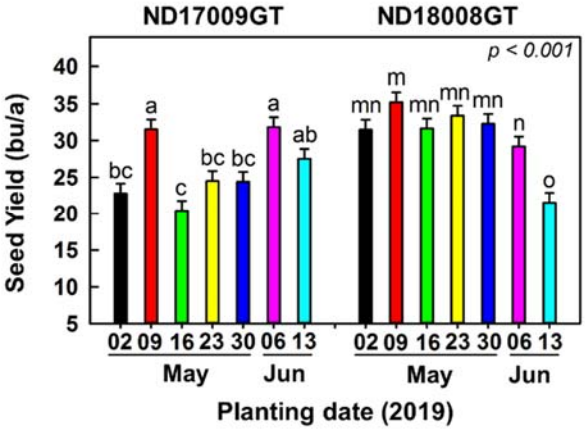


Figure 4. Effect of variety on soybean test weight.

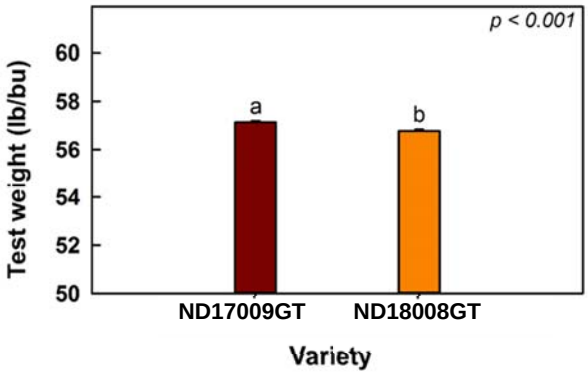


Figure 5. Effect of planting date on soybean test weight.

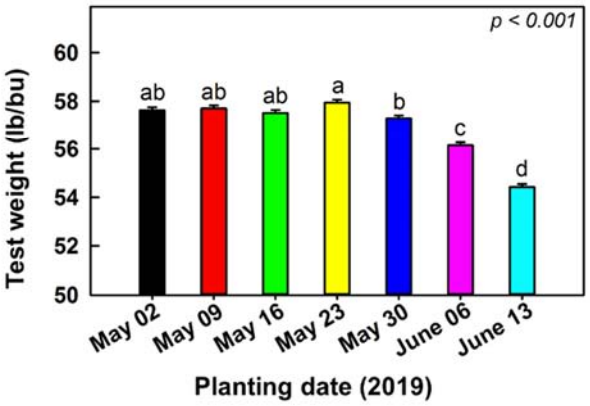
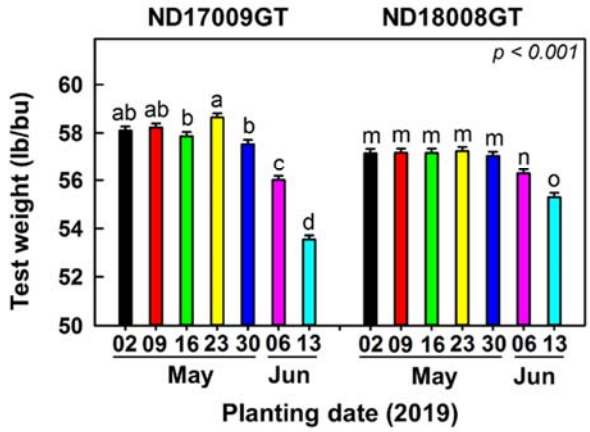


Figure 6. Differential responses of soybean varieties to planting dates for test weight.



Flax Seeding Date and Rate for No-Till Semi-arid Western North Dakota

Gautam P. Pradhan, Jerald W. Bergman, James Staricka
Meridith Miller, Cameron Wahlstrom
Funding Agency: AmeriFlax

Introduction

North Dakota (ND) is the largest flax growing state in the nation. In ND, more than 40% of the flax acreage belonged to the northwestern region of the state (USDA/NASS 2018). This region is characterized by cold semi-arid climate and no-till production practices. There is a lack of information on suitable agronomic practices that enhance flax yield and quality under these conditions. Seeding date and rate play a significant role in field crop production. Early or late seeding 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). On the other hand, a higher seeding rate may decrease yield and quality due to competition for resources (water, solar radiation, soil nutrients) and lower seeding rate may adversely affect plant growth and yield due to the scanty number of plants per unit area, heavy weed infestation, and nonuniform maturity. The objective of this experiment is to determine suitable flax seeding date and rate for no-till semiarid western ND that enhance flax yield, quality, and the profit of flax producers.

Materials and Methods

This experiment was conducted at NDSU Williston Research Extension Center, Williston, ND (Lat. 48.1346°, Lon. -103.7400°; Elevation 2105 ft). The soil type of the research site is Williams-Bowbells Loam. The average long-term annual precipitation of the research site is <15". The experiment was seeded using a GPS based autosteered seven rows plot seeder that maintained a row to row distance of 7". The treatments comprised of six seeding dates: Apr 23rd, May 2nd, 9th, 16th, 23rd, and 30th as main plots; two Varieties: CDC Melyn and CDC Glas as subplots; and four seeding rates: 15, 25, 35, 45 lb/ac as sub-sub plots. During plant growth, plant stand was estimated by counting the seedlings, and the physiological data were recorded using an unmanned aircraft system equipped with multispectral and thermal cameras. The soil moisture data were collected using a neutron probe. At maturity, flax was harvested using a plot combine.

Results

There was a significant effect of seeding date, variety, and seeding rate on plant stand when averaged across the other treatments. The May end seeding increased plant stand by 59 to 271% compared to early seeding dates (Fig. 1A). The variety, CDC Glas, had 121% more plant stand than CDC Melyn (Fig. 1B). The seeding rate of 45 lb/ac had 22 to 128% more plant stand than other seeding rates (Fig. 1C). There was a significant effect of seeding date and variety on plant height and days to flowering, when averaged across the other treatments. Flax seeded after the third week of May was about two to seven inches taller than earlier seeding dates (Fig. 2A) and CDC Glas was about one inch taller than CDC Melyn (Fig. 2B). Flax seeded after the second week of May took three to twelve fewer days to flower than earlier seeding dates (Figure 3A) and CDC Glas flowered one and half-day earlier than the CDC Melyn (Fig. 3B).

There was a significant effect of seeding date, variety, and seeding rate on seed yield and test weight, when averaged across the other treatments. Flax seeded at the end of May produced 2 to 11 more bu/ac of seeds (Fig. 4A) and had 2 to 5 more lb/bu of test weight (Fig. 5A) than earlier seeding dates. CDC Glas outperformed CDC Melyn for seed yield by 9.4 bu/ac (Fig. 4B); however, the test weight of CDC Glas was 1 lb/bu fewer than the CDC Melyn (Fig 5B). The seeding rate of 45 lb/ac produced 2.4 to 4.3 more bu/ac of flax seeds as compared to seeding rates of 15 and 25 lb/ac (Fig. 4C); however, higher seeding rates resulted in 0.5 to 1 fewer lb/bu of test weight than 15 lb/ac seeding rate (Fig. 5C).

There was a differential response of varieties to the seeding date and/or seeding rate for plant stand, yield, and test weight (data not presented). In this experiment, the data from April 23rd seeding was not analyzed for all traits as the 3rd and 6th rows were never seeded due to seed tube clogging.

Summary

Under the no-till semiarid condition of western ND, flax seeded on the last week of May had higher plant stand, plant height, and yield compared to earlier seeding dates. An increase in seeding rate from 15 to 45 lb/ac resulted in higher plant stand and seed yield. In general, flax variety CDC Glas had higher plant stand, plant height, and yield and lower test weight than CDC Melyn. This experiment will be repeated next year to validate the findings.

Figure 1. Response of flax to (A) seeding date, (B) variety, and (C) seeding rate for plant stand.

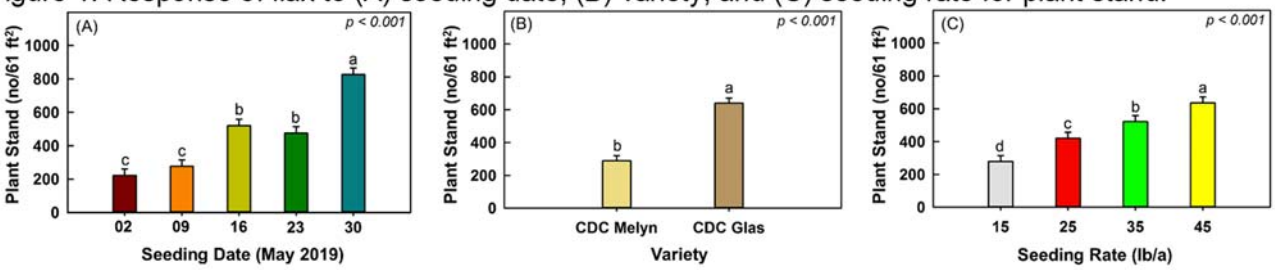


Figure 2. Response of flax to (A) seeding date and (B) variety for plant height.

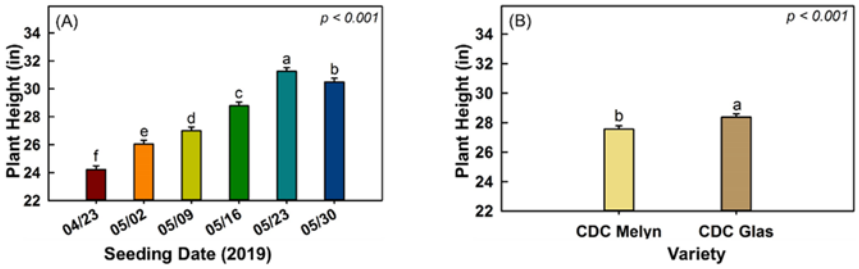


Figure 3. Response of flax to (A) seeding date and (B) variety for days to flowering.

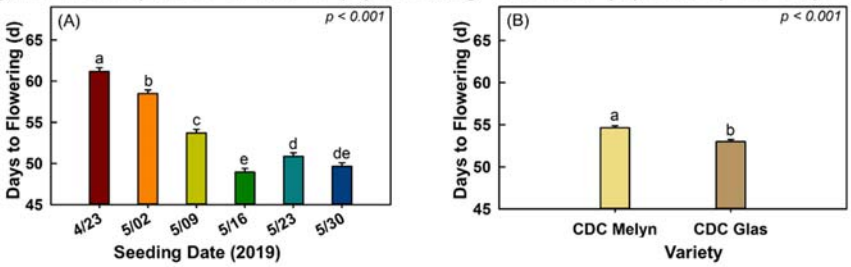


Figure 4. Response of flax to (A) seeding date, (B) variety, and (C) seeding rate for seed yield.

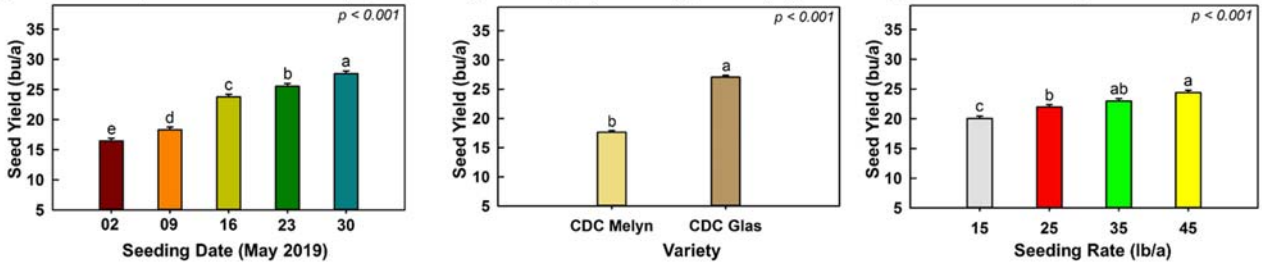
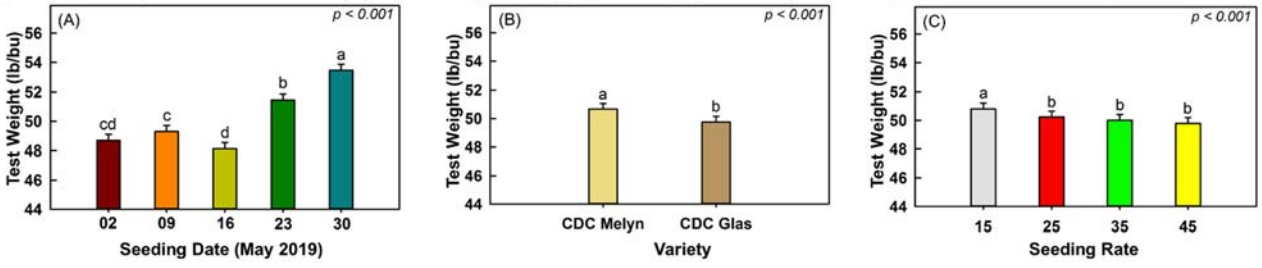


Figure 5. Response of flax to (A) seeding date, (B) variety, and (C) seeding rate for test weight.

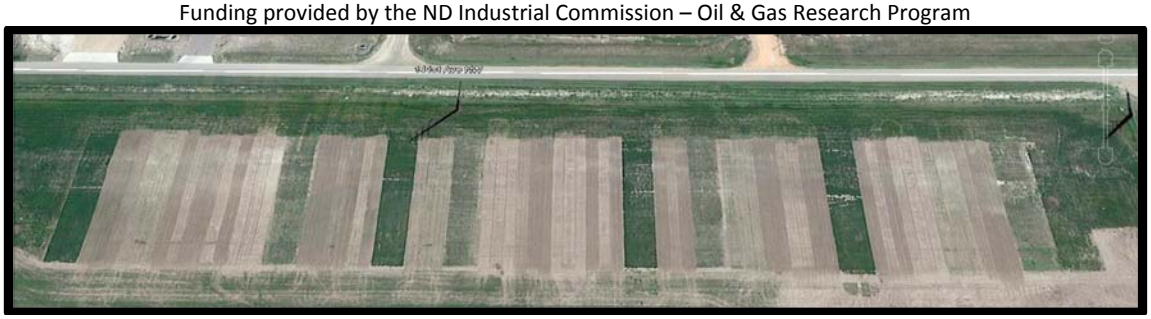


Effects of Cropping Sequence, Ripping, and Manure on Pipeline Reclamation in Western North Dakota

Meridith Miller[1], Tom DeSutter[2], Jim Staricka[1], Kevin Sedivec[3], Jerry Bergman[1], Chris Augustine[4], Kevin Horsager[2], Kyle Dragseth[1], Nick Birkhimer[2], Cameron Wahlstrom[1],

[1]NDSU Williston Research Extension Center, Williston, ND; [2]NDSU Dept. of Soil Science, Fargo, ND; [3]NDSU Range Program, Fargo, ND; [4]NDSU Extension Service, Minot, ND

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 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 2015, installation of a 36" water pipeline was completed at the Williston Research Extension Center. 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 and manure are being tested as subplots 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

Rotation	2015	2016	2017	2018	2019	2020	2021
1	Durum	Durum	Durum	Durum	Durum	Durum	Flax
2	Durum	Peas	Barley	Safflower	Durum	Flax	Flax
3	Peas	Barley	Safflower	Durum	Durum	Peas	Flax
4	Cover Crop*	Durum	Cover Crop	Durum	Durum	Cover Crop	Flax
5	Durum	Cover Crop	Durum	Cover Crop	Durum	Safflower	Flax
6	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Durum	Durum	Flax
7	Perennial Grass	Perennial Grass	Perennial Grass	Perennial Grass	Perennial Grass	Perennial Grass	Perennial Grass

Figure 1. The crop rotations used in this study for the first five years and planned for the next two years. *Cover Crop 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

Figure 2. The plots for each cropping sequence were sub-divided in to sub-plots with one sub-plot being no/minimal tillage, one was deep-ripped, and the third was deep-ripped and had manure added.

Figure 3. Manure application and tillage methods.

Soil Compaction and Subsidence

Soil compaction is a serious problem along pipelines and reclaimed well pads. The heavy equipment traffic and mixing of topsoil and subsoil leads to varying degrees of soil compaction, decreased water infiltration and holding capacity. Compacted soil can severely impact soil health and reduce crop yields.

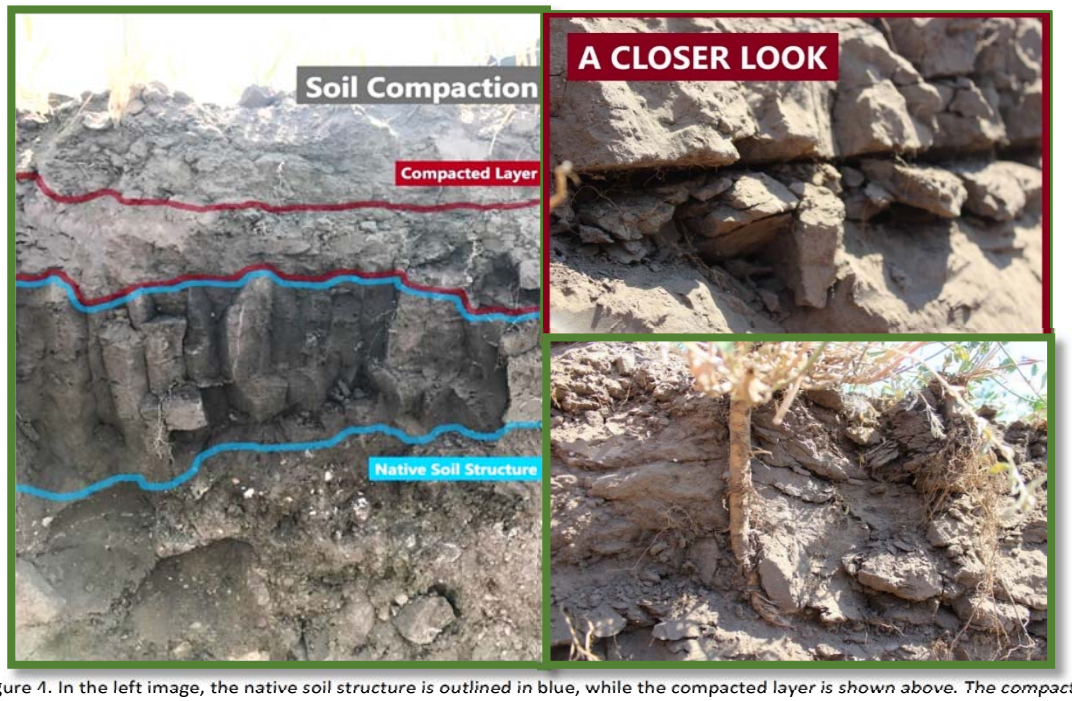


Figure 4. In the left image, the native soil structure is outlined in blue, while the compacted layer is shown above. The compacted layer doesn't have any of the structure of the native soil. The upper right image shows a close up of compacted soil in the roadway area of this project. The bottom right image is of a taproot unable to penetrate the compaction, which restricts its growth.

Soil subsidence is another problem that is frequently encountered following pipeline installations. The soil can compress and sink down along the pipeline, increasing the compaction of the soil in that area. This can lead to low spots and crevices in the field which can be hazardous for farm equipment. The need to fill in the subsided areas leads to further compaction from additional heavy equipment traffic and soil fertility issues. Following a significant rain event in July 2018, much of the pipeline disturbance area subsided. In some areas, crevices as deep as 30 inches occurred. Due to the severity of the subsidence, we were not able to harvest the pipeline plots. This demonstrates the potential impacts similar occurrences could have on producer's yields.

Figure 5. Images of subsidence along the pipeline disturbance area. The upper two images were taken shortly after the subsidence occurred in July 2018. The aerial image was taken in March of 2019, the sunken area is outlined in white.

We used a truck-mounted dynamic cone penetrometer to measure compaction throughout the three disturbance areas. During the first two years of the project, no reduction in compaction occurred. In 2017, the ripping and manure treatments were introduced. This appears to reduce compaction more effectively than full-season tap-rooted cover crops in the roadway area (the most compacted of the three areas).

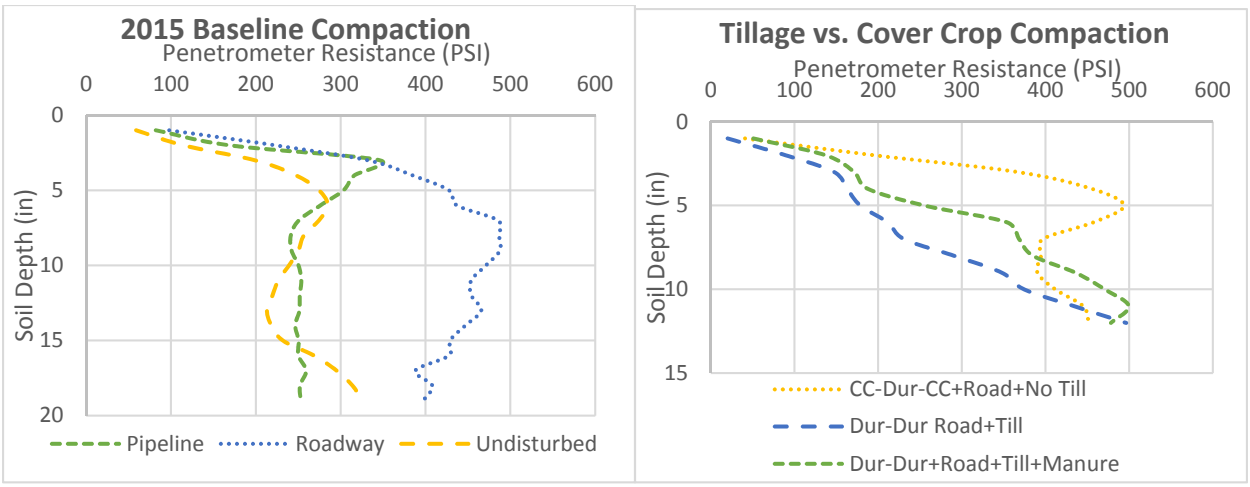


Figure 6. The baseline compaction in the first year of the study (2015) is on the left. The roadway is considerably more compacted than both the undisturbed and pipeline disturbance area. Any compaction in excess of 300 PSI is considered extremely compacted and begins to impact plant growth. The graph on the right shows the roadway compaction in Year Three (2017) after ripping and manure additions. The compaction was reduced more on the ripped plots than on the no-till plots that had deep tap-rooted cover crops planted for two of the three years.

Preliminary Agronomic Results

- In Years One and Two, annual crops yielded significantly less in road and pipeline areas, the roadway areas had the lowest small grain yields both years ($P \leq .05$).
- In Year Three (2017), all three areas had reduced yields in the annual crops due to the drought conditions
- Year Four (2018) had increased yields in all three disturbance areas, but the compacted roadway still had lower yields.
- 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 ($P \leq .05$).
- Dynamic Cone Penetrometer data trends suggest tillage treatments reduce compaction initially more effectively than deep-rooted annual cover crops.

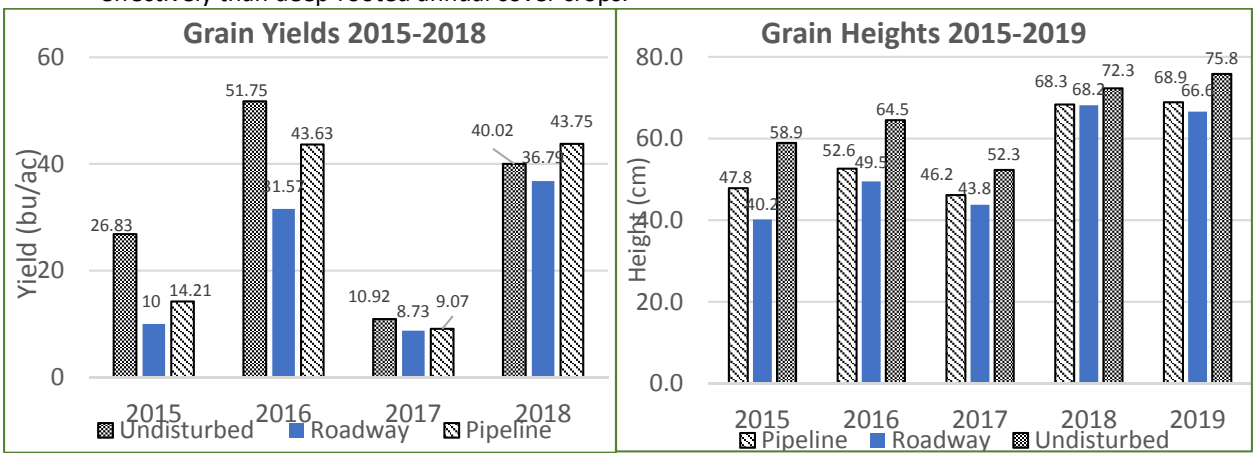


Figure 7. Grain Yields for Year One through Four (on the left) and Grain Heights for Years One through Five (on the right). In Year One (2017), spring wheat was planted, the other years durum was planted.

Future Work

- In 2020, we will be planting a variety of annual crops to compare yields and effects across disturbance areas.
- In 2021, we will plant the entire study area, excluding the perennial grass plots, to one crop (flax) to better compare the different cropping rotations and tillage methods across disturbance areas.
- We are still working to complete in-depth data analysis for each year of the project, comparing the different crops, cropping rotations and perennial covers (alfalfa and grasses) to determine which crops and rotations are the most effective at reducing compaction and restoring soil health.

Evaluation of Spring Canola Varieties in Eastern Montana

EARC, Sidney, MT

Chengci Chen, Simon Fordyce, Apurba Sutradhar, Calla Kowatch-Carlson, and Thomas Gross

Materials and Methods:

Irrigated

Location: EARC
Latitude 47.7288N; Longitude 104.1501 W; Elevation 1949
Planted: 05/16/2019
Tillage: Conventional
Experimental design: Randomized Complete Block
Varieties: 14
Pesticide: Sevin @ 16 oz/ac three times on 7/3/2019, 6/4/2019, and 6/18/2019
Rainfall: 10.4”

Previous crop: Sugarbeet
Soil type: Williams Clay Loam
Harvested: 08/26/2019
Plot size: 5” x 18”
Harvest type: Direct cut
Replications: 4
Herbicide: Stinger @ 6 oz/ac sprayed on 6/24/2019
Irrigation: 6.5”

Comments: 1. Grain yield was adjusted to 8% moisture; 2. Grain yield may have been affected by early season flea beetle damage; & 3. Early season weed damage.

Table 1. Initial soil test results. A composite soil sample was collected prior to planting canola.

Depth	pH	OM	NO_3-N	P-Olsen	K	Ca	Mg	Na	Zn	Fe	Mn	Cu	B	CEC
Inch		%	---------- ppm ----------											meq/100g
0-12	8.2	3.7	38.0	17	431	6050	615	148	0.57	8.1	6.08	1.18	1.8	37.1

Table 2. Description of Varieties

Variety name	Description				
	Distributor	Shatter Resistance	Herbicide	Blackleg	Clubroot
16CH4181	Cargill	N	Conventional	R	--
16MH6001	Cargill	N	CL	R	--
16MH6004	Cargill	N	CL	R	--
4187RR	Brett Young	N	RR	R	R
5545CL	Brett Young	Y	CL	R	--
6090RR	Brett Young	Y	RR	R	R
CP930RR	Winfield	Y	RR	R	--
CP955RR	Winfield	Y	RR	R	R
DKTF91SC	Dekalb/Bayer	Y	TruFlex RR	R	--
DKTF92SC	Dekalb/Bayer	Y	TruFlex RR	R	--
InVigor L233P	BASF	Y	LL	R	--
InVigor L234P	BASF	Y	LL	R	R
InVigor L255P	BASF	Y	LL	R	R
NCC101S	Photosyntech	Y	Conventional	MR	--

Note: Shatter resistance, N = no, Y = yes; Herbicide resistance, CL = Clearfield, RR = Roundup Ready, LL = LibertyLink; Blackleg disease, R = resistance, MR = moderately resistance; and Clubroot disease, R = resistance. No significant shattering and lodging observed.

Table 3. Summary of Agronomic Data of Canola Varieties Tested.

Variety	Plant Stand (acre)	Plant Height (inch)	Test Weight (lb/Bu)	Grain Yield (lb/ac)	Oil (%)	Oil Yield (lb/ac)
16CH4181	291307	24.8 a	52.2 e	1288 abc	44.0 cd	575 abc
16MH6001	294030	17.0 bc	54.2 ab	1160 abcd	45.1 abc	529 bcd
16MH6004	242302	18.8 bc	53.3 abcde	1428 a	44.5 bc	643 ab
4187RR	358009	19.8 b	53.7 abcd	1544 a	46.6 a	724 a
5545CL	355286	19.0 bc	54.1 ab	1024 bcde	46.0 ab	472 bcde
6090RR	300061	15.2 bc	53.2 bcde	661 efg	43.4 cde	287 efg
CP930RR	302197	24.3 a	53.9 abc	1408 ab	46.7 a	658 ab
CP955RR	322616	26.8 a	54.1 ab	1386 ab	46.2 ab	641 ab
DKTF91SC	302197	18.8 bc	52.7 cde	907 cdef	42.4 def	389 cdef
DKTF92SC	250470	16.0 bc	50.9 f	595 fg	41.1 f	248 fg
InVigor L233P	296752	17.5 bc	52.4 de	993 cde	42.4 def	425 cdef
InVigor L234P	370260	15.3 c	52.4 de	904 cdef	42.0 ef	383 def
InVigor L255P	345757	15.5 c	54.5 a	869 def	44.6 bc	389 cdef
NCC101S	393401	17.3 bc	48.8 g	359 g	35.4 g	127 g
Mean	315414	19.0	53.0	1046	43.6	468
P > *F*	0.15	<0.01	<0.01	<0.01	<0.01	<0.01
LSD (*P* = 0.05)	102001	3.80	1.35	389	1.83	187
CV (%)	22.3	13.8	1.68	25.6	2.90	27.6

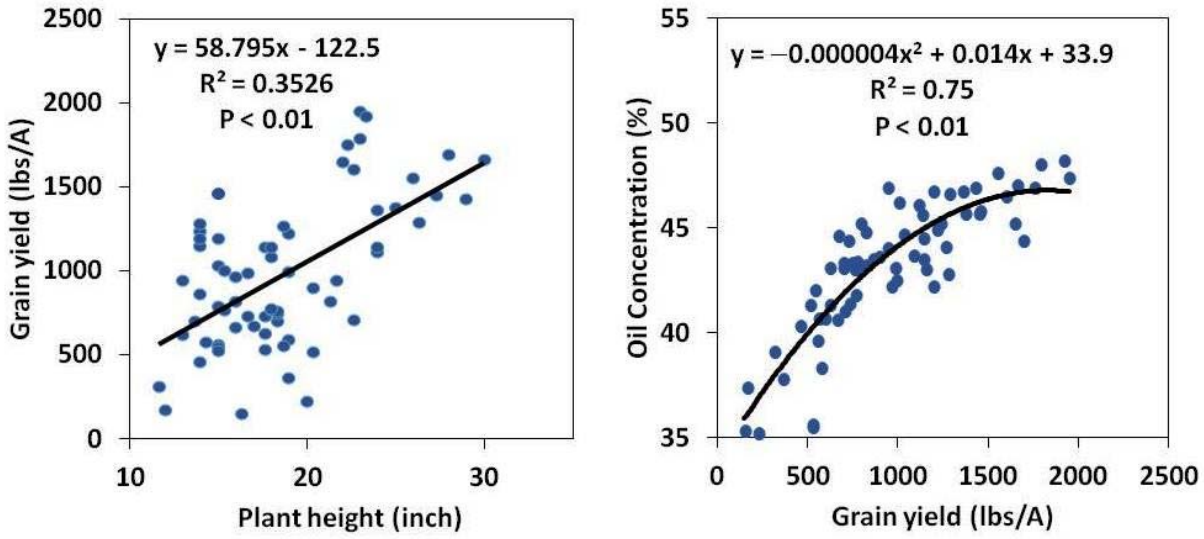


Figure 1. Relationships between canola grain yield, plant height and seed oil concentration.

DON Accumulation in Durum Varieties

Taheni Jbir, Cameron Wahlstrom, Marilen Nampiijja, Eric Eriksmoen, Dr. 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 ten locations in 2019. 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

DON was highest at the Rugby site. There was no DON detected in any durum varieties at the Arnegard, Minot, Mohall and Nesson Valley locations. Average DON in harvested grain for each variety at six sites is presented in Table 1. Williston is excluded in the means calculated across sites due to low DON.

	Scab Rating	DON (ppm)						
Variety	(1-9)*	Crosby	Garrison	Keene	Williston	Rugby	Wilton	ALL**
Alkabo	6	0.3 *bc*	< 0.3	0.3	< 0.3	0.6 *c*	0.8	0.4 *bc*
Carpio	5	< 0.3 *c*	0.3	0.9	< 0.3	0.7 *bc*	0.4	0.5 *abc*
Divide	5	< 0.3 *c*	0.4	0.3	< 0.3	0.6 *c*	0.3	0.3 *bc*
Grenora	6	0.2 bc	0.9	0.4	< 0.3	0.7 *c*	0.4	0.5 *abc*
Joppa	5	0.3 *bc*	< 0.3	0.4	< 0.3	0.4 *c*	0.4	0.3 *c*
Lebsock	6	< 0.3 *c*	0.6	0.8	< 0.3	0.5 *c*	0.4	0.5 *abc*
Mountrail	8	0.9 *a*	0.8	0.7	< 0.3	1.3 *abc*	0.6	0.8 *abc*
ND Grano	6	0.6 *ab*	0.6	0.7	< 0.3	1.8 *ab*	0.3	0.8 *ab*
ND Riveland	5	< 0.3	0.5	< 0.3	< 0.3	0.5 *c*	0.5	0.4 *bc*
Tioga	6	0.6 *ab*	0.8	0.6	0.6	2 *a*	0.8	0.9 *a*
Mean		0.4	0.5	0.5	< 0.3	0.9	0.5	0.6
p-value ($\alpha < 0.05$)		< 0.0001	NS	NS	NA	0.0003	NS	0.0001

Table 1. Average DON in durum varieties across selected sites in 2019. Different letters within columns (sites) indicate treatments that are significantly different. For statistical analysis, treatments with no detectable DON were assigned a value of 0.15. NS = non-significant. NA = not analyzed due to no/low of DON *NDSU durum breeder scab rating scores from 1-9, with 1 = resistant and 9 = very susceptible. ** Williston data excluded from the analysis

Conclusions

Durum varieties Mountrail, Tioga and ND Grano had the highest DON according to results of Crosby and Rugby sites as well as average DON from five locations. ND Riveland and Divide had the lowest DON. Other varieties tested had more variation in DON accumulation across sites and were considered intermediate based on these data. Varieties with lower DON according to this study should not be considered resistant, but may provide slightly better performance under moderate scab pressure.

Fungicide Rotations for Ascochyta Blight Management in Chickpea

Nicole Stanhope, Makenna Girard, Darby Howatt, Taheni Jbir and Dr. Audrey Kalil

Introduction

A study was initiated at the Nesson Valley Irrigated Research Site to evaluate fungicides within a three-spray program for control of Ascochyta Blight in chickpea. Previous research by Dr. Michael Wunsch at the Carrington REC has found tank mixing Proline with chlorothalonil to be beneficial for the control of Ascochyta blight. Thus, fungicides were applied with and without the addition of chlorothalonil to the tank mix.

Study Description

The study was a randomized complete block design with 5 ft x 18 ft plots, 4 replicates per treatment. Registered Sierra chickpea seed was purchased for this study. The trial was planted April 24th. Outside border plots were inocluated June 12th with one handful each of overwintered chickpea residue. Foliar fungicide applications were made June 25th at initial bloom (A), July 8th (B) and July 23rd (C) (15 gal/ac water, NIS @ 0.25% v/v). Care was taken to ensure that chlorothalonil mixes were adequately agitated prior to application. Ascochyta disease assessments were made June 20th, July 8th, July 18th and August 5th on 10 plants per plot based on percent canopy necrosis. The trial was harvested September 6th. Treatments are listed in the table below.

Fungicide Rotation Treatments (A, B, C)	
1	Untreated
2	**A:** Quadris Opti **B:** Miravis Top **C:** Miravis Neo
3	**A:** Quadris Opti **B:** Miravis Top + chlorothalonil **C:** Miravis Neo + chlorothalonil
4	**A:** Miravis Neo **B:** Miravis Top **C:** Proline
5	**A:** Miravis Neo + chlorothalonil **B:** Miravis Top + chlorothalonil **C:** Proline + chlorothalonil
6	**A:** Miravis Top **B:** Miravis Top **C:** Proline
7	**A:** Miravis Top + chlorothalonil **B:** Miravis Top + chlorothalonil **C:** Proline + chlorothalonil

Results

Treatment	Ascochyta Severity (%) 7/8/2019	Ascochyta Severity (%) 7/18/2019	Ascochyta Severity (%) 8/5/2019	Yield @ 13.5% moisture (lb/ac)
1	26.3 a	85.3 a	82.3 a	0 c
2	7.9 b	33.6 bc	52.6 b	323 bc
3	4.9 b	54.8 b	59.0 b	491.5 b
4	4.2 b	30.0 cd	55.4 b	343.7 bc
5	2.5 b	9.1 de	31.8 c	1064.3 a
6	2.4 b	18.0 cde	44.0 bc	326 bc
7	1.6 b	6.8 e	29.1 c	798.3 ab

Differences among treatments are indicated by different letters ($\alpha < 0.05$).

Conclusions

Treatments 5 and 7 had the lowest disease at the last time point assessed and the highest overall yield. Both of these treatments included chlorothalonil in the tank mix and yield was more than doubled in comparison to treatments 4 and 6, which were the same except for chlorothalonil was not added. Treatment 3 had similar levels of disease and yield to treatment 2, despite the addition of chlorothalonil in treatment 3. Based on these data it is unclear whether there is a synergy when tank mixing chlorothalonil with the Miravis products. This trial will need to be repeated to confirm results.

2019 Pulse Disease and Insect Pest Scouting

Dr. Audrey Kalil, Nicole Stanhope, Darby Howatt, Makenna Girard, Honggang Bu, Dr. Janet Knodel, Dr. Julie Pasche, Dr. Kim Zitnick-Anderson, Dimitri Fonseka, Taheni Gargouri-Jbir and Marilen Nampijja

Introduction

In the 2019 growing season a pea, lentil and chickpea scouting program funded by the Northern Pulse Growers Association was conducted. The goals of the program were to scout farmer fields for diseases and insect pests, monitor root rot pathogens and publish relevant findings in the NDSU Extension *Crop and Pest Report* and weekly maps on the NDSU IPM website.

Methods

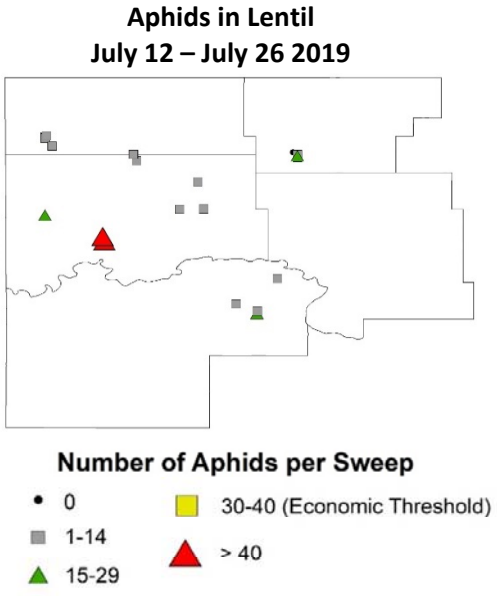
Pea, chickpea and lentil fields were scouted for diseases including root rots, bacterial blight, Ascochyta blight, downy mildew, white mold, and powdery mildew, among others, and insect pests. Insect pests monitored were cutworms, grasshoppers, pea leaf weevil and aphids. Fields were located in the five northwest North Dakota counties. A total of 56 pea fields, 62 chickpea fields and 77 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 cutworm and pea leaf weevil damage, and a 15-inch sweep net for grasshoppers and aphids. 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 summary 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

Fields were scouted for cutworm feeding damage in May and June. The overall percentage of fields where cutworm damage was identified was – 39% of lentil fields, 29% of pea fields and 0% of chickpea fields. Damage levels were generally low and below economic thresholds.



Aphids were common in pea and lentil fields late July and into early August. White flecks (feeding damage) on the leaves were observed on samples brought in to the WREC. Populations reached and exceeded economic thresholds, however, this was when the crop was at later podding growth stages when insecticides are no longer considered necessary to manage feeding damage. One item of concern is that aphids can transmit viruses such as Pea Seedborne Mosaic Virus, among several others. The NDSU Plant Diagnostic Lab can test seed for PSbMV if growers are concerned about contaminated seed-lots.

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 2019, the pulse crop scout looked for feeding injury (leaf notching) caused by pea leaf weevil by examining 100 plants per field. Pea leaf weevil was found in Williams, Burke, Divide, McKenzie and Mountrail Counties this year. When the number of leaf notches are greater than 9 per

plant, yield loss in that field can be significant next season (2020) if conditions are favorable for pea leaf weevil in the spring (warm springs, > 68°F). None of the counties scouted had fields where damage levels were that high.

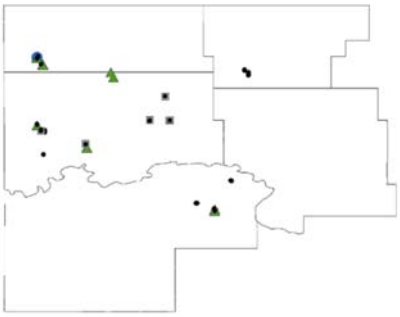
Diseases

Lentil: Very little foliar disease was observed in lentils this season. Of primary concern was root rot caused by *Fusarium* sp. and *Aphanomyces euteiches*. Above-ground symptoms of root rot including stunting, wilting and yellowing were present in 27% of fields scouted and up to 34% of plants were affected in one field. Above-ground symptoms became most obvious beginning in mid-July at the early pod growth stage, however infection likely began much earlier in the season. Isolations performed from diseased roots confirmed the presence of Fusarium root rot (Pasche, Zitnick-Anderson and Fonseka). Bioassays performed from diseased roots and field soil also confirmed the presence of *Aphanomyces euteiches* in some fields (Kalil, Howatt, Nampijja and Jbir).

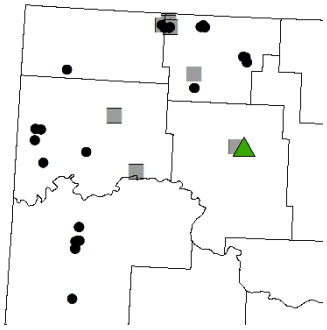
Peas: Bacterial blight symptoms were observed in field pea beginning in late May when the crop was at early vegetative growth stages and was also detected in late July at late pod-fill. Incidence ranged from 2-14% of plants being affected with 1-4% of the crop canopy exhibiting symptoms. Ascochyta blight was observed in Williams and Burke Counties with highest levels in Burke County at late pod-fill. Incidence reached up to 32%, however, only 1% of the crop canopy was affected. Root rot was observed in 16% of pea fields scouted.

Chickpeas: Onset of Ascochyta blight was in mid-June when the crop was at mid to late vegetative growth stages. Incidence of Ascochyta varied widely among fields, with some staying below 4% the entire season and others reaching 72% by the end of July. Percent of the crop canopy exhibiting symptoms generally stayed below 2%.

Root Rot Incidence
2019 Season Final
Lentil



Pea

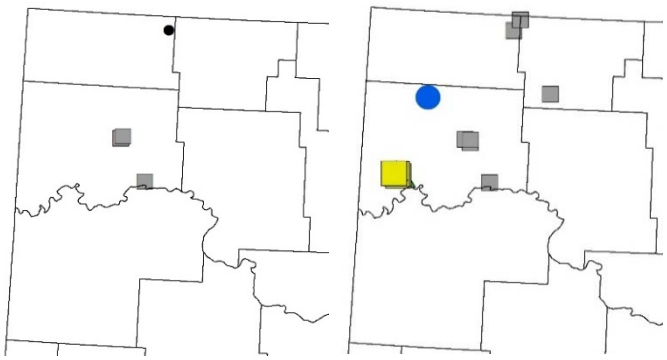


Percent of Plants with Root Rot Symptoms

0 16-30 48-83
1-15 31-47 84-100

Chickpea Ascochyta Blight Incidence

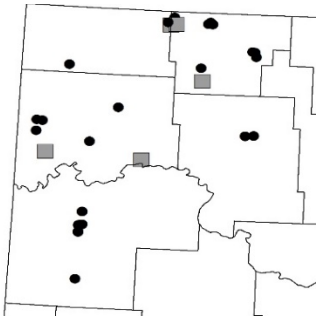
June 14 – June 28 **July 26 – August 9**



Percent of Plants with Ascochyta Symptoms

0 1-15 16-30 31-47 48-83 84-100

Pea Ascochyta Blight Severity
2019 Season Final



Percent of Crop Canopy with Ascochyta Blight Symptoms

0 31-47
1-15 48-83
16-30 84-100

2019 Chickpea Foliar Trial EARC, Sidney, MT

Frankie Crutcher and Amber Ferda

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

MATERIALS AND METHODS:

Irrigated
Variety: Sierra
Location: Sidney, MT
Planted: 4/25/19
Harvested: 9/6/19
Plot Size: 5' x 20'
Seeding Rate: 4 LS/ft²
Soil Type: Savage silty clay loam
Previous Crop: Sugarbeet
Residual Soil N to 3 ft: 25 lbs/A
Applied Fertilizer: None
Residual Soil P to 6 in: 25 ppm
Irrigated (sprinkler) on: 6/7/19, 6/13/19, 6/14/19, 7/22/19
Herbicide Applications: Durango 24 fl oz/A, Outlook 12 fl oz/A
Precipitation April – September: 19.38 inches
Vigor: 5/31/19
Treatments: Miravis Top, Miravis Neo, Proline, Propulse, Delaro, Endura, Quadris Opti
Date of first application: 6/26/19
Date of second application: 7/8/19
Date of third application: 7/21/19
Date of fourth application: 8/4/19
Disease assessments: 7/12/19, 7/30/19, 8/9/19

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). Fungicides were applied using a Teejet 80015VS Even Flat Spray nozzle tips at 14 GPA. Incidence was 100% for all treatments for disease assessments on 7/30/19 and 8/9/19. Trial was desiccated with Gramoxone (32 fl oz/A) on 8/28/19.

RESULTS:

Table 1: Effect of Fungicide Treatments on Chickpeas to Control *A. rabiei*

Trt #	% Severity[a] 7/12	% Incidence[b] 7/12	% Severity[a] 7/30	% Severity[a] 8/9	Yield (lbs/A)
1	22.5 A	100.0 A	79.8 A	76.8 A	54.6 F
2	14.3 AB	97.5 A	19.6 D-F	31.3 E-H	1975.0 BC
3	12.4 B	92.5 A	47.3 BC	52.5 BC	898.1 DE
4	11.5 B	80.0 AB	15.5 EF	23.5 F-H	2661.7 AB
5	12.8 AB	85.0 A	10. F	20.5 GH	2803.1 AB
6	10.0 B	57.5 B	8.50 F	18.3 H	3008.5 A
7	14.8 AB	80.0 AB	31.3 C-E	37.3 C-F	1754.9 C
8	14.9 AB	85.0 A	32.0 C-E	39.5 C-E	892.6 D-F
9	14.8 AB	85.0 A	44.5 C	49.5 B-D	463.8 EF
10	13.5 AB	77.5 AB	31.3 C-E	35.8 D-G	1379.7 CD
11	13.0 AB	87.5 A	64.0 AB	58.8 B	151.0 EF
12	16.8 AB	100.0 A	34.5 CD	44.0 B-E	1319.4 CD
Mean	14.3	85.6	34.9	40.6	1446.9
CV (%)	47.5	23.4	66.9	46.8	76.6
LSD (0.05)	9.9	26.9	17.7	15.5	841.0

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Severity: Average area of ten plants covered by disease.
[b]Incidence: Percent of ten plants per plot that had disease.
[c]Number of plants per acre calculated by stand counts.

Table 2: Fungicide Treatments for Irrigated Chickpeas

Treatment #	Application Timing	Fungicide*	Rate
1	None	Control	None
2	A	Quadris Opti	25 fl oz/A
	B	Miravis Top	13.7 fl oz/A
	C	Miravis Neo	13.7 fl oz/A
	D	Quadris Opti	25 fl oz/A
3	A	Quadris Opti	25 fl oz/A
	B	Miravis Top + Echo 720	13.7 fl oz/A + 22 fl oz/A
	C	Miravis Neo + Echo 720	13.7 fl oz/A + 22 fl oz/A
	D	Quadris Opti	25 fl oz/A
4	A	Miravis Neo	13.7 fl oz/A
	B	Miravis Top	13.7 fl oz/A
	C	Proline	5.7 fl oz/A
	D	Miravis Neo	13.7 fl oz/A
5	A	Miravis Neo + Echo 720	13.7 fl oz/A + 22 fl oz/A
	B	Miravis Top + Echo 720	13.7 fl oz/A + 22 fl oz/A
	C	Proline + Echo 720	5.7 fl oz/A + 22 fl oz/A
	D	Miravis Neo	13.7 fl oz/A
6	A	Miravis Top	13.7 fl oz/A
	B	Miravis Top	13.7 fl oz/A
	C	Proline	5.7 fl oz/A
	D	Miravis Top	13.7 fl oz/A
7	A	Miravis Top + Echo 720	13.7 fl oz/A + 22 fl oz/A
	B	Miravis Top + Echo 720	13.7 fl oz/A + 22 fl oz/A
	C	Proline + Echo 720	5.7 fl oz/A + 22 fl oz/A
	D	Miravis Top	13.7 fl oz/A
8	A, B, C, D	Proline	5.7 fl oz/A
9	A	Delaro	12 oz/A
	B	Endura	6 oz/A
	C	Proline	5.7 oz/A
	D	Miravis Top	13.7 fl oz/A
10	A	Proline + Echo 720	5.7 oz/A + 22 oz/A
	B	Endura	6 oz/A
	C	Proline + Echo 720	5.7 oz/A + 22 oz/A
	D	Miravis Top	13.7 fl oz/A
11	A	Delaro	12 oz/A
	B	Proline + Echo 720	5.7 oz/A + 22 oz/A
	C	Propulse	8 oz/A
	D	Proline	5.7 oz/A
12	A	Delaro	12 oz/A
	B	Proline	5.7 oz/A
	C	Propulse	10.3 oz/A
	D	Proline	5.7 fl oz/A

*All treatments contained NIS Activator 90 except Delaro and Endura.

Efficacy of Seed Treatments for Control of Chickpea Ascochyta Blight

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

OBJECTIVE: Test the efficacy of different seed treatments for control of seed borne *A. rabiei* on chickpeas under dryland conditions.

MATERIALS AND METHODS:

Dryland
Variety: Farmer reported Sierra
Location: Sidney, MT
Planted: 4/18/19
Harvested: 9/3/19
Plot Size: 5' x 20'
Seeding Rate: 4 LS/ft²
Soil Type: Savage silty clay loam
Previous Crop: Wheat

Residual Soil N to 3 ft: 7.5 lbs/A
Residual Soil P to 6 in: 26 ppm
Applied Fertilizer: None
Irrigated (sprinkler): None
Chemical Applications: Durango 24 fl oz/A, Proline 5 fl oz/A
Precipitation April – September: 18.35 inches
Vigor and stand counts: 5/14/19, 5/30/19, 6/10/19
Seedling disease assessment: 6/13/19
Foliar disease assessment: 7/30/19

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). Experiment used 16% QOI resistant *A. rabiei* infested seed. Trial was desiccated with Gramoxone (32 fl oz/A) on 8/28/19.

RESULTS:

Table 1: Seed Treatment Evaluation for Control of *Ascochyta rabiei* on Chickpeas

Trt #	Stem lesions[a] 6/13	Diseased Leaves[b] 6/13	% Root Severity[c] 6/13	% Root Incidence[d] 6/13	Plants/A[e] 5/14	Plants/A[e] 5/30	Plants/A[e] 6/10	% Severity[f] 7/30	Yield (lbs/A)
1	18.5 A	12.3 A	10.6 A	32.5 A	7187.4 C	11434.5 A	12414.6 A	25.2 A	770.8 B
2	15.8 AB	5.8 A	8.4 A	27.5 A	10998.9 A	14048.1 A	13721.4 A	23.9 A	1155.1 AB
3	17.0 AB	2.0 A	6.4 A	17.5 A	8603.1 BC	11761.2 A	11325.6 A	24.6 A	842.5 AB
4	12.8 AB	2.8 A	7.3 A	15.0 A	9909.9 AB	11652.3 A	10563.3 A	26.4 A	981.8 AB
5	17.3 AB	6.8 A	6.1 A	32.5 A	8603.1 BC	10890.0 A	10781.1 A	25.6 A	1087.4 AB
6	12.5 AB	0.5 A	7.0 A	5.0 A	8494.2 BC	11216.7 A	11216.7 A	18.0 A	1379.2 A
7	12.0 B	6.8 A	10.8 A	32.5 A	10127.7 AB	12196.8 A	11543.4 A	22.6 A	924.6 AB
8	13.5 AB	3.5 A	11.6 A	22.5 A	8929.8 A-C	10998.9 A	11107.8 A	21.4 A	871.7 AB
Mean	14.9	5.0	8.5	23.1	9106.8	11774.8	11584.2	23.4	1001.6
% CV	29.9	170.6	50.5	96.0	20.1	20.4	23.2	24.8	40.6
LSD (0.05)	6.2	13.0	6.3	33.2	2388.3	3655.9	4153.0	8.7	597.5

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Average number of lesions per stem. Ten stems were evaluated for each plot.
[b]Average number diseased leaves per seedling. Ten plants were evaluated for each plot.
[c]Average percent area of root covered by disease. Ten roots were evaluated for each plot.
[d]Percent of ten plants per plot that had visible root necrosis.
[e]Number of plants per acre calculated from stand counts.
[f]Average area of ten plants covered by disease.

Table 2: Seed Treatments for Control of Chickpea Ascochyta Blight

Trt #	Product	Application Rate
1	Cruiser	1.28 fl oz/cwt
2	Cruiser Apron Maxx RTA	1.28 fl oz/cwt 5 fl oz/cwt
3	Cruiser Vibrance Maxx	1.28 fl oz/cwt Slurried w/ H_2O to 5 total oz/cwt (3.46 oz H_2O/cwt + 1.54 oz/cwt V.M.)
4	Cruiser Vibrance Maxx Mertect	1.28 fl oz/cwt Slurried w/ H_2O to 5 total oz/cwt (3.46 oz H_2O/cwt + 1.54 oz/cwt V.M.) 1.57 fl oz/cwt
5	Cruiser Maxx Vibrance Pulse	5 fl oz/cwt
6	Cruiser Maxx Vibrance Pulse Mertect	5 fl oz/cwt 1.57 oz/cwt
7	Cruiser Evergol Energy	1.28 fl oz/cwt 1 fl oz/cwt
8	Gaucho Evergol Energy	1.6 fl oz/cwt 1 fl oz/cwt

Efficacy of Seed Treatments for Control of Chickpea Ascochyta Blight

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

OBJECTIVE: Test the efficacy of different seed treatments for control of *A. rabiei* on chickpeas.

MATERIALS AND METHODS:

Not Irrigated (Site 1)
Variety: Farmer reported Sierra
Location: Sidney, MT
Planted: 4/25/19
Harvested: 9/5/19
Plot Size: 5' x 20'
Seeding Rate: 4 LS/ft²
Soil Type: Savage silty clay loam
Previous Crop: Sugarbeet

Residual Soil N to 3 ft: 25 lbs/A
Residual Soil P to 6 in: 25 ppm
Applied Fertilizer: None
Irrigated (sprinkler): None
Chemical Applications: Durango 24 fl oz/A, Proline 5 fl oz/A
Precipitation April – September: 19.38 inches
Vigor and stand counts: 5/22/19, 6/5/19, 6/17/19
Seedling disease assessment: 6/14/19
Foliar disease assessment: 7/30/19

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). Experiment used 16% QOI resistant *A. rabiei* infested seed. No yield data was collected due to mechanical issues at harvest. Trial was desiccated with Gramoxone (32 fl oz/A) on 8/28/19.

RESULTS:

Table 1: Seed Treatment Evaluation Control of Ascochyta on Chickpeas

Trt #	Stem lesions[a]	Diseased Leaves[b]	% Root Severity[c]	% Root Incidence[d]	Plants/A[e]	Plants/A[e]	Plants/A[e]	% Severity[f]
1	10.25 B	2.73 A	8.90 A	95.00 A	8712.00 B	9147.60 B	9365.40 C	50.00 A
2	18.50 AB	4.60 A	7.25 A	92.50 A	8494.20 B	8929.80 B	8929.80 C	56.25 A
3	14.50 AB	4.18 A	6.63 A	95.00 A	10127.70 AB	10890.00 AB	10672.20 BC	46.25 A
4	18.00 AB	1.73 A	8.25 A	95.00 A	12850.20 A	13830.30 A	13503.60 AB	48.75 A
5	16.50 AB	2.80 A	6.75 A	87.50 A	12595.10 A	14048.10 A	14048.10 A	64.13 A
6	32.25 A	5.53 A	6.13 A	77.50 A	10781.10 AB	11652.30 AB	11107.80 A-C	61.63 A
7	18.50 AB	1.78 A	7.50 A	82.50 A	10454.40 AB	11434.50 AB	11325.60 A-C	55.50 A
8	15.50 AB	4.48 A	8.65 A	82.50 A	11107.80 AB	11979.00 AB	10890.00 BC	50.75 A
Mean	18	3.48	7.51	88.44	10685.81	11488.95	11230.31	54.16
% CV	75.27	88.32	35.53	14.39	23.50	23.58	22.68	23.57
LSD (0.05)	20.1	4.6	4.1	18.1	3249.9	3381.4	3148.6	18.7

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Average number of lesions per stem. Ten stems were evaluated for each plot.
[b]Average number diseased leaves per seedling. Ten plants were evaluated for each plot.
[c]Average percent area of root covered by disease. Ten roots were evaluated for each plot.
[d]Percent of ten plants per plot that had visible root necrosis.
[e]Number of plants per acre calculated from stand counts.
[f]Average area of ten plants covered by disease.

Table 2: Seed Treatments for Chickpea Ascochyta Blight

Trt #	Product	Application Rate
1	Cruiser	1.28 fl oz/cwt
2	Cruiser Apron Maxx RTA	1.28 fl oz/cwt 5 fl oz/cwt
3	Cruiser Vibrance Maxx	1.28 fl oz/cwt Slurried w/ H_2O to 5 total oz/cwt (3.46 oz H_2O/cwt + 1.54 oz/cwt V.M.)
4	Cruiser Vibrance Maxx Mertect	1.28 fl oz/cwt Slurried w/ H_2O to 5 total oz/cwt (3.46 oz H_2O/cwt + 1.54 oz/cwt V.M.) 1.57 fl oz/cwt
5	Cruiser Maxx Vibrance Pulse	5 fl oz/cwt
6	Cruiser Maxx Vibrance Pulse Mertect	5 fl oz/cwt 1.57 oz/cwt
7	Cruiser Evergol Energy	1.28 fl oz/cwt 1 fl oz/cwt
8	Gaucho Evergol Energy	1.6 fl oz/cwt 1 fl oz/cwt

EARC Assistant Professor, Frankie Crutcher, speaking, and EARC Research Associate, Amber Ferda, assisting during EARC Field Day

Resistance of Durum Varieties to Fusarium Head Blight

Frankie Crutcher, Mike Giroux, Amber Ferda, Samantha Hoesel **EARC, Sidney, MT**

OBJECTIVE: Test the resistance of different durum varieties to Fusarium head blight caused by *F. graminearum*.

MATERIALS AND METHODS:

Irrigated
Variety: Misc.
Location: Sidney, MT
Planted: 5/8/19
Harvested: 8/22/19
Plot Size: 5' x 10'
Seeding Rate: 129 lbs/A
Soil Type: Savage silty clay loam
Previous Crop: Wheat

Residual Soil N to 3 ft: 25 lbs/A
Residual Soil P to 6 in: 17 ppm
Applied Fertilizer: 100-30
Irrigated (sprinkler) on: 6/15/19, 6/27/19
Chemical Applications: Durango 24 fl oz/A, Proline 5 fl oz/A, Carnivore 10 fl oz/A, Discover 16 fl oz/A
Precipitation April – September: 19.38 inches
Vigor: 5/31/19
Disease assessment(s): 7/21/19, 7/30/19

COMMENTS: Corn spawn inoculated with five isolates of *F. graminearum* was applied to the field on 6/14/19.

RESULTS:

Table 1: Durum Variety Reponses to Fusarium Head Blight

Variety	Severity(%)[a] 7/21	Incidence(%)[b] 7/21	Severity(%)[a] 7/30	Incidence(%)[b] 7/30	% FDK[c]	Yield (Bu/A)	DON (ppm)
Alkabo	10.41 BC	86.67 AB	64.00 A-C	100.00 A	12.50 DE	36.83 E-I	9.01 D
Alzada	36.83 A	98.33 A	70.33 A	100.00 A	22.50 B	15.21 J	16.22 A-D
Carpio	9.08 C	71.67 B	43.17 FG	100.00 A	20.00 BC	51.99 A	13.14 A-D
Divide	11.08 BC	86.67 AB	46.83 D-G	98.33 AB	15.00 C-E	50.39 AB	11.98 A-D
Dynamic	22.08 B	93.33 A	53.83 B-F	100.00 A	15.00 C-E	41.41 A-H	19.97 AB
Fortitude	15.42 BC	91.67 A	61.17 A-E	100.00 A	12.50 DE	31.28 HI	17.50 A-D
Grano	20.83 BC	100.00 A	55.17 A-F	100.00 A	15.00 C-E	39.98 B-H	20.64 AB
Grenora	13.83 BC	93.33 A	47.17 D-G	100.00 A	15.00 C-E	40.96 A-H	12.25 A-D
Joppa	10.50 BC	86.67 AB	45.17 E-G	96.67 B	15.00 C-E	45.07 A-F	12.99 A-D
Mountrail	12.25 BC	86.67 AB	55.33 A-F	98.33 AB	15.00 C-E	40.18 B-H	14.68 A-D
MTD16001	12.92 BC	90.00 A	42.67 FG	98.33 AB	17.50 B-D	49.38 A-C	13.93 A-D
MTD16002	17.25 BC	98.33 A	60.00 A-E	100.00 A	12.50 DE	38.32 C-I	13.43 A-D
MTD16004	17.67 BC	100.00 A	64.00 A-C	100.00 A	15.00 C-E	36.00 E-I	14.73 A-D
MTD16005	17.67 BC	96.67 A	64.33 A-C	98.33 AB	20.00 BC	39.50 B-I	17.68 A-D
MTD16006	18.67 BC	98.33 A	68.33 AB	100.00 A	17.50 B-D	34.40 F-I	21.80 A
MTD16007	21.67 BC	100.00 A	57.33 A-F	100.00 A	20.00 BC	41.26 A-H	21.42 AB
MTD16008	19.25 BC	96.67 A	64.83 A-C	100.00 A	35.00 A	29.72 HI	16.40 A-D
MTD16009	20.75 BC	98.33 A	69.83 AB	100.00 A	22.50 B	27.89 HI	16.27 A-D
MTD16010	19.50 BC	93.33 A	57.50 A-F	98.33 AB	17.50 B-D	33.01 G-I	16.68 A-D
MTD16011	18.08 BC	98.33 A	61.63 A-D	100.00 A	17.50 B-D	36.14 E-I	19.45 A-C
Precision	15.00 BC	95.00 A	50.33 C-G	100.00 A	8.00 E	43.82 A-G	9.76 CD
Riveland	11.00 BC	85.00 AB	34.00 G	98.33 AB	9.00 E	46.37 A-E	14.00 A-D
Tioga	15.25 BC	95.00 A	49.50 C-G	98.33 AB	22.50 B	49.24 A-D	11.68 B-D
Vivid	12.67 BC	83.33 AB	42.83 FG	96.67 B	11.50 DE	37.61 D-I	12.95 A-D
Mean	16.65	92.64	55.39	99.24	16.81	40.00	15.4
% CV	43.71	9.73	20.44	1.59	36.00	23.33	32.0
LSD (0.05)	12.9	16.9	16.4	3.3	7.4	11.7	9.9

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Pest Severity: Average percent area of head covered by disease. Thirty heads were evaluated for each plot.
[b]Pest Incidence: Percent of thirty plants per plot that had visible FHB symptoms.
[c]Fusarium diseased kernels.

Efficacy of Seed Treatments for Control of Rhizoctonia Root Rot on Lentils

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

OBJECTIVE: Test the efficacy of different seed treatments for control of *R. solani* on lentils.

MATERIALS AND METHODS:

Not Irrigated
Variety: Richlea
Location: Sidney, MT
Planted: 5/10/19
Harvested: 9/4/19
Plot Size: 5' x 20'
Seeding Rate: 12 LS/ft²
Soil Type: Savage silty clay loam
Previous Crop: Sugarbeet

Residual Soil N to 3 ft: 34 lbs/A
Residual Soil P to 6 in: 31 ppm
Applied Fertilizer: None
Irrigated (sprinkler): None
Chemical Applications: Durango 24 fl oz/A
Precipitation April – September: 19.38 inches
Vigor and stand counts: 5/30/19, 6/10/19, 6/17/19
Root disease assessment: 6/18/19

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). Trial was desiccated with Gramoxone (32 fl oz/A) on 8/28/19. *R. solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting.

RESULTS: Pythium root rot was observed in all samples. In the entire trial, not just the treatments listed here, those that contained mefenoxam all performed better than those that contained metalaxyl. We believe this is why there are significant differences between treatments for yield, not the presence of Rhizoctonia root rot.

Table 1: Seed Treatment Evaluation Control of Rhizoctonia on Lentils

Trt #	% Root Severity[a] 6/18	% Root Incidence[b] 6/18	Plants/A[c] 5/30	Plants/A[c] 6/10	Plants/A[c] 6/17	Yield (lbs/A)
1	11.7 BC	100.0 A	27181.4 AB	28139.8 AB	27878.4 A	776.0 AB
2	17.7 A	100.0 A	19602.0 C	20908.8 C	20037.6 B	496.4 C
3	11.9 BC	100.0 A	27094.3 AB	27791.3 AB	27094.3 A	841.7 A
4	13.6 BC	98.0 AB	24655.0 AB	24916.3 A-C	24306.5 A	679.8 A-C
5	14.0 A-C	100.0 A	24655.0 AB	27181.4 AB	25961.8 A	750.9 A-C
6	10.6 C	90.0 B	26310.2 AB	26920.1 AB	24829.2 A	821.1 A
7	14.1 A-C	100.0 A	28575.4 A	29011.0 A	26223.1 A	639.1 A-C
8	14.7 AB	100.0 A	23348.2 BC	24045.1 BC	23696.6 AB	579.0 A-C
9	12.6 BC	98.0 AB	25526.2 AB	28052.6 AB	25961.8 A	547.9 BC
10	13.2 BC	97.8 AB	23348.2 BC	26484.5 AB	24219.4 AB	788.6 AB
Mean	13.4	98.4	25029.6	26345.1	25020.9	692.1
% CV	24.4	7.5	15.7	15.8	14.7	32.4
LSD (0.05)	3.8	9.6	4336.6	4880.2	4248.9	270.8

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Severity: Average percent area of root covered by disease. Ten roots were evaluated for each plot.
[b]Incidence: Percent of ten plants per plot that had visible root necrosis.
[c]Number of plants per acre calculated by stand counts.

Table 2: Seed Treatments for Rhizoctonia on Lentils

Trt #	Product	Rhizoc	Oomycete Control	Application Rate
1	Cruiser	No	-	30 ga/100kg
2	Cruiser	Yes	-	30 ga/100kg
3	Cruiser Apron Maxx RTA	No	- Mefenoxam	30 ga/100kg 5 fl oz/cwt
4	Cruiser Apron Maxx RTA	Yes	- Mefenoxam	30 ga/100kg 5 fl oz/cwt
5	Cruiser Vibrance Maxx	Yes	- Mefenoxam	30 ga/100kg 1.54 fl oz/cwt
6	Cruiser Maxx Vibrance Pulse	Yes	Mefenoxam	5 fl oz/wt
7	Cruiser Evergol	Yes	- Metalaxyl	30 ga/100kg 1 oz/cwt
8	Gaucho Evergol	Yes	- Metalaxyl	1.6 fl oz/cwt 1 fl oz/cwt
9	Cruiser Obvius	Yes	- Metalaxyl	30 ga/100kg 4.6 fl oz/cwt
10	Cruiser A22782	Yes	- N/A	30 ga/100kg 26.25 ga/100kg

Resistance of Spring Wheat Varieties to Fusarium Head Blight

Frankie Crutcher, Luther Talbert, Amber Ferda, Samantha Hoesel **EARC, Sidney, MT**

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

MATERIALS AND METHODS:

Irrigated
Variety: Misc.
Location: Sidney, MT
Planted: 5/8/19
Harvested: 8/23/19
Plot Size: 5' x 10'
Seeding Rate: 60 lbs/A
Soil Type: Savage silty clay loam
Previous Crops: Wheat

Residual Soil N to 3 ft: 25 lbs/A
Residual Soil P to 6 in: 17 ppm
Applied Fertilizer: 100-30
Irrigated (sprinkler) on: 6/15/19, 6/27/19
Chemical Applications: Durango 24 fl oz/A, Proline 5 fl oz/A, Carnivore 10 fl oz/A, Discover 16 fl oz/A
Precipitation April – September: 19.38 inches
Vigor: 5/31/19
Disease assessment(s): 7/21/19, 7/30/19

COMMENTS: Corn spawn inoculated with five isolates of *F. graminearum* was applied to the field on 6/14/19.

RESULTS:

Table 1: Spring Wheat Variety Reponses to Fusarium Head Blight

Variety	Severity(%)[a] 7/21	Incidence(%)[b] 7/21	Severity(%)[a] 7/30	Incidence(%)[b] 7/30	% FDK[c]	Yield (Bu/A)	DON (ppm)
Dagmar	11.78 BC	90.00 A	50.44 B	91.11 AB	15.00 D	36.14 C	9.32 AB
Lanning	11.50 BC	86.67 A	46.44 BC	87.78 AB	15.00 D	42.23 BC	6.93 BC
McNeal	26.17 A	94.44 A	72.22 A	98.89 A	38.33 A	18.40 E	10.53 A
MT1716	4.56 D	46.67 D	21.67 E	74.44 BC	4.67 E	54.06 A	2.49 E
MT1807	6.61 CD	64.44 B-D	27.11 DE	64.44 C	16.67 CD	41.76 BC	4.57 C-E
MT1809	7.23 CD	62.22 CD	23.22 E	73.33 BC	5.33 E	45.48 B	3.52 DE
MT1821	11.94 BC	73.33 A-C	32.78 DE	80.00 A-C	20.00 B-D	19.80 E	8.08 AB
MT1870	14.00 B	84.44 AB	52.22 B	97.78 A	25.00 B	26.57 D	7.41 A-C
MT1872	11.06 B-D	81.11 A-C	50.44 B	85.56 AB	21.67 BC	38.66 C	8.18 AB
Vida	11.83 BC	80.00 A-C	37.11 CD	82.22 A-C	6.67 E	38.10 C	5.94 B-D
Mean	11.67	76.33	41.37	83.56	16.83	36.12	3.4
% CV	55.88	23.15	39.63	16.96	61.58	31.63	44.5
LSD (0.05)	6.6	21.5	11.9	19.3	6.1	6.6	3.4

Letters in common did not differ significantly according to a t-test at a significance level of 5%.
[a]Pest Severity: Average percent area of head covered by disease. Thirty heads were evaluated for each plot.
[b]Pest Incidence: Percent of thirty plants per plot that had visible FHB symptoms.
[c]Fusarium diseased kernels.

Treatment Evaluation for Control of Rhizoctonia Root Rot of Sugarbeet

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

OBJECTIVE: Test the ability of different seed treatments to control Rhizoctonia root rot on sugar beet.

MATERIALS AND METHODS:

Irrigated

Variety: BS39RR8N
Location: Sidney, MT
Planted: 5/10/19
Harvested: 9/27/1
Plot Size: 6' x 30'
Seeding Rate: 43,560 seeds/A
Soil Type: Savage silty clay loam
Previous Crops: Barley
Residual Soil N to 3 ft: 14 lbs/A
Residual Soil P to 6 in: 24 ppm
Applied Fertilizer: 160-40
Irrigated (flood) on 6/27/19, 6/28/19, 7/23/19, 8/5/19, 8/6/19, 8/16/19, 8/30/19, 9/4/19
Chemical Applications: Durango 24 fl oz/A
Seed Treatments: Kabina 14, Vibrance, Stamina, Systiva, Metlock, Rizolex
Foliar Treatments: Priaxor, Quadris, Elatus
Precipitation April – September: 19.38 inches
Stand counts: 6/3/19, 6/17/19, 7/1/19, 7/17/19

COMMENTS: *Rhizoctonia solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting.

RESULTS:

Table 1: Seed Treatment and Foliar Application Evaluations for *R. solani* 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 (w/o *Rhizoc)*	26.11 B	73.06 A	37.56 A	31.39 D	2.89 B
	None (w/ *Rhizoc*)	97.98 A	1.94 B	1.23 B	79.17 A	72.77 A
	Kabina 14	98.06 A	1.67 B	1.35 B	56.67 BC	88.37 A
	Vibrance	93.17 A	6.67 B	3.27 B	49.72 C	65.70 A
	Stamina + Systiva 2.5	95.83 A	4.17 B	1.52 B	56.39 BC	77.48 A
	Stamina + Systiva 5.0	95.99 A	3.89 B	1.93 B	56.67 BC	77.26 A
	Metlock + Rizolex	98.45 A	1.67 B	0.64 B	70.00 AB	80.04 A
Priaxor 0.37 fl oz/1000 ft row	None (w/o *Rhizoc)*	32.34 B	66.11 A	39.88 A	35.28 D	0.00 D
	None (w/ *Rhizoc*)	98.69 A	1.39 B	0.39 B	88.33 A	80.45 AB
	Kabina 14	98.49 A	1.11 B	0.30 B	55.83 C	91.47 A
	Vibrance	93.02 A	6.11 B	3.10 B	60.83 BC	55.37 C
	Stamina + Systiva 2.5	96.55 A	2.78 B	1.62 B	71.94 B	74.55 A-C
	Stamina + Systiva 5.0	95.52 A	3.89 B	2.07 B	53.89 C	68.74 BC
	Metlock + Rizolex	98.10 A	1.11 B	2.74 B	65.56 BC	75.57 A-C
Quadris 0.38 fl oz/1000 ft row	None (w/o *Rhizoc)*	30.83 B	68.89 A	37.71 A	33.61 C	1.82 C
	None (w/ *Rhizoc*)	98.21 A	1.67 B	2.00 B	88.89 A	70.43 AB
	Kabina 14	96.51 A	3.06 B	2.95 B	61.67 B	78.51 A
	Vibrance	94.92 A	3.89 B	2.08 B	58.61 B	46.15 B
	Stamina + Systiva 2.5	95.79 A	3.33 B	3.01 B	60.56 B	73.65 AB
	Stamina + Systiva 5.0	94.13 A	5.83 B	5.26 B	58.89 B	52.77 AB
	Metlock + Rizolex	98.41 A	1.11 B	1.83 B	71.94 B	76.25 A
Elatus 0.547 oz wt/1000 ft row	None (w/o *Rhizoc)*	23.65 D	75.83 A	40.86 A	36.11 C	0.00 C
	None (w/ *Rhizoc*)	97.86 A	1.94 D	3.60 C	85.00 A	75.46 A
	Kabina 14	95.87 AB	4.17 CD	3.07 C	57.50 B	66.01 A
	Vibrance	86.87 C	10.83 B	8.21 BC	55.00 B	32.47 BC
	Stamina + Systiva 2.5	91.59 BC	6.94 BC	6.76 BC	65.83 B	44.01 AB
	Stamina + Systiva 5.0	86.47 C	11.67 B	12.14 B	59.44 B	31.10 BC
	Metlock + Rizolex	96.03 AB	3.33 CD	3.96 C	63.89 B	72.59 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[a]	% Ruppel 0-3	Yield (ton/A)	Pre-emergence damping off (%)	Post-emergence damping off (%)
None	28.23 C	70.97 A	39.00 A	34.10 E	1.18 D
None + *Rhizoc*	98.18 A	1.74 C	1.81 C	85.35 A	74.78 A
Kabina 14	97.23 A	2.50 C	1.92 C	57.92 CD	81.09 A
Vibrance	91.99 B	6.88 B	4.17 BC	56.04 D	49.92 C
Stamina + Systiva 2.5	94.94 AB	4.31 BC	3.22 BC	63.68 BC	67.42 AB
Stamina + Systiva 5.0	93.03 B	6.32 B	5.35 B	57.22 CD	57.47 BC
Metlock + Rizolex	97.75 A	1.81 C	2.29 C	67.85 B	76.11 A
Mean	85.9	13.5	8.3	60.3	58.3
CV (%)	28.5	180.8	162.7	31.4	60.0
LSD (0.5)	3.6	3.6	2.6	7.2	13.9

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.

Industrial Hemp- A Potential Crop for Eastern Montana EARC, Sidney, MT

Chengci Chen, Apurba Sutradhar, Bill Frank, Rebecca Garza, Calla Kowatch-Carlson, Thomas Gross, and Ronald Brown

Materials and Methods:

Irrigated

Location: EARC
Varieties: CRS-1 and Katani
Planted: Early Planting 5/8/2019
Late Planting 5/29/2019
Tillage: Conventional
Experimental design: Randomized Complete Block
Pesticide: None
Fertilizers (obtained): 100 lb N/ac and 30 lb P_2O_5/ac blend applied at rosette stage
Rainfall: 10.4”

Previous crop: Sugarbeet
Soil type: Williams Clay Loam
Harvested for seed: 8/29/2019
Harvest type: Direct cut
Plot size: 6” x 30”
Replications: 4
Herbicide: None

Irrigation: 2.3”

Comments: The plots were hand hoed and cultivated to control weeds.

Table 1. Initial soil test results. A composite soil sample was collected before planting hemp that contained at least 10 individual cores.

Depth	pH	OM	NO_3-N	P-Olsen	K	Ca	Mg	Na	Zn	Fe	Mn	Cu	B	CEC
Inch		%	---------- ppm ----------											meq/100g
0-12	8.3	2.1	11.0	16	161	5324	402	114	0.69	6.1	4.47	0.80	1.0	30.9

Table 2: Main effect of planting time and variety on industrial hemp height, biomass yield, seed yield, and cannabidiol (CBD) concentration.

Effect	Treatments	Plant Height (inch)	Biomass (lb/ac)	Seed Yield (lb/ac)	CBD (%)	Wheat Yield† (bu/ac)
Planting Time	Early	65.6 A	10835 A	1257 A	0.89	41.8
	Late	59.0 B	6361 B	739 B	0.83	31.7
Variety	CRS-1	72.7 a	924 a	1055	0.84	--
	Katani	51.9 b	794 a	941	0.88	--
Sources of Variation		----------P > F----------				
Time		0.0004	<0.0001	0.009	0.71	0.08
Variety		<0.0001	0.09	0.47	0.75	--
Time*Variety		0.72	0.40	0.40	0.42	--

† Wheat variety Elgin was planted. Yield was adjusted to 12% moisture content.

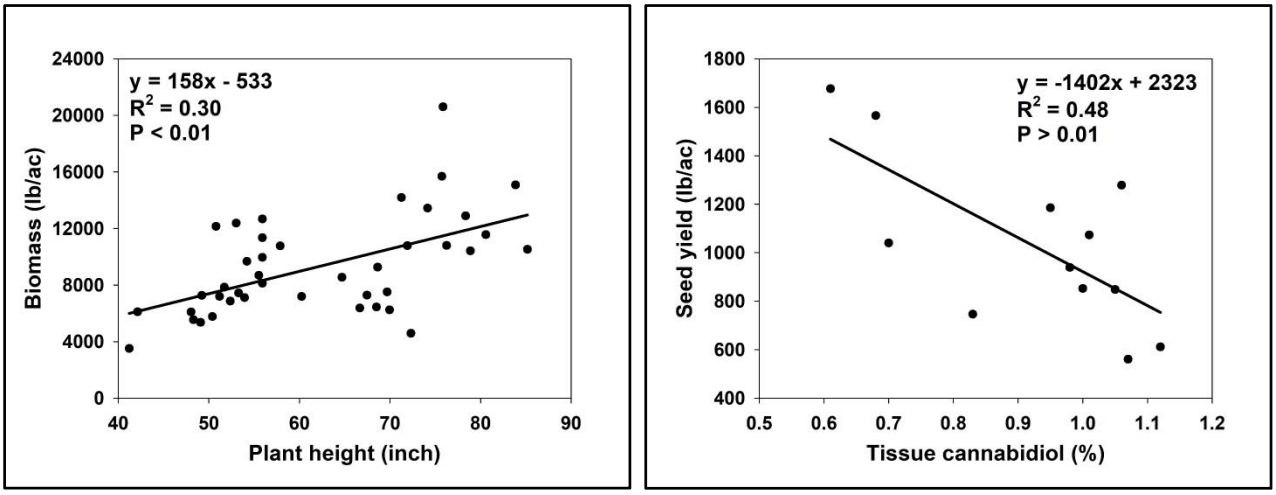
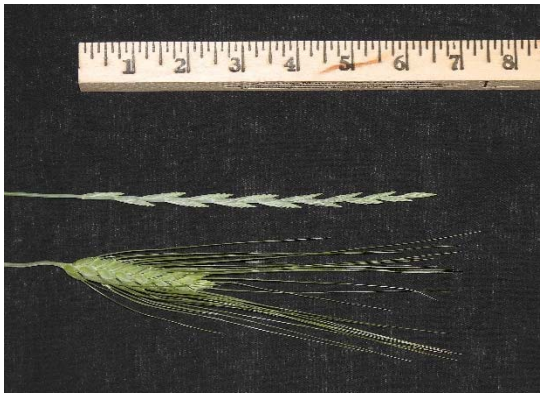


Figure 1: Relationships between biomass and plant height (left), and between seed yield and tissue CBD concentration (right).

Kernza® a new dual-use crop for the MonDak

Clair Keene



Kernza head (top) and HRSW head (below).

Kernza® is intermediate wheatgrass (*Thinopyrum intermedium*), a cool-season perennial grass that has been bred intensively for the last 15 years for increased seed size and yield. Old forage types of intermediate wheatgrass have been grown in the Northern Great Plains for over 40 years and have done well in our semi-arid, short season conditions. Kernza lines are being developed by breeders at The Land Institute (TLI) in Salina, Kansas and the University of Minnesota. Kernza is the first perennial grain brought to market in the United States and there are many food companies eager to include a perennial grain in their supply chains. Spring growth of Kernza is comparable to a high-quality grass forage and can be grazed or hayed. Grain harvest occurs in late summer and the quality of remaining biomass is comparable to wheat straw and can be used as bedding or mixed in to feed rations. Most Kernza research to date has been done in Minnesota and Wisconsin, and in these environments, 2 or 3 years of grain harvest have been observed. It is possible that in drier regions, 3 or 4 years of grain production may be possible, but there has been little research on Kernza in semi-arid environments.

Kernza variety trial at the Williston REC

A Kernza variety trial was seeded at the WREC dryland farm on Sept 7, 2018. Nine varieties were included: 2 from TLI, 5 from UMN, and 2 old forage types Oahe and Rush. The trial was no-till seeded into cover crop residue at 10 lbs per ac at 0.75” depth. No fertilizer was applied and no herbicides were used. Kernza is a hulled grain: combined samples were sent to TLI for cleaning and de-hulling to obtain naked seed yield per acre. Hulls are estimated to account for 30% of harvested weight.

Variety	Yield lbs/ac	Seed weight†
Oahe	149	141
Rush	161	137
TLI-C3	342	181
TLI-C5	352	215
MN-1501	293	222
MN-1502	245	184
MN-1503	251	179
MN-1504 (Clearwater)	273	184
MN-1505	342	187
Mean	267	181
LSD 5%	73	13

†Seed weight = mg / 20 de-hulled seeds

Harvested: 9/16/2019

TLI-C5, TLI-C3, and MN-1505 had the highest yields and TLI-C5 and MN-1501 had the highest seed weight. Kernza lines exhibited roughly twice the yield and 1.5 times the seed weight of old forage types. This variety trial and a spring-seeded trial planted on May 10, 2019 will continue next year. Additional trials planned for 2020 include evaluating herbicide safety and spring N fertilizer rates.

Funding for this work provided by The Land Institute and ND-APUC project # BDAPUC19-24

Saline Seep Formation and Background of the Seep at WREC

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

Background

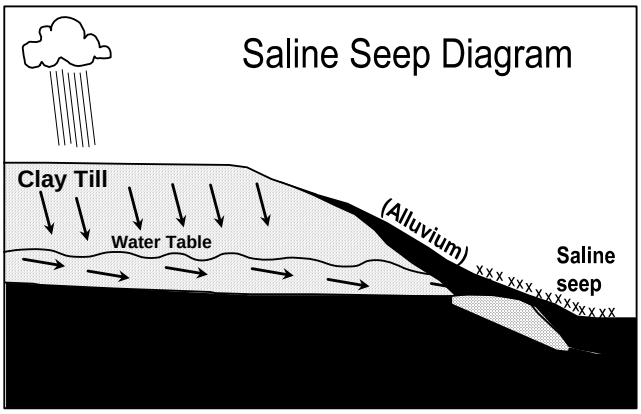
The WREC and Montana Salinity Control Association (MSCA) partnered to monitor and reclaim a saline seep at the WREC dryland research farm. The project is located in T154N R102W Section 36 of the Fifth Principle Meridian Public Land Survey System (PLSS).

The saline seep started forming in the 1990's and was characterized by a depression in the south west corner of the field that lay wet in the spring, struggled to produce crops, and had a weedy cover of foxtail barley and kochia. In dry years, ground water and salts wicked upwards from the shallow water table to evaporate and form a white, salt crust on the soil surface. At the study outset, the seep was approximately one acre in size, however, a larger area of the field exhibited reduced production.

Investigation

Fieldwork: 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" 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.

Saline Seep Reclamation with Salt-tolerant Perennial Forages Update

Clair Keene, Jim Staricka, and Kyle Dragseth

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 AFX 457, PGI 427, Magnum Salt, and Rugged; perennial grasses 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. In early June 2019, alfalfa stands were rated as good to very good and the perennial grasses were starting to fill in, though they still had not achieved consistent ground cover in all the plots. May 2019 average temperatures were 10°F cooler than May 2018 and we think this was a major cause of slower spring growth and less biomass accumulation in 2019.

The variety trial plots were cut once in the seeding year and twice in 2017, 2018, and 2019. In 2017, the region experienced a severe drought and less than 1" of rain 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 water table. In 2018, about 8" of rain was received between May and July and second cutting yields were similar to the first cut. In 2019, April and May were cool and dry, but June and July rainfall totaled about 7." The fall of 2019 was extremely wet with 2" of rain in August and a record-breaking 8" in September. The September rain prevented us from harvesting a second cutting in most of the field.

Saline seep alfalfa yields 2016 - 2019 in Tons/ acre.

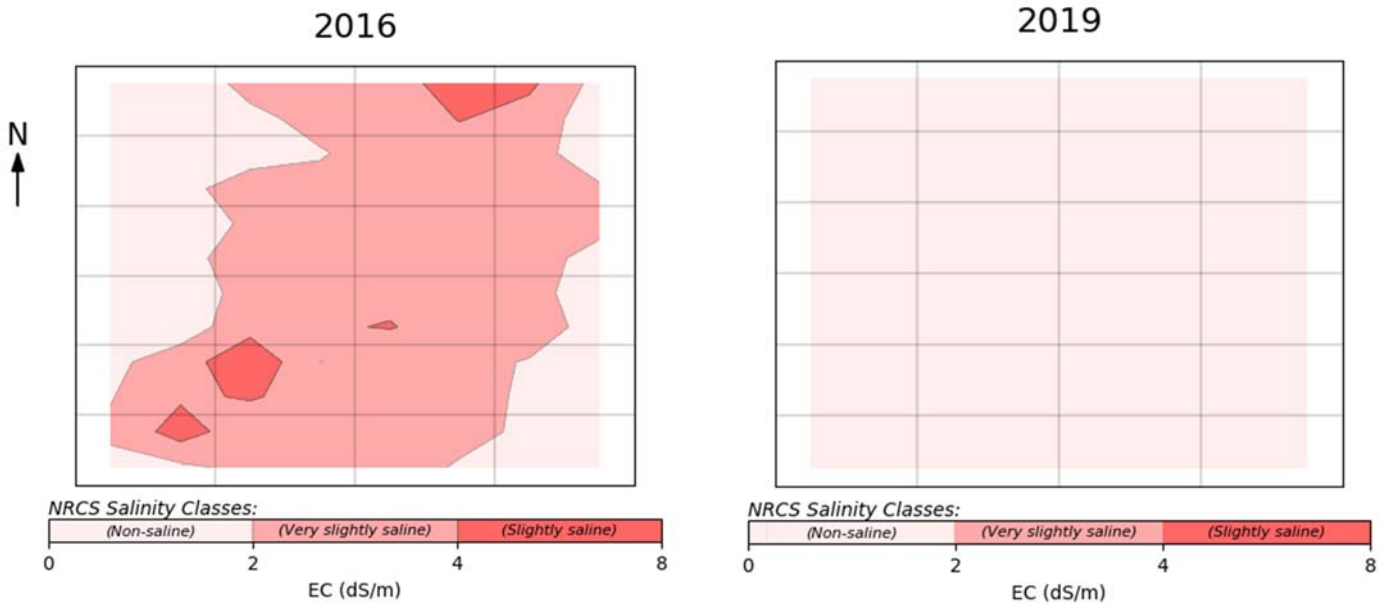
	2016	2017			2018			2019		
	12 WAP†	1st cutting	2nd cutting	Total	1st cutting	2nd cutting	Total	1st cutting	2nd cutting	Total
Alfalfa variety										
AFX 457	0.7	2.0	1.7	**3.7**	2.2	2.0	**4.2**	1.1	1.3	**2.4**
PGI 427	0.6	1.9	1.2	**3.1**	2.7	2.1	**4.8**	2.3	1.2	**3.5**
Rugged	0.7	1.7	1.9	**3.6**	2.3	2.2	**4.5**	1.4	0.7	**2.1**
Magnum Salt	0.7	1.7	1.3	**3.0**	2.0	1.8	**3.8**	1.7	1.1	**2.8**

†WAP = weeks after planting

In 2019, 125 round hay bales weighing 1,600 lbs each were made from the approximately 40 acres of the saline seep field and the strip of alfalfa running along the east side of the quarter section. Our best estimate of per acre yield for the field is 2.5 tons/ acre.

Soil Salinity Monitoring

Fall soil sampling has been conducted each year to monitor changes is electrical conductivity (EC), an indicator of salinity. Soil cores were taken with a hand probe to a depth of 3 inches in a grid pattern and then in the lab, cores were mixed with deionized water to form a thick paste prior to measuring with a Field Scout® Direct Soil EC Meter (Spectrum Technologies). Below are maps of EC values measured in 2016 on the left and in 2019 on the right. The scale shown is EC values by NRCS Salinity Classes, ranging from non-saline (0-2 dS/m), very slightly saline (2-4 dS/m), to slightly saline (4-8 dS/m) at this site. We note that this site was not strongly saline at the outset. If this site had been strongly saline, EC > 16 dS/m, we do not anticipate that the alfalfa varieties tested would have been as successful establishing as they were. This highlights the importance of testing soil EC prior to planting perennials to determine how salt-tolerant a species is needed. In 2016, the average EC of all samples was 2.18 dS/m; in 2019, the average is 0.85 dS/m. These data show we have successfully reduced salinity in the top 0-3” of the soil profile.



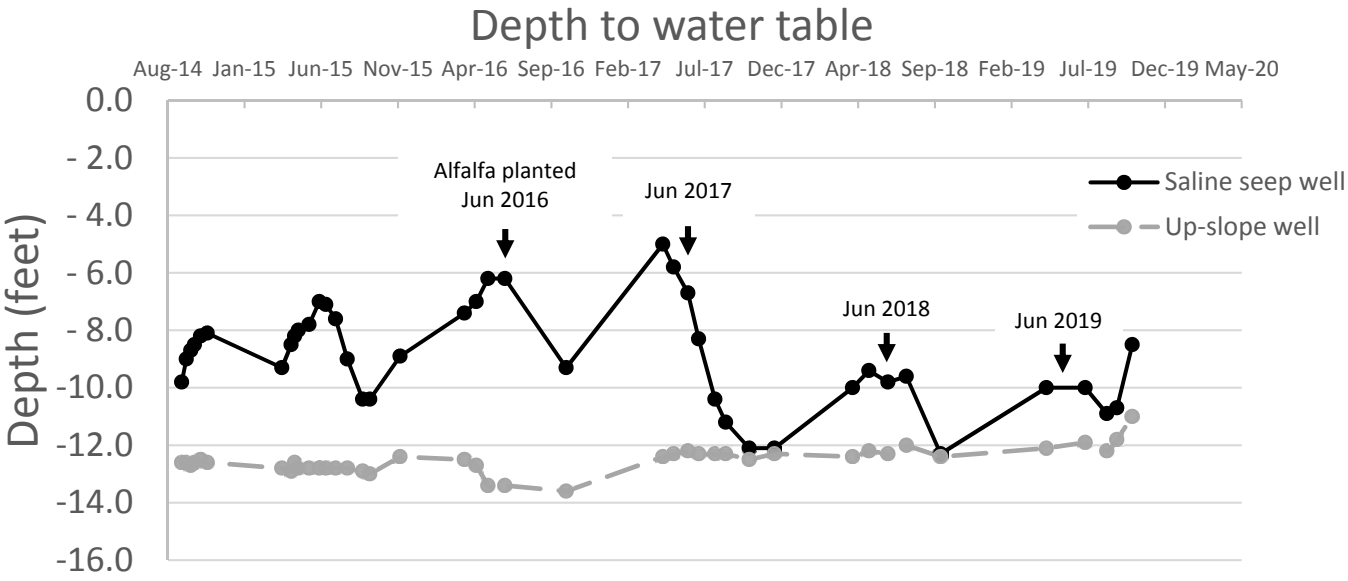
In 2018 and 2019, we took a series of deep soil cores with a hydraulic probe to check EC values (salinity) in deeper layers of the soil profile. These cores were tested by the NDSU Soil Testing Lab. In all samples, EC values increased with depth; from 2018 to 2019 EC decreased in all plots at all depths. We attribute this to the extremely high rainfall, approximately 17”, received July-September 2019 flushing salts deeper into the soil. We are encouraged to see the deep core results parallel those of the 0-3” samples tested at WREC illustrated in the figures above. The high in-season rainfall flushed salts deeper than the 24” sampling depth. This progress reducing EC in the top 24”, a critical zone for plant establishment, is encouraging. This sampling will be repeated in 2020.

Deep Soil EC (dS/m)

	Plot	201		206		301		306	
	Year	18	19	18	19	18	19	18	19
Depth (in)	0-3”	3.3	0.8	3.3	2.1	2.9	1.8	4.0	2.0
	3-6”	5.4	2.5	6.0	3.6	4.2	3.7	6.9	3.9
	6-12”	7.9	3.2	8.0	5.2	6.9	4.9	8.1	5.5
	12-24”	9.2	4.7	--	--	9.1	5.8	--	--

Water Table Management

Depth to water table has been monitored using shallow ground water wells. Below is a figure of measurements taken at two wells at the site from 2014-2019. The black line is from the well closest to the saline seep and the gray dotted line is from a well at a higher elevation up-slope from the seep. The peaks in the black line show the water table rising under the seep, i.e. ground water recharge, after spring snow melt. We see a strong drawdown in the water table during the dry 2017 growing season when the alfalfa used soil water without additions from precipitation. The truncated peak in 2018 shows that the alfalfa successfully limited recharge during a growing season with above-normal precipitation. In 2019, another truncated peak shows the alfalfa preventing a spike in the groundwater after a snowy 2018-2019 winter. The sharp increase in the water table observed at the last reading in October 2019 is a result of the 8" of rain received during September.



Summer interns sampling alfalfa biomass in June 2019.

Dr. Jim Staricka soil sampling the top 0-3" of the plots in October 2019.

Acknowledgements: Jane Holzer, Montana Salinity Control Association and Don Miller, Alforex Seeds

Irrigation Research at Nesson Valley 2019

Justin Jacobs, NDSU – Williston Research Extension Center

Weather Summary - Nesson Valley, ND[+]

	Precipitation		Temperature		
Month	2019	Avg‡	2019	Avg	Days above 89[0]
	-inches-		-------degrees F[0]-------		
Oct-Dec. 2018	0.70	3.85			
April	0.89	0.44	41.8	33.7	0
May	0.88	1.49	49.6	58.5	1
June	2.90	4.54	63.1	65.6	5
July	3.46	2.36	67.7	67.7	6
August	2.17	1.07	65.8	66.7	6
September	**10.03**	1.85	57.3	52.9	2
April-July	8.13	8.83	55.5	56.4	12
April-Sept	20.33	11.74	57.5	57.5	20
Total- (Oct 2018 - September 2019)	21.03	15.59			

Last spring frost = May 12, 2019 (27.6°)

First fall frost = October 2, 2019 (31.8°)

[+] NDAWN Hofflund site
‡ Average since January 1, 2006

Two-thousand and nineteen was a very challenging year to say the least. The weather certainly threw a loop into the plans that we had for the year. New job opportunities arose for some staff, so we said goodbye to two hard workers during the year. However, despite the challenges, we managed to conduct research and get a crop harvested once again.

As I sit down to write out the update for the 2019 year, I realize that in 2018 I wrote about some of the same items. I never thought that I would see the monthly rainfall total top 10 inches of rain as it did in September of 2019. Two-thousand and nineteen was also a wet and wild year. Thankfully we were able to complete a majority of the harvest before the September rains started. However, there were several crops that were unharvested when the rain started falling, and it did impact yields.

There were a total of 20 variety trials in 17 different crops. The yields were average or slightly below average for most of the crops and trials this year. Heavy rains in the early part of the year caused nitrate leaching in the corn variety trial. Supplemental N was applied but was too late and impacted growth and yields. The heavy rains also caused pods to shatter and shell out in canola, field pea, and soybean. The table below identifies the average yields for each of the trials conducted this year. Several of the trials had additional varieties compared to previous years. It is important to include the newest varieties along with the older varieties each year to provide multi-year data for varietal selection. If there are varieties that have not been tested that you wish to see, please let me know. The complete tables for these crops can be found throughout this Ag Research Update.

Crop (# of varieties)	2019 Average	Crop	2019 Average
Winter Wheat (22)	**99 bu/a**	Misc Bean (12)	**1736 lb/a**
Spring Wheat (48)	**93 bu/a**	Field Pea (6)	**50 bu/a**
Durum Wheat (21)	**72 bu/a**	Lentil (11)	**2096 lb/a**
Barley (12)	**132 bu/a**	Flax (13)	**32 bu/a**
Oat (15)	**152 bu/a**	Safflower (22)	**1215 lb/a**
Corn (24)	**152 bu/a**	Canola (12)	**1960 lb/a**
Faba Bean (5)	**2209 lb/a**	Sunflower (16)	**2329 lb/a**
Navy Bean (3)	**1324 lb/a**	RR Soybean (41)	**37 bu/a**
Pinto Bean (10)	**1719 lb/a**	Conventional Soybean (27)	**44 bu/a**

This was the second year of research on intercropping at Nesson, looking at interseeding chickpea and flax together and field pea and canola. The chickpea/flax trial was not used as the chickpeas failed to emerge. The results from the field pea and canola show positive results when interseeded together versus planted alone. The objective of this project is to see that when field pea and canola are interplanted together, lodging in the field pea is reduced, and a secondary objective, is to see that when canola is added to field pea, that the field pea yield is not negatively affected, and that a second crop can be grown and be marketable. Both of these objectives have been observed. I have highlighted the results in a written report in this Ag Research Update.

Two-thousand and twenty will bring some new challenges, but will continue to work hard to bring the best data out of Nesson Valley. We will be looking to fill two positions this winter and get these individuals on board and ready to go prior to spring planting. As always we hope that you will join us for our Irrigated Field Tour, July 9, 2020!

Improving Efficiency Using Intercropping – 2019
Intercropping under Irrigation

Justin Jacobs and James Staricka, NDSU – Williston Research Extension Center

Objective

Current agricultural practices are undergoing a major change and shift towards a more sustainable or regenerative system. Lowering commodity prices and its impacts on production Ag has changed the approach towards increasing production efficiency over normal practices of the past. Intercropping is being looked at as a way to become more efficient. Intercropping is a practice that has not been widely adopted, but has been around for a significant amount of time. Some early manuscripts suggest that the ancient Eygptians and ancicent Romans practiced intercropping. Recent history even tells us that the Native Americans practiced a form of intercropping by growing corn, beans, and squash together in the same field. The practice of intercropping is growing two or more crops together in the same field.

Farmers have previously utilized production practices with companion crops to give an advantage or benefit to the cash crop being grown. Similarly cattle producers have been growing multiple crops together as a source of hay or forage. The idea of growing two crops together to be separated as individual cash crops is a relatively new and emerging idea. One of the key concepts of growing two crops together is to have varying seed sizes in order to allow for seeds to be separated easily. Another important factor is to make sure the crops have similar maturities. Field pea and canola would be an example of two crops working together.

Two-thousand and nineteen was the second year of intercropping research conducted at Nesson Valley. The intercropping study is looking at the use of irrigation to further increase the efficiency of intercropping. Non-irrigated intercropping is being conducted at the same time to draw comparisons between the two environments. One of the objectives with intercropping field pea and canola, is to utilize canola's standability to reduce lodging in field pea.

Materials and Methods

In 2018 there were six treatments comparing alternating rows to mixed rows. In the 2018 trial year the alternating rows showed the most potential, though, the canola yields suffered as a result of no Nitrogen fertlizer applied. As a result of the alternating rows out perfroming the mixed rows, and the recognition of a need for fertilizer to increase the canola yields, the decision was made to look solely at alternating rows in combination with three rates of Nitrogen fertilizer in 2019. In the future there is potential to take a look at the mixed rows once again. There are many unanswered questions with intercropping, therefore it is easier to answer one or two questions at a time. The Nitrogen fertilizer rates were adjusted according to the soil test data obtained the previous fall. A Potassium Sulfate fertilizer was applied to the entire trial in order to achieve a 30 lb/a rate of sulfur for the canola. Each planting ratio was planted once in each of the fertilizer rates being tested, and replicated four times. Additionally the trial was replicated as an irrigated and a non-irrigated trial.

Table 1. Planting ratios in a field pea and canola intercrop

Ratio	Planting Rate	Plant Population
(Field Pea : Canola)	(lb/a)	(seeds/a)
100:0	180 : 0	352,000 : 0
0:100	0 : 4	0 : 304,000
66:66	120 : 2.6	239,000 : 203,000
66:33	120 : 1.3	239,000 : 101,000
50:50	90 : 2	176,000 : 159,000
33:66	60 : 2.6	112,000 : 203,000

The trial was planted on May 10. Each crop was planted separately, with field pea being planted first followed by canola. The field pea variety used was AC Agassiz and the canola variety was CS2200 CL. The use of a clearfield canola allowed the use of Imazamox to be applied for a broader control of broadleaf weeds that would be tougher to control with a convetional canola variety. Prowl H2O was used as a preemergent herbicide; Section 3EC and Assure II were applied for grass control, and Beyond was used for broadleaf control. In-season observations on lodging in field pea, flowering dates, plant height, and maturity dates were recorded during the growing season. Harvest occurred on August 30. After harvest, yield, oil content, and protein content were measured on the harvested seeds.

Table 2. Nitrogen fertilizer rates in a field pea and canola intercrop

Fertilizer Percentage	Nitrogen Fertilizer Rate
(%)	(lb/a)
100	120
50	60
0	0

30 lb/a of Sulfur was applied using Potassium Sulfate

Results and Discussion

Table 3. Field pea lodging across planting ratios

Field Pea					
IRRIGATED			**NON-IRRIGATED**		
Ratio	**Lodging**	**Means separation**	**Ratio**	**Lodging**	**Means separation**
(Field Pea : Canola)	**(0-9)***		**(Field Pea : Canola)**	**(0-9)***	
100:0	2.75	a	100:0	3.83	a
66:33	2.25	ab	66:33	2.58	b
50:50	2.17	ab	66:66	2.17	b
66:66	1.67	bc	50:50	2.00	b
33:66	1.25	c	33:66	1.83	b

* (0-9) : 0 = no lodging, 9 = plants lying flat

In 2018 a reduction was seen in the lodging of field pea when intercropped with canola. Additionally the trial in 2019 also showed a significant reduction in the lodging of field pea when intercropped with canola. Table 3 shows the lodging scores given to the planting ratios in both the irrigated and non-irrigated trials. The lodging scale is a 0-9 scale with 0 being the plants standing straight up, and with 9 being the plants lying flat. Values that are followed by the same lower case letter are not significantly different. However, lodging can only be compared to results in the same system (i.e. irrigated or non-irrigated). As the ratio of canola increased in the intercropped treatments the lodging in field pea was reduced.

Table 4. Field pea yield across planting ratios

Field Pea		
IRRIGATED		
Ratio	**Yield**	**Means separation**
(Field Pea : Canola)	**(bu/a)**	
100:0	40	a
66:33	28	b
66:66	26	bc
50:50	23	bc
33:66	22	c
NON-IRRIGATED		
Ratio	**Yield**	**Means separation**
(Field Pea : Canola)	**(bu/a)**	
100:0	34	a
66:66	28	b
66:33	27	b
50:50	21	c
33:66	20	c

Significant differences were seen in yields of both canola and field pea across fertilizer rates and planting ratios in both the irrigated and non-irrigated trial. As the rate of fertilizer increased, the yield of field pea decreased, while the canola yield increased. The yield of the field pea and means seperation across planting ratios can be seen in table 4. The irrigated trial showed no significant difference between the 66:66, 66:33, and the 50:50 planting ratios. The 50:50 ratio showed significant difference from the 66:66 and 66:33 ratios in the non-irrigated trial. Table 5 shows the canola yield in both the irrigated and non-irrigated trials. Canola yields were affected by the planting ratios being tested. There was no significant difference between the canola yield in the 66:66, 66:33, 50:50 and 33:66 treatments in the irrigated trial. Significant differences were seen in the 33:66 and 66:66 treatments when compared to the monocropped canola. Similarly the 50:50, 33:66, and 66:66 treatments showed significant difference in yield compared to the monocropped canola plot in the non-irrigated trial.

Table 5. Canola yield across planting ratios

Canola		
IRRIGATED		
Ratio	**Yield**	**Means separation**
(Field Pea : Canola)	**(lb/a)**	
33:66	1704	a
66:66	1662	a
66:33	1581	ab
50:50	1469	ab
0:100	1249	b
NON-IRRIGATED		
Ratio	**Yield**	**Means separation**
(Field Pea : Canola)	**(lb/a)**	
50:50	1346	a
33:66	1240	ab
66:66	1073	ab
0:100	864	b
66:33	831	b

Summary

The addition of fertilizer to the trial resulted in higher canola yields and better performance in an intercropped system. Field pea lodging was reduced across planting ratios. Yields in field pea were reduced when intercropped, while the use of intercropping increasesd the yield of the canola. When an economic analysis is taken into consideration, the addition of canola into an intercropping production practice provides favorable returns. Research will continue in 2020, and will include testing on chickpeas and flax.

Effects of Sugarbeet Factory Spent Lime on Soil and Crop Production in a Crop Rotation of Wheat and Sugarbeet. (Sidney Sugars).

Tyler Tjelde, James Staricka, Justin Jacobs, David Schmidt, Kyra Candee, and Ken Burback

Introduction

Sidney Sugars contracts on average 30,000 acres of sugarbeets yearly. Each year there is approximately 16-18 thousand tons of spent lime produced as a by-product of the beet sugar purification process. There is approximately 75 years' worth of the spent lime available at the Sidney Sugars facility. Is this a product that can be utilized to improve soil health, increase nutrients in the soil, and/or improve crop production? Research has been conducted in eastern ND and western MN demonstrating the benefits of lime on the soil and crop production. Some of the benefits reported from this work are long term control of *Aphanomyces* and the addition of phosphorus and other micro nutrients. No negative responses from the lime were determined. How will this lime affect the sugarbeet production and how will other rotational crops be affected by the addition of lime to the soil? Will the results differ in western ND where the soil pH is upper 7 to low 8, compared to eastern ND and northwestern MN where the soil pH is upper 6 to low 7.

Methods and Experimental Design

The study is being conducted at the Nesson Valley Irrigation Research Site (48°09'75" N, 103°06'32" W), approximately 28 miles east of Williston, ND. The soil type is a Lihen sandy loam (sandy, mixed, frigid Entic Haplustoll), consisting of very deep, somewhat excessively or well drained, nearly level soil that formed in sandy alluvium, glacio-fluvial, and eolian deposits in places over till or sedimentary bedrock (Soil Survey of Williams County, ND 1991).
The experimental design is a Randomized Complete Block Design (RCBD) with four replications. Each plot is 25 ft. by 75 ft. with lime rates randomized for each plot. The treatments consist of six lime rates (0, 2.5, 5, 10, 15, 20 tons per acre) applied only once for the duration of the project. Soil samples were taken from each plot prior to lime application and each year following harvest. Lime application occurred in the spring 2016 for each plot at the treatment rate. Lime was incorporated using a mulcher prior to planting wheat. Soil analysis includes nitrogen, phosphorus, potassium, sodium, calcium, zinc, manganese, iron, copper, magnesium, sulfur, EC, pH, and organic matter.

Year 1 Results

Wheat was planted May 3, 2016 and after emergence, plant growth was observed to identify any differences between treatments. Plant heights prior to harvest and yields were measured from each plot and data statistically analyzed. Spent lime showed no significant effects on plant growth or yield (Table 1). Significant differences ($P<0.05$) between protein and test weight were observed among treatments but the relationship between treatments did not reflect the addition of spent lime. Soil sampling occurred following harvest and the most notable change was an increase in calcium and pH.

Table 1. Irrigated Durum — **WREC - Nesson Valley 2016**

Treatment Spent Lime	Plant Height	Protein[1] 2016	Test Weight	Yield 2016
tons/a	inch	%	lb/bu	bu/a
0	39	16.4	56.3	66.1
2.5	39	16.4	56.9	64.2
5	39	16.1	57.1	64.8
10	39	16.5	56.5	63.4
15	39	16.2	57.4	67.3
20	39	16.6	56.8	63.0
Mean	39.0	16.4	56.8	64.8
C.V.%	-	1.5	0.6	8.4
LSD 5%	-	0.31	0.45	n.s.

Planted: 5/3/2016 — Harvested: 8/16/2016

Protein[1] = reported on an as is moisture basis

Year 2 results

Sugarbeet was planted April 28, 2017. Stand counts were taken after emergence and no differences observed between the treatments. No visual differences in crop growth were observed throughout the growing season. Root samples were taken from ten feet of row in each plot on August 10th, August 30th and September 19th. Stand counts, percent sugar, and yields were measured for each treatment from these samples. Significant differences (P<0.1) between yield and recoverable sugar were observed among treatments in the August 10 and 30th root samples (Table 2 and 3). The September 19th final harvest sample did not show any statistical differences between treatments (Table 4).

Spent lime had no effect on soil nutrients except calcium and pH increased with increased rates of applied lime (see graphs below).

Table 2. Sugarbeet (August 10) — **WREC - Nesson Valley 2017**

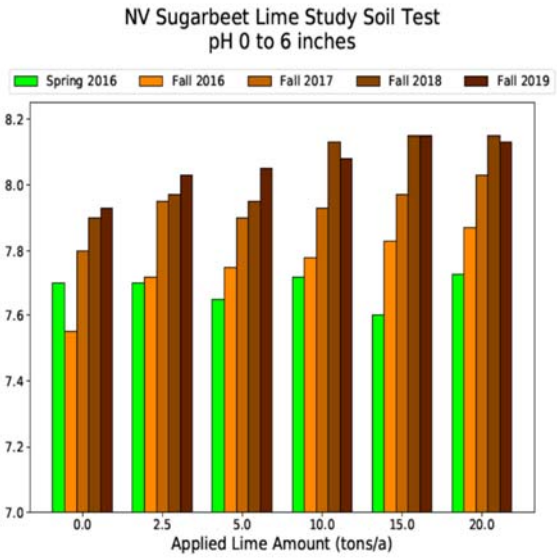
Treatment Spent Lime	Plant Stand	Sugar 2017	Yield 2017	Recoverable Sugar
tons/a	beets/10ft	%	ton/a	lb/a
0	14	13.6	27.4	7486
2.5	13	13.4	29.1	7794
5	14	13.4	28.1	7547
10	12	13.3	32.6	8669
15	14	13.2	31.7	8374
20	13	13.1	30.9	8112
Mean	13.2	13.3	30.0	7997.0
C.V.%	24.4	3.3	8.2	8.6
LSD 10%	n.s.	n.s.	3.0	848.0
Planted: 4/28/2017			Harvested: 9/19/2017	

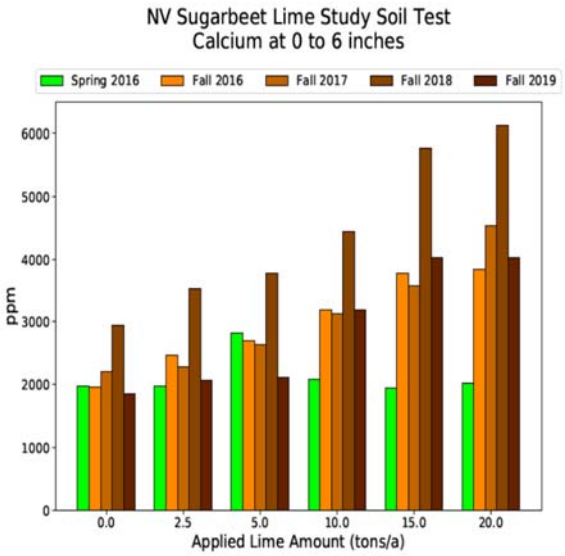
Table 3. Sugarbeet (August 30) — **WREC - Nesson Valley 2017**

Treatment Spent Lime	Plant Stand	Sugar 2017	Yield 2017	Recoverable Sugar
tons/a	beets/10ft	%	ton/a	lb/a
0	12	16.3	32.0	10413
2.5	13	16.1	35.2	11320
5	12	16.2	32.4	10507
10	11	16.1	38.4	12366
15	11	16.6	33.5	11143
20	11	15.8	30.7	9684
Mean	11.8	16.2	33.7	10905.4
C.V.%	27.3	2.3	9.7	9.4
LSD 10%	n.s.	0.46	4.0	1543.6

Table 4. Sugarbeet (September 19) — **WREC - Nesson Valley 2017**

Treatment Spent Lime	Plant Stand	Sugar 2017	Yield 2017	Recoverable Sugar
tons/a	beets/10ft	%	ton/a	lb/a
0	9	17.1	38.4	13111
2.5	9	17.5	37.1	12947
5	10	17.0	42.6	14440
10	11	17.1	40.2	13704
15	11	17.3	39.6	13698
20	10	17.2	37.3	12814
Mean	10.2	17.2	39.2	13452.4
C.V.%	25.0	2.9	14.2	12.9
LSD 10%	n.s.	n.s.	n.s.	n.s.





Year 3 Results

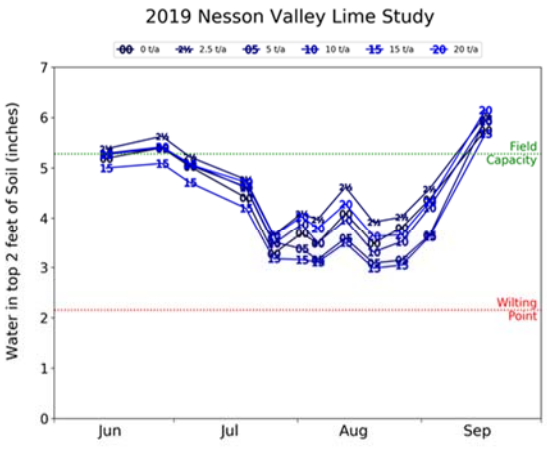
Wheat was planted May 7, 2018 and after emergence, plant growth was observed to identify any differences between treatments. Plant heights prior to harvest and yields were measured from each plot and data statistically analyzed. The addition of spent lime showed no significant effects (P<0.05) on plant growth, protein, test weight or yield (Table 5). Soil sampling occurred following harvest and the most notable change was an increase in calcium and pH.

Table 5. Irrigated HRSW			WREC - Nesson Valley 2018	
Treatment Spent Lime	Plant Height	Protein[1] 2018	Test Weight	Yield 2018
tons/a	inch	%	lb/bu	bu/a
0	23	18.6	58.8	70.9
2.5	23	18.7	59.2	74.3
5	22	18.8	58.7	70.9
10	23	18.6	59.1	72.1
15	22	18.9	58.8	71.4
20	22	18.8	58.8	66.7
Mean	22.6	18.7	58.9	71.1
C.V.%	4.7	2.7	0.9	10.2
LSD .10	n.s.	n.s.	n.s.	n.s.
Planted: 5/7/2018				Harvested: 8/31/2018
Protein[1] = reported on an as is moisture basis				

Year 4 Results

Sugarbeet was planted May 6, 2019. Stand counts were taken after emergence and no differences observed between the treatments. No visual differences in crop growth were observed throughout the growing season. Root samples were taken from ten feet of row in each plot on September 23. Stand counts, percent sugar, and yields were measured for each treatment from these samples. No significant differences (P<0.1) were observed between sugar percent, yield and recoverable sugar among treatments. Moisture readings were taken from each plot throughout the growing season to measure available soil moisture and to identify if the addition of lime influenced these moisture readings in any way. In this particular location the water holding capacity of the soil has not changed with the addition of lime.

Sugarbeet (September 23)			WREC - Nesson Valley 2019	
Treatment Spent Lime	Plant Stand	Sugar 2017	Yield 2017	Recoverable Sugar
tons/a	beets/10ft	%	ton/a	lb/a
0	16	17.8	33.3	11850
2.5	17	17.7	31.9	11297
5	15	17.6	34.4	12096
10	14	17.7	35.7	12596
15	15	17.5	34.7	12136
20	15	17.5	32.7	11427
Mean	15.1	17.6	33.8	11900.1
C.V.%	10.6	2.1	10.2	9.1
LSD 10%	1.9	n.s.	n.s.	n.s.



On-Farm Evaluation of Micronutrients on Sugarbeet Root Yield, Sugar Content, and Sugar Quality EARC, Sidney, MT

Chengci Chen, Apurba Sutradhar, Bill Frank, Rebecca Garza, Calla Kowatch-Carlson, Thomas Gross, Ronald Brown, W. Tanner Stevens, and Sooyoung Frank

Materials and Methods:

Locations: Crane, Culbertson and Sidney
Plot size: 12”W x 30”L
Experimental design: Randomized Complete Block
Tillage: No-till
Replications: 4

Table 1. Treatments structure. All micronutrient products were foliar sprayed. Treatment 3 was applied about a month before final sampling for sugarbeet root yield and quality measurements.

Trt no.	Product name	Rate / product description
1	Check	No micronutrient products were applied
2	Sugar Mover (early)	@ 2.0 quart/ac. Contains nitrogen (3.0%), boron (8.0%), and molybdenum (0.004%).
3	Sugar Mover (Late)	@ 2.0 quart/ac. Contains nitrogen (3.0%), boron (8.0%), and molybdenum (0.004%).
4	Harvest More Urea Mate	@ 2.5 lb/ac. Contains nitrogen (5.0%), available phosphate (P_2O_5, 10.0%), soluble potash (K_2O, 27.0%), calcium (4.0%), magnesium (1.5%), boron (0.15%), cobalt (0.008%), copper (0.3%), manganese (0.5%), molybdenum (0.008%), and zinc (0.5%).
5	Stroller Grow	@ 16.0 oz/ac. Contains nitrogen (4.0%), soluble potash (3.0%), copper (0.4%), magnesium (0.5%), manganese (0.4%), and zinc (1.6%).
6	Bio-Forge Advanced	@ 1.0 pint/ac. Contains nitrogen (3.0%), soluble potash (1.0%), cobalt (1.0%), and molybdenum (1.0%).
7	EDTA-Mg	@ 1.0 lb Mg/ac.
8	EDTA-Zn	@ 0.8 lb Zn/ac.

Table 2: Initial soil test results. Composite soil samples were collected on in the spring before sugarbeet planting from 12 inch depth.

Site	pH	OM	NO_3-N	P-Olsen	K	Ca	Mg	Na	Zn	Fe	Mn	Cu	B	CEC
		%	---------- ppm ----------											meq/100g
Crane	8.3	2.3	17.5	17	159	5158	554	162	0.81	7.5	2.39	1.06	0.9	31.5
Culbertson	8.3	2.4	12.5	8	157	4421	450	116	1.07	11.9	1.84	0.93	0.9	26.8
Sidney	8.1	1.5	17.5	34	158	3537	317	46	1.28	9.1	3.17	0.57	0.8	20.9

Results: Interactions between sites and all measured parameters were significant. Therefore, results are presented separately for each site.

Table 3. Sugarbeet stand, root yield, sucrose concentration, and sugar quality at Crane.

Treatment No.	Plant stand (ac)	Root yield (ton/ac)	Sucrose (%)	Sucrose Yield (lb/ac)	Impurity value	SLM (%)	Ext. sucrose yield (lb/ac)
1	38115	25.5	15.5	7934	0.55	0.82	7525
2	40838	25.8	15.3	7946	0.55	0.83	7522
3	49005	24.2	15.7	7590	0.52	0.78	7212
4	43841	28.9	15.2	8817	0.60	0.89	8299
5	39476	30.3	15.5	9378	0.59	0.88	8850
6	40838	28.2	15.3	8647	0.55	0.83	8180
7	40838	28.2	15.4	8639	0.61	0.91	8125
8	39476	27.9	15.3	8525	0.49	0.74	8118
Mean	41452	27.4	15.4	8435	0.56	0.84	7979
P -value	0.37	0.47	0.75	0.59	0.40	0.4	0.66
CV	15.3	14.7	2.47	15.3	13.6	13.6	15.7
LSD (0.05)	9551	5.93	0.56	1900	0.11	0.18	1840

Table 4. Sugarbeet stand, root yield, sucrose concentration, and sugar quality at Culbertson.

Treatment No.	Plant stand (ac)	Root yield (ton/ac)	Sucrose (%)	Sucrose Yield (lb/ac)	Impurity value	SLM (%)	Ext. sucrose yield (lb/ac)
1	47644	35.8	16.2	11562	0.60	0.90	10939
2	46283	39.1	16.0	12542	0.53	0.80	11920
3	43560	40.5	15.4	12452	0.53	0.80	11803
4	49005	36.8	15.9	11658	0.50	0.75	11107
5	54450	39.7	16.0	12636	0.60	0.90	11936
6	49005	39.0	15.9	12357	0.51	0.76	11766
7	47644	34.3	16.2	11697	0.60	0.90	11051
8	46283	41.5	15.5	12840	0.43	0.65	12293
Mean	47984	38.3	15.9	12235	0.54	0.80	11620
P -value	0.44	0.33	0.14	0.96	0.30	0.30	0.96
CV	16.7	16.6	2.84	16.2	19.30	19.30	16.3
LSD (0.05)	11770	9.38	0.68	2985	0.16	0.23	2856

Table 5. Sugarbeet stand, root yield, sucrose concentration, and sugar quality at Sidney.

Treatment No.	Plant stand (ac)	Root yield (ton/ac)	Sucrose (%)	Sucrose Yield (lb/ac)	Impurity value	SLM (%)	Ext. sucrose yield (lb/ac)
1	49005	33.4	14.6	9775	0.67	1.00	9111
2	46283	41.4	15.3	12663	0.60	0.91	11909
3	44921	40.9	15.0	12224	0.62	0.93	11465
4	49005	36.7	14.9	10949	0.66	0.99	10219
5	47644	37.3	14.7	10993	0.66	1.00	10251
6	51728	33.8	15.2	10214	0.61	0.91	9592
7	47644	35.3	14.6	10354	0.67	1.00	9650
8	54450	39.4	15.0	11857	0.66	1.00	11059
Mean	48834	37.3	14.9	11129	0.64	0.97	10407
P -value	0.86	0.54	0.50	0.40	0.24	0.24	0.36
CV	18.6	17.6	3.54	17.6	7.21	7.21	17.5
LSD (0.05)	13382	9.64	0.78	2882	0.07	0.10	2671

Fall and Spring Nitrogen Application and Foliar Application of Magnesium and Zinc to Improve Sugarbeet Yield and Sugar Content in Conventional Tilled and No-Till Managements EARC, Sidney, MT

Chengci Chen, Apurba Sutradhar, Bill Frank, Rebecca Garza, Calla Kowatch-Carlson, Thomas Gross, Ronald Brown, W. Tanner Stevens, and Sooyoung Frank

Material and Methods:

Irrigated

Location: EARC
Planted: 4/24/2019
Tillage: Conventional and no-till
Plot size: 24”W x 30”L
Variety: Crystal S696 GEM 100
Experimental design: Randomized Complete Block

Mg and Zn rates: Mg @ 1.0 lb/ac and Zn @ 0.8 lb/ac foliar applied once

Rainfall: 10.4”

Previous crop: Spring Wheat
Harvested: 9/24/2019
Soil type: Williams Clay Loam
Row spacing: 2 ft.
Replications: 4
N rates: 120, 160, and 200 lb. N/ac applied in fall 2018 and in spring 2019
Herbicide: Powermax @ 24 oz/ac on 5/23/2019, 6/10/2019, and 6/24/2019. To control cercospora leaf spot, Inspire XT was aerial sprayed @ 8.5 oz/ac on 8/28/2019
Irrigation: 9.81”

Table 1. Initial soil test results. Composite soil samples were collected from conventional tillage (CT) and no-till (NT) managements from 12 inch depth in the spring before sugarbeet planting.

Mgt	pH	OM	NO_3-N	P-Olsen	K	Ca	Mg	Na	Zn	Fe	Mn	Cu	B	CEC
		%	ppm											meq/100g
CT	8.2	3.7	38.0	17	431	6050	615	148	0.57	8.1	6.08	1.18	1.8	37.1
NT	8.3	3.3	32.0	15	351	6209	614	156	0.54	8.5	5.74	1.33	1.8	37.7

Table 2: Sugarbeet stand, root yield, sucrose concentration, and sucrose yield as affected by tillage, N application timing, and fertilizer treatments.

Experimental Factor	Treatments	Stand (ac)	Root Yield (ton/ac)	Sucrose (%)	Sucrose Yield (lb/ac)
Tillage	Conventional	40888 A	37.9 B	16.3	12374 B
	No-till	34082 B	41.7 A	16.2	13540 A
N application Timing	Fall	37258	39.7	16.3	12923
	Spring	37712	39.9	16.3	12931
Fertilizer Treatment	120 N	39249	38.2	17.1 a	13013
	120 N + Mg	40611	39.3	16.1 bcd	12636
	120 N + Zn	38342	36.1	16.4 bc	11833
	160 N	35166	40.7	16.6 ab	13491
	160 N + Mg	35166	42.7	15.8 d	13500
	160 N + Zn	36300	37.8	16.2 bcd	12280
	200 N	37434	39.8	16.3 bcd	12985
	200 N + Mg	37661	43.7	15.9 cd	13964
	200 N + Zn	37434	40.0	16.2 bcd	12909
Sources of Variation		P > F			
Tillage		<0.01	<0.01	0.47	<0.01
Timing		0.68	0.84	0.79	0.85
Treatment		0.32	0.02	<0.01	0.16
Tillage*Timing		0.55	0.09	0.01	0.47
Tillage*Treatment		<0.01	0.83	0.80	0.83
Treatment*Timing		0.46	0.49	0.97	0.60
Tillage*Timing*Treatment		0.25	0.93	0.33	0.84

Results:

Table 3: Sugarbeet stand, root yield, sucrose concentration, and sucrose yield as affected by seed treatments.

Treatments	Stand	Root Yield	Sucrose	Sucrose Yield
	--ac--	--ton/ac--	--%--	--lb/ac--
Plain Talc	53543	40.9	16.7	13713
Micro Talc	59895	41.9	17.2	14406
Micro Talc + SB MicroSurge	50820	37.1	16.9	12548
Micro Talc + Inceptive	62618	39.5	16.8	13319
Micro Talc + Encompass	62618	37.5	17.1	12838
Micro Talc + SB MicroSurge + Inceptive	61710	42.0	16.9	14218
Micro Talc + Encompass + Inceptive	48097	39.2	16.8	13235
EDTA-Mg	51728	40.1	16.7	13379
EDTA-Zn	61710	36.7	16.9	12418
Mean	56970	39.4	16.9	13342
P > *F*	0.08	0.15	0.74	0.19
CV (%)	14.3	7.86	2.36	8.24
LSD (0.05)	11911	4.52	0.58	1605

Table 4: Sugarbeet quality as affected by seed treatments.

Trt. No.	Concentration in Extract			Concentration in Sugarbeet			IV	SLM	Extract	Ext. Sucrose
	Na	K	Amino-N	Na	K	Amino-N				
	---------- ppm ----------							---------%---------		--lb/ac--
1	53.2	209	14.6	417	1637	115	0.66	1.00	94.0	12900
2	35.4	164	14.3	278	1289	112	0.53	0.79	95.4	13745
3	44.8	201	16.6	352	1573	130	0.64	0.96	94.3	11837
4	43.9	204	15.7	344	1599	124	0.64	0.96	94.3	12567
5	42.4	181	13.7	333	1416	108	0.57	0.86	95.0	12621
6	44.6	197	14.3	350	1545	112	0.62	0.92	94.5	13442
7	45.7	196	16.1	359	1539	126	0.63	0.95	94.3	12498
8	42.7	205	13.5	335	1606	106	0.62	0.93	94.4	12631
9	43.1	197	17.7	338	1542	139	0.64	0.95	94.4	11718
Mean	44.0	195	15.2	345	1531	119	0.62	0.93	94.5	12663
P > *F*	0.27	0.02	0.93	0.27	0.02	0.93	0.29	0.29	0.39	0.21
CV (%)	17.8	7.96	28.9	17.8	7.96	28.9	11.0	11.0	0.77	8.56
LSD (0.05)	11.7	23.1	6.55	91.5	182	51.4	0.10	0.15	1.08	1614

Note: IV, impurity value; SLM, sucrose loss to molasses; Ext. Sucrose, Extractable sucrose.

Determination of the Efficacy of the Talc Products in Enhancing Sugarbeet Yield and Sucrose Concentration EARC, Sidney, MT

Chengci Chen, Apurba Sutradhar, Bill Frank, Rebecca Garza, Calla Kowatch-Carlson, Thomas Gross, Ronald Brown, W. Tanner Stevens, and Sooyoung Frank

Materials and Methods:

Irrigated

Location: EARC
Planted: 4/24/2019
Tillage management: Conventional
Experimental design: Randomized Complete Block
Fertilizers: 150 lb N/ac + 40 lb P_2O_5/ac applied in fall 2019

Rainfall (Apr – Aug): 10.40”
Irrigation: 14.16”

Previous crop: Wheat
Harvested: 9/24/2019
Plot size: 12” x 30”, alley: 5”
Replications: 4
Herbicide: Powermax @ 24 oz/ac on 05/23/2019, 06/10/2019, and 06/24/2019 and Inspire XT @ 8.5 oz/ac on 08/28/2019 as aerial application.
Soil type: Williams Clay Loam

Table 1: Treatment description.

No.	Product	Description
1	Plain Talc	No nutrients
2	Micro Talc	0.7% iron and 0.9% manganese by volume
3	Micro Talc + SB MicroSurge	SB MicroSurge contains two strains of *Azospirillum Brasiliense* that increase nitrogen availability.
4	Micro Talc + Inceptive	Inceptive is a harpin protein immune system booster.
5	Micro Talc + Encompass	Encompass incorporates five microbial inoculants that fix nitrogen and mobilizes phosphorus.
6	Micro Talc + SB MicroSurge + Inceptive	--
7	Micro Talc + Encompass + Inceptive	--
8	EDTA-Mg	0.11 oz actual magnesium mixed with 2.2 lbs sugarbeet seeds
9	EDTA-Zn	0.11 oz actual zinc mixed with 2.2 lbs sugarbeet seeds

Note:
Treatments 1-7: 1/8 teaspoon talc products mixed with 400 seeds
Seeds were treated before planting.

Table 2: Initial soil test results. A composite soil sample was collected before planting sugarbeet.

Depth	pH	OM	NO_3-N	P-Olsen	K	Ca	Mg	Na	Zn	Fe	Mn	Cu	B	CEC
Inch		%	----------	----------	----------	ppm	----------	----------	----------	----------	----------	----------	----------	meq/100g
0-12	8.1	3.0	50.0	24	325	6217	534	105	0.82	6.8	6.31	1.12	1.4	36.8

Results:

Table 3: Sugarbeet stand, root yield, sucrose concentration, and sucrose yield as affected by seed treatments.

Treatments	Stand	Root Yield	Sucrose	Sucrose Yield
	--ac--	--ton/ac--	--%--	--lb/ac--
Plain Talc	53543	40.9	16.7	13713
Micro Talc	59895	41.9	17.2	14406
Micro Talc + SB MicroSurge	50820	37.1	16.9	12548
Micro Talc + Inceptive	62618	39.5	16.8	13319
Micro Talc + Encompass	62618	37.5	17.1	12838
Micro Talc + SB MicroSurge + Inceptive	61710	42.0	16.9	14218
Micro Talc + Encompass + Inceptive	48097	39.2	16.8	13235
EDTA-Mg	51728	40.1	16.7	13379
EDTA-Zn	61710	36.7	16.9	12418
Mean	56970	39.4	16.9	13342
P > *F*	0.08	0.15	0.74	0.19
CV (%)	14.3	7.86	2.36	8.24
LSD (0.05)	11911	4.52	0.58	1605

Table 4: Sugarbeet quality as affected by seed treatments.

Trt. No.	Concentration in Extract			Concentration in Sugarbeet			IV	SLM	Extract	Ext. Sucrose
	Na	K	Amino-N	Na	K	Amino-N				
	---------- ppm ----------							---------%---------		--lb/ac--
1	53.2	209	14.6	417	1637	115	0.66	1.00	94.0	12900
2	35.4	164	14.3	278	1289	112	0.53	0.79	95.4	13745
3	44.8	201	16.6	352	1573	130	0.64	0.96	94.3	11837
4	43.9	204	15.7	344	1599	124	0.64	0.96	94.3	12567
5	42.4	181	13.7	333	1416	108	0.57	0.86	95.0	12621
6	44.6	197	14.3	350	1545	112	0.62	0.92	94.5	13442
7	45.7	196	16.1	359	1539	126	0.63	0.95	94.3	12498
8	42.7	205	13.5	335	1606	106	0.62	0.93	94.4	12631
9	43.1	197	17.7	338	1542	139	0.64	0.95	94.4	11718
Mean	44.0	195	15.2	345	1531	119	0.62	0.93	94.5	12663
P > *F*	0.27	0.02	0.93	0.27	0.02	0.93	0.29	0.29	0.39	0.21
CV (%)	17.8	7.96	28.9	17.8	7.96	28.9	11.0	11.0	0.77	8.56
LSD (0.05)	11.7	23.1	6.55	91.5	182	51.4	0.10	0.15	1.08	1614

Note: IV, impurity value; SLM, sucrose loss to molasses; Ext. Sucrose, Extractable sucrose.

Effect of Date and Rate of Planting on Mung and Adzuki Beans Growth and Yield EARC, Sidney, MT

Fatemeh Etemadi, Chengci Chen, William Franck, Thomas Gross, Rebecca Garza, and Calla Kowatch-Crlson

OBJECTIVE: Find the best date and rate of planting for Mung and Adzuki Beans in Montana

MATERIALS AND METHODS:

Irrigated (sprinkler)

Location: Sidney, MT	Planted: 05/14/2019
Mung Bean Variety: Organic, L.N.	Harvested: 09/25/2019
Adzuki Bean Variety: Organic, O.R.	Soil type: Clay loam
Plot size: 5.5' x 15'	Precipitation April – September 2019 = 21.13"
Applied Fertilizer: None	Chemical Applications: Outlook
Treatments:	
Seeding date 1: 05/20/2019	
Seeding date 2: 05/30/2019	
Seeding rate 1: 8 s/ft^2	
Seeding rate 2: 12 s/ft^2	

RESULTS: Different date of planting caused the significant differences on yield and yield components. Mid-May planting of Mung and Adzuki Beans, better than planting late to produce higher yield. Different Rate of planting did not show significant differences on seed yield. So, planting with higher than 8 plants/ft^2 does not improve the seed yield. Further study will be conducted with lower seeding rate to optimize the best seeding rate for Mung and Adzuki Beans.

Table 1: Date of planting effect on seed yield and components of Mung Beans

Treatment (Date of planting)	Seed Yield (lb/ac)	Pod#/Plant	Seed#/Pod	1000 seed wt. (g)
Seeding date 1	1656a	5.9a	10.9a	63.4a
Seeding date 2	1117b	4.8a	10.9a	55.3b
Mean	1387	5.4	11	59.3
CV (%)	32	26.5	9.2	14.1
LSD (0.05)	384.4	1.2	0.8	7.1
Letters in common did not differ significantly according to a t-test at a significance level of 5%.				

Table 2: Date of planting effect on seed yield and components of Adzuki Beans

Treatment (Date of planting)	Seed Yield (lb/ac)	Pod#/Plant	Seed#/Pod	1000 seed wt. (g)
Seeding date 1	1458a	6.2a	7.3a	84a
Seeding date 2	1071b	5.5a	7.2a	63b
Mean	1264	5.9	7.2	74
CV (%)	30.5	17.3	15.8	14.1
LSD (0.05)	329.3	0.9	1.0	8.9
Letters in common did not differ significantly according to a t-test at a significance level of 5%.				

Effect of Fertility and Rhizobium on Mung and Adzuki Beans Nitrogen Fixation

EARC, Sidney, MT

Fatemeh Etemadi, Chengci Chen, Calla Kowatch-Carlson, Thomas Gross, Rebecca Garza, and William Franck

OBJECTIVE: Testing if combination of fertilizer and rhizobium can increase nitrogen fixation and seed yield of Mung and Adzuki Beans

MATERIALS AND METHODS:
Mung Bean Variety: Organic, L.N.
Adzuki Bean Variety: Organic, O.R.
Location: Sidney, MT
Planted: 05/14/2019
Harvested: 09/25/2019
Plot Size: 5.5' x 15'
Seeding Rate: 12 s/ft²
Soil Type: Clay Loam

Irrigated (sprinkler)
Chemical Applications: Sonalan
Precipitation April – September, 2019: 21.13 in.
Treatments:

(1) 100lb/ac (20-20-20),
(2) 100 lb/ac (20-20-20) + 100 lb/ac (46-0-0),
(3) 100 lb/ac (20-20-20) + 100 lb/ac (46-0-0) + Rhizobium,
(4) 100 lb/ac (20-20-20) + Rhizobium,
(5) Rhizobium

RESULTS: At full rate of fertilizer with rhizobium, Mung Beans yield was higher than Adzuki Beans. Applying fertilizer make significant differences among treatments. Applying full fertilizers (100lb/ac of 20-20-20 plus 100lb/ac of 46-0-0) with rhizobium to the seeds, produced the highest seed yield in both Beans following by applying both fertilizer without inoculation, 100 lb of 20-20-20 with inoculation, 100lb of 20-20-20, and just inoculation. It showed that application of just rhizobium is not enough and the combination with fertilizer could produce higher seed yield. The study will be repeated to optimize the fertility needs of Mung and Adzuki Beans.

Table 1: Fertility and Rhizobium effect on seed yield and components of Mung Beans

Treatment	Seed Yield (lb/ac)	Pod#/Plant	Seed#/Pod	1000 seed wt. (g)
1	1113c	6.1b	11.1b	66.9b
2	1900ab	7.9a	11.0b	83.3a
3	2171a	6.9ab	13.5a	85.4a
4	1602b	6.7b	12.8a	70.6b
5	882c	3.6c	8.1c	49.9c
Mean	1534	6	11	71
CV (%)	23.4	15.2	9.7	10.2
LSD (0.05)	321	1.1	1.3	8.7

Letters in common did not differ significantly according to a t-test at a significance level of 5%.

Table 2: Fertility and Rhizobium effect on seed yield and components of Adzuki Beans

Treatment	Seed Yield (lb/ac)	Pod#/Plant	Seed#/Pod	1000 seed wt. (g)
1	1009bc	6.2c	6.8a	75.6ab
2	1131ab	12.2ab	7.3a	76.6ab
3	1388a	13.7a	7.5a	88.4a
4	1053bc	9.0bc	7.1a	76.3ab
5	863c	5.8c	7.1a	71.8b
Mean	1089	9.4	7.2	77.8
CV (%)	33.4	36.6	11.2	15.6
LSD (0.05)	252.8	4.1	1	14.5

Letters in common did not differ significantly according to a t-test at a significance level of 5%.

Dryland and Irrigated Horticultural Crops Research Update

By: Kyla Splichal

Horticulture in 2019

"If you want to be happy for a lifetime, plant a garden."
-Chinese proverb

The summer of 2019 is here and gone-just like that. I ask myself every year where did the summer go? But the answer remains: time flies when you're having fun especially with the summer staff who work so hard to make the WREC horticulture gardens and landscapes look their absolute best. In addition to the returning folks, two new staff members joined the horticulture fun, one of which who had the opportunity of working alongside her mother, and the other who followed in her big sister's footsteps. I appreciate their hard work and dedication. I certainly could not do this job without them.

This year's weather patterns have undoubtedly been a lively topic of conversation. Winter began in its usual form with somewhat milder temps and little to no snow fall. It was looking like we were in the clear for any major snow storms-that is until the New Year began. Spring was a welcome relief to western North Dakota after the brutal subzero temperatures, and relentless snowfall events that seemed to never end in the months of January and February. Mother Nature had yet a few more surprises throughout the season, however, with relatively low growing degree days recorded from NDAWN at 2051 from May 1 through October 1 (base of 50), and a record rainfall of 7.9 inches in the month of September- making harvest extremely difficult to impossible for farmers in the region.

All-America Selection Garden

This year, we planted 20 different varieties of All-America Selection flowers and nearly 50 vegetable varieties. Due to the low growing degree days, some of the vegetables performed under par compared to others, but all in all over 700 pounds of produce was collected from the garden. 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

Haskap, also known as the Honeyberry (*Lonicera* caerulea) is an edible fruiting shrub belonging to the Honeysuckle family. The fruits are unique in that they are oval to oblong shaped, and bluish to purple in color. In the early 2000's, several cultivars have come out of two primary breeding programs, Dr. Bob Bors with the University of Saskatchewan and Dr. Maxine Thompson with Oregon State University, and are now available to home gardeners (See Table 1 for WREC cultivar trial information).

Haskap flowers are not self-compatible and do require a pollinator or companion plant in order to outcross and set fruit. In most cases the breeders have produced and released cultivars in pairs or series. See Table 1. Pollination information to see which cultivars coordinate with one another in the WREC trials.

Hops

The hop research program was started in 2014 as a result of a Specialty Crop Block Grant (SCBG) award to conduct a variety trial. In the fall of 2016, WREC was awarded a continuation SBCG to look at management practices on the established hop yards. Early, mid and late spring stringing dates were evaluated in 2017-2018. The 2019 growing season marked the 5th year of hops research through NDSU. The 5 year trend in overall yield can be found in in Figure 1. Significant differences were shown in all three effects, cultivar, year and cultivar by year interaction (Table 2.).

The stringing trial was conducted in 2017 and 2018 which impacted yields in those years. The overall trend in 2017 appears to be a reduction in yields with the exception of the cultivars 'Zeus' and 'Galena'. (Figure 1.). The cultivars with the lowest overall yields in 5 years were 'Mt. Hood' and 'Spalt Select' (Table 3.).

Master Gardener Pollinator Garden

Williams County and WREC received additional funds through the Extension Master Gardener Pollinator Garden Grants for the continued maintenance of the garden. This year we planted a 'Red Splendor' Crabapple tree. 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.

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/). See Table 4 for species and cultivar information.

High Tunnel

In the fall of 2017, 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 how far Northern growers could go into the off-season using appropriate vegetable crops. Crops chosen for this research were spinach and kale cultivars for the off season (early spring and late fall) and beans and basil cultivars for the regular growing season (summer). Frost preventative tools such as low tunnel row covers and soil heating cables were used to evaluate the environmental influences on each crop. Data from this trial is being collected and will be evaluated at the conclusion of the study.

Table 1. Williston haskap cultivar trial information

Cultivar name	Avg. berry size g	Flavor	Bloom time	Ancestry Country of origin	Breeder	Pollination information
Aurora	2.2	Sweet	Early-mid	Japan/Russia	BB[1]	Pollinator for Borealis, Tundra, Indigo varieties
Berry Smart Blue	0.8	Tart/sweet	Mid-Late	Russia	Jim Gilbert	Pollinates “Indigo” varieties
Boreal Beauty	2.6	Sweet	Mid-Late	Japan/Russia/Kurile	BB	Pairs with other "Boreal" varieties
Boreal Blizzard	2.8	Sweet	Mid-Late	Japan/Russia	BB	Pairs with other "Boreal" varieties
Indigo Gem	1.3	Sweet/tangy	Early	Japan/Russia/Kurile	BB	Needs a pollinator like Berry Smart Blue or Honeybee
Indigo Treat	1.4	Sweet	Early	Japan/Russia/Kurile	BB	Needs a pollinator like Berry Smart Blue or Honeybee
Sugar Mountain® Blue	--	Sweet	Early	Czech Republic	Frantisek Krejci	Pairs with Sugar Mountain®Eisbar
Sugar Mountain® Eisbar	--	Sweet/tangy	Early	Czech Republic	Kordes Jungpflanzen	Pairs with Sugar Mountain®Blue
Yesberry®Solo	1.8	Sweet/tangy	Late	Japan	MT[2]	Pairs with Maxie or other Yezberry® variety
YezBerry®Honey Bunch	1.6	Sweet	Late	Japan	MT	Pairs with other Yezberry® variety
Yezberry® Maxie	2.0	Sweet/tangy	Late	Japan	MT	Pairs with Solo or other Yezberry® variety
Yezberry® Sugar Pie	1.8	Sweet	Late	Japan	MT	Pairs with other Yezberry® variety

[1]BB = Dr. Bob Bors-University of Saskatchewan breeding program
[2]MT = Dr. Maxine Thompson- Oregon State University

Table 2. P values for 5 year mean yield of hop trial conducted from 2015-2019.

Effect	df	Yield ---Probability > F---
Cultivar	11	0.0001
Year	4	0.0153
Cultivar * year	44	<.0001

Table 3. Williston hop trial cultivar information.

Cultivar	Origin[1]	Brew Usage[2]	Typical Beer Style	Typical Alpha Acid Ranges	2018 Tested Alpha Acid[3]	2018 Harvested Moisture	2018 Hop Storage Index[4]	Yield 5 year Avg.
				----------%----------				g/plant
Brewer's Gold	UK	B	Ale	8-10	3.3	74	0.22	1249
Cascade	DM	A	American Pale Ale	5-7	5.0	75	0.34	1080
Centennial	DM	D	American Pale Ale	9.5-11	8.1	73	0.25	1037
Challenger	UK	D	English Ale	6.5-9	6.2	79	0.20	1869
Galena	DM	B	English Ale	10-15	6.7	77	0.10	1831
Glacier	DM	D	American Pale Ale	5.5	2.6	77	0.16	933
Mt. Hood	DM	A	Lager	4-7	2.2	74	0.17	450
Newport	DM	B	Barley Wine	13-17	6.2	78	0.24	940
Nugget	DM	B	Barley Wine	12-14	9.1	71	0.21	958
Spalt Select	GE	A	Bock	3-6.5	2.7	73	0.26	423
Willamette	DM	A	English Style Ale	4-6	2.9	76	0.28	774
Zeus	DM	B	Pale Ale	20	3.0	78	0.15	1924

[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 adjusted 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.

Figure 1. Hop cultivar average yields over five years

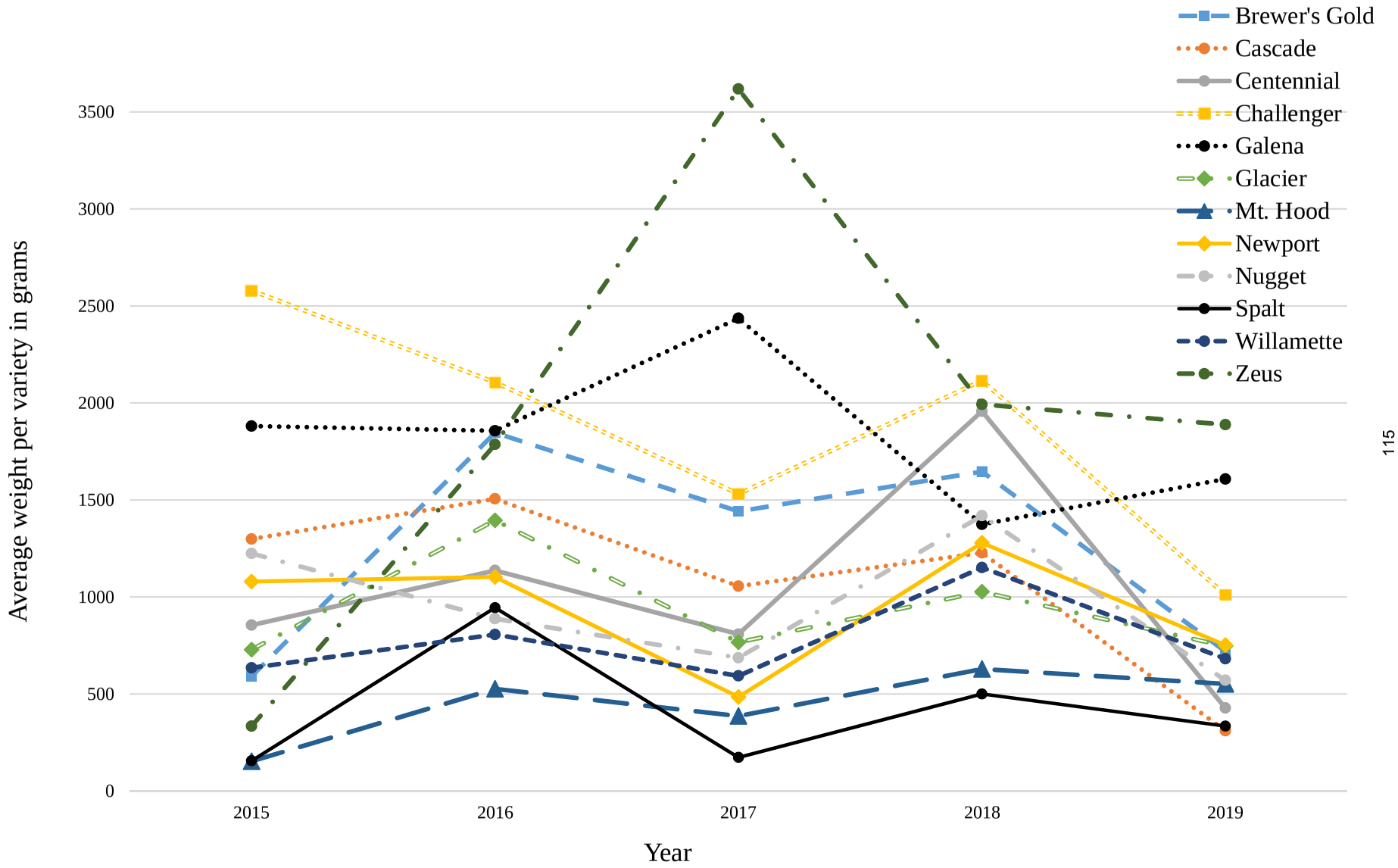


Table 4. Western Tree Trial cultivars

(*) Indicates survival as of summer 2019

Maples:
- Commemoration® sugar maple
- Fall Fiesta® sugar maple
- Firefall™ freeman maple*
- Hot Wings® Tartarian maple*
- Northwood red maple
- Princeton Gold® Norway maple
- Red November™ Amur maple*
- Royal Red Norway maple
- Silver Queen silver maple*
- Unity® sugar maple

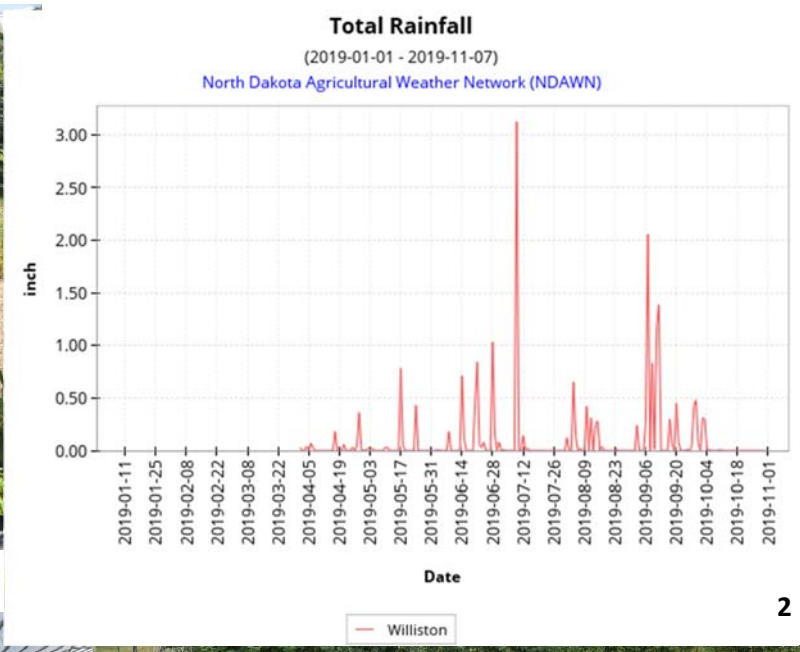
Elms:
- New Horizon hybrid elm*
- Patriot elm*
- Prairie Expedition® elm*
- Princeton American elm*
- Valley Forge American elm*

Oak:
- Chinkapin oak
- Crimson Spire® hybrid oak
- Majestic Skies™ northern pin oak*
- Prairie Stature™ hybrid oak
- Regal Prince® hybrid oak
- Swamp white oak*
- Urban Pinnacle® bur oak

Crabapple:
- Red Baron crabapple*
- Gladiator™ crabapple*
- Ivory Spear™ crabapple*
- Marilee® crabapple*
- Pink Spires crabapple*

Other species:
- Mountain Sentinel® aspen*
- Prairie Gold® aspen*
- Prairie Dream® paper birch*
- Purple Robe black locust
- Homestead buckeye
- Sutherland caragana*
- Heartland® catalpa
- Espresso™ Kentucky coffee tree
- Eye Stopper™ cork tree phellodendron*
- His Majesty™ cork tree phellodendron
- Autumn Gold ginko biloba
- Prairie Sentinel® hackberry*
- Northern Acclaim® honeylocust*
- Street Keeper® honeylocust
- Ivory Pillar™ Japanese tree lilac*
- Boulevard American linden
- Harvest Gold Mongolian linden
- Amur maackia
- MaacNificent® maackia*
- Ironwood (Ostrya)
- Mountain Frost® pear
- Spring Wonder™ Sargent cherry*

1



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7

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Photos from top right clockwise: 1. 2019 Horticulture staff from left to right: back row Corynna Turnquist, Tayder Jones and Ann Reinke. Front row Rojee Pradhan, Kyla Splichal and Grisha Pradhan; 2. Summarization of rain fall Williston; 3. All-America Selections display; 4. High tunnel at Nesson Valley; 5. Haskap berries; 6. Hop cones; 7. Summer staff in action.

WREC Foundation Seed Increase Update

NDSU Williston Research Extension Center

Kyle Dragseth, David Weltikol, Kelly Stehr, and Jerry Bergman

Well another year came and went and the future outlook for agriculture is shaky at best. With input prices rising and commodity prices hanging at the lowest prices in decades, there isn't a lot of optimism in the industry. However, we can help here at the Williston Research Extension Center. NDSU prides itself on truly caring about the state Ag economy and individual producers profitability. That is why NDSU has released 2 new durum varieties, ND Riveland & ND Grano, both with outstanding yields, low cadmium uptake, good quality, and good straw strength. ND Riveland had the highest yields and lowest Fusarium head blight and DON accumulation in variety testing plots across the state.

Another big way in which NDSU is striving to help producers is by 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 input costs for soybean production is considerably cheaper than the private industry. Which really helps with the current downtrend in soybean prices and to make them profitable further west is drier climates.

There is also a new NDSU chickpea (Crown) and a new NDSU yellow pea on the horizon for availability in 2021.

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.

HRWW	**HRSW**	**Durum**	**Soybeans**	**Lentils**	**Peas**	**Oats**
Ray	Bolles	ND Riveland	ND17009GT	Avondales	Hampton (green)	Paul
	ND Vit-pro	ND Grano				
	Lanning	Lebsock				
	Mott	Carpio				
		Tioga				
		Divide				

The Capital Campaign
Invest in the Future of Agriculture

Seed Conditioning Facility

A $1.5M capital fundraising campaign has been authorized by the North Dakota Legislative Assembly to fund construction of a new larger capacity seed conditioning facility with modern seed cleaning technology. A larger capacity horizontal handling and seed cleaning system with optical sorting technology is needed to condition and distribute pure seed of new value-added small grain, pulse crop, oilseed, and other specialty crop varieties for our North Dakota and Montana producers.

The current antiquated 5 floor seed conditioning facility at WREC, built in 1954, is the oldest and most outdated seed cleaning facility at the Research Extension Centers. This seed conditioning plant cleans only 35 bushels per hour, and is not suitable for cleaning pulse crops and other fragile seeds that require gentle handling and horizontal seed cleaning equipment and lines. New and improved varieties offer producers opportunities to increase profitability and enhance soil health.

A new seed conditioning facility with 200 bushel per hour capacity, optical sorter technology, and horizontal equipment layout is paramount to enable WREC to provide ample quality seed of new crop varieties to ag producers on a timely basis and transfer the economic and environmental benefits to our producers in North Dakota and Montana.

Multi-Use Greenhouse Facility

The North Dakota Legislative Assembly recently authorized WREC to proceed with a $400,000 fundraising campaign for a WREC greenhouse. The 3,700 sq. ft. facility will include a 37' x 100' greenhouse, (2) zones/environments, ventilation system, evaporative cooling system, rolling benches 5' x 45', and crop lighting.

A WREC greenhouse facility will allow 1) the horticultural staff to conduct research on greenhouse crop production of fruits and vegetables 2) our plant pathologist to conduct new types of applied plant pathology research and fungicide efficacy testing 3) allow agronomic greenhouse studies on seed/seedling quality and plant.

The Capital Campaign Wall of Honor will be displayed in the entrance of the Ernie French Center

Leadership	$25,000+
Major	$15,000-$24,999
Special	$10,000-$14,999
Patron	$5,000-$9,999
Contributor	$1,000-$4,999
Supporter	$100-$999

Your gift to the seed conditioning plant facility and/or a greenhouse facility campaign is an investment in the economic improvement of agricultural crop for western North Dakota and eastern Montana. Anyone wishing to contribute is invited to contact the Williston Research Extension Center.

Checks should be made payable to the NDSU Development Foundation with the memo 'WREC Capital Campaign.' Contributions to the Development Foundation are deductible under Sections 170 (c) and 501 (c) (3) of the Internal Revenue Code.

Williston Research Extension Center
14120 Highway 2
Williston, ND 58801

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Upcoming Events for 2020

January 14	Diversity Direction & Dollars – Ramada Grand Dakota Lodge – Dickinson
January 27–28	Northern Pulse Growers Assn. (NPGA) Annual Convention – Riverside Holiday Inn – Minot
January 29–31	Ag Expo–North Dakota State Fair Center – Minot
February 4-5	Montana Soil Health Symposium – Billings, MT
February 11–12	Agri International Trade Show – Bismarck Event Center – Bismarck
February 13	National Hard Spring Wheat Show – Raymond Center – Williston
February 14	Best of the Best in Wheat Production in the West – Clarion Hotel – Minot
February 14 -15	GATE – Eastern Plains Event Center – Glendive
February 19	MonDak Pulse Day – Elks Club – Glasgow, MT
February 28	2020 NDFMGA & Local Foods Conference – Baymont Inn & Suites–Mandan
March 12–13	MonDak Ag Days – Richland County Event Center – Sidney
March 10–11	Western Crop/Pest Management School – Dickinson, ND
March 17–18	KATQ Northeast Montana Farm Expo – Plentywood
June 23	MSU–EARC & Sidney ARS Dryland Field Day – Sidney
June 25	Northern Ag Research Center Field Day – Havre
June 24–28	UMVF – Williston
June 30	Southern Ag Research Center Field Day – Huntley
TBD	Dickinson Research Extension Center Field Day – Dickinson
July 8	Williston Research Ext. Center Field Day (4:00 p.m.) – Williston
July 9	Nesson Valley Irrigation Field Day – Nesson Valley
July 9	Northwestern Ag Research Center Field Day – Kalispell
July 10	Hettinger Research Extension Center Field Day – Hettinger
July 13 (estimated)	Agronomy Seed Farm Field Days – Casselton
July 14	MSU Central Ag Research Center Field Day – Moccasin
July 14 (estimated)	Carrington Research Extension Center Field Days – Carrington
July 15	North Central Research Extension Center Field Day – Minot
July 16	MSU Eastern Ag Research Center Field Day – Sidney
July 16–17	MT DRC Summer Conference at MSU–EARC – Sidney
July 18	Langdon Research Extension Center Field Day – Langdon
July 22–30	North Dakota State Fair – Minot
July 30	Western Ag Research Center Field Day – Corvallis
August 5–8	Richland County Fair
October 12	Northeast Montana Ag Expo–Valley Event Center – Glasgow

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