2020 Agricultural Research Update

NDSU Williston Research Extension Center

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MSU Eastern Agricultural Research Center

Serving the MonDak Region

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North Dakota State University
ND Agricultural Experiment Station

MONTANA STATE UNIVERSITY
MONTANA AGRICULTURAL EXPERIMENT STATION

Regional Report No. 26—December 2020

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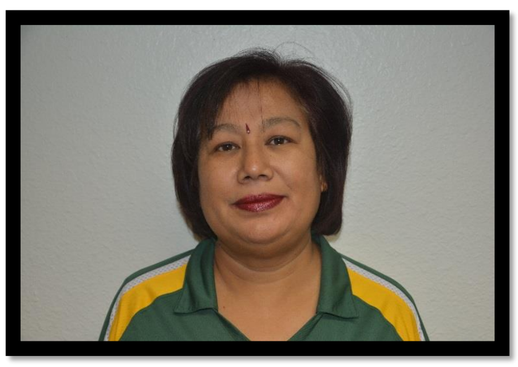
Plant Pathology
Research Specialist



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Horticulture Technician

Tyler Tjelde
Irrigation Scientist

Justin Jacobs
Irrigation Research
Specialist

Andrina Turnquist, Irrigation
Research Specialist

Lynn Staricka
Part-Time Seed
Processing Technician

Karla Quintana-Martinez,
Part-Time Seed
Processing Technician

Nick Birkhimer
Graduate Research Assistant

Employees Not Pictured:
Andrew Wherley,
Graduate Research
Assistant

Current Vacant Positions:

Irrigation Technician-Mechanic

Horticulture Research Specialist

Table of Contents

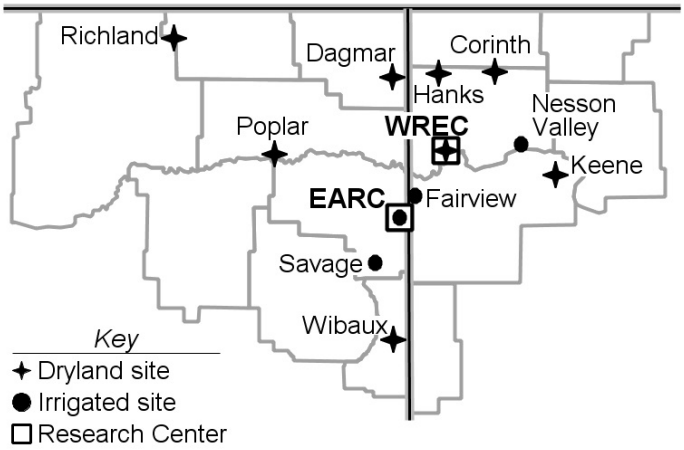
Off-Station Cooperators – Producers – CES Agents

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:
East Fairview - Philip &/or Laurie Hurley
East Fairview - Texas-Red Enterprises, Inc.
Savage - Conradsen Land & Livestock, Inc.

NORTH DAKOTA
SMALL GRAIN--PULSES--OIL SEEDS:
Keene - Beau Wisness - Agent Devon Leo
Corinth - Don Schilke - Agent Travis Binde
Grenora - Lavern Johnson - Agent Travis Binde

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 2020	Precipitation Avg	Temperature 2020	Temperature Avg	*
	- inches -		- degrees F -		
Oct-Dec. 2019	1.68	1.76			
January-March	0.80	1.17			
April	0.11	1.15	36.3	46.0	0
May	0.75	2.22	54.9	57.0	0
June	1.41	2.66	65.7	65.0	3
July	1.99	2.23	70.8	72.0	7
August	0.41	1.54	76.3	71.0	10
September	0.09	1.36	59.2	60.0	0
April-July	4.26	8.26			
April-Sept	4.76	11.16			
Total-Oct 19-Sept 20	7.24	14.09			

*Number of Days over 89° F

Last Spring Frost – May 11, 2020 (24.9° F)

First Fall Frost – October 14, 2020 (28° F)

Weather Summary Sidney, MT

Month	Precipitation 2020	Precipitation Avg	Temperature 2020	Temperature Avg	*
	- inches -		- degrees F -		
Oct-Dec. 2019	1.22	1.84			
January-March	1.29	1.30			
April	0.03	1.13	39.3	44.4	0
May	1.48	2.15	54.9	56.0	0
June	1.10	2.71	64.9	64.6	3
July	1.62	2.08	69.3	70.1	8
August	0.89	1.46	70.4	68.7	11
September	0.30	1.38	57.9	58.0	1
April-July	4.23	8.07			
April-Sept	5.42	10.91			
Total- Oct 19-Sept 20	7.93	14.05			

*Number of Days over 89° F

Last Spring Frost – May 11, 2020 (20.5° F)

First Fall Frost – September 8, 2020 (28.0° F)

Off-Station Precipitation* North Dakota

Site	April	May	June	July	Aug	Total
Beach	0.60	1.13	1.58	1.26	0.90	5.47
Crosby	0.02	1.08	3.37	2.34	0.65	7.46
Nesson Valley	0.13	0.45	2.22	1.73	0.76	5.29
Watford City	0.29	0.97	2.42	2.22	0.86	6.76

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

Off-Station Precipitation* Montana

Site	April	May	June	July	Aug	Total
Dagmar	.01	1.55	1.70	2.14	0.28	5.68
E Fairview	0.14	1.63	1.25	1.96	1.02	6.00
Poplar	0.24	1.59	3.21	2.34	0.34	7.72
Richland	0.11	1.55	3.52	1.92	0.10	7.20
Savage	0.33	1.19	2.60	2.70	NR	6.82
Wibaux	1.28	2.91	2.01	2.86	0.94	10.00

*Actual rainfall received at plot location may have been more or less.
NR: No Report

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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 Concord	Canada	2019	Medium	Medium	M	R	R	M	MR	R	Medium	HIGH
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 Frohberg	ND	2020	M TALL	MEDIUM	MR	R	MR	NA	MR	NA	NA	NA
ND VitPro	ND	2016	MEDIUM	M EARLY	MR	R	MA	NA	M	NA	HIGH	HIGH
Prestige	Pulse USA	2015	MEDIUM	M EARLY	MR	NA	NA	NA	NA	S	MEDIUM	MEDIUM
Prevail	SDSU	2014	M SHORT	EARLY	M	NA	NA	NA	M	NA	HIGH	M HIGH
Prosper	NDSU	2011	MEDIUM	MEDIUM	MR	R	S	M	M	S	MEDIUM	M HIGH
Redstone	Pulse USA	2015	SHORT	M LATE	R	NA	R	NA	MR	MA	M LOW	MEDIUM
Reeder	NDSU	1999	MEDIUM	MEDIUM	MR	R	MS	S	S	S	MEDIUM	MEDIUM
Shelly	MN	2016	MEDIUM	MEDIUM	MR	NA	MR/MS	NA	M	NA	NA	NA
Surpass	SDSU	2016	M SHORT	EARLY	MR	NA	MR/MS	NA	MR	NA	NA	NA
SY Ingmar	Syngenta	2014	MEDIUM	MEDIUM	MR	MR	MR	MS	MR	S	M HIGH	M HIGH
SY Rockford	Syngenta	NA	MEDIUM	M LATE	M	MR	M	MR	MR	NA	M HIGH	M HIGH
SY Rowyn	Syngenta	2013	M SHORT	M EARLY	MR	MR	MR	NA	MR	S	M HIGH	M LOW
SY Soren	Syngenta	2011	M SHORT	M EARLY	MR	R	MR	M	M	S	M HIGH	MEDIUM
SY Valda	Syngenta	2015	MEDIUM	M EARLY	MR	R	MR	MR	M	NA	MEDIUM	M HIGH
TCG-Climax	21st C gen.	2017	M SHORT	LATE	MR	R	S	NA	MS	NA	HIGH	HIGH
TCG-Cornerstone	21st C gen.	2015	M SHORT	MEDIUM	MR	R	MR/MS	NA	MA	NA	NA	HIGH
TCG-Glenville	21st C gen.	2018	M SHORT	M EARLY	MR	NA	R	NA	M	NA	NA	NA
TCG-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

[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 2020**

Variety	Days to heading (DAP)	Plant height (in)	Protein (%)	Test weight (lb/bu)	Yield 2020 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
TCG-SPITFIRE	59	20	17.8	59.4	33.1	51.0	54.5
LCS TRIGGER	63	21	18.3	59.6	34.3	51.2	54.4
ELGIN-ND	56	22	18.1	58.6	30.2	50.7	53.6
SHELLY	59	20	17.9	60.2	32.1	50.1	52.6
SY ROCKFORD	57	28	17.3	58.7	31.4	50.6	52.2
LANNING	55	20	18.6	59.1	30.6	46.4	51.9
FALLER	60	23	18.5	58.4	36.5	50.5	51.6
AAC Brandon	56	22	17.7	59.0	34.5	51.8	51.3
SY VALDA	55	20	19.1	59.8	31.0	50.2	51.2
LCS REBEL	54	23	15.4	60.0	34.1	51.2	50.6
MS CHEVELLE	55	24	16.2	59.5	28.7	50.2	49.7
ND VITPRO	54	28	16.6	60.4	28.2	44.3	48.5
GLENN	53	28	18.0	60.9	29.2	44.5	47.9
SY SOREN	56	21	18.2	60.1	28.5	44.8	46.3
MS Camaro	55	19	16.1	59.6	24.5	43.4	46.3
LCS CANNON	52	21	18.3	61.3	26.7	43.8	46.1
LINKERT	55	21	15.3	59.3	28.4	42.1	46.1
BARLOW	54	23	17.5	60.0	25.9	42.8	46.0
MS BARRACUDA	53	20	17.3	59.4	27.9	44.7	44.6
BOLLES	58	27	17.9	58.4	28.0	44.8	44.2
LANG-MN	55	23	17.2	59.0	29.8	46.3	44.1
SYINGMAR	56	27	17.6	60.6	29.9	45.0	43.9
BOOST	59	23	18.2	58.2	28.5	46.1	43.6
SY LONGMIRE	55	22	17.2	60.0	32.9	49.3	-
COMMANDER	54	21	18.0	60.1	29.5	48.5	-
AMBUSH	53	22	20.1	59.8	28.7	48.0	-
TCG-HEARTLAND	53	21	18.4	60.1	34.5	47.9	-
CP3910	53	26	18.3	60.4	27.5	47.5	-
CP3915	55	22	17.8	60.1	30.4	47.2	-
SY MCCLOUD	55	20	18.2	61.3	26.5	47.0	-
CP3530	59	23	15.6	59.4	31.2	46.0	-
MN-WASHBURN	58	20	17.4	59.2	29.0	43.7	-
SY611CL2	56	19	18.1	60.5	36.8	-	-
TCG-WILDCAT	58	21	15.6	60.0	32.8	-	-
LNR2076	63	19	19.2	58.3	32.6	-	-
MN-TORGY	54	25	17.2	60.0	32.1	-	-
BALLISTIC	56	22	18.7	58.9	31.8	-	-
MS RANCHERO	53	21	18.5	58.7	31.6	-	-
CP3903	54	21	18.4	60.2	30.1	-	-
VELOCITY	55	22	17.3	59.7	28.7	-	-
DRIVER	57	23	17.4	60.6	28.7	-	-
ND FROHBERG	56	22	18.3	59.3	28.7	-	-
DAGMAR	54	22	17.9	59.0	28.6	-	-
AP MURDOCK	52	25	18.4	59.3	28.0	-	-
AAC Concord	55	25	17.0	58.5	27.0	-	-
Mean	22	56	17.7	59.6	29.9	-	-
CV (%)	21.8	1.4	2.3	0.6	9.7	-	-
LSD (5%)	7.9	1.3	0.6	0.5	4.7	-	-
LSD (10%)	6.6	1.1	0.5	0.5	3.9	-	-

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

Planted: 04-24-2020 Harvested: 08-07-2020

Soil test (0-6"): P=20 ppm; K=285 ppm; pH=6.4; OM=2.0% Soil type: Williams-Bowbells loam
(0-24"): NO3-N=17 lb/a

Applied fertilizers in lb/a: N=86; P_2O_5=20; K_2O=0

Herbicide Application: Supremacy @ 6 oz/A; Tacoma @ 10 oz/A (06-09-2020)

Hard Red Spring Wheat Dryland Variety Trial - NDSU

Keene, McKenzie County, ND 2020

Variety	Protein (%)	Test weight (lb/bu)	Yield (bu/a)
Lanning	14.1	56.9	52.9
Elgin-ND	13.6	59.7	50.7
Faller	13.6	58.5	49.1
Barlow	14.5	61.7	47.1
SY Valda	14.2	60.0	44.8
Bolles	14.9	59.4	43.6
Linkert	14.5	60.1	40.8
SY Ingmar	14.9	60.5	40.6
Glenn	14.3	62.6	39.8
SY Soren	15.3	60.0	39.0
ND VitPro	14.7	61.8	38.7
ND Frohberg	13.9	60.1	32.8
Mean	14.4	60.1	43.3
CV (%)	3.2	0.9	12.9
LSD (5%)	0.8	1.0	9.4
LSD (10%)	0.6	0.8	7.8

Location: Keene ND; Latitude 47° 59' N; Longitude 102° 48' W; Elevation 2444 ft

Planted: 05/20/2020 Harvested: 09/03/2020

Previous crop: wheat Soil type: Williams-Bowbells loam

Applied fertilizers in lb/a: N=98; P_2O_5=24; K_2O=0

Herbicide Application: Bison @ 1.5 pts/a ; Tacoma @ .66 pts/a

Hard Red Spring Wheat Dryland Variety Trial - NDSU

Corinth, Williams County, ND 2020

Variety	Protein (%)	Test weight (lb/bu)	Yield (bu/a)
Faller	13.0	61.2	75.3
Elgin-ND	14.5	62.1	73.8
Linkert	15.0	61.6	71.9
Lanning	15.4	60.7	71.1
SY Valda	13.1	61.6	70.1
SY Soren	15.2	62.1	68.8
Barlow	14.1	63.0	66.6
ND VitPro	14.6	63.8	66.4
Glenn	14.4	64.4	66.2
SY Ingmar	14.3	62.4	65.0
Bolles	14.9	61.2	61.4
ND Frohberg	14.6	61.6	49.5
Mean	14.4	62.1	67.2
CV (%)	8.2	0.6	10.5
LSD (5%)	2.0	0.6	12.0
LSD (10%)	1.7	0.5	9.9

Location: Corinth ND; Latitude 48° 36' N; Longitude 103° 19' W; Elevation 2205 ft

Planted: 05/21/2020 Harvested: 09/04/2020

Previous crop: wheat Soil type: Williams-Bowbells loam

Applied fertilizers in lb/a: N=98; P_2O_5=24; K_2O=0

Herbicide Application: Bison @ 1.5 pts/a ; Tacoma @ .66 pts/a

Spring Wheat Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9+)	Protein† 2020 (%)	Protein† 2-Yr Avg (%)	Protein† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2020 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
TCG Spitfire	26	59	0	16.1	15.3	15.1	61.8	76.9	86.6	92.2
LCS Trigger	29	62	0	14.1	13.7	13.7	62.6	83.7	87.9	89.0
Lanning	27	55	1	17.4	16.5	16.5	61.1	88.7	88.8	88.9
SY Ingmar	27	57	0	17.1	16.2	16.1	62.5	76.4	90.7	88.7
LCS Rebel	30	54	2	17.1	16.1	16.2	63.3	77.4	87.5	87.6
MS Chevelle	26	53	2	16.4	15.1	15.2	61.9	79.0	86.6	87.1
CP3419	27	60	0	16.2	15.2	15.1	61.3	75.9	82.5	85.7
CP3530	29	59	0	16.1	15.5	15.7	61.4	83.6	84.9	85.3
SY Rockford	29	58	0	16.1	16.1	15.9	60.0	86.3	82.9	85.1
Faller	28	58	1	16.7	15.3	15.2	60.9	79.6	85.2	84.8
Prosper	29	59	0	16.1	15.5	15.6	61.6	79.1	87.0	84.7
SY Soren	26	56	0	17.2	16.1	16.3	61.8	71.8	88.2	84.2
LCS Cannon	28	52	2	16.8	15.9	16.0	63.3	76.8	89.6	84.2
Redstone	26	52	2	17.0	15.9	15.5	61.3	68.6	80.9	83.9
Mott	30	59	0	16.4	15.9	16.2	61.6	75.0	81.0	83.1
Glenn	35	54	1	17.3	16.5	16.5	63.8	76.4	82.4	82.5
Elgin-ND	30	56	1	17.0	16.4	16.4	61.6	76.4	80.8	81.2
LCS Breakaway	27	53	0	17.3	15.7	16.1	62.7	71.6	84.8	80.4
ND-VitPro	30	55	1	17.7	16.6	16.6	63.3	75.9	80.2	79.0
Bolles	29	59	0	18.9	17.9	18.0	60.5	63.0	78.3	78.0
TCG Climax	27	61	0	18.4	17.8	17.7	63.4	64.6	76.0	77.8
MS Camaro	27	54	0	16.9	16.1	16.6	61.1	70.2	81.1	76.6
Dyna-Gro Commander	27	54	1	16.6	15.7	-	62.3	75.7	91.3	-
SY McCloud	28	55	0	17.4	16.4	-	62.4	75.5	90.8	-
Dyna-Gro Ambush	29	54	0	17.0	16.0	-	62.7	79.3	90.7	-
CP3888	26	57	0	16.3	15.6	-	61.3	78.8	89.2	-
TCG Heartland	25	52	1	17.2	16.4	-	63.2	79.1	89.1	-
MS Barracuda	27	52	1	17.8	16.7	-	61.5	72.4	87.5	-
SY Longmire	27	55	1	17.4	16.4	-	62.4	76.6	85.1	-
TCG Stalwart	25	56	0	17.2	17.4	-	61.0	69.8	72.0	-
Dagmar	30	54	2	17.2	-	-	62.3	84.1	-	-
MN-Torgy	30	56	0	17.2	-	-	62.1	83.2	-	-
CP3910	27	52	1	17.4	-	-	63.0	80.4	-	-
MS Ranchero	30	55	0	16.2	-	-	61.8	79.8	-	-
ND-Frohberg	29	56	0	16.7	-	-	62.3	79.6	-	-
MN-Washburn	27	58	0	16.5	-	-	61.4	77.8	-	-
Ballistic	29	57	0	16.7	-	-	60.8	77.5	-	-
8432	27	52	1	17.4	-	-	62.9	77.2	-	-
Driver	27	58	0	16.7	-	-	62.9	76.9	-	-
CP3915	26	56	1	16.9	-	-	62.8	76.4	-	-
AP Murdock	25	57	0	17.3	-	-	61.5	70.9	-	-
TCG Wildcat	27	57	0	17.7	-	-	62.3	70.6	-	-
MEAN	27.8	55.8	0.5	16.93	16.06	16.00	62.04	76.63	84.98	84.09
C.V. (%)	6.7	2.1	94.9	3.67	-	-	0.63	9.01	-	-
LSD (5%)	2.6	1.6	0.6	1.01	-	-	0.63	9.66	-	-
LSD (10%)	1.3	1.3	0.5	0.85	-	-	0.53	8.09	-	-

* 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=18 ppm; K=216 ppm; pH=7.7; OM=2.4 % Previous crop: Field Pea

(0-24 in.): NO3-N=21 lb/a Planted: 4/27/2020

Yield goal: 90 bu/a Harvested: 8/18/2020

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

Fertilizer applied: 330 lb/a of Urea (46-0-0) [4/30] Plot size: 92ft^2

Herbicides applied: Perfect Match (1pt/a), Class Act (2qt/100gal) [5/26] Rainfall: 4.7 inches [4/27 - 8/18]

Fungicide applied: Prosaro 421 (8oz/a) [6/29] Irrigation: 11.85 inches [4/27 - 8/18]

Irrigated Advanced Spring Wheat Trial - MSU **EARC, Sidney, MT 2020**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
AGRIPR 141	30.7	175	66.7	15.1	101.4
AGRIPR 161	31.2	176	64.6	14.3	97.0
BZ 92413R	30.2	174	65.6	14.1	90.5
BZ 996434	31.5	171	65.7	14.9	93.6
CI 13596	38.2	176	64.6	15.0	69.0
CP3099A	34.6	179	63.4	12.0	101.3
CP3530	36.6	176	66.0	14.6	104.8
CP3903	33.4	172	67.5	14.7	92.1
CP3910	30.4	171	67.0	14.4	108.6
CP3915	32.2	174	67.5	13.9	100.5
LIMAGR 171	34.6	172	66.9	15.4	100.7
LIMAGR 181	31.0	170	67.5	15.2	101.0
LIMAGR 201	34.0	179	64.0	12.4	107.9
MS 201	33.6	171	65.3	14.0	106.6
MS 202	30.7	170	65.9	15.2	101.1
MS 203	31.9	172	66.0	14.0	111.3
MT 1716	34.4	173	66.5	14.8	99.5
MT 1743	33.5	176	63.7	14.7	93.0
MT 1750	34.4	172	66.2	15.0	101.0
MT 1775	33.0	176	63.9	15.0	94.2
MT 1809	33.1	174	64.7	15.1	106.2
MT 1815	32.3	177	64.8	15.0	92.1
MT 1824	33.4	174	64.8	14.6	104.2
MT 1853	31.5	175	65.1	15.4	86.4
MT 1855	34.5	177	64.8	14.9	92.1
MT 1857	34.4	175	65.7	15.0	85.3
MT 1862	34.0	173	64.9	15.0	96.5
MT 1866	32.7	174	65.2	15.2	97.9
MT 1868	33.5	174	63.6	14.4	88.3
MT 1871	33.5	175	64.6	14.7	89.8
MT 1872	32.4	171	65.7	14.9	97.5
MT 1902	31.8	170	66.1	14.7	98.5
MT 1904	32.4	177	65.0	14.3	90.7
MT 1905	32.7	175	64.4	14.4	102.3
MT 1906	32.4	174	64.6	15.0	95.2
MT 1909	31.0	170	66.2	14.4	92.0
MT 1922	32.9	174	64.0	14.6	88.2
MT 1927	33.8	176	64.2	14.4	96.6
MT 1931	31.4	170	65.0	15.9	100.1
MT 1932	32.7	171	63.6	15.6	96.4
MT 1934	31.8	172	64.0	15.9	97.8
MT 1935	34.0	174	64.2	14.9	99.1
MT 1936	34.3	174	66.1	14.8	103.5
MT 1938	33.6	173	64.7	15.4	97.8

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Irrigated Advanced Spring Wheat Trial - MSU **EARC, Sidney, MT 2020**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
MT 1939	32.6	173	65.3	14.8	98.9
MT 1943	33.3	172	65.3	16.3	98.4
MT 1951	36.5	174	62.6	16.1	99.4
MT 1959	29.9	171	64.7	16.3	92.3
MT 1961	32.0	172	64.6	16.4	91.6
ND 695	34.2	174	65.4	15.1	94.6
PI 574642	34.0	177	64.2	15.3	85.7
PI 633974	32.4	175	64.2	15.6	88.0
PI 642366	35.0	175	64.6	14.9	96.0
PI 660981	33.5	171	64.4	15.0	89.1
PI 671855	32.2	176	63.4	16.1	79.6
PI 676978	31.4	171	64.7	16.1	100.1
PI 679964	32.9	176	63.5	15.8	87.2
PI 690450	34.0	171	65.2	16.1	97.1
SYN 181	30.6	172	66.7	15.5	94.5
SYN 182	32.7	175	66.1	14.7	100.8
SYN 183	29.9	174	66.5	14.9	104.5
SYN 201	32.2	174	65.7	14.5	101.0
SYN 202	29.2	176	66.2	14.8	98.6
SYN 203	31.5	174	66.0	15.3	101.8
WB 171	28.8	172	65.5	15.3	94.7
WB 173	28.5	175	67.7	14.6	93.9
WB 201	28.2	170	65.5	16.1	86.4
WB 9879 CLP	32.3	176	64.9	15.2	86.2
WSCIA	34.6	175	65.2	14.7	88.7
Mean	32.6	173.7	65.2	15.0	95.9
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	3.9	0.6	0.5	3.1	5.8
LSD (0.05)	2.1	1.6	0.5	0.8	9

Planted: 4/24/2020
Harvested: 8/20/2020
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield were adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 22
N added (lb/ac): 94

Previous crop: Sugar Beet
Soil Type: Savage Silty Clay
Plot Width: 5 ft
Crop Year Precipitation: 7.93"
Irrigation (Sprinkler): 5.25"
Soil Test P_2O_5 (ppm): 17.5
P_2O_5 added (lb/ac): 28

STOP FOCUSING ON HOW
STRESSED YOU ARE AND
REMEMBER HOW
BLESSED
YOU ARE.

Recrop Spring Wheat - MSU **EARC, Sidney, MT 2020**

Variety	Stand (%)	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Brennan	85.0	23.1	170	65.0	16.4	46.2
Choteau	85.0	21.9	175	64.3	16.4	44.4
CP3099A	76.7	26.4	179	62.1	13.6	45.6
CP3530	85.0	26.5	176	63.6	16.2	46.3
CP3903	88.3	24.7	173	65.9	16.1	46.9
CP3910	86.7	23.5	170	66.0	15.5	51.9
CP3915	83.3	23.3	175	65.4	17.0	43.1
Dagmar	86.7	26.0	171	65.0	16.3	50.5
Duclair	86.7	23.2	170	63.1	15.7	45.5
Egan	90.0	23.1	175	61.8	17.3	43.8
Lanning	83.3	22.5	169	64.0	16.6	46.6
Longmire	85.0	24.3	174	65.0	16.5	43.5
MT 1716	88.3	24.1	170	65.2	15.1	50.6
MT 1855	83.3	27.4	175	64.5	16.1	48.8
MT 1866	86.7	25.6	174	64.3	15.1	54.1
NS Presser CLP	86.7	23.4	175	62.6	17.1	42.7
Reeder	88.3	24.3	174	64.6	16.2	45.0
SY Ingmar	81.7	21.9	173	65.4	16.0	48.4
SY Soren	88.3	21.8	172	64.7	16.8	40.3
Vida	85.0	24.8	175	64.2	15.3	50.8
XY McCloud	90.0	23.7	172	65.3	16.2	47.8
XY Rockford	88.3	24.0	176	63.5	16.2	48.0
Mean	85.8	24.1	173.4	64.3	16.1	46.9
P-Value	0.75	<0.0001	<0.0001	<0.0001	<0.0001	0.10
CV (%)	7.0	4.9	0.8		3.0	9.9
LSD (0.05)	9.9	1.9	2.2		0.8	7.7

Planted: 4/22/2020
Harvested: 8/13/2020
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield were adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 21
N added (lb/ac): 63

Previous crop: Pea
Soil Type: Williams Clay Loam
Plot Width: 5 ft
Crop Year Precipitation: 8.16"
Soil Test P_2O_5 (ppm): 21.3
P_2O_5 added (lb/ac): 19

"Integrity is choosing your thoughts and actions based on values rather than personal gain."

UNKNOWN

Roosevelt County Dryland Spring Wheat - MSU **Poplar, MT 2020**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Brennan	26.7	66.2	16.1	57.8
Choteau	30.5	64.8	15.6	65.1
CP3099A	34.4	61.0	12.5	58.4
CP3530	32.8	65.0	15.4	68.0
CP3903	30.4	66.4	15.4	60.3
CP3910	29.6	66.3	15.6	70.3
CP3915	29.1	66.3	15.4	64.2
Dagmar	29.9	65.3	16.4	66.7
Duclair	29.3	64.5	14.9	65.6
Egan	30.3	63.6	16.5	62.6
Lanning	29.6	65.0	16.9	70.4
Longmire	29.6	65.7	15.7	66.0
MT 1716	31.5	66.0	15.3	70.1
MT 1855	33.5	64.7	15.5	64.3
MT 1866	31.9	65.3	15.3	71.5
NS Presser CLP	33.2	63.4	16.4	62.8
Reeder	31.8	65.7	15.8	69.2
SY Ingmar	29.0	65.9	16.1	61.2
SY Soren	28.5	65.9	16.2	63.3
Vida	31.7	64.4	15.5	72.0
XY McCloud	30.2	66.5	15.9	60.5
XY Rockford	31.2	64.0	15.8	65.2
Mean	30.7	65.1	15.6	65.2
P-Value	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	5.1	0.7	1.5	5.2
LSD (0.05)	2.6	0.7	0.4	5.6

Planted: 4/29/2020 Previous crop: Pea
Harvested: 8/25/2020 Plot Width: 5 ft
(Julian*) is a continuous count of days since January 1 Crop Year Precipitation: 7.72"
† Test weight and grain yield were adjusted to 12.0% moisture P_2O_5 added (lb/ac): 19
N added (lb/ac): 63 10-40-0-10 sulfur-1Zn Additional Fertilizer: MESZ @ 80 lbs/ac

Sheridan County Dryland Spring Wheat - MSU **Dagmar, MT 2020**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Brennan	24.8	66.2	16.9	53.3
Choteau	28.7	65.2	15.8	62.9
CP3099A	31.1	61.5	12.3	53.9
CP3530	31.0	65.4	16.0	62.9
CP3903	28.6	66.7	15.9	62.2
CP3910	25.3	67.5	15.7	64.2
CP3915	27.6	67.0	16.0	66.3
Dagmar	27.7	66.0	16.6	63.4
Duclair	27.5	65.0	15.1	64.1
Egan	28.2	63.7	16.4	57.6
Lanning	28.3	65.0	17.3	65.3
Longmire	28.5	66.8	15.9	65.6
MT 1716	28.0	66.8	15.0	67.2
MT 1855	31.5	65.7	15.2	63.2
MT 1866	28.5	66.1	15.3	70.4
NS Presser CLP	27.6	63.8	16.2	59.0
Reeder	30.2	66.1	15.9	68.0
SY Ingmar	27.0	67.3	16.1	62.9
SY Soren	25.7	66.5	17.2	58.2
VIDA	28.5	65.8	15.1	70.4
XY McCloud	27.8	66.6	16.9	53.5
XY Rockford	29.1	65.1	15.4	61.4
Mean	28.2	65.7	15.8	62.5
P-Value	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.4	0.4	1.6	5.6
LSD (0.05)	2.0	0.4	0.4	5.7

Planted: 4/30/2020 Previous crop: Lentil
Harvested: 8/31/2020 Plot Width: 5 ft
(Julian*) is a continuous count of days since January 1 Crop Year Precipitation: 5.68"
† Test weight and grain yield were adjusted to 12.0% moisture P_2O_5 added (lb/ac): 19
N added (lb/ac): 63

Wheat Variety Comparisons, Williston, ND 2020

Gautam Pradhan, Jerald Bergman, Kyle Dragseth

The gross return per acre was based on three-year average yield of spring wheat (2018, 2019, 2020) and two-year average yield of durum wheat (2019, 2020) from dryland varietal trials, and the market price obtained in the third week of November 2020 from different grain elevators in and around Williston.

Spring Wheat

Variety	3 Yr Avg. Yield bu/a	3 Yr Avg. Protein[#] %	Gross Return $/a	+ or - ND VitPro $/a
TCG-Spitfire	54.5	15.5	289.00	31.96
LCS Trigger	54.4	13.9	288.45	31.41
Elgin-ND	53.6	15.7	284.23	27.19
Shelly	52.6	14.8	278.98	21.94
SY Rockford	52.2	15.1	276.63	19.59
Lanning	51.9	16.0	275.30	18.26
Faller	51.6	15.5	273.40	16.36
AAC Brandon	51.3	15.8	271.88	14.84
SY Valda	51.2	15.0	271.17	14.13
LCS Rebel	50.6	15.4	268.02	10.98
MS Chevelle	49.7	15.1	263.60	6.56
ND VitPro	48.5	14.9	257.04	0.00
Glenn	47.9	15.8	253.64	-3.40
SY Soren	46.3	16.4	245.57	-11.47
MS Camaro	46.3	16.0	245.20	-11.84
LCS Cannon	46.1	15.0	244.44	-12.60
Linkert	46.1	16.3	244.24	-12.80
Barlow	46.0	15.6	243.71	-13.33
ND Frohberg*	44.6	17.0[§]	236.15	-20.89
MS Barracuda	44.6	15.6	236.12	-20.92
Bolles	44.2	16.7	234.52	-22.52
Lang-MN	44.1	16.1	233.47	-23.57
SY Ingmar	43.9	15.8	232.44	-24.60
Boost	43.6	15.9	231.13	-25.91

#This year protein credit was not available for spring wheat.

*ND Frohberg is a newly released variety.

[§]Average of two years (2019 & 2020).

Durum

Variety	2 Yr Avg. Yield bu/a	2 Yr Avg. Protein %	Gross Return $/a	+ or - ND Riveland $/a
TCG-Bright	49.5	15.5	296.97	3.19
Grenora	49.2	16.7	295.05	1.27
ND Riveland	49.0	17.3	293.78	0.00
CDC Verona	48.3	16.9	289.88	-3.90
Divide	47.6	18.0	285.62	-8.17
Mountrail	46.8	17.5	280.66	-13.13
AC Commander	46.5	17.9	278.81	-14.97
VT Peak	46.0	16.2	276.22	-17.56
Rugby	46.0	16.3	275.76	-18.02
Alkabo	45.6	16.5	273.32	-20.46
Tioga	45.1	17.4	270.79	-22.99
ND Grano	45.1	17.1	270.43	-23.35
Ben	44.9	16.7	269.48	-24.30
Carpio	44.6	16.9	267.34	-26.44
Joppa	44.4	16.7	266.51	-27.27
Strongfield	44.4	17.2	266.47	-27.31
Maier	44.3	16.6	266.00	-27.78
Lebsock	44.2	16.5	264.92	-28.86
Pierce	43.8	17.2	263.05	-30.73
AAC Cabri	43.8	17.8	262.91	-30.87
TCG-Webster	42.6	15.7	255.37	-38.41
Normanno	40.8	16.3	244.89	-48.90
Alzada	39.7	17.2	237.99	-55.79

YOU MIGHT BE A FARMER IF:

You only need two tools - Duct tape and WD-40.

If it moves and shouldn't,
use duct tape.
If it doesn't move and should,
use WD-40.

DURUM VARIETY DESCRIPTIONS

VARIETY	ORIGIN[1]	YEAR RELEASE	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	LATE	M	R	MS	M	VS	MEDIUM	LARGE	M HIGH	GOOD
AAC CABRI* **	CANADA	2016	M TALL	M LATE	M	R	M	NA	MS	MEDIUM	M LARGE	HIGH	EXCELLENT
ALKABO	NDSU	2005	MEDIUM	MEDIUM	R	R	MR	M	MS	HIGH	LARGE	M LOW	GOOD
ALZADA	WB	2004	SHORT	EARLY	M	R	S	M	VS	MEDIUM	LARGE	MEDIU	EXCELLENT
BEN	NDSU	1996	TALL	MEDIUM	MR	R	MR	M	S	V HIGH	V LARGE	M HIGH	AVERAGE
CARPIO	NDSU	2012	TALL	M LATE	MS	R	M	NA	M	MEDIUM	LARGE	M HIGH	EXCELLENT
CDC VERONA	CANADA	2010	M TALL	M LATE	M	R	MR	NA	S	MEDIUM	LARGE	M HIGH	GOOD
DIVIDE	NDSU	2005	M TALL	M LATE	M	R	M	M	MR	MEDIUM	MEDIUM	M HIGH	EXCELLENT
GRENORA	NDSU	2005	MEDIUM	M EARLY	M	R	M	MR	MS	MEDIUM	MEDIUM	MEDIU	GOOD
JOPPA	NDSU	2013	MEDIUM	MEDIUM	R	R	M	NA	M	MEDIUM	LARGE	MEDIU	GOOD
LEBSOCK	NDSU	1999	M TALL	MEDIUM	R	R	M	MS	MS	HIGH	LARGE	MEDIU	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	MEDIU	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	MEDIU	EXCELLENT
RUGBY	NDSU	1973	TALL	M EARLY	R	R	MR	M	S	MEDIUM	MEDIUM	MEDIU	POOR
SILVER	MT	2012	SHORT	EARLY	R	NA	M	NA	S	M HIGH	SMALL	M HIGH	GOOD
AAC SPITFIRE*	CANADA	2016	M	MEDIUM	R	R	M	NA	S	MEDIUM	M LARGE	HIGH	GOOD
AAC [illegible]	CANADA	2018	M	MEDIUM	R	R	M	NA	MS	MEDIUM	M LARGE	HIGH	GOOD
AC STRONGFIELD*	CANADA	2004	M TALL	M LATE	M	R	M	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	MEDIU	EXCELLENT
TCG-WEBSTER	TCG	2021	SHORT	EARLY	R	R	MS	M	S	MEDIUM	MEDIUM	MEDIU	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. **Indicates Solid Stem sawfly tolerance

Durum Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Days to heading	Plant height	Stand	Protein	Test weight	Yield		
						2020	2-Yr Avg	3-Yr Avg
	(DAP)	(in)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
AC COMMANDER	59	19	93	18.0	58.9	29.5	46.5	43.7
CDC VERONA	60	22	90	18.6	58.8	31.2	48.3	43.6
GRENORA	56	20	85	17.0	58.9	30.7	49.2	43.6
DIVIDE	60	23	88	17.5	58.6	31.6	47.6	42.9
TIOGA	59	23	87	16.9	59.7	24.2	45.1	42.6
MOUNTRAIL	60	21	88	17.4	58.2	25.9	46.8	42.5
ALKABO	58	21	83	16.6	59.3	28.2	45.6	42.3
STRONGFIELD	60	21	87	19.4	58.5	25.5	44.4	42.2
VT PEAK	57	23	90	17.6	59.8	27.7	46.0	42.2
NDRIVELAND	59	21	93	17.7	59.0	29.4	49.0	42.2
JOPPA	59	23	88	16.8	58.9	27.4	44.4	41.6
CARPIO	60	22	93	16.2	59.4	29.3	44.6	41.2
MAIER	59	21	85	18.5	58.5	23.2	44.3	40.6
NDGRANO	60	20	87	17.6	59.4	26.5	45.1	39.9
RUGBY	58	24	90	18.1	58.8	27.5	46.0	39.8
LEBSOCK	56	22	92	16.8	59.2	25.5	44.2	39.8
BEN	58	24	83	17.8	58.7	26.9	44.9	39.7
PIERCE	58	24	90	16.2	59.7	26.1	43.8	39.5
AL ADA	56	20	87	17.1	58.3	25.1	39.7	38.3
NORMANNO	56	17	87	16.0	57.3	24.6	40.8	38.3
TCG-Bright	57	21	94	15.9	59.7	31.4	49.5	-
AAC CABRI	62	22	88	19.3	59.0	24.4	43.8	-
TCG-Webster	55	20	87	15.6	59.6	24.6	42.6	-
AAC Stronghold	59	21	88	18.2	59.2	27.0	-	-
Mean	59	22	88	17.8	58.9	27.1	-	-
CV (%)	1.7	7	5.3	2.1	0.7	11.3	-	-
LSD (5%)	1.7	3	7.5	0.6	0.6	4.9	-	-
LSD (10%)	1.4	2	6.3	0.5	0.5	4.1	-	-

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

Planted: 04-23-2020 Harvested: 08-06-2020

Soil test (0-6"): P=20 ppm; K=285 ppm; pH=6.4; OM=2.0% Soil type: Williams-Bowbells loam
(0-24"): NO3-N=17 lb/a

Applied fertilizers in lb/a: N=86; P_2O_5=20; K_2O=0

Herbicide Application: Supremacy @ 6 oz/a ; Tacoma @ 10 oz/a (6/9/20)

Farm Girl Tip:
Frisk the laundry!
If not, you will
always find interesting
things in your dryer:
corn, soybeans, bolts, etc.

Durum Dryland Variety Trial - NDSU

Keene, McKenzie County, ND 2020

Variety	Protein (%)	Test weight (lb/bu)	Yield (bu/a)
Divide	16.4	58.9	39.7
Carpio	15.3	58.7	39.1
ND Riveland	15.3	59.5	38.0
Grenora	15.5	57.7	37.7
Tioga	15.2	59.4	37.3
AAC Spitfire	17.1	56.6	36.7
Joppa	15.3	59.2	35.1
ND Grano	15.6	57.9	32.6
Alkabo	15.1	58.8	31.5
Mountrail	15.3	57.6	31.1
Lebsock	16.5	58.2	30.5
AAC Stronghold	17.3	58.4	28.8
Mean	15.8	58.4	34.8
CV (%)	3.1	0.9	8.9
LSD (5%)	0.8	0.8	5.2
LSD (10%)	0.7	0.7	4.3

Location: Keene ND; Latitude 47° 59' N; Longitude 102° 48' W; Elevation 2444 ft

Planted: 05/20/2020 Harvested: 09/03/2020

Previous crop: wheat Soil type: Williams-Bowbells loam

Applied fertilizers in lb/a: N=98; P_2O_5=24; K_2O=0

Herbicide Application: Bison @ 1.5 pts/a ; Tacoma @ .66 pts/a (6/23/20)

Durum Dryland Variety Trial - NDSU

Corinth, Williams County, ND 2020

Variety	Protein (%)	Test weight (lb/bu)	Yield (bu/a)
AAC Stronghold	17.8	60.8	81.3
ND Grano	16.7	61.8	80.5
AAC Spitfire	16.4	60.7	75.3
Grenora	16.3	60.8	71.2
Tioga	15.9	61.5	70.4
ND Riveland	16.0	61.6	69.4
Joppa	16.1	61.8	69.3
Carpio	15.9	61.9	68.7
Lebsock	16.2	62.0	67.0
Alkabo	14.6	61.7	63.7
Mountrail	15.7	60.8	62.8
Divide	17.3	60.7	58.8
Mean	16.2	61.3	69.9
CV (%)	6.1	0.5	11.5
LSD (5%)	1.7	0.5	13.6
LSD (10%)	1.4	0.4	11.2

Location: Corinth ND; Latitude 48° 36' N; Longitude 103° 19' W; Elevation 2205 ft

Planted: 05/21/2020 Harvested: 09/04/2020

Previous crop: wheat Soil type: Williams-Bowbells loam

Applied fertilizers in lb/a: N=98; P_2O_5=24; K_2O=0

Herbicide Application: Bison @ 1.5 pts/a ; Tacoma @ .66 pts/a (6/23/20)

Durum Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Days to Head (DAP)	Plant Height (in)	Lodging (0 - 9⁺)	Protein† 2020 (%)	Protein† 2-Yr Avg (%)	Protein† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2020 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
Grenora	58	31	0	17.2	15.8	15.9	61.3	96.7	84.7	77.6
ND Riveland	60	37	0	17.4	16.1	16.2	61.9	87.3	79.9	75.0
Joppa	60	31	0	17.6	15.6	15.7	61.4	80.5	79.8	72.6
AC Commander	59	27	0	17.9	16.0	16.0	61.0	83.2	81.8	71.7
Divide	60	30	0	18.6	16.5	16.6	60.2	71.0	73.8	69.6
Tioga	59	34	0	17.8	16.2	16.2	60.1	71.9	73.8	69.4
Alkabo	58	28	0	17.5	16.0	15.9	60.8	71.8	72.4	69.1
Carpio	61	32	0	18.5	16.5	16.4	60.8	72.0	71.0	68.9
ND Grano	60	30	0	17.6	16.0	16.0	61.5	74.0	74.9	68.5
Mountrail	60	30	0	18.6	16.5	16.3	59.8	70.5	73.3	67.9
Alzada	56	26	0	17.2	15.9	15.8	61.5	82.8	74.8	67.8
Strongfield	58	32	0	19.4	17.1	17.2	60.5	68.1	70.8	67.0
Lebsock	59	30	0	18.8	16.8	16.6	61.1	73.5	71.5	66.3
Rugby	58	34	0	18.8	16.9	16.8	60.2	70.0	69.9	65.0
Pierce	58	32	0	18.2	16.4	16.3	61.0	67.5	69.6	63.3
Maier	59	29	0	20.0	17.7	17.4	59.0	64.7	67.4	62.8
CDC Verona	59	28	0	20.3	18.0	18.0	60.2	66.1	62.5	61.7
AAC Cabri	61	30	1	20.5	17.8	-	60.7	71.9	72.9	-
VT Peak	58	30	0	19.0	16.9	-	61.4	67.4	70.1	-
AAC Stronghold	58	30	0	18.8	-	-	61.5	75.5	-	-
MEAN	58.8	30.5	0.1	18.49	16.56	16.42	60.79	74.31	82.69	74.71
C.V. (%)	3.2	9.9	542.9	4.39	-	-	1.44	11.89	-	-
LSD (5%)	2.6	4.3	0.4	1.35	-	-	1.44	15.63	-	-
LSD (10%)	2.2	3.6	0.3	1.12	-	-	1.20	13.05	-	-

* 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=18 ppm; K=242 ppm; pH=7.5; OM=2.2 % — Previous crop: Field Pea

(0-24 in.): NO3-N= 17 lb/a — Planted: 4/27/2020

Yield goal: 90 bu/a — Harvested: 8/17/2020

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

Fertilizer applied: 330 lb/a of Urea (46-0-0) [4/30] — Plot size: 92 ft^2

Herbicides applied: Perfect Match (1pt/a), Class Act (2qt/100gal) [5/26] — Rainfall: 4.7 inches [4/27 - 8/17]

Fungicide applied: Prosaro 421 (8oz/a) [6/29] — Irrigation: 11.85 inches [4/27 - 8/17]

Irrigated Statewide Durum - MSU **EARC, Sidney, MT 2020**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alzada	29.9	173	63.2	14.6	79.7
Carpio	38.5	178	65.3	14.3	105.0
CDC-Vivid	35.6	178	64.7	15.5	85.5
Divide	39.0	179	65.4	14.6	98.3
Grenora	35.7	177	64.7	14.4	89.2
Joppa	38.3	178	65.1	14.1	95.7
Mountrail	39.3	178	65.4	13.9	108.0
MTD16001	35.8	178	64.7	13.6	102.3
MTD16002	38.1	179	65.0	14.7	92.5
MTD16005	38.3	178	64.8	15.0	96.6
MTD18067	37.5	178	63.3	14.2	100.1
MTD18091	38.6	178	65.7	13.5	96.1
MTD18148	28.2	175	63.9	14.7	91.9
MTD18155	31.8	177	63.9	15.0	88.4
MTD18172	37.5	180	65.4	14.9	96.1
MTD18179	38.1	177	64.1	14.4	108.1
MTD18181	39.3	182	64.1	15.3	79.6
MTD18213	40.4	179	65.1	13.9	104.4
MTD18217	41.3	181	65.2	14.1	97.1
MTD18256	41.1	180	65.0	14.2	92.6
MTD18266	37.1	181	65.7	14.7	95.0
MTD18313	29.1	175	65.3	14.7	96.7
MTD18348	41.3	180	65.3	14.2	93.1
MTD18381	35.8	175	63.8	15.4	83.9
MTD18413	37.1	178	64.3	15.3	95.7
MTD18430	42.8	182	63.4	14.6	84.8
MTD18486	38.9	182	65.4	13.3	99.8
ND-Grano	36.8	178	65.4	14.0	106.8
ND-Riveland	41.3	178	65.5	14.0	100.4
Tioga	39.8	178	64.7	14.3	96.0
Mean	37.4	178.4	64.8	14.4	95.3
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	0.01
CV (%)	5.3	0.4	1.0	2.5	9.1
LSD (0.05)	3.2	1.2	1.1	0.6	2.5

Planted: 4/24/2020
Harvested: 8/19/2020
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield were adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 22
N added (lb/ac): 94

Previous crop: Sugar Beet
Soil Type: Savage Silty Clay
Plot Width: 5 ft
Crop Year Precipitation: 7.93"
Irrigation (sprinkler): 5.25"
Soil Test P_2O_5 (ppm): 17.5
P_2O_5 added (lb/ac): 28

If it was easy...
everybody would do it.

Dryland Statewide Durum - MSU **EARC, Sidney, MT 2020**

Variety	Stand	Plant Height	Days to Headin	Test Weight†	Protein	Grain Yield†
	%	(inch)	(Julian*)	(lb/bu)	(%)	(bu/ac)
Alzada	78.3	22.4	170	64.0	14.1	38.2
Carpio	78.3	26.5	176	65.2	15.3	47.8
CDC-Vivid	86.7	27.9	174	64.6	16.1	47.8
Divide	76.7	27.8	174	65.2	15.7	43.5
Grenora	81.7	25.3	174	65.2	15.2	44.9
Joppa	66.7	27.0	174	65.3	15.3	40.4
Mountrail	70.0	26.9	175	64.5	15.3	44.4
MTD16001	75.0	27.1	176	64.5	14.9	42.4
MTD16002	78.3	28.0	177	65.3	16.0	42.4
MTD16005	78.3	27.7	175	64.0	16.0	47.2
MTD18067	70.0	26.9	175	64.4	15.6	40.4
MTD18091	73.3	26.5	176	65.1	15.3	42.3
MTD18148	81.7	20.2	172	64.9	14.8	42.8
MTD18155	81.7	25.3	173	64.6	15.8	43.6
MTD18172	85.0	26.8	175	65.7	16.6	44.3
MTD18179	73.3	27.3	174	62.9	16.3	39.0
MTD18181	65.0	28.5	178	65.2	16.4	38.0
MTD18213	81.7	26.8	177	63.7	15.8	44.8
MTD18217	78.3	27.1	179	64.7	16.2	44.2
MTD18256	78.3	29.2	178	64.8	16.0	50.4
MTD18266	78.3	27.0	177	65.5	16.8	46.4
MTD18313	68.3	21.5	169	66.4	15.4	41.3
MTD18348	80.0	29.1	177	64.6	15.3	54.3
MTD18381	73.3	24.8	173	63.5	15.3	32.1
MTD18413	78.3	26.4	173	64.7	16.3	42.6
MTD18430	76.7	29.1	179	63.3	15.8	43.7
MTD18486	86.7	26.1	179	65.8	15.7	43.9
ND-Grano	80.0	26.1	176	65.7	15.6	41.3
ND-Riveland	66.7	29.4	175	65.3	15.9	47.4
Tioga	78.3	29.4	176	65.4	15.4	41.1
Mean	76.8	26.7	175.3	64.8	15.7	43.4
P-Value	0.12	<0.0001	<0.0001	<0.0001	<0.0001	0.29
CV (%)	10.7	5.1	0.5	0.56	1.9	15.2
LSD (0.05)	13.5	2.2	1.5	0.59	0.50	10.8

Planted: 4/21/2020 Previous crop: Fallow

Harvested: 8/12/2020 Soil Type: Williams Clay Loam

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

† Test weight and grain yield were adjusted to 12.0% moisture Crop Year Precipitation: 8.16"

Soil Test N Avail (lb/ac): 29 Soil Test P_2O_5 (ppm): 25.7

N added (lb/ac): 76 P_2O_5 added (lb/ac): 23

"Be happy with what you have
while working for what you want."
HELEN KELLER

Roosevelt County Dryland Durum - MSU **Poplar, MT 2020**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alzada	27.3	63.6	14.2	46.1
Carpio	35.0	65.4	14.7	62.0
CDC-Dynamic	34.5	64.9	15.9	61.5
CDC-Fortitude	31.2	64.5	16.1	53.3
CDC-Vivid	34.3	65.0	16.3	58.8
Divide	35.8	65.1	15.7	59.0
Grenora	33.5	65.1	14.9	59.8
Joppa	36.4	65.6	14.5	57.7
Mountrail	32.6	65.2	15.1	66.6
MTD-16001	32.9	64.3	14.6	57.5
MTD16002	37.5	65.1	15.0	63.5
MTD16005	33.7	64.4	15.7	61.2
ND-Grano	34.1	65.8	15.2	59.6
ND-Riveland	36.1	65.1	14.8	62.7
Tioga	36.6	65.6	15.3	65.8
Transcend	36.9	65.1	16.4	53.6
Mean	34.3	65.0	15.3	59.3
P-Value	<0.0001	<0.0001	<0.0001	0.0006
CV (%)	3.7	0.6	1.4	7.4
LSD (0.05)	2.1	0.7	0.4	7.4

Planted: 4/29/2020 Previous crop: Pea

Harvested: 8/25/2020 Plot Width: 5 ft

(Julian*) is a continuous count of days since January 1 Crop Year Precipitation: 7.72"

† Test weight and grain yield were adjusted to 12.0% moisture P_2O_5 added (lb/ac): 19

N added (lb/ac): 63 Additional Fertilizer: MASZ @ 80 lbs/ac

10-40-0-10 sulfur-1Zn

Sheridan County Dryland Durum - MSU **Dagmar, MT 2020**

Variety	Plant Height (inch)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
Alzada	25.6	64.9	13.5	46.1
Carpio	31.8	66.4	13.7	63.0
CDC-Dynamic	31.2	66.1	15.2	60.8
CDC-Fortitude	29.0	66.0	14.7	55.9
CDC-Vivid	32.0	65.8	15.1	57.7
Divide	31.4	66.4	14.6	57.4
Grenora	27.7	66.0	13.8	53.4
Joppa	31.8	66.5	13.6	52.6
Mountrail	30.8	65.9	14.1	58.7
MTD-16001	32.0	65.6	13.5	58.4
MTD16002	33.5	66.0	14.1	59.8
MTD16005	31.0	65.9	14.9	57.0
ND-Grano	31.5	66.5	13.8	54.4
ND-Riveland	32.4	65.6	14.2	55.1
Tioga	33.3	66.1	14.1	55.5
Transcend	32.3	66.6	15.3	61.9
Mean	31.1	66.0	14.3	56.7
P-Value	0.0002	<0.0001	<0.0001	0.0005
CV (%)	5.4	0.5	1.8	6.2
LSD (0.05)	2.8	0.5	0.4	5.9

Planted: 4/30/2020 Previous crop: Lentil

Harvested: 8/31/2020 Plot Width: 5 ft

(Julian*) is a continuous count of days since January 1 Crop Year Precipitation: 5.68"

† Test weight and grain yield were adjusted to 12.0% moisture P_2O_5 added (lb/ac): 19

N added (lb/ac): 63

HARD RED WINTER WHEAT VARIETY DESCRIPTIONS

VARIETY	ORIGIN[1]	YEAR RELEASED	HEIGHT	MATURITY	WINTER HARDINESS[3]	RESISTANCE TO[2]				QUALITY FACTORS	
						LODGING	STEM RUST	LEAF RUST	FOLIAR DISEASE	TEST WEIGHT	GRAIN PROTEIN
AAC GATEWAY	CANADA	2012	M SHORT	MEDIUM	**GOOD**	R	R	R	NA	MEDIUM	MEDIUM
AAC GOLDRUSH	CANADA	2017	MEDIUM	MEDIUM	**GOOD**	NA	MR	R	M	NA	NA
AAC WILDFIRE	CANADA	2015	MEDIUM	MEDIUM	**GOOD**	NA	M	MS	NA	NA	NA
ACCIPITER	CANADA	2008	SHORT	MEDIUM	**GOOD**	R	R	MS	S	MEDIUM	MEDIUM
BEARPAW*	MT	2011	M SHORT	MEDIUM	FAIR	R	R	S	NA	MEDIUM	LOW
BRAWL CL PLUS	CO	2011	SHORT	EARLY	FAIR	NA	NA	NA	NA	M HIGH	M HIGH
BROADVIEW	CANADA	2009	MEDIUM	MEDIUM	**GOOD**	R	R	R	NA	MEDIUM	MEDIUM
CDC CHASE	CANADA	2013	MEDIUM	MEDIUM	**GOOD**	M	R	MR	R	M HIGH	MEDIUM
DECADE	MT/NDSU	2010	MEDIUM	M EARLY	**GOOD**	R	R	S	M	MEDIUM	MEDIUM
DENALI	CO/KSU	2011	MEDIUM	M LATE	NA	NA	MR	S	NA	MEDIUM	M HIGH
EMERSON	CANADA	2011	SHORT	MEDIUM	**GOOD**	NA	R	MS	NA	M HIGH	MEDIUM
FLOURISH	CANADA	2010	SHORT	EARLY	**GOOD**	R	MR	R	NA	MEDIUM	M LOW
IDEAL	SDSU	2011	SHORT	MEDIUM	**GOOD**	R	MR	MR	MS	MEDIUM	MEDIUM
KELDIN	WB	2011	SHORT	MEDIUM	**GOOD**	NA	MR	MR	MR	NA	NA
JERRY	NDSU	2001	MEDIUM	MEDIUM	**GOOD**	MR	R	MR	M	MEDIUM	M HIGH
JUDEE*	MT	2011	MEDIUM	MEDIUM	FAIR	R	S	S	NA	MEDIUM	M HIGH
LOMA	MT	2016	MEDIUM	M LATE	**GOOD**	NA	R	NA	NA	MEDIUM	MEDIUM
LYMAN	SDSU	2008	MEDIUM	MEDIUM	FAIR	M	R	R	MR	M HIGH	M HIGH
MOATS	CANADA	2010	MEDIUM	MEDIUM	**GOOD**	MS	R	MR	NA	M HIGH	MEDIUM
NORTHERN	MT	2015	M SHORT	M LATE	FAIR	NA	R	NA	NA	MEDIUM	MEDIUM
OVERLAND	NE	2006	M TALL	MEDIUM	FAIR	MS	MS	MR	NA	M HIGH	MEDIUM
PEREGRINE	CANADA	2008	MEDIUM	M LATE	V **GOOD**	MR	R	MR	NA	M HIGH	M LOW
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 **WREC, Williston, ND 2020**

Variety	Height	Days to Heading	Protein	Winter Survival	Test Weight	Yield		
						2020	2-Yr Avg	3-Yr Avg
	(in)	(Julian)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
Peregrine	25	158	13.1	80	55.9	39.5	51.5	51.3
WB-4595	22	158	13.6	55	59.9	40.5	51.1	51.1
Northern	21	158	13.4	80	57.8	46.2	52.6	50.7
Oahe	23	155	12.1	95	57.6	50.4	53.8	50.3
Ideal	22	157	11.7	90	57.4	38.4	51.1	49.9
SY Monument	24	155	11.5	95	56.6	45.3	51.4	49.8
Jerry	24	157	13.7	80	58.9	43.9	50.5	49.8
Keldin	24	159	14.6	50	58.1	38.8	49.1	49.0
Thompson	23	156	12.6	85	57.0	40.7	48.8	48.3
SY Wolf	21	155	13.3	70	58.3	41.5	49.4	47.9
AC Emerson	23	157	15.1	80	56.7	39.8	47.7	45.8
Ray	28	N/A	14.6	N/A	58.3	54.3	54.1	-
WB-4462	22	153	12.6	60	56.7	44.8	49.5	-
TCG-Boomlock	22	158	13.4	50	57.3	45.8	45.1	-
ND Noreen	21	153	13.8	80	57.9	40.1	50.0	-
MT1683	26	158	13.1	55	57.0	52.3	-	-
17NORD-96	21	159	11.9	70	57.2	49.6	-	-
NE14696	25	158	13.6	70	57.2	47.5	-	-
AAC-Wildfire	23	159	13.8	90	55.7	46.9	-	-
SY Wolverine	19	153	12.5	70	58.4	44.5	-	-
NW13493	21	154	12.5	80	56.6	43.6	-	-
MT1793	19	155	14.1	85	56.8	43.5	-	-
CP7017AX	22	153	12.0	65	57.3	40.9	-	-
SY Sunrise	17	155	12.6	70	58.0	40.2	-	-
CP7050AX	21	150	13.6	85	59.6	38.3	-	-
CP7909	19	150	12.8	75	58.2	36.2	-	-
Mean	22	155	13.1	76	57.5	44.9	-	-
CV (%)	5.7	0.8	5.6	17.0	0.7	8.9	-	-
LSD (5%)	2.1	2.0	1.2	21.4	0.7	6.6	-	-
LSD (10%)	1.7	1.6	1.0	17.8	0.6	5.5	-	-

Location of the WREC: Latitude 48 8'; Longitude 103 44'W; Elevation 2105 ft Previous Crop: soybeans

Planting Date: 9/24/2019 Harvest Date: 7/22/2020

Soil test to 6" in ppm: P=35 ppm K= 277 ppr OM=1.9% pH=5.4 Soil type: Williams-Bowbells loam

Soil test to 24" in lb/a: N=12 lb/a

Applied fertilizers in lb/a: N=42; P=20; K=0; S = 0.5

Herbicide Application: Supremacy at 6 oz/a; Tacoma at 10 oz/a (5/22/2020)

I HEAR WHAT YOU ARE SAYING
BUT I REALLY JUST WANT TO
Talk About
TRACTORS

Winter Wheat Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Winter Survival	Plant Height	Days to Head	Lodging	Protein†			Test Weight	Yield		
					2020	2-Yr Avg‡	3-Yr Avg¥		2020	2-Yr Avg‡	3-Yr Avg¥
	(%)	(in)	(julian+)	(0 - 9*)	(%)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
Peregrine	98	25	165	0	14.3	13.4	12.3	62.2	105.0	109.1	117.2
Accipiter	89	19	164	0	14.8	13.7	12.7	60.8	89.3	100.9	112.7
Decade	93	25	162	0	16.2	15.8	13.9	61.9	96.7	97.4	110.3
AC Broadview	96	23	164	0	14.1	14.0	13.1	60.9	105.1	93.1	106.6
Oahe	96	20	160	0	15.8	15.6	13.6	61.1	84.5	91.0	105.4
Ideal	96	21	162	0	14.8	14.3	13.3	61.7	92.0	93.9	105.3
Jerry	96	26	163	0	14.8	14.8	13.2	61.3	105.3	101.5	103.8
AC Gateway	98	22	164	0	16.1	15.1	14.0	63.0	97.0	89.4	102.2
Northern	93	21	165	0	15.9	14.7	13.2	62.0	94.0	103.1	102.2
Yellowstone	98	23	165	0	14.5	13.8	-	61.9	106.0	109.5	-
FourOSix	91	25	165	0	14.4	14.3	-	62.2	111.7	108.6	-
CDC Chase	94	26	165	0	14.9	14.1	-	62.4	105.7	107.1	-
AAC Wildfire	98	25	167	0	14.4	14.0	-	62.3	109.6	104.9	-
ND Noreen	95	25	163	0	15.2	14.9	-	63.3	101.8	104.1	-
Loma	85	21	166	1	15.2	14.4	-	61.8	104.2	103.6	-
AAC Goldrush	97	25	165	0	15.8	14.5	-	62.1	96.1	96.5	-
Redfield	98	20	161	0	15.5	15.0	-	61.1	86.1	91.4	-
Keldin	96	20	164	0	15.0	-	-	61.2	98.6	-	-
TCG Boomlock	95	21	161	1	15.7	-	-	61.9	97.6	-	-
CP7017AX	94	19	158	1	13.6	-	-	61.5	79.3	-	-
CP7909	84	20	157	3	14.1	-	-	61.6	67.9	-	-
CP7050AX	93	19	155	3	16.1	-	-	61.7	54.7	-	-
MEAN	94.2	22.4	162.6	0.5	15.03	14.49	13.27	61.81	94.92	100.31	107.29
C.V. (%)	7.5	10.7	1.1	204.9	3.34	-	-	0.76	16.09	-	-
LSD (5%)	10.0	3.4	2.5	1.4	0.71	-	-	0.67	21.58	-	-
LSD (10%)	8.4	2.8	2.1	1.2	0.59	-	-	0.56	18.03	-	-

+ Days after January 1, 2020 * 0: no lodging - 9: plants lying flat on the ground † Protein content adjusted to 0% moisture

‡ 2-Yr average from 2019 and 2020 ¥ 3-Yr average from 2017, 2019, and 2020

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

Soil test (0-6 in.): P=18 ppm; K=216 ppm; pH=7.7; OM=2.4 % — Previous crop: Field Pea

(0-24 in.): NO3-N=21 lb/a — Planted: 9/24/2019

Yield goal: 120 bu/a — Harvested: 8/3/2020

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

Fertilizer applied: 330 lb/a of Urea (46-0-0) [4/30] — Plot size: 92 ft_2

Herbicides applied: Perfect Match (1pt/a), and Class Act (2qt/100gal) [5/26] — Rainfall: 6.3 inches [9/24 - 8/3]

Fungicide applied: Prosaro 421 (8oz/a) [6/29] — Irrigation: 11.85 inches [9/24 - 8-3]

Dryland Intrastate Winter Wheat Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Winter Survival	Plant Height	Days to Heading	Test Weight†	Protein	Grain Yield†
	%	(inch)	(Julian*)	(lb/bu)	(%)	(bu/ac)
AAC Wildfire	98.3	25.3	165	59.9	14.1	57.0
Bobcat	90.0	23.2	161	60.9	13.7	59.8
Brawl CL Plus	91.7	22.6	155	62.9	13.2	58.6
Byrd CL Plus	81.7	26.2	159	59.9	12.4	60.9
CP7909	81.7	22.8	154	61.2	12.4	55.1
Flathead	95.0	25.2	156	61.4	13.3	61.3
FourOsix	91.7	22.4	160	61.2	13.9	61.4
Incline AX	85.0	22.7	160	60.2	12.6	53.3
Judee	86.7	23.4	161	62.8	14.6	54.3
Keldin	90.0	26.0	161	61.9	12.7	64.2
Langin	86.7	21.8	155	59.9	12.1	56.1
LCS Jet	76.7	20.7	162	60.0	13.3	60.7
LCS Photon AX	88.3	24.0	157	63.3	13.1	47.9
LCS15ACC-8-21	85.0	23.0	156	63.1	12.2	60.5
LCS-18-7071	73.3	24.1	162	62.2	11.7	54.5
Loma	91.7	23.1	163	61.0	13.8	59.5
Long Branch	96.7	23.0	155	60.8	12.2	56.3
Mpress (SWW)	95.0	23.5	163	59.7	12.3	67.2
MT1642	98.3	25.2	158	60.4	13.9	68.3
MT1683	95.0	27.4	161	61.0	13.6	68.3
MT1745	98.3	23.5	161	59.7	13.1	57.4
MT1746	93.3	23.5	159	61.1	13.1	55.7
MT1787	93.3	23.4	161	61.4	13.9	64.2
MT1793	96.7	24.9	159	60.6	14.1	62.9
MT1845	95.0	25.3	159	61.1	13.4	62.0
MT1848	91.7	22.6	162	60.2	14.9	54.5
MT1855	88.3	21.8	163	61.4	14.2	57.9
MT1866	80.0	22.7	161	60.4	13.8	49.9
MT1867	91.7	24.5	159	57.6	13.4	55.7
MT1872	96.7	24.9	161	61.2	12.8	57.9
MTCL1732	95.0	23.6	159	58.7	13.9	54.8
MTCL1737	88.3	22.4	163	61.3	14.1	64.9
MTCS1601R	98.3	24.3	162	59.7	13.6	53.8
MTS1810	96.7	23.4	164	61.9	14.8	50.5
MTS18116	95.0	22.0	163	62.1	13.3	64.0
MTS18149	88.3	20.9	163	61.3	13.7	63.0
MTS1831	88.3	23.0	165	62.6	12.7	63.4
Northern	96.7	24.9	162	61.4	14.1	65.4
SY 517 CL2	88.3	21.9	156	62.3	13.7	45.5
SY Clearstone 2CL	100.0	25.5	161	60.4	13.9	68.2
SY Legend CL2	95.0	24.7	158	58.8	14.0	55.6
SY Monument	80.0	24.0	159	59.5	12.4	56.0
SY Wolverine	81.7	21.9	155	60.7	13.0	53.2
Warhorse	95.0	23.0	161	60.8	14.2	54.3

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Dryland Intrastate Winter Wheat Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Winter Survival	Plant Height	Days to Heading	Test Weight†	Protein	Grain Yield†
	%	(inch)	(Julian*)	(lb/bu)	(%)	(bu/ac)
WB4269	80.0	21.5	158	62.3	12.2	58.0
WB4311	78.3	23.2	159	63.4	13.1	52.0
WB4418	83.3	22.3	155	61.3	12.4	60.0
WB4792	83.3	24.9	160	64.1	12.3	64.3
Yellowstone	98.3	27.2	161	62.0	13.2	75.1
Mean	90.1	23.6	159.8	61.1	13.3	58.9
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	8.9	6.8	0.7	1.3	1.9	9.7
LSD (0.05)	13	2.6	1.9	1.3	0.4	9.3

Planted: 9/25/2019 Previous crop: Fallow
Harvested: 7/28/2020 Soil Type: William Clay Loam
N added (lb/ac): 72 lb/ac Plot Width: 5 ft
(Julian*) is a continuous count of days since January 1 Crop Year Precipitation: 8.16"
† Grain yield were adjusted to 12.0% moisture Irrigation: N/A

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.

Barley Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Days to heading	Plant height	Stand	Plumps	Thins	Protein	Test weight	Yield		
								2020	2-Yr Avg	3-Yr Avg
	(DAP)	(in)	(%)	(%)	9%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
Two-Row										
AAC Synergy	69	18	95	95.5	1.0	13.6	51.4	36.4	70.8	69.5
Pinnacle	62	18	96	95.4	1.3	11.5	52.3	40.2	74.8	69.1
ND Genesis	63	20	93	96.0	0.5	11.4	51.3	40.8	75.2	68.3
AAC Connect	66	17	95	95.0	0.8	13.9	51.4	38.1	66.6	66.6
Explorer	72	15	95	95.0	1.1	13.8	51.7	37.7	71.7	65.2
Hockett	71	18	97	95.8	1.2	14.2	52.7	38.6	68.8	62.2
CDC Bow	68	18	97	95.3	0.9	13.4	51.6	36.2	67.0	-
Conlon	58	19	96	96.7	1.1	13.0	51.1	35.5	64.0	-
Six-Row										
Tradition	60	18	94	85.3	1.2	14.6	50.2	27.9	50.7	51.7
Mean	65	17	96	94.6	1.0	12.7	51.0	37.7	-	-
CV (%)	2.9	9.0	3.4	1.0	25.9	3.1	0.6	10.9	-	-
LSD (5%)	3.1	2.6	5.3	1.5	0.4	0.6	0.5	6.8	-	-
LSD (10%)	2.6	2.1	4.4	1.3	0.4	0.5	0.4	5.7	-	-

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

Planted: 04/23/2020 — Harvested: 07/29/2020

Soil test (0-6"): P=20 ppm; K=285 ppm; pH=6.4; OM=2.0% — Soil type: Williams-Bowbells loam

(0-24"): NO3-N=17 lb/a

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

Herbicide Application: Supremacy at 6 oz/a; Axial XL at 12.4 oz/a (6/09/20)

Barley Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Plant Height	Days to Head	Lodging	Protein†			Test Weight	Plump %	Yield		
				2020	2-Yr Avg	3-Yr Avg			2020	2-Yr Avg	3-Yr Avg
	(in)	(DAP*)	(0 - 9⁺)	(%)	(%)	(%)	(lb/bu)	(6/64)	(bu/a)	(bu/a)	(bu/a)
TWO ROW											
ND Genesis	31	56	0	11.5	12.5	12.6	55.2	71.6	139.1	135.8	123.3
Pinnacle	31	56	0	11.0	12.3	12.7	56.5	73.0	125.4	132.6	121.8
AAC Synergy	28	60	0	12.7	13.9	14.1	55.4	72.5	128.7	125.1	118.5
Explorer	23	59	0	12.1	13.2	13.8	55.4	71.5	121.9	130.2	111.9
Hockett	28	57	1	12.9	14.0	13.9	55.8	69.8	115.9	119.6	111.6
Conlon	29	51	0	13.2	13.7	14.0	55.2	73.0	114.3	113.0	104.4
AAC Connect	29	58	0	12.9	13.6	-	54.8	71.2	130.4	135.7	-
CDC Bow	30	60	0	12.7	-	-	55.3	72.4	137.8	-	-
SIX ROW											
Celebration	31	56	0	13.1	14.3	14.9	54.8	70.2	153.6	145.3	136.4
Innovation	29	55	0	12.0	13.3	13.9	54.1	71.9	145.8	136.6	131.0
Tradition	32	55	0	13.2	13.9	14.1	55.1	71.4	139.5	141.5	130.7
MEAN	29.2	56.5	0.1	12.49	13.47	13.77	55.23	71.69	132.04	131.53	121.06
C.V. (%)	6.3	1.9	328.0	3.97	-	-	0.78	1.22	10.85	-	-
LSD (5%)	2.7	1.6	0.3	0.84	-	-	0.74	1.99	20.69	-	-
LSD (10%)	2.2	1.3	0.3	0.70	-	-	0.61	1.65	17.20	-	-

* 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=18 ppm; K=242 ppm; pH=7.5; OM=2.2% — Previous crop: Field Pea

(0-24 in.): NO3-N=17 lb/a — Planted: 4/29/2020

Yield goal: 120 bu/a — Harvested: 8/10/2020

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

Fertilizer applied: 200 lb/a Urea [4/30] — Plot size: 92 ft^2

Herbicides applied: Aim (0.5oz/a), Bison (1.5pt/a), Axial XL (16oz/a), Class Act (1qt/100gal) [5/29] — Rainfall: 4.4 inches [4/29 - 8/10]

Fungicide applied: Prosaro 421 (8oz/a) [6/29] — Irrigation: 11.85 inches [4/29 - 8/10]

Irrigated Intrastate Barley Evaluation - MSU **EARC, Sidney, MT 2020**

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	30.3	174	98.7	1.2	54.1	11.8	135.1
AAC Connect	31.4	177	98.3	1.6	54.4	11.8	119.1
ABI Eagle	31.0	176	95.7	3.8	55.2	12.4	149.3
Buzz	29.9	174	98.2	1.6	54.4	11.6	129.6
Hockett	30.4	173	97.9	1.8	56.1	12.5	128.8
KWS Fantex	28.0	177	98.2	1.5	54.0	12.1	149.7
KWS Jessie	26.7	175	98.7	1.2	54.2	11.8	135.2
Merit 57	32.4	176	94.9	4.6	53.6	12.7	133.6
MT16M00209	30.1	170	99.6	0.4	53.9	12.4	120.4
MT16M00305	30.8	172	98.9	1.1	53.7	12.9	128.1
MT16M00406	32.4	176	99.1	0.8	54.0	12.0	127.5
MT16M00407	32.0	171	99.0	1.0	54.1	13.4	125.9
MT16M00504	30.3	171	99.1	0.9	53.3	12.5	125.9
MT16M00603	32.8	173	98.7	1.3	53.5	12.8	137.4
MT16M00610	33.5	171	98.9	1.0	55.4	12.8	122.6
MT16M00707	32.3	175	98.3	1.6	54.5	12.0	135.1
MT16M00709	32.6	174	98.5	1.5	54.6	11.2	123.9
MT16M00806	33.7	174	98.1	1.7	55.3	13.0	138.4
MT16M01405	30.4	172	98.9	1.0	55.4	12.1	140.2
MT16M01705	30.7	169	98.2	1.7	55.2	12.3	127.8
MT16M01801	30.8	175	98.1	1.8	54.4	11.4	151.8
MT16M01819	29.9	170	98.8	1.1	54.5	12.8	120.4
MT16M01901	29.8	172	98.9	0.9	54.6	12.0	126.2
MT16M01902	31.1	172	98.8	1.1	54.4	12.4	143.7
MT16M02101	31.5	170	97.3	2.5	52.8	11.6	130.5
MT16M02107	34.1	170	98.3	1.5	55.5	12.6	145.8
MT16M02201	32.8	174	99.1	0.8	53.1	12.0	126.7
MT16M05403	29.9	178	96.5	3.1	55.0	11.8	125.4
MT16M05610	31.6	177	98.0	1.9	54.3	12.7	116.7
MT16M06404	30.8	175	97.5	2.3	55.7	12.5	129.2
MT16M07806	29.5	176	98.1	1.7	56.5	12.1	111.9
MT16M09602	28.7	171	98.3	1.4	55.6	12.0	124.3
MT17M00302	32.3	176	98.0	1.8	55.4	11.2	132.2
MT17M00504	31.8	170	99.1	1.2	55.2	12.4	138.7
MT17M01711	29.6	174	97.7	2.0	53.7	11.8	139.1
MT17M01906	29.1	171	99.0	0.9	53.9	12.2	143.8
MT17M01908	31.0	171	99.1	0.9	54.3	11.6	124.6
MT17M02009	33.8	174	98.4	1.4	54.0	11.7	141.4
MT17M02507	31.6	174	98.6	1.3	55.3	11.1	149.5
MT17M02510	31.0	170	98.6	1.3	54.3	12.1	141.0
MT17M04801	33.8	174	97.8	2.0	55.6	11.6	132.7
MT17M05416	29.6	175	97.0	2.8	54.8	11.9	133.7
MT17M05502	34.9	176	98.5	1.4	55.6	11.8	127.8
MT17M05508	33.0	177	98.2	1.7	54.9	11.8	129.0

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Irrigated Intrastate Barley Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
MT17M05808	30.2	174	97.9	1.9	54.5	12.5	112.9
MT17M07704	30.8	173	97.0	2.6	54.8	13.0	133.4
MT17M08702	29.8	172	97.2	2.5	56.0	11.7	133.3
MT17M08808	29.9	174	98.0	1.8	55.5	11.3	152.2
MT17M09602	31.0	173	98.4	1.6	55.1	10.6	118.3
Mean	31.1	173.4	98.2	1.6	54.7	12.1	132.0
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	4.4	0.6	0.5	28.0	1.1	2.3	8.0
LSD (0.05)	2.2	1.8	0.8	0.8	0.9	0.5	17.2

Planted: 4/23/2020
Harvested: 8/17/2020
(Julian*) is a continuous count of days since January 1
† Test weight and grain yield were adjusted to 12.0% moisture
Soil Test N Avail (lb/ac): 22
N added (lb/ac): 76

Previous crop: Sugar Beet
Soil Type: Savage Silty Clay
Plot Width: 5 ft
Crop Year Precipitation: 7.93"
Irrigation (sprinkler): 4.64"
Soil Test P_2O_5 (ppm): 17.5
P_2O_5 added (lb/ac): 23

Becky Garza - EARC Research Assistant

Dryland Intrastate Barley Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Emergence (%)	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular> 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
2IM14-8212	81.7	21.5	173	96.9	2.7	52.7	13.0	67.5
AAC Connect	85.0	22.2	175	96.3	3.5	54.5	13.7	61.4
ABI Eagle	93.3	21.0	175	93.5	6.0	55.1	13.6	61.5
Buzz	91.7	22.4	170	97.6	1.4	54.3	12.2	65.4
Hockett	93.3	22.8	174	97.2	2.5	56.4	13.6	66.3
KWS Fantex	91.7	19.6	179	97.4	2.4	55.3	14.1	69.6
KWS Jessie	90.0	21.0	173	97.3	2.4	53.8	14.0	62.6
Merit 57	91.7	24.9	174	91.1	8.3	54.5	14.3	62.3
MT16M00209	90.0	21.6	168	99.4	0.5	54.5	13.0	59.6
MT16M00305	88.3	22.6	170	98.9	1.0	53.7	13.7	62.3
MT16M00406	86.7	25.1	177	98.2	1.6	55.4	13.0	65.3
MT16M00407	90.0	23.5	169	98.3	1.5	55.2	13.7	54.8
MT16M00504	95.0	20.4	171	98.0	1.6	55.2	12.9	60.5
MT16M00603	90.0	24.3	171	98.1	1.6	54.9	13.5	56.8
MT16M00610	85.0	24.3	167	98.4	1.4	55.7	13.4	55.5
MT16M00707	83.3	24.7	175	97.6	2.2	55.9	12.9	61.1
MT16M00709	85.0	27.3	172	97.1	2.6	55.2	12.3	69.8
MT16M00806	90.0	23.6	173	97.0	2.8	55.8	13.7	60.4
MT16M01405	75.0	20.8	169	97.8	1.9	54.5	13.2	53.9
MT16M01705	86.7	22.3	169	96.0	3.3	54.5	13.3	50.2
MT16M01801	80.0	24.7	174	96.9	2.6	55.6	12.6	62.4
MT16M01819	88.3	23.4	167	97.4	2.1	56.2	13.7	51.8
MT16M01901	91.7	21.7	169	97.9	1.9	55.6	11.8	62.2
MT16M01902	88.3	23.9	170	98.1	1.7	54.9	13.4	70.2
MT16M02101	91.7	24.6	169	94.7	4.8	54.1	12.6	66.2
MT16M02107	90.0	23.1	169	97.4	2.3	56.1	14.0	62.6
MT16M02201	93.3	23.6	170	97.9	1.9	53.9	12.3	70.8
MT16M05403	90.0	22.6	176	94.8	4.8	56.3	12.8	67.2
MT16M05610	81.7	23.6	175	98.0	1.9	56.1	14.0	59.0
MT16M06404	88.3	23.6	175	96.9	2.8	55.6	14.5	52.0
MT16M07806	83.3	23.7	174	97.6	2.2	56.4	13.6	54.3
MT16M09602	85.0	22.0	168	97.6	2.0	56.4	13.0	54.8
MT17M00302	91.7	24.4	175	97.6	2.3	56.5	12.2	68.9
MT17M00504	81.7	24.2	169	97.7	1.7	54.7	13.0	55.7
MT17M01711	90.0	22.7	171	97.3	2.4	53.4	13.0	75.0
MT17M01906	85.0	22.6	169	96.5	2.9	54.7	13.2	62.4
MT17M01908	90.0	23.9	168	97.6	2.2	54.8	12.4	63.0
MT17M02009	93.3	24.0	169	96.0	3.7	54.8	12.7	62.5
MT17M02507	95.0	23.7	170	96.9	2.7	54.1	11.9	72.2
MT17M02510	90.0	21.8	168	98.9	1.0	55.6	12.7	59.1
MT17M04801	88.3	25.6	170	97.2	2.7	55.6	13.3	64.5
MT17M05416	86.7	24.2	174	96.5	3.2	54.7	13.1	59.6
MT17M05502	90.0	24.4	175	97.4	2.4	55.8	14.6	55.3
MT17M05508	81.7	25.8	176	96.4	3.4	55.6	14.2	59.5

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Dryland Intrastate Barley Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Emergence (%)	Plant Height (inch)	Days to Heading (Julian*)	Plump >6/64 (%)	Regular> 5/64 (%)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
MT17M05808	88.3	22.8	174	97.1	2.6	54.9	13.9	67.6
MT17M07704	88.3	23.9	172	96.2	3.4	55.8	14.7	57.8
MT17M08702	95.0	21.0	169	97.6	2.1	56.3	12.8	61.2
MT17M08808	91.7	23.1	173	96.6	2.8	55.7	12.4	67.5
MT17M09602	98.3	23.7	171	97.5	2.2	56.8	11.5	61.0
Mean	88.6	23.2	171.7	97.1	2.6	55.2	13.2	61.9
P-Value	0.2329	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	8.1	7.1	0.9	0.8	26.6	0.8	2.8	9.4
LSD (0.05)	11.6	2.7	2.5	1.2	1.1	0.8	0.6	9.4

Planted: 4/20/2020 Previous crop: Fallow

Harvested: 8/10/2020 Soil Type: William Clay Loam

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

† Test weight and grain yield were adjusted to 12.0% moisture Crop Year Precipitation: 8.16"

Soil Test N Avail (lb/ac): 29 Soil Test P_2O_5 (ppm): 25.7

N added (lb/ac): 63 P_2O_5 added (lb/ac): 19

Harvesting Kernza plots at WREC

Irrigated Hulless Barley Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Grain Yield† (bu/ac)
09WA-265.12	32.4	176	65.4	13.2	5736.7
Havener	30.6	177	65.6	13.2	6193.0
MT16H09302	32.4	174	64.3	13.0	5856.4
MT16H09308	30.4	173	64.1	12.4	6228.1
MT18H01302	31.5	175	62.2	14.5	5616.8
MT18H01402	31.0	176	62.9	14.9	4904.9
MT18H01901	30.6	171	64.5	14.3	5154.1
MT18H02702	34.0	176	64.5	13.8	6156.0
MT18H02801	33.6	180	64.0	12.8	5971.4
MT18H02901	32.9	175	65.2	14.0	5664.7
MT18H03001	32.8	174	66.1	17.1	3677.6
MT18H03002	31.6	175	64.2	15.1	3931.4
MT18H03003	29.0	169	65.1	15.1	4803.9
MT18H03101	30.3	177	63.6	15.2	3974.7
MT18H03102	29.8	174	63.0	13.2	4936.9
OR29-2-B	30.0	175	62.9	13.3	6126.9
Mean	31.4	174.8	64.2	14.1	5308.3
P-Value	<0.01	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	5.1	0.4	0.9	2.3	7.4
LSD (0.05)	2.7	1.1	1.0	0.5	653.3

Planted: 4/23/2020 Previous crop: Sugar Beet
Harvested: 8/17/2020 Soil Type: Savage Silty Clay
(Julian*) is a continuous count of days since January 1 Plot Width: 5 ft
† Test weight and grain yield were adjusted to 12.0% moisture Crop Year Precipitation: 7.93"
Soil Test N Avail (lb/ac): 22 Irrigation (sprinkler): 4.64"
N added (lb/ac): 63 P2O5 added (lb/ac): 19 Soil Test P_2O_5 (ppm): 17.5

Dryland Hulless Barley Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Emergence (%)	Plant Height (inch)	Days to Heading (Julian*)	Test Weight† (lb/bu)	Protein (%)	Yield† (bu/ac)
09WA-265.12	73.3	24.5	177	64.4	16.0	2473.2
Havener	63.3	22.8	176	65.7	15.3	2244.1
MT16H09302	76.7	24.1	172	64.3	15.1	2103.8
MT16H09308	70.0	23.7	171	64.1	13.9	1995.6
MT18H01302	70.0	23.2	171	62.1	16.0	1868.7
MT18H01402	63.3	23.4	175	63.2	16.6	1847.2
MT18H01901	63.3	24.5	172	64.1	15.8	1855.8
MT18H02702	73.3	25.3	175	65.0	15.5	2611.7
MT18H02801	78.3	24.7	180	65.1	15.0	2770.4
MT18H02901	78.3	25.3	173	65.0	16.1	2336.7
MT18H03001	53.3	25.7	172	65.1	18.5	927.5
MT18H03002	80.0	24.3	174	64.2	16.4	1902.8
MT18H03003	75.0	23.6	167	64.7	16.6	1611.3
MT18H03101	85.0	22.7	173	64.0	15.3	1684.3
MT18H03102	86.7	22.8	169	64.1	14.2	1665.5
OR29-2-B	78.3	22.8	175	63.2	16.5	2020.9
Mean	73.0	24.0	173.2	64.3	15.8	1995.0
P-Value	0.059	0.55	<0.0001	<0.0001	<0.0001	<0.0001
CV (%)	15.0	7.4	0.9	0.8	3.0	12.1
LSD (0.05)	18.3	3.0	2.5	2.9	0.8	402.8

Planted: 4/20/2020 Previous crop: Fallow
Harvested: 8/11/2020 Soil Type: William Clay Loam
(Julian*) is a continuous count of days since January 1 Plot Width: 5 ft
† Test weight and grain yield were adjusted to 12.0% moisture Crop Year Precipitation: 8.16"
Soil Test N Avail (lb/ac): 29 Irrigation: N/A
N added (lb/ac): 63 P2O5 added (lb/ac): 19 Soil Test P_2O_5 (ppm): 25.7

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.

DON'T LOOK BACK

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YOU'RE NOT HEADED THAT WAY

Oats Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Days to heading (DAP)	Plant height (in)	Test weight (lb/bu)	Yield 2020 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
Killdeer	51	26	45.3	74.8	134.7	115.9
CS Camden	52	26	44.1	71.7	133.3	114.7
Jury	51	28	45.7	68.7	126.1	113.1
Leggett	52	24	44.5	63.9	127.3	112.5
CDC Dancer	50	25	46.6	64.9	125.5	111.0
ND131603	52	22	45.6	66.5	126.3	110.1
Rockford	53	29	45.5	68.5	126.5	108.2
ND141338	53	23	46.8	67.7	121.4	107.4
ND141327	53	26	46.2	61.1	117.9	106.8
Deon	53	24	45.4	60.1	118.4	105.8
Otana	53	28	44.3	65.8	118.4	105.6
Minstrel CDC	53	27	45.7	65.1	118.9	104.4
Hayden	51	23	45.1	60.7	118.5	103.0
ND130202	51	26	46.6	66.1	117.7	102.9
Stallion	51	27	45.3	66.7	111.6	102.4
ND141363	53	27	46.3	59.0	112.9	101.8
HiFi	54	26	43.5	61.2	112.6	101.2
Newburg	52	26	45.5	70.0	108.9	101.1
Souris	51	26	46.1	63.3	112.8	99.4
Beach	50	25	45.0	62.4	100.2	94.6
ND Heart (ND121901)	48	26	44.4	58.5	100.1	89.9
Hytest	48	25	44.9	55.9	91.5	80.3
Paul	54	27	51.4	41.0	80.6	72.1
ND040341 (High oil)	54	27	52.6	34.6	66.6	57.9
ND151085	53	26	45.3	63.0	118.0	-
ORE3542M	51	24	43.5	68.6	116.5	-
Warrior	49	28	44.6	62.0	114.0	-
ORE3541M	49	26	45.5	67.0	106.9	-
ND161472	49	27	45.4	77.8	-	-
ND161473	49	26	45.0	76.1	-	-
ND160259	53	27	48.0	76.0	-	-
ND161443	52	24	44.3	70.4	-	-
ND161488	49	25	43.4	70.1	-	-
ND161367	52	25	44.4	68.4	-	-
ND160171	52	27	48.0	65.5	-	-
ND160173	53	26	45.4	65.0	-	-
CDC Haymaker	54	28	45.0	42.4	-	-
Mean	51.6	25.9	45.7	64.1	-	-
CV (%)	1.9	12.3	1.3	8.6	-	-
LSD (5%)	1.6	5.2	1.0	9.0	-	-
LSD (10%)	1.4	4.3	0.8	7.5	-	-

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

Planted: 05-15-2020 Harvested:08-21-2020 Previous crop: Soybeans

Soil test (0-6"): P=20 ppm; K=285 ppm; pH=6.4; OM=2.0%

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

Applied fertilizers in lb/a: N=72; P_2O_5=20; K_2O=0

Herbicide Application: Supremacy @ 6 oz/a (6/09/2020)

Oat Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Plant Height (in)	Days to Head (DAP*)	Lodging (0 - 9+)	Test Weight (lb/bu)	Yield 2020 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
Deon	40	57	0	45.4	198.1	186.7	198.9
CS Camden	33	57	0	43.5	218.4	203.1	198.3
Hayden	37	56	0	45.4	186.3	184.2	185.9
Hytest	40	54	0	46.9	170.1	156.4	151.6
ORE3541M	36	55	0	46.7	198.4	191.1	-
ORE3542M	33	55	0	45.3	201.6	185.7	-
Warrior	36	55	0	45.4	200.1	-	-
ND Heart	36	54	0	44.2	195.0	-	-
MEAN	36.4	55.2	0.0	45.34	195.98	184.55	183.70
C.V. (%)	5.9	1.8	ns	1.17	10.44	-	-
LSD (5%)	3.2	1.4	ns	0.93	30.11	-	-
LSD (10%)	2.6	1.2	ns	0.76	24.91	-	-

* 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=18 ppm; K=242 ppm; pH=7.5; OM=2.2% — Previous crop: Field Pea

(0-24 in.): NO3-N=17 lb/a — Planted: 4/29/2020

Yield goal: 200 bu/a — Harvested: 8/10/2020

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

Fertilizer applied: 430 lb/a of Urea (46-0-0) [4/30] — Plot size: 92 ft^2

Herbicides applied: Aim (0.5oz/a), Bison (1.5pt/a), Class Act (1qt/100gal) [5/29] — Rainfall: 4.4 inches [4/29 - 8/10]

Fungicides applied: None applied — Irrigation: 11.85 inches [4/29 - 8/10]

In Every Journey,
Who You Travel With
Can Be More Important
Than Your Destination.

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	FAIR	GOOD	V HIGH	LOW	MED	S	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	MS	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 2020**

Variety	Days to Flowering	Plant height	Stand	Oil	Test weight	Yield				
						2020	2019	2018	2-Yr Avg	3-Yr Avg*
	(DAP)	(in)	(%)	(%)	(lb/bu)	(lb/a)	(lb/a)	(lb/a)	(lb/a)	(lb/a)
Chickadee	83	23.2	76	41.9	43.1	1269	1865	1136	1567	1423
Cardinal	85	22.0	39	43.5	43.0	1280	1583	1241	1432	1368
Hybrid 300	83	23.2	78	35.9	43.6	1516	1400	1162	1458	1359
Hybrid 1601	83	22.5	78	42.2	35.9	1380	1375	1273	1378	1343
Hybrid 446	82	23.4	81	34.2	43.3	1221	1375	1305	1298	1300
Hybrid 528	82	22.6	70	45.0	35.3	1066	1500	1261	1283	1275
Hybrid 200	82	25.3	76	35.0	42.9	1271	1239	1300	1255	1270
Morlin	80	20.8	84	45.5	39.9	1171	1442	1095	1306	1236
Montola 2003	81	21.2	65	41.6	41.6	1311	1216	989	1264	1172
MonDak	82	21.9	64	39.4	41.6	1161	1360	914	1260	1145
Finch	82	21.2	68	44.3	45.1	1215	934	926	1074	1025
NutraSaff	82	21.1	78	52.7	37.2	1043	986	959	1014	996
Hybrid 621	84	23.5	70	45.6	32.7	1046	856	1001	951	968
Rubis Red	81	20.2	63	38.9	45.1	729	1143	885	936	919
Montola 2000	82	20.3	74	42.1	41.2	1196	1452	-	1324	-
Montola 2001	84	22.8	91	41.7	37.5	1021	-	1361	-	-
STI 1201	85	22.5	68	45.1	38.1	1198	938	-	1068	-
STI 1401	83	22.6	66	49.6	35.1	877	-	-	-	-
Mean	82	22.2	71	43.1	39.3	1117	-	-	-	-
CV (%)	2.3	8.4	25.0	1.8	2.1	17.8	-	-	-	-
LSD (5%)	2.6	2.6	25.0	1.1	1.2	281.3	-	-	-	-
LSD (10%)	2.2	2.2	20.9	0.9	1.0	235.1	-	-	-	-

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

Planted: 04/30/2020 Harvested: 09/15/2020

Soil test to 6" in ppm: P= 22 K= 264 OM= 1.9% pH=5.6 Soil type: Williams-Bowbells loam

Soil test to 24" in lb/a: N= 10

Applied fertilizers in lb/a: N=30; P_2O_5=18; K_2O=0

Applied fungicides: 07/15/2020 - Azoxystar @ 8 oz/A

Applied herbicides: 06/15/2020- Clethodin @ 8 oz/A, 07/06/2020-Allure II @ 12 oz/A

Safflower Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Days to Flower (DAP*)	Oil† 2020 (%)	Oil† 2-Yr Avg (%)	Oil† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2020 (lb/a)	Yield 2-Yr Avg (lb/a)	Yield 3-Yr Avg (lb/a)
Hybrid 446	75	33.4	35.9	33.5	41.7	2012	1818	1706
Hybrid 300	76	35.5	37.6	34.6	41.2	1684	1777	1638
Hybrid 200	76	33.2	35.9	33.6	40.0	1703	1615	1593
MonDak	76	37.1	39.2	36.3	39.9	1723	1593	1499
Montola 2003	77	39.7	40.9	38.4	39.3	1220	1204	1369
Chickadee	76	38.4	40.3	38.1	40.3	1347	1349	1330
Hybrid 1601	77	41.8	42.3	38.6	35.2	1262	1183	1323
Rubis Red	75	36.4	37.0	33.4	43.9	1717	1425	1306
Cardinal	77	41.9	41.4	38.2	42.3	1354	1323	1291
STI 1201	75	43.1	43.4	42.1	36.1	1388	1286	1187
Hybrid 621	77	43.8	43.2	42.3	31.2	1079	1033	1060
Finch	75	41.3	40.8	38.1	40.9	1343	1165	1011
Morlin	77	43.3	40.7	39.1	38.6	1287	1115	993
STI 1401	77	46.9	46.7	45.8	33.7	1097	970	859
NutraSaff	76	50.3	47.7	46.4	37.0	1158	965	752
Montola 2000	76	39.2	40.8	-	37.6	1265	1330	-
Montola 2001	77	38.3	36.6	-	33.7	1133	1069	-
MEAN	76.2	35.59	38.31	36.98	38.38	1398.4	1307.0	1261.1
C.V. (%)	1.2	1.71	-	-	2.34	13.2	-	-
LSD (5%)	1.5	1.15	-	-	1.50	305.9	-	-
LSD (10%)	1.3	0.95	-	-	1.24	254.4	-	-

* Days after planting † Oil content reported on oven dried basis

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

Soil test (0-6 in.): P=24 ppm; K=158 ppm; pH=7.9; OM=2.9 % — Previous crop: Durum

(0-24 in.): NO3-N=29 lb/a — Planted: 5/14/2020

Yield goal: 2,000 lb/a — Harvested: 9/18/2020

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

Fertilizer applied: 160 lb/a of Urea (46-0-0) [5/19] — Plot size: 40 ft^2

Herbicides applied: Prowl H2O (1.5 pt/a) [5/19], Section 3 (5.33 oz/A), Superb (1 qt/A) [6/16] — Rainfall: 5.1 inches [5/14 - 9/18]

Fungicide applied: Priaxor (8oz/A) [7/21] [8/3] — Irrigation: 8.0 inches [5/14 - 9/18]

Safflower Irrigated Variety Trial **MSU-EARC Sidney, MT 2020**

Variety	Oil	Test Weight (lb/bu)	Yield 2020 (lb/a)	Yield 2019 (lb/a)	Yield 2-Yr Avg (lb/a)
Hybrid 300	37.4	43.2	3391	3135	3263
Hybrid 200	36.6	42.8	3769	2521	3145
MonDak	40.4	40.5	3274	3011	3142
Montola 2003	41.4	40.8	3024	3193	3108
Hybrid 446	35.4	43.0	3533	2360	2947
Chickadee	42.8	43.2	3227	2652	2939
Hybrid 1601	44.0	36.5	2903	2363	2633
STI 1201	48.4	40.0	3041	2204	2623
STI 1401	52.8	36.3	2927	2187	2557
Hybrid 621	46.7	33.9	2849	1981	2415
Morlin	45.8	39.7	2634	2115	2375
Rubis Red	38.2	45.4	2256	2442	2349
Montola 2000	42.7	39.3	2548	2100	2324
Hybrid 528	46.9	36.9	2555	1973	2264
NutraSaff	54.0	38.4	2671	1799	2235
Cardinal	43.7	41.7	2086	1710	1898
Finch	44.1	40.8	2149	1365	1757
Montola 2001	42.1	37.6	1750	1707	1729
Mean	43.8	39.8	2792	-	-
CV (%)	1.0	1.8	17.1	-	-
LSD (5%)	0.7	1.2	788.0	-	-
LSD (10%)	0.6	1.0	656.2	-	-

Location: Sidney, MT Previous Crop: Wheat

Planted: 05/08/2020 Harvested: 09/15/2020

Applied fertilizers: 60 lb/A at planting Soil Type: Williams Clay Loam

Applied fungicides: Quadris @ 16 oz/A at 10% flowering

Applied herbicides: 04/09/2020- Sonalan @ 3 pts/A & Eptam @ 3 pts/A

Irrigation : 5/14/2020 0.55"
5/20/2020 1.00"
6/3/2020 1.04"
6/11/2020 1.04"

Sunflowers-Clearfield Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Origin	Hybrid Type	Oil Type	Days to Flowering	Plant height	Oil	Test weight	Yield		
								2020	2-Yr Avg	3-Yr Avg
				(DAP)	(in)	(%)	(lb/bu)	(lb/a)	(lb/a)	(lb/a)
Camaro II	NuSeed	CL	Nusun	73	42.5	42.2	28.4	1455	1253	1673
N4H470 CL Plus	NuSeed	CL	High Oleic	73	42.7	43.6	26.1	1025	1227	1537
H49HO19CL	Dyna-Gro	CL	High Oleic	72	40.2	41.4	26.0	1496	1395	-
H44HO12CL	Dyna-Gro	CL	High Oleic	69	40.9	44.6	26.9	1443	1391	-
H45NS16CL	Dyna-Gro	CL	Nusun	71	38.8	41.9	27.5	1196	1296	-
H42HO18CL	Dyna-Gro	CL	High Oleic	71	38.7	40.6	27.1	1325	1066	-
12G25CL	Proseed	CL	High Oleic	71	44.3	44.7	28.4	1785	-	-
SF440	S W Seed Company	CL	High Oleic	74	40.5	41.0	25.8	1537	-	-
SF110	S W Seed Company	CL	High Oleic	72	35.3	41.1	27.1	1263	-	-
E-50016	Proseed	CL	High Oleic	72	42.1	42.1	28.1	1253	-	-
N4H422 CL	NuSeed	CL	High Oleic	73	46.7	41.1	26.7	1186	-	-
Mean				71	40.8	42.0	27.2	1367	-	-
CV (%)				1.8	7.1	1.6	2.1	19.5	-	-
LSD (5%)				1.9	4.1	1.0	0.8	383.6	-	-
LSD (10%)				1.5	3.5	0.8	0.7	319.1	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: wheat
Planted: 05/28/2020 Harvested: 10/05/2020
Soil test to 6" in ppm: P = 22; K = 264; OM =1.9%, pH = 5.6 Soil type: Williams-Bowbells loam
Soil test to 24" in lb, N=10 lb/a DAP = Days after planting
Applied fertilizers in N=130; P=20; K=0; S=40
Herbicide Application: Valor @ 3 oz/a (10/21/19); PowerMax @ 32 oz/a (6/2/20); Assure II @ 12 oz/a (7/6/2020)

Sunflowers-Express Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Origin	Hybrid Type	Oil Type	Days to Flowering	Plant height	Oil	Test weight	Yield		
								2020	2-Avg	3-Avg
				(DAP)	(in)	(%)	(lb/bu)	(lb/a)	(lb/a)	(lb/a)
Falcon	NuSeed	Express	Nusun	74	43.1	43.1	27.6	1153	1070	1561
N4H302 E	NuSeed	Express	High Oleic	72	42.5	40.2	25.8	1312	1225	1196
CP455E	Croplan	Express	High Oleic	72	43.7	39.4	26.0	2012	1500	-
CP450E	Croplan	Express	High Oleic	73	43.5	40.2	26.4	1730	1459	-
E-91	Proseed	Express	Nusun	75	55.6	41.1	27.4	1617	1239	-
H45HO10EX	Dyna-Gro	Express	High Oleic	71	44.4	39.8	25.6	1426	1056	-
E-93 E	Proseed	Express	Nusun	73	54.2	40.3	24.7	1816	-	-
Mean				72	46.8	40.9	26.4	1636	-	-
CV (%)				1.0	6.9	2.1	2.3	19.9	-	-
LSD (5%)				1.0	4.7	1.3	0.9	474.8	-	-
LSD (10%)				0.8	3.9	1.1	0.7	393.6	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: wheat
Planted: 05/28/2020 Harvested: 10/05/2020
Soil test to 6" in ppm: P =22; K = 264; OM = 1.9%; pH = 5.6 Soil type: Williams-Bowbells loam
Soil test to 24" in lb/a: N=10 lb/a DAP = Days after planting
Applied fertilizers in lb/a: N=130; P=20; K=0; S=40
Herbicide Application: Valor @ 3 oz/a (10/21/19); PowerMax @ 32 oz/a (6/2/20); Assure II @ 12 oz/a (7/6/2020)

Sunflower Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Brand / Company	Oil Type¥	Plant Height (in)	Days to Flower (DAP*)	Days to Maturity (DAP*)	Oil† 2020 (%)	Oil† 2-Yr Avg (%)	Test Weight (lb/bu)	Harvest Moisture (%)	Yield‡ 2020 (lb/a)	Yield‡ 2-Yr Avg (lb/a)
N4H470 CL Plus	NuSeed	HO	70	70	116	44.3	43.0	32.3	9.7	3108	2969
N4H302 E	NuSeed	HO	63	69	116	41.1	39.6	29.8	8.6	3075	2794
Camaro II	NuSeed	NS	72	69	115	42.2	41.1	32.3	8.6	2834	2719
Falcon	NuSeed	NS	66	70	116	41.9	41.1	31.2	7.7	2320	2699
H45HO10EX	Dyna-Gro	HO	66	68	117	42.3	40.9	28.8	7.9	2853	2547
H44HO12CL	Dyna-Gro	HO	67	65	115	44.0	42.1	31.8	8.5	2923	2516
H42HO18CL	Dyna-Gro	HO	65	66	115	41.4	40.1	31.0	7.7	2730	2509
E-91 E	Proseed	HO	76	69	116	40.9	38.3	30.8	7.9	2690	2392
SF440	S W Seed Company	HO	75	72	116	43.7	-	31.8	8.9	3189	-
E-50016	Proseed	HO	71	70	116	38.4	-	29.2	7.8	3010	-
SF110	S W Seed Company	HO	70	67	116	41.7	-	31.7	7.5	2641	-
E-93 E	Proseed	NS	76	68	115	38.1	-	28.5	7.9	2612	-
12G25 CL	Proseed	HO	67	67	115	42.3	-	31.9	8.9	2387	-
MEAN			69.4	68.3	115.6	32.7	36.2	30.9	8.3	2798	2643
C.V. (%)			6.5	1.5	0.6	3.32	-	2.50	7.26	14.97	-
LSD (5%)			7.7	1.7	1.2	1.83	-	1.30	1.00	705.77	-
LSD (10%)			6.4	1.4	1.0	1.52	-	1.08	0.83	585.05	-

* Days after planting ⁺ 0: no lodging - 9: plants lying flat on the ground † Oil content adjusted to 10% moisture ‡ Yield adjusted to harvest moisture
¥ HO=high oleic, NS=NuSun

Location: Latitude 48 9.9222'N; Longitude 103 6.132'W
Soil test (0-6 in.): P=20 ppm; K=134 ppm; pH=7.7; OM=1.9%
(0-24 in.): NO3-N=29 lb/a
Yield goal: 2,500 lb/a
Planting population: 22,000 seeds/a
Fertilizer applied: 270 lb/a of Urea (46-0-0) [5/28]
Herbicides applied: Prowl H2O (2pt/a) [5/29], Cornerstone (32oz/a), Class Act NG (1qt/100gal) [5/29], Section 3 (5.33oz/a), Superb (1qt/100gal) [6/26
Fungicides applied: none applied

Elevation: 1902 ft
Previous crop: Winter Wheat
Planted: 5/27/2020
Harvested: 11/5/2020
Soil type: Lihen Loamy Fine Sand
Plot size: 90 ft^2
Rainfall: 5.0 inches [5/27-11/5]
Irrigation: 18.8 inches [5/27 -11/5]

Canola - Roundup Ready Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Company	Duration of Flowering (Days)	Days to Maturity (DAP)	Height (in)	Oil (%)	Test Weight (lb/bu)	Yield 2020 (lb/a)	Yield 2-Yr Avg (lb/a)	Yield 3-Yr Avg (lb/a)
Star 402	Star Specialty	30	94	27.2	44.3	49.8	881	948	948
6090RR	BrettYoung	26	95	29.9	41.6	49.5	824	899	827
CP930RR	Winfield/Croplan	32	93	27.9	44.5	49.9	1019	1127	-
CP955RR	Winfield/Croplan	30	93	28.4	43.7	50.8	1176	1077	-
CP9978TF	Winfield/Croplan	27	95	28.6	39.9	49.6	795	1067	-
StarFlex	Star Specialty	28	95	29.0	42.4	50.4	894	1002	-
CS2100	Meridian/Canterra	27	94	26.5	39.2	49.5	783	978	-
CS2600 CR-T	Meridian/Canterra	30	94	28.4	40.8	49.9	942	912	-
CS2300	Meridian/Canterra	29	96	29.2	41.6	49.6	759	842	-
CP9919RR	Winfield/Croplan	32	94	23.6	40.2	48.6	777	516	-
BY 6204TF	BrettYoung	27	95	29.3	40.4	49.8	944	-	-
DKTF91SC	Bayer/Dekalb	31	94	26.0	40.7	49.2	740	-	-
Mean		29	94	28	41.7	49.8	886	-	-
CV %		4.7	0.6	9.3	1.1	1.8	15.8	-	-
LSD 0.05		2.0	0.8	3.7	0.7	1.3	201.2	-	-
LSD 0.10		1.6	0.7	3.1	0.6	1.1	167.5	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Soybeans
Planted: 05/13/2020 Harvested: 08/20/2020
Soil test to 6" in ppm: P=20 ppm; K=285; OM=2.0; pH=6.4 Soil type: Williams-Bowbells loam
Soil test to 24" in lb/a: N=17 lb/a
Applied fertilizers in lb/a: N=90; P=20; K=0; S=24
[1]DAP = Days after planting.
Herbicide Application: PowerMax @ 22 oz/a (5/18/20 and 6/15/20)

Clearfield Canola Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Company/Brand	Flower Duration	Days to Maturity	Plant height	Oil (%)	Test weight	Yield (lb/a)	Yield 2-Yr Avg
CS2500 CL	Meridian/Canterra	28	95	29	41.9	48.3	1086	1255
CS2700 CL	Meridian/Canterra	27	95	31	43.7	49.6	969	-
Mean		27	95	29	42.5	48.8	1013	-
CV (%)		5.9	0.9	7.1	1.1	4.2	11.8	-
LSD (5%)		1.7	0.9	2.2	0.5	2.2	127.7	-
LSD (10%)		1.4	0.7	1.8	0.4	1.8	104.9	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: Soybeans
Planted: 05/13/2020 Harvested: 08/20/2020
Soil test to 6" in ppm: P = 20; K = 285; OM = 2.0; pH = 6.4 Soil type: Williams-Bowbells loam
Soil test to 24" in lb/a: N = 17 lbs/a
Applied fertilizers in lb/a: N=90; P=20; K=0; S=24
[1]DAP = Days after planting.
Herbicide Application: PowerMax @ 32 oz/a (5/18/20); Beyond @ 4 oz/a (6/15/20)

If the saying is true,
that what doesn't
kill you
makes you
stronger,
at this point
I should be able
to bench
press a semi.

RR Canola Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Days to Flower (DAP*)	Days to Maturity (DAP*)	Plant Height (in)	Lodging (0 - 9+)	Oil† 2020 (%)	Oil† 2-Yr Avg (%)	Oil† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2020 (lb/a)	Yield 2-Yr Avg (lb/a)	Yield 3-Yr Avg (lb/a)
Star 402	54	95	42	1	42.0	43.2	42.7	51.5	2298	2060	2183
6090RR	55	99	45	1	39.1	40.8	40.4	50.4	2130	2048	2117
CP955RR	53	97	41	0	41.7	42.9	-	51.8	2712	2397	-
CP930RR	52	96	41	1	41.9	42.8	-	51.3	2771	2375	-
CP9978TF	53	98	38	1	39.9	40.8	-	51.7	2612	2303	-
StarFlex	54	96	43	1	40.3	41.4	-	52.1	2308	2080	-
CP9919RR	54	98	30	4	37.2	38.8	-	50.5	1820	1726	-
BY6204TF	55	96	43	1	37.8	-	-	50.8	2500	-	-
MEAN	53.7	96.7	40.4	1.2	39.99	41.53	41.57	51.27	2394.1	2141.2	2149.8
C.V. (%)	3.8	1.8	7.1	57.7	3.11	-	-	1.56	10.5	-	-
LSD (5%)	3.0	2.6	4.2	2.1	1.83	-	-	1.17	369.9	-	-
LSD (10%)	2.5	2.1	3.5	0.8	1.52	-	-	0.97	306.0	-	-

* 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=24 ppm; K=158 ppm; pH=7.9; OM=2.9 % — Previous crop: Durum

(0-24 in.): NO3-N=29 lb/a — Planted: 5/5/2020

Yield goal: 2,500 lb/a — Harvested: 8/19/2020

Planting population: 520,000 seeds/a — Soil type: Lihen Loamy Fine Sand

Fertilizers applied: 125 lb/a of AMS (21-0-0-24S) [5/8], 197 lb/a of Urea (46-0-0) [5/11] — Plot size: 61 ft^2

Herbicides applied: Sonolan HFP (1.5 pt/a) [5/11], Cornerstone (24oz/a) and Class Act (1pt/100gal) [6/24] — Rainfall: 4.6 inches [5/5 - 8/19]

Irrigation: 10.2 inches [5/5 - 8/19]

Fungicide applied: Proline (5oz/a) [7/6]

YOU MIGHT BE A FARMER'S DAUGHTER IF...

YOU SPEND YOUR FRIDAY NIGHTS
in the combine with your dad,

RATHER THAN OUT ON A DATE.

Roundup Ready Soybean Dryland Variety Trial - NDSU
Keene, McKenzie County, ND 2020

Variety	Company/Brand	Relative Maturity	Protein (%)	Oil (%)	Test weight (lb/bu)	Yield (bu/a)
S009XT68	Dyna-Gro Seed	00.9	36.3	21.9	56.9	27.5
LGS00899RX	LG Seeds	00.8	34.2	23.5	57.5	25.0
50-10	Proseed	0.1	38.2	23.0	57.3	24.8
XT20-07	Proseed	00.7	34.2	23.2	56.9	24.7
XT70-09	Proseed	00.9	34.8	23.3	57.5	24.7
ND18008GT	NDSU	00.8	37.4	22.7	57.3	23.3
20215	Integra	0.2	38.3	22.0	56.3	22.7
ND17009GT	NDSU	00.9	39.3	22.5	58.6	22.6
EL80-093	Proseed	00.9	36.3	22.4	57.1	22.5
LGS0111RX	LG Seeds	0.1	36.6	23.0	57.0	19.1
50309N	Integra	0.3	37.5	21.9	57.0	19.1
S03XT29	Dyna-Gro Seed	0.3	35.0	22.7	56.6	18.7
ND14-6120	NDSU	00.8	35.3	22.8	57.9	18.5
RX0411	REA Hybrids	0.4	36.0	23.0	56.8	18.1
40201N	Integra	0.2	37.4	22.1	55.6	14.4
ND15-22873	NDSU	0.7	37.3	22.0	55.9	14.0
S02EN71	Dyna-Gro Seed	0.2	36.3	22.5	56.3	13.2
RX0520	REA Hybrids	0.5	39.3	22.0	56.1	10.9
Mean			36.6	22.6	56.9	20.2
CV (%)			2.5	1.6	1.1	11.6
LSD (5%)			1.5	0.6	1.1	3.9
LSD (10%)			1.3	0.5	0.9	3.2

Location: Keene ND; Latitude 47° 59' N; Longitude 102° 48' W; Elevation 2444 ft
Planted: 05/20/2020 Harvested: 10/09/2020
Previous crop: wheat Soil type: Williams-Bowbells loam
Applied fertilizers in lb/a: N=0; P_2O_5=0; K_2O=0
Herbicide Application: PowerMax @ 32 oz/a (5/22/20 and 6/23/20)

Roundup Ready Soybean Dryland Variety Trial - NDSU
Corinth, Williams County, ND 2020

Variety	Company/Brand	Relative Maturity	Protein (%)	Oil (%)	Test weight (lb/bu)	Yield (bu/a)
XT20-07	Proseed	00.7	34.7	22.2	56.5	35.2
20215	Integra	0.2	37.3	20.2	57.5	33.1
50309N	Integra	0.3	37.4	20.4	56.8	32.4
ND17009GT	NDSU	00.9	39.6	21.8	58.7	32.0
XT70-09	Proseed	00.9	35.3	22.2	57.6	31.7
EL80-093	Proseed	00.9	34.6	21.3	57.9	30.7
S009XT68	Dyna-Gro Seed	00.9	36.8	20.2	58.5	30.6
S03XT29	Dyna-Gro Seed	0.3	38.5	20.4	57.2	29.3
LGS00899RX	LG Seeds	00.8	35.5	22.6	57.6	29.3
50-10	Proseed	0.1	37.5	22.4	57.9	27.9
LGS0111RX	LG Seeds	0.1	36.9	21.3	57.4	26.0
ND18008GT	NDSU	00.8	39.2	21.3	58.1	26.0
ND14-6120	NDSU	00.8	35.5	21.6	58.1	25.6
RX0411	REA Hybrids	0.4	34.5	19.8	56.8	24.5
40201N	Integra	0.2	36.7	19.7	57.4	24.4
S02EN71	Dyna-Gro Seed	0.2	36.3	19.9	57.4	23.5
RX0520	REA Hybrids	0.5	37.8	19.6	57.2	22.8
ND15-22873	NDSU	0.7	36.1	19.7	57.8	21.9
Mean			36.7	20.9	57.6	28.2
CV (%)			3.2	2.3	0.6	13.5
LSD (5%)			1.9	0.8	0.5	6.3
LSD (10%)			1.6	0.7	0.4	5.2

Location: Corinth ND; Latitude 48° 36' N; Longitude 103° 19' W; Elevation 2205 ft
Planted: 05/21/2020 Harvested: 10/09/2020
Previous crop: wheat Soil type: Williams-Bowbells loam
Applied fertilizers in lb/a: N=0; P_2O_5=0; K_2O=0
Herbicide Application: PowerMax @ 32 oz/a (5/22/20 and 6/23/20)

Dry Bean Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Days to Maturity (DAP*)	Canopy Height (in)	Lodging (0 - 9+)	Hundred Seed Weight (g)	Seeds / Pound	Test Weight (lb/bu)	Yield 2020 (lb/a)	Yield 2-Yr Avg (lb/a)	Yield 3-Yr Avg (lb/a)
PINTO BEAN									
La Paz	96	14	1	31	1455	63.2	4259	2842	2736
ND Palomino	97	11	2	35	1286	59.9	3405	2680	2680
Lariat	96	13	2	33	1365	61.5	3579	2641	2563
Monterrey	97	14	1	32	1413	63.1	3069	2379	2480
Stampede	95	11	1	32	1427	60.2	3262	2400	2271
Windbreaker	95	12	1	37	1221	60.1	2120	2031	1981
Torreon	96	14	1	34	1332	62.1	3799	2846	-
Vibrant	99	11	1	31	1441	63.3	2708	2290	-
ND Falcon	100	13	0	33	1391	58.3	2284	1927	-
NAVY BEAN									
T9905	98	12	1	18	2579	65.5	2533	1918	1723
Blizzard	97	12	0	17	2639	64.3	2327	1774	-
BLACK BEAN									
Eclipse	95	12	0	19	2425	64.3	2053	1798	1797
Black Tails	96	13	0	19	2395	65.7	2706	2247	-
SMALL RED									
Merlot	97	10	2	30	1504	62.2	2287	2134	1911
Viper	95	14	1	24	1880	62.5	3768	2754	-
GREAT NORTHERN									
ND Pegasus	98	16	1	30	1496	61.9	3834	2817	-
MEAN	96.7	12.5	0.9	28.5	1702.9	62.38	2999.5	2342.4	2238.1
C.V. (%)	1.3	14.3	94.2	3.5	4.0	1.78	14.4	-	-
LSD (5%)	2.1	3.0	1.4	1.6	113.4	1.85	720.3	-	-
LSD (10%)	1.8	2.5	1.2	1.4	94.2	1.54	598.4	-	-

* 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=20 ppm; K=134 ppm; pH=7.7; OM=1.9% — Previous crop: Winter Wheat

(0-24 in.): NO3-N=29 lb/a — Planted: 5/29/2020

Yield goal: 2,500 lb/a — Harvested: 9/22/2020

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

Fertilizer applied: 223 lb/a of Urea (46-0-0) [5/29] — Plot size: 51 ft^2

Herbicides applied: Cornerstone (32oz/a), Class Act NG (1qt/100gal) [5/29], Section 3(5.33oz/a), Superb (1qt/100gal) [6/26], and Varisto (21oz/a), Raptor (4oz/a), Basagran (1pt/a), and Superb HC (1.5pt/a) [6/26] — Rainfall: 4.9 inches [5/29 - 9/22]

Irrigation: 17.8 inches [5/29 -9/22]

Fungicide applied: Priaxor (8 oz/a) [7/21]

Corn Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Company	Relative Maturity	Days to Silk (DAP[1])	Ear Height (in)	Test Weight (lb/bu)	Yield[#] 2020 (bu/a)	Yield 2-Yr Avg (bu/a)
1974	Proseed	74	72	21.9	57.3	71.8	89.4
3009 VT2P RIB	Wilbur Ellis	79	71	22.0	54.5	59.4	77.2
1980 VT2P	Proseed	80	72	26.3	53.2	56.2	75.9
3282 VT2P RIB	Wilbur Ellis	82	77	31.1	53.3	36.3	60.9
1B750	REA Hybrids	75	72	23.1	54.8	48.4	-
1B821	REA Hybrids	82	74	25.8	51.4	43.6	-
2B851	REA Hybrids	85	73	29.5	49.3	53.8	-
3431 VT2P RIB	Wilbur Ellis	84	76	23.7	51.8	58.1	-
2078 GT	Proseed	78	75	28.4	51.4	43.2	-
1882 VT2P	Proseed	82	76	29.9	54.2	35.0	-
Mean			74	26	53	51	-
CV (%)			2.1	13.1	1.7	17.7	-
LSD (5%)			2.2	5.0	1.3	13.0	-
LSD (10%)			1.9	4.1	1.1	10.8	-

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

Planted: 5/21/20 Harvested: 10/07/2020

Soil test to 6" in ppm: P=22 ppm; K=285 ppm; OM=2.0%; pH=6.4 Soil type: Williams-Bowbells loam

Soil test to 24" in lb/a: N=17 lb/a

Applied fertilizers in lb/a: N=74; P_2O_5=32; K_2O=0; S=8

[1]DAP = Days after planting

Yield was very poor do to lack of moisture and early freeze. Froze September 8th @ 26F
Rainfall total during season = 4.38"

Herbicide Application: PowerMax @ 32 oz/a (5/21/20 and 6/15/20)

Corn Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Company / Brand	Relative Maturity	Days to Silk	Ear Height	Harvest Moisture ¥	Test Weight	Yield ‡		
							2020	2-Yr Avg	3-Yr Avg
			(DAP*)	(in)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
1B780	REA Hybrids	79	74	42	12.6	53.3	183.4	171.7	180.6
3718 VT2P RIB	INTEGRA	87	77	44	14.1	53.7	183.3	168.8	-
1974	Proseed	74	73	33	12.9	56.9	143.2	152.3	-
3537 VT2P RIB	INTEGRA	85	78	44	13.0	53.7	153.5	144.6	-
3282 VT2P RIB	INTEGRA	82	77	44	12.7	54.0	137.5	135.4	-
1980 VT2P	Proseed	80	72	39	13.3	56.3	192.5	-	-
2B851	REA Hybrids	85	75	41	12.8	53.8	181.8	-	-
1B821	REA Hybrids	82	75	39	12.7	53.8	178.5	-	-
3431 VT2P RIB	INTEGRA	84	76	44	13.0	54.5	172.4	-	-
CX20181 VC / D21VC81	Dyna-Gro	81	75	42	12.8	54.4	160.1	-	-
D22QZ42	Dyna-Gro	82	75	42	14.5	54.3	155.8	-	-
D27VC87RIB	Dyna-Gro	87	77	36	13.1	53.8	150.8	-	-
1882 VT2P	Proseed	82	76	43	12.7	55.2	137.5	-	-
2078 GT	Proseed	78	76	45	12.2	52.0	138.1	-	-
1B750	REA Hybrids	75	74	34	12.5	56.4	127.4	-	-
MEAN			75.2	40.8	12.98	54.41	159.73	154.58	180.60
C.V. (%)			1.9	8.0	3.16	1.43	12.57	-	-
LSD (5%)			2.1	4.6	0.59	1.11	33.23	-	-
LSD (10%)			1.7	3.9	0.49	0.93	27.69	-	-

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

¥ Killing frost occurred on September 7, 2020. Corn did not reach physiological maturity or development of black layer.

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

Soil test (0-6 in.): P=20 ppm; K=134 ppm; pH=7.7; OM=1.9% — Previous crop: Winter Wheat

(0-24 in.): NO3-N=29 lb/a — Planted: 5/14/2020

Yield goal: 190 bu/a — Harvested: 11/4/2020

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

Fertilizer applied: 450 lb/a of Urea (46-0-0) [5/19] — Plot size: 105 ft^2

Herbicides applied: Cornerstone (24oz/a) and Class Act NG (3oz/a) [6/5], [6/10], & [6/26] — Rainfall: 5.4 inches [5/14-11/4]

Fungicide applied: none applied — Irrigation: 18.8 inches [5/14 -11/4]

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.

Lentil Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Days to Flowering	Days to Maturity	Plant height	1000 Kernel Weight	Protein	Test weight	Yield		
							2020	2-Yr Avg	3-Yr Avg
	(DAP)	(DAP)	(in)	(g)	(%)	(lb/bu)	------	(lb/a)	-----
Large Green									
CDC Greenstar	55	95	15	131.4	26.0	59.7	1260.0	-	-
Medium Green									
CDC Richlea	54	94	12	108.3	24.9	60.6	1260.0	1932.0	1662.0
Avondale	53	93	12	103.5	24.9	61.3	1254.0	1956.0	1620.0
Small Green									
ND Eagle	51	92	12	82.8	25.9	62.3	984.0	1782.0	1500.0
CDC Kermit	56	92	11	67.3	26.4	62.6	1062.0	-	-
CDC Invincible CL	55	92	13	73.3	27.0	62.4	1038.0	-	-
Small Red									
CDC Impala CL	55	91	12	65.5	N/A	63.1	1266.0	-	-
CDC Maxim CL	54	93	12	83.9	N/A	62.2	1248.0	-	-
Mean	54	93	12	89.5	25.9	61.8	1170.0	-	-
CV (%)	1.7	0.6	8.2	2.0	2.3	0.4	11.9	-	-
LSD (5%)	1.6	1.0	1.8	3.1	1.1	0.5	246.0	-	-
LSD (10%)	1.3	0.9	1.5	2.5	0.9	0.4	198.0	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft. Previous crop: wheat
Planted: 04/29/2020 Harvested: 08/17/2020
Soil test to 6" in ppm: P = 22 ppm; K = 264 ; OM = 1.9%; pH= 5.6 Soil type: Williams-Bowbells loam.
Soil test to 24" in lb/a: N = 10 lb/a
Applied fertilizers in lb/a: N=0; P=0; K=0; S=0
Herbicide Application: Valor @ 3oz/a (10/21/19); Clethodim @ 8 oz/a (6/15/2020) ; Assure II @ 8 oz/a (7/6/2020)

Irrigated Lentil Variety Evaluation - MSU **Sidney, MT 2020**

Variety	Days to Flower (DAP)[1]	Plant Height (cm)	Test Weight (lb/bu)	1000 Seed Weight (g)	Adjusted Grain Yield (lb/a)
Avondale	54	15.5	62.3	48.7	3332
CDC Impala	60	15.8	64.9	31.7	3182
CDC Impress	55	16.7	62.2	55.3	3031
CDC Richlea	56	15.4	61.1	51.3	3210
CDC Viceroy	56	15.5	64.4	34.6	3230
NDL090170L	54	15.6	60.0	74.3	2860
NDL090185R	54	16.1	61.8	52.4	3259
NDL120600R	54	16.7	61.0	55.0	2887
Sage	54	14.8	64.0	36.8	3638
Mean	55	15.8	62.4	48.9	3181
P-Value	<0.0001	0.48	<0.0001	<0.0001	0.001
LSD	1.4	NS	0.3	1.3	312.1
CV (%)	1.7	8.1	0.4	1.8	6.7

Location: EARC; Sidney, MT
Previous crop: Sugarbeet
Planted: April 23, 2020
Harvested: Aug. 6, 2020
Applied fertilizers in lb/a: None
Soil type: Savage Silty Clay Loam
Yield adjusted to 13% moisture content
Herbicide: Outlook at 12 oz/ac preemergence
DAP[1] = Days after planting

Dryland Lentil Variety Evaluation - MSU **Richland, MT 2020**

Variety	Plant Height (inch)	Test Weight (lb/bu)	1000 Seed Weight (g)	Adjusted Grain Yield (lb/a)
Avondale	15.9	63.7	46.9	3433
CDC Greenstar	15.8	61.2	65.3	2813
CDC Impala	16.0	66.4	25.9	2923
CDC Impress	14.5	63.2	47.0	2712
CDC Imvincible	15.9	65.6	28.3	2896
CDC Kermit	14.1	66.3	26.2	3151
CDC Maxim CL	15.6	65.3	36.1	3102
CDC Richlea	15.6	62.7	49.2	3189
CDC Viceroy	15.2	65.8	29.0	2840
NDL090170L	15.9	61.9	64.2	2735
NDL090185R	16.7	63.5	45.3	3338
NDL120600R	14.9	62.3	50.5	2412
Sage	13.9	65.7	35.3	3139
Mean	15.4	64.1	42.2	2976
P-Value	0.4	<0.0001	<0.0001	<0.0001
LSD	NS	0.4	1.8	304.6
CV (%)	5.9	0.4	3.1	7.1

Location: Richland, MT
Previous crop: Spring Wheat
Planted: May 6, 2020
Harvested: Aug. 27, 2020
Applied fertilizers in lb/a: None
Soil type: Farnuf-Reeder Loam
Yield adjusted to 13% moisture content

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: CANADA represents developers from that country; NDSU = North Dakota State University; SD = South Dakota State University.
[3]M = Medium. [4]MR = Moderately resistant; MS = Moderately susceptible; NA = Data not available; R = Resistant; S = Susceptible.

Flax Dryland Variety Trial – NDSU

WREC, Williston, ND 2020

Variety	Days to Heading	Days to Flowering	Plant Height	Stand*	Oil	Test Weight	Yield		
							2020	2-Yr Avg	3-Yr Avg
	(DAP)	(DAP)	(in)	(%)	(%)	(lb/bu)	(bu/a)	(bu/a)	(bu/a)
CDC Buryu	50	94	20	65	43.8	52.9	17.3	22.1	22.1
Omega	53	95	22	50	43.2	53.0	15.0	18.4	19.2
CDC Glas	51	94	23	58	44.6	51.9	16.3	18.8	17.6
York	50	94	22	66	43.6	53.0	17.0	16.6	17.1
Prairie Thunder	52	95	23	60	43.1	53.2	18.5	18.9	16.3
CDC Neela	52	96	21	45	44.2	51.7	14.6	15.4	15.9
Bison	50	93	21	69	43.7	52.7	17.8	15.2	15.3
Webster	51	94	21	68	44.4	52.8	18.7	15.9	15.1
Carter	50	97	22	54	43.5	52.3	14.2	14.0	14.7
ND Hammond	51	95	23	64	42.5	52.5	16.2	16.1	14.6
Gold ND	52	96	23	41	44.4	52.4	12.7	13.3	14.3
CDC Plava	52	94	20	61	44.5	53.0	19.9	24.3	-
CDC Dorado	46	92	19	85	44.0	52.3	18.2	-	-
AAC Bright	51	94	20	58	46.2	50.7	14.9	-	-
Mean	51	95	22	58	43.7	52.5	16.3	-	-
CV (%)	1.9	1.8	8.3	22.4	0.7	1.0	19.0	-	-
LSD (5%)	0.5	0.8	0.8	6.0	0.1	0.2	1.4	-	-
LSD (10%)	0.4	0.7	0.7	5.1	0.1	0.2	1.2	-	-

Location: WREC; Latitude 48° 8' N; Longitude 103° 44' W; Elevation 2105 ft — Previous crop: Wheat
Planted: 5/5/2020 — Harvested: 08/25/2020
Soil test to 6" in ppm: P= 22 ; K = 264, OM = 1.9%; pH = 5.6 — Soil type: Williams-Bowbells loam
Soil test to 24" in lb/a: N = 10
Applied Fertilizer in lbs/a: N = 80; P = 20; K = 0; S = 5
Herbicide Application: Valor @ 3oz/a (10/21/19); Clethodim @ 8 oz/a (6/15/2020); Assure II @ 8 oz/a (7/6/2020)
*Poor stands were established, due to dry soil and previous crop residue

Flax Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Days to Flower (DAP*)	Days to Maturity (DAP*)	Plant Height (in)	Lodging (0 - 9⁺)	Oil† 2020 (%)	Oil† 2-Yr Avg (%)	Oil† 3-Yr Avg (%)	Test Weight (lb/bu)	Yield 2020 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
Bison	54	95	29	0	38.7	38.5	38.4	51.4	44.7	41.7	35.1
ND Hammond	53	96	27	0	39.4	39.0	38.5	51.7	41.6	38.4	33.4
Prairie Thunder	55	96	30	0	38.1	37.7	37.6	52.0	41.9	40.0	33.2
York	54	94	28	1	39.0	39.0	38.6	52.2	41.9	37.3	32.5
Gold ND	59	96	30	0	40.7	40.5	39.7	52.7	41.1	36.1	31.5
CDC Glas	57	94	29	0	38.6	39.3	39.0	50.1	45.3	33.2	30.1
CDC Buryu	51	91	28	1	39.1	-	-	50.8	46.3	-	-
CDC Plava	54	91	26	1	39.6	-	-	51.1	44.9	-	-
CDC Neela	54	93	28	0	38.8	-	-	51.7	44.2	-	-
CDC Durado	52	91	24	0	39.8	-	-	51.4	42.0	-	-
AAC Bright	55	93	28	0	41.0	-	-	49.9	41.6	-	-
Omega	54	94	25	0	39.8	-	-	52.7	41.5	-	-
Webster	56	96	31	1	39.2	-	-	52.0	38.5	-	-
MEAN	54.3	93.6	28.0	0.3	39.36	38.99	38.62	51.51	42.72	37.79	32.61
C.V. (%)	4.8	2.7	5.1	159.1	2.02	-	-	1.27	8.84	-	-
LSD (5%)	3.7	3.7	2.1	0.6	1.34	-	-	1.10	5.42	-	-
LSD (10%)	3.1	3.0	1.7	0.5	1.11	-	-	0.91	4.51	-	-

* 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=24 ppm; K=158 ppm; pH=7.9; OM=2.9 % — Previous crop: Durum

(0-24 in.): NO3-N=29 lb/a — Planted: 5/5/2020

Yield goal: 50 bu/a — Harvested: 8/24/2020

Planting population: 1.1 million seeds/a — Soil type: Lihen Loamy Fine Sand

Fertilizer applied: 110 lb/a of Urea (46-0-0) [5/11] — Plot size: 61 ft^2

Herbicides applied: Spartan Charge (2oz/a) [5/11], Section 3 (5.33oz/a) and Superb (1qt/a) [6/16] — Rainfall: 4.6 inches [5/5 - 8/24]

Fungicide applied: Proline 480SC (5oz/a) [7/6] — Irrigation: 10.2 inches [5/5 - 8/24]

Farm-er (fahr-mer):
noun
1. A person who is outstanding in his field.

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	SL	SD	SHORT	EARLY	MEDIUM	MR
PSTSP34	PHOTOSYNTECH	NA	NA	NA	NA	NA	NA
PSTSPS32	PHOTOSYNTECH	SL	SD	MEDIUM	MEDIUM	MEDIUM	MR
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.

Field Pea Dryland Variety Trial - NDSU **WREC, Williston, ND 2020**

Variety	Stand (%)	Days to Flowering (DAP)	Days to Maturity (DAP)	Height (in)	Protein (%)	1000 Kernel Weight (g)	Test Weight (lb/bu)	2020 Yield (bu/a)	2-YR Avg (bu/a)	3-YR Avg (bu/a)
Yellow Cotyledon Type										
AAC Chrome	86	55	85	15	24.1	291.0	64.4	26.9	50.9	45.3
CDC Saffron	94	54	81	15	25.0	253.3	64.6	30.9	45.8	42.7
AAC Carver	97	53	82	17	24.0	257.3	64.4	28.4	48.0	42.2
AAC Profit	93	53	82	16	25.0	267.5	64.3	22.9	44.5	41.1
Agassiz	90	52	83	16	25.4	278.1	64.7	26.0	44.1	40.6
CDC Inca	96	54	83	18	25.7	253.5	64.5	26.8	46.3	40.1
Jetset	97	50	81	17	26.5	247.3	64.3	26.1	44.2	39.0
LGPN 4915	95	50	82	18	29.8	244.2	64.6	27.9	42.3	38.7
CDC Amarillo	95	56	84	18	25.3	264.4	64.4	28.3	43.8	38.1
Hyline	91	54	82	18	25.6	282.9	64.8	24.1	43.3	38.0
Durwood	92	52	83	18	27.0	261.7	64.2	22.2	41.9	36.8
LG Sunrise	83	51	82	17	26.0	264.4	64.8	20.9	39.2	36.5
Salamanca	90	52	83	18	29.4	281.3	64.0	22.2	40.1	36.5
DS Admiral	91	50	82	15	25.8	266.6	65.1	23.7	39.1	36.4
Korando	88	49	85	14	31.3	287.4	63.7	19.2	38.2	36.2
ND Dawn	91	51	81	17	24.9	262.3	63.9	17.8	36.6	-
Kite (PS07100925)	91	50	80	13	26.3	254.2	64.2	17.1	36.7	-
PSTSP27	89	50	82	16	31.5	293.8	64.4	19.1	38.0	-
Peregrine	89	48	78	13	26.1	257.0	64.5	21.4	39.3	-
PS16100102	83	52	83	14	24.6	246.7	65.4	18.6	40.3	-
DL Apollo	88	52	83	19	29.1	246.8	64.7	22.4	41.2	-
N13029-10	90	50	81	19	26.7	293.9	64.1	23.0	41.7	-
PS1710N 0016	89	52	82	15	26.5	275.0	64.8	19.5	43.0	-
N13068-1	96	51	82	18	26.7	313.2	63.8	23.7	44.3	-
CDC Spectrum	93	54	86	17	26.8	272.6	64.2	25.8	44.9	-
PS17100022	97	52	81	17	24.6	266.3	65.4	22.3	46.0	-
CDC Dakota	89	59	85	19	29.0	239.2	64.9	28.5	-	-
MS-20YP4	92	56	85	16	25.2	280.4	64.2	28.5	-	-
AAC Asher	97	52	82	13	25.9	290.6	64.1	26.9	-	-
MS-19YP3	94	51	82	16	26.1	248.1	65.8	26.5	-	-
PSTSP43	95	53	84	17	26.2	294.9	64.2	24.7	-	-
PSTSP41	93	50	81	17	28.1	279.7	65.1	24.5	-	-
PSTSP39	97	54	83	19	27.5	263.5	64.3	22.2	-	-
PSTSP44	91	52	81	16	22.8	234.2	65.3	22.1	-	-
Orchestra	94	50	86	17	31.2	281.8	63.7	20.2	-	-
Nette 2010	91	50	83	17	25.8	273.7	65.3	20.0	-	-
LG Equator	93	50	86	15	29.5	239.1	63.8	18.2	-	-
Cronos	94	48	83	16	31.5	268.6	62.2	13.4	-	-
Green Cotyledon Type										
Arcadia	93	51	82	14	25.1	227.1	65.0	25.2	43.3	39.5
CDC Striker	88	54	85	18	29.5	263.0	64.6	22.9	43.6	39.5
AAC Comfort	95	59	88	15	25.0	319.3	62.9	26.6	46.6	38.8
CDC Greenwater	93	54	85	16	25.3	266.0	64.0	27.2	42.0	37.1
Shamrock	96	54	81	16	25.0	267.3	64.5	18.4	40.5	34.8
Viper	85	50	82	17	29.4	261.3	63.7	18.5	36.0	33.0
PSTSP38	97	49	82	17	26.7	276.9	64.4	23.1	42.2	-
Empire	94	55	83	21	26.5	262.3	65.2	24.5	40.2	-
Hampton	93	54	86	17	29.4	263.7	63.8	22.6	39.2	-
N13073-17	88	53	85	15	28.4	301.9	63.5	18.2	39.0	-
NDP100144G	93	57	87	20	24.1	235.3	64.6	27.8	-	-
PSTSP42	94	54	83	16	24.0	265.4	65.1	27.3	-	-
MS-20GP5	93	54	83	18	25.3	268.5	64.2	25.3	-	-
Daytona	95	53	83	17	28.9	288.3	64.1	21.2	-	-
Greenwood	89	50	77	15	25.2	217.3	64.5	16.1	-	-
Aragorn	89	50	76	15	27.3	228.8	62.6	15.7	-	-
Maple Cotyledon Type										
PSTSP40	95	53	90	17	26.9	254.3	64.8	28.4	-	-
Mean	92	52	83	17	26.7	266.2	64.4	23.1	-	-
CV %	5.0	2.1	3.6	12.3	2.5	3.5	0.7	16.2	-	-
LSD 0.05	6.4	1.5	4.1	2.8	0.9	13.0	0.6	5.2	-	-
LSD 0.10	5.3	1.3	3.5	2.4	0.8	10.9	0.5	4.4	-	-

Location of the WREC: Latitude 48 8'; Longitude 103 44'W; Elevation 2105 ft Previous Crop: wheat
Planting Date: 4/27/2020 Harvest Date: 7/31/2020
Soil test to 6" in ppm: P = 22; K = 264; OM = 1.9%; pH = 5.6 Soil type: Williams-Bowbells loam
Soil test to 24" in lb/a: N= 10
Applied fertilizers in lb/a: none
Herbicide Application: Valor @ 3oz/a (10/21/19)Clethodim @ 8 oz/a (6/15/2020); Assure II @ 8 oz/a (7/6/2020)

Field Pea Irrigated Variety Trial - NDSU **WREC, Nesson Valley, ND 2020**

Variety	Days to Flower (DAP*)	Days to Maturity (DAP*)	Canopy Height (in)	Lodging (0 - 9⁺)	Protein † 2020 (%)	Protein † 2-Yr Avg (%)	Test Weight (lb/bu)	Yield 2020 (bu/a)	Yield 2-Yr Avg (bu/a)	Yield 3-Yr Avg (bu/a)
YELLOW COTYLEDON										
Agassiz	53	90	28	5	29.6	27.7	63.0	63.3	58.3	58.9
DS Admiral	52	85	26	4	25.1	24.6	65.2	81.1	63.1	-
CDC Amarillo	57	91	31	3	27.3	-	63.9	67.8	-	-
ND Dawn	49	88	25	5	26.2	-	63.1	67.3	-	-
GREEN COTYLEDON										
CDC Striker	55	88	23	4	28.0	26.5	64.5	54.5	52.5	53.2
Arcadia	54	86	14	7	25.9	25.4	64.1	67.5	57.6	-
Aragorn	49	86	14	7	26.8	-	62.8	61.5	-	-
MEAN	54.1	87.6	24.6	4.5	27.17	26.08	64.13	66.85	57.91	56.07
C.V. (%)	1.9	3.2	18.6	14.5	3.97	-	0.91	12.36	-	-
LSD (5%)	1.5	4.2	6.4	1.1	1.59	-	0.86	12.16	-	-
LSD (10%)	1.2	3.5	5.3	0.9	1.31	-	0.71	10.04	-	-

* 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=24 ppm; K=158 ppm; pH=7.9; OM=2.9 % — Previous crop: Durum

(0-24 in.): NO3-N=29 lb/a — Planted: 5/6/2020

Yield goal: 50 bu/a — Harvested: 8/12/2020

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

Fertilizer applied: seed innoculated — Plot size: 55 ft^2

Herbicides applied: Prowl H2O (1.5pt/a) [5/8], Section Three (5.33oz/a) and Superb HC (1pt/100gal) [6/16] — Rainfall: 4.4 inches [5/6 - 8/12]

Fungicide applied: Proline 480SC (5oz/a) [7/2] — Irrigation: 9.3 inches [5/6 - 8/12]

You know you're a farmer when...

you know more about the
weather than the weatherman

More about tractors than a mechanic

**AND MORE ABOUT YOUR LAND
THAN ANYONE ELSE.**

Irrigated Green Dry Pea Variety Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Days to Flower	Plant Height	Test Weight	1000 Seed Weight	Protein	Adjusted Grain Yield
	(DAP)[1]	(inch)	(lb/bu)	(g)	(%)	(lb/a)
Aragorn	53	25.0	62.9	201	22.6	3926
CDC Striker	57	25.7	65.1	238	22.5	3864
Hampton	54	24.5	63.6	217	22.3	4368
Majoret	55	26.2	65.8	229	22.3	4024
NDP100144G	57	28.0	64.3	196	22.8	4063
NDP160028	56	27.1	66.0	216	21.6	4667
PSO877MT457	52	27.6	63.3	224	24.2	3837
Mean	55	26.3	64.4	217.3	22.6	4107
P-Value	<0.0001	0.1	0.0007	<0.0001	<0.0001	<0.0001
LSD (0.05)	1.4	NS	1.4	6.4	0.6	280.1
CV (%)	1.7	6.8	1.5	2.0	1.9	4.6

Irrigated Yellow Dry Pea Variety Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Days to Flower	Plant Height	Test Weight	1000 Seed Weight	Protein	Adjusted Grain Yield
	(DAP)[1]	(inch)	(lb/bu)	(g)	(%)	(lb/a)
Delta	53	24.1	64.8	233	21.3	4305
DS-Admiral	53	27.9	65.3	235	20.9	4468
ND Dawn	54	28.7	64.5	235	21.3	4602
PS0877MT632	54	24.1	63.3	215	22.6	3729
Mean	54	26.2	64.5	229.4	21.5	4276
P-Value	0.008	0.0004	0.001	<0.0001	<0.0001	<0.0001
LSD (0.05)	0.5	1.8	0.7	6.6	0.4	253.6
CV (%)	0.6	4.3	0.7	1.8	1.2	3.7

Location: EARC; Sidney, MT
Previous crop: Sugarbeet
Planted: April 23, 2020
Harvested: July 31, 2020
Applied fertilizers in lb/a: None
Soil type: Savage Silty Clay Loam
Yield adjusted to 13% moisture content
Herbicide: Outlook at 12 oz/ac preemergence
DAP[1] = Days after planting

Kaleb Jimison, WREC summer intern

Dryland Green Dry Pea Variety Evaluation - MSU **Richland, MT 2020**

Variety	Plant Height	Test Weight	1000 Seed Weight	Protein	Adjusted Grain Yield
	(inch)	(lb/bu)	(g)	(%)	(lb/a)
AAC Comfort	35.6	64.4	269	24.1	4815
Aragorn	29.6	63.2	236	24.8	3886
Bluemoon	30.5	64.1	264	24.4	4194
CDC Greenwater	35.9	64.8	244	23.6	4333
CDC Striker	34.1	64.8	251	25.2	4018
Daytona	31.5	64.3	279	23.9	4867
Empire	37.0	66.3	232	24.8	4277
Ginny 2	29.3	63.7	244	25.1	4031
Hampton	27.4	63.5	239	25.4	4773
Majoret	31.3	64.5	248	25.4	3962
NDP100144G	36.5	63.8	198	24.9	4469
NDP160028	32.3	66.3	235	24.1	4548
Pro 141-6258	28.7	64.6	233	24.4	4043
PSO877MT457	34.1	63.6	253	26.1	4252
Shamrock	35.6	66.3	250	23.8	4204
Mean	32.6	64.6	244.5	24.7	4300
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	0.1000
LSD	3.8	0.6	8.6	0.6	NS
CV (%)	7.9	0.6	2.4	1.5	10.9

Dryland Yellow Dry Pea Variety Evaluation - MSU **Richland, MT 2020**

Variety	Plant Height	Test Weight	1000 Seed Weight	Protein	Adjusted Grain Yield
	(inch)	(lb/bu)	(g)	(%)	(lb/a)
AAC Asher	29.9	64.6	274	24.0	5079
AAC Carver	33.9	64.9	247	22.6	5209
AAC Chrome	32.1	64.2	245	23.3	5068
AC Agassiz	30.8	64.2	248	24.2	4538
AC Earlystar	34.7	64.7	228	22.5	5151
CDC Amarillo	35.9	64.8	233	23.4	4824
CDC Dakota	33.4	66.3	201	26.6	4372
CDC Inca	36.5	64.9	240	24.5	4742
CDC Saffron	31.9	65.0	263	24.7	4721
CDC Spectrum	32.7	64.3	249	25.0	4647
Delta	31.5	65.0	258	24.5	3674
DL Apollo	35.0	65.2	240	25.0	4847
DS-Admiral	33.6	65.3	256	23.5	4717
Durwood	35.0	64.6	257	24.4	4359
Goldenwood	27.6	64.9	183	26.2	4029
Hyline	31.3	64.8	259	22.8	4881
Jetset	33.0	64.2	254	24.8	4759
Korando	31.8	65.0	285	25.4	4548
LG Amigo	30.2	63.7	245	24.1	4520
LG Sunrise	36.5	65.3	248	23.1	4735
Majestic	34.5	65.0	270	24.6	4429
MS-19YP3	33.7	66.4	250	24.2	4746
ND Dawn	31.8	63.8	252	23.2	4514
Nette 2010	30.9	65.2	252	23.4	4831
Orchestra	36.7	65.0	288	25.8	5194
Pro 093-7410	33.4	64.9	236	22.7	4865
Pro 133-6243	31.8	65.0	306	24.5	4738
Pro 143-6220	31.2	63.6	232	25.2	3546
Pro 143-6230	31.8	63.8	227	25.3	4266
Pro 153-7409	29.8	63.7	264	24.8	3898
PSO877MT632	29.4	64.8	237	26.0	3901
Salamanca	33.8	64.8	276	24.5	4348
Mean	32.7	64.7	249.8	24.3	4593
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD	3.7	0.5	9.0	0.5	595.0
CV (%)	7.8	0.6	2.5	1.4	9.0

Location: Richland, MT
Previous crop: Spring Wheat
Planted: May 6, 2020
Harvested: Aug. 18, 2020
Applied fertilizers in lb/a: None
Soil type: Farnuf-Reeder Loam
Yield adjusted to 13% moisture content

Irrigated Chickpea Variety Evaluation - MSU **EARC, Sidney, MT 2020**

Variety	Seed sizes greater than 22/64 inches (%)	Adjusted Grain Yield (lb/a)
CDC Frontier	47.0	5539
CDC Orion	79.1	5590
Myles	0.0	3226
Nash	90.4	4359
ND Crown	76.7	4738
Royal	88.7	4380
Sawyer	60.1	4252
Sierra	87.8	3888
Mean	66.2	4497
P-Value	<0.0001	<0.0001
LSD	5.9	384.2
CV (%)	6.1	5.8

Location: EARC; Sidney, MT
Previous crop: Sugarbeet
Planted: April 23, 2020
Harvested: Aug. 26, 2020
Applied fertilizers in lb/a: None
Soil type: Savage Silty Clay Loam
Yield adjusted to 13% moisture content
Herbicide: Outlook at 12 oz/ac preemergence
Fungicide: Miravis Top @ 14 oz/ac on 6/24/20 and 7/15/20

Dryland Chickpea Variety Evaluation - MSU **Richland, MT 2020**

Variety	Seed sizes greater than 22/64 inches (%)	Adjusted Grain Yield (lb/a)
CDC Frontier	17.3	2244
CDC Leader	36.3	2793
CDC Orion	63.1	2714
CDC Palmer	60.6	2757
Kasin	2.3	1119
Myles	0.0	2301
Nash	82.1	719
ND Crown	66.1	1358
Royal	82.9	809
Sawyer	45.5	1819
Sierra	83.8	787
Mean	49.1	1742
P-Value	<0.0001	<0.0001
LSD	7.7	533.9
CV (%)	10.9	20.9

Location: Richland, MT
Previous crop: Spring Wheat
Planted: May 6, 2020
Harvested: Sept. 3, 2020
Applied fertilizers in lb/a: None
Soil type: Farnuf-Reeder Loam
Yield adjusted to 13% moisture content

Note: Ascochyta disease pressure was significant, adversely affecting yields of susceptible varieties

Dryland Crop Performance Comparisons – Williston, ND 2020

Gautam Pradhan, Jerald Bergman, Kyle Dragseth

Crop	Type	Variety	Yield 3 Year Avg* (bu/a)	Market Price† ($/bu)	Gross Return ($/a)	+ or - spring wheat ($/a)
HR Spring Wheat		ND VitPro	37.0	5.03	185.94	0.00
HR Winter Wheat		Jerry	48.1	4.93	237.06	51.12
Durum Wheat		ND Riveland	41.8	6.00	251.00	65.06
Barley	(Feed)	ND Genesis	69.8	2.25	157.05	-28.89
Oats		Jury	106.1	2.09	221.15	35.21
Corn		Average‡	70.0	3.70	258.926	72.98
Soybeans	(Conventional#)	ND Benson#	21.4	11.19	239.73	53.78
Soybeans	(Roundup Ready)	ND 17009GT	26.0	11.19	290.57	104.62
Field Peas	(Green)	Arcadia	36.4	6.25	227.19	41.25
	(Yellow)	Agassiz	36.4	5.25	191.00	5.05
Flax		Average‡	14.7	12.00	176.52	-9.42
			lb/a	(¢/lb)		
Lentils	(Medium green)	Avondale	1653.0	21.00	347.13	161.19
Chickpeas	(Large Kabuli)	CDC Frontier	1520.0	24.62	374.22	188.28
Canola	(Roundup Ready)	Star 402	946.7	17.95	169.94	-16.00
Safflower		MonDak	1391.0	21.00	292.11	106.17
Sunflower	(Oil)	Camaro II	1758.0	18.00	316.44	130.50

*The average yield of a crop was based on a three-year average yield (2017, 2019, 220) from dryland varietal trials.

†The market price was obtained in the third week of November 2020 from different grain elevators in and around Williston.

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

#May command a premium.

Use of Lime Banded in Seed Row to Remediate Soil Surface Acidification

Jim Staricka, Jerry Bergman, and Cameron Wahlstrom – Williston Research Extension Center

Repeated surface application of urea or ammonium-based fertilizers without subsequent incorporation, such as in the case of no-till farming systems, has resulted in acidification of the soil surface. This acidification is detrimental to crop growth through the release of toxic elements such as aluminum and the tie-up of essential elements such as phosphorus. In humid and sub-humid regions where the entire soil profile is naturally acidic, the application of agricultural lime to reduce the soil acidity level has a long history. However, the rates recommended for use in these areas may be excessive for semi-arid regions where the artificially acidified soil surface overlies a subsoil that remains non-acidic. Alternative methods of lime application, such as applications in bands corresponding to the seed row, may be sufficient to maintain crop root growth through the acidic surface soil until the roots can reach the neutral or alkali subsoil. In addition, some crop varieties may be sufficiently acid-tolerant to grow in soils where the acidity is limited to the soil surface.

The objective of this study is to investigate the growth and yield of spring wheat and durum with and without a banded application of pelletized limestone, when grown in soil having an acidified surface.

Methods and Materials

The experiment looked at the effect of three lime rates on the performance of four crop varieties. The three lime rates were 0, 50, and 100 lb/a in the form of pelletized limestone applied in the seed row at planting. The four varieties were Lanning and Reeder hard red spring wheat and Mountrail and Riveland durum. Lanning is acid-tolerant whereas Reeder is not. Acid tolerance has not been identified among durum varieties. The experimental design was a randomized complete block design with four replications utilizing plots 15 feet wide by 20 feet long.

Soil samples were taken in October 2019 and analyzed for nutrient availability (Table 1).

Table 1: Soil test values (Oct. 2019).

Nutrient	Depth (inches)	Value
N	0 to 24	10 lb/a
P	0 to 6	42 ppm
K	0 to 6	257 ppm
pH	0 to 6	5.4
OM	0 to 6	2.8%

Crops were seeded and lime applied on 5 May 2020. Additional fertilizer applications during planting were 50 lb/a of Microessentials® S10 (12-40-0-10S) with the seed and 215 lb/a of urea mid-row banded.

A mid-season soil sampling was performed on June 19. Extremely dry soil conditions resulted in limiting the sampling to the 0 and 100 lb/a treatments of Reeder HRSW. Soil cores to the 12-inch depth were obtained directly in the crop row using a hand sampler. Cores were divided into 2-inch increments for measurement of pH. Soil pH measurement was conducted at the WREC using a handheld pH meter and a 1:1 soil:water mixture.

Plots were harvested on August 19 for grain yield and quality determination.

A post-harvest soil sampling was performed on October 21. Soil cores to the 12-inch depth were obtained directly in the crop row using a truck-mount hydraulic-assisted sampler and divided into 3-inch increments for measurement of pH. As with the mid-season soil sampling, sampling was limited to the 0 and 100 lb/a treatments of Reeder HRSW due to the persistent dry soil conditions.

Soil pH Results

At the June soil sampling, soil pH of the 0 to 2-inch depth zone was 4.8 where lime was not applied and 5.1 where lime was applied (Fig. 1). These values are classified as "*very strongly acid*" and "*strongly acid*", respectively, by the USDA-Natural Resources Conservation Service (NRCS). Many crops commonly grown in the MonDak region, including wheat, barley, pea, lentil, and alfalfa, will have reduced yields when soil pH is less than 5.3.

The application of lime did not affect the soil pH below the 2-inch depth. This is likely due to the dry soil conditions that inhibited the lime from dissolving or moving deeper in the soil. Intact lime particles were observed in the 0 to 2-inch soil even six weeks after lime application. Soil pH increased (i.e., the

soil became less acidic) with depth. At the 10 to 12-inch depth the soil pH was 6.4, which the NRCS classifies as "*slightly acid*".

At the October soil sampling, soil pH values differed little from those measured in June when accounting for the differences in sample depths (Fig. 2). The application of lime did not affect the soil pH at any depth. The soil pH of the 0 to 3-inch depth zone was 5.3, which the NRCS considers to be "*strongly acid*". The pH increased with depth and at the 9 to 12-inch depth was 6.3 ("*slightly acid*" in the NRCS classification). The dry soil conditions experienced during the early growing season persisted into October. Intact lime particles were still visible in the upper-most sampling depth, albeit not as prevalent as during the June soil sampling.

Fig. 1: June 19 soil pH values with and without lime application.

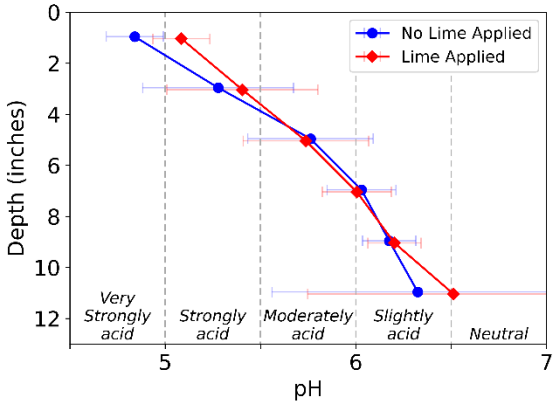
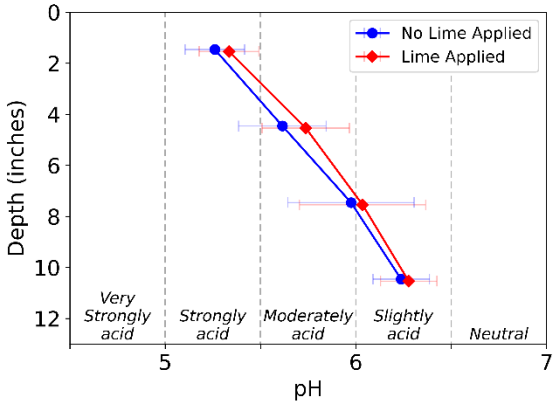


Fig. 2: October 21 soil pH values with and without lime application.



Crop Performance Results

Crop grain yield, test weight, and protein were not affected by lime application, but yield and test weight did differ among crop varieties (Table 2). Spring wheat out yielded durum. The test weight of Reeder spring wheat was greater than that of the other three varieties. Grain protein did not differ among varieties. It is interesting to note that the acid-tolerant variety, Lanning, did not perform significantly better than the non-acid-tolerant variety Reeder.

Discussion

The 2020 growing season was characterized by well below normal precipitation. In April, soil moisture was ample. However, only 3.94 inches of rain occurred between planting (May 5) and harvest (August 19).

Plant available soil moisture levels in the upper foot of soil:
- 85% on May 6
- 31% on June 17
- 13% on August 19

This resulted in the plant available soil moisture levels steadily decreasing during the growing season (see sidebar). (*Note: All soil moisture values were obtained from durum plots in a neighboring study*).

Table 2: Crop grain yield, test weight, and protein among varieties.

Variety	Yield	TestWt	Protein
	bu/a	*lb/bu*	*%*
Lanning	33.4 *a*	61.8 *b*	18.1 *a*
Reeder	32.4 *a*	62.2 *a*	18.0 *a*
Mountrail	29.1 *b*	61.6 *b*	18.2 *a*
Riveland	27.3 *b*	61.6 *b*	18.3 *a*

Within a column, numbers followed by the same letter are not significantly different at the 5% probability level.

Dry soil this year likely limited the dissolution and dispersion of the lime, thus reducing its effectiveness. In a preliminary study conducted last year, 100 lb/a of pelletized limestone applied in the seed row during planting was more effective. In that study, the pH of the 0 to 2-inch depth was increased by 0.95 units versus only 0.25 units this year.

This study will be repeated next year to further evaluate the effectiveness of banded application of pelletized limestone and acid-tolerant varieties to remediate soil surface acidification.

Sustainable Agroecosystem for Soil Health in the Northern Great Plains (Williston, ND - 2020)

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Introduction

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 a randomized complete block with four replications. The plot size is 60 ft. x 200 ft. In 2019/2020, based on the results from the previous five years, the treatment structure was modified to seven fixed rotations and two dynamic rotations, which are as follows:

Fixed Rotations from 2019

Rotation #	2019	2020	2021	2022	2023	2024
1	Durum	Fallow	Durum	Fallow	Durum	Fallow
2	Durum	Durum	Durum	Durum	Durum	Durum
3	Cover Crop	Sunflower	Pea	Durum	Safflower	Cover Crop
4	HRWW	Safflower	Pea	Durum	Sunflower	HRSW
5	Lentil	Durum	Pea	Durum	Lentil	TBD
6	Durum + SC	SC	Durum + SC	SC	Durum + SC	TBD
7	Perennial Mix	Perennial Mix	Perennial Grass	Perennial Mix	Perennial Mix	Perennial Mix

Note: Cover crop is a mixture of turnip, soybean, flax, sorghum sudangrass, and oats. HRWW = hard red winter wheat, which was replaced by hard red spring wheat (HRSW) in 2020 as HRWW was winter killed; SC = sweet clover. SC + Durum = sweet clover is companion cropped with durum.

Dynamic Rotations from 2019

Rotation #	2019	2020	2021	2022	2023	2024
8	Durum	Safflower	TBD	TBD	TBD	TBD
9	Safflower	HRSW	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).

Materials and Methods

The experimental design was a randomized complete block design with four replications. The treatment number and corresponding rotation and crops are given in Table 1. Seeding date, seeding rate, varieties, and harvest dates are indicated in Table 2. Crops were differentially fertilized based on soil tests and crop history. Durum and safflower received 50 lb of MEZ (12-40-0-10S-1Zn). Regarding N fertilization, durum and hard red spring wheat were fertilized based on a 130 lb/ac target minus a 50 lb no-till credit and a 40 lb/ac legume credit. Safflower was fertilized based on an 80 lb/ac target minus a 30 lb/ac no-till credit. The cover crop was fertilized based on 120 lb/ac. Pea, sweet clover, and the perennial mix did not receive any fertilizer. The soil test N and starter fertilizer N, where applicable, were deducted in calculating the amount of N fertilizer for each crop. No fungicides were applied to durum, hard red spring wheat, peas, lentils, sunflower, sweet clover, cover crops, and perennial mix. Safflower was treated with a foliar fungicide (azoxystrobin, 9 oz/ac) at early bloom and mid-bloom for control of Alternaria blight.

Table 1. Treatment number, rotation type, and Crops in 2019 and 2020.

Treatment #	Rotation		Crop and Year	
	Type	#	2019	2020
1	Fixed	1	Durum	Fallow
2	Fixed	1	Fallow	Durum
3	Fixed	2	Durum	Durum
4	Fixed	3	Cover Crop	Sunflower
5	Fixed	3	Pea	Durum
6	Fixed	3	Durum	Safflower
7	Fixed	3	Safflower	Cover Crop
8	Fixed	3	Canola	Pea
9	Fixed	4	HRWW	Safflower
10	Fixed	4	Pea	Durum
11	Fixed	4	Durum	Sunflower
12	Fixed	4	Safflower	Pea
13	Fixed	4	Canola	HRSW
14	Fixed	5	Lentil	Durum
15	Fixed	6	Durum+SC	(SC)
16	Fixed	5	Pea	Durum
17	Fixed	6	(SC)	Durum+SC
18	Fixed	5	Durum	Lentil
19	Fixed	5	Durum	Pea
20	Fixed	7	P. Mix	P. Mix
21	Dynamic	8	Durum	Safflower
22	Dynamic	9	Safflower	HRSW

Table 2. Seeding rate, seeding date, variety, and harvest date of different crops.

Crop	Variety/Type	Seeding Rate	Seeding Date	Harvest Date
Durum	ND Riveland	1.2 million PLS/ac	04/27/2020	08/15/2020
HRSW	(Bolles)	1.2 million PLS/ac	05/05/2020*	08/16/2020
Sunflower	Express/NuSun	20,000 PLS/ac	05/28/2020	10/08/2020
Safflower	Rubis Red	25 lb/ac	05/04/2020	10/08/2020
Peas	Midas	375,000 PLS/ac	04/24/2020	08/03/2020
Lentils	Richlea	70 lb/ac	05/04/2020	08/17/2020
Sweet Clover	Yellow	10 lb/ac	04/27/2020	-

*HRSW after canola (Treatment 13) was seeded on June 11, 2020, after burning down the winter-killed HRWW.

Results – Agronomic

The effect of crop rotation was not observed on the plant height of the crops. The effect of crop rotation was not evident on the yield of durum, lentil, safflower, and sunflower. Averaged across the crop rotation, the yield of durum, lentil, safflower, and sunflower were 37.4 bu/ac, 29.2 bu/ac, 1208 lb/ac, and 469 lb/ac, respectively.

There was a significant effect of crop rotation on HRSW yield and test weight but not on protein. The yield of HRSW following safflower (Treatment 22) was 29.9 bu/ac, which was 100% higher than HRSW following canola (Treatment 13). HRSW following safflower had about 6 lb/bu higher test weight than HRSW following canola (Table 3). HRSW followed by canola (Treatment 13) was seeded very late (June 11, 2020), which may be one of the reasons for such a drastic decrease in yield and test weight.

Table 3. Yield, test weight, and protein content of HRSW under different treatments.

Treatment	Crop		Yield	Test Weight	Protein
#	2019	2020	(bu/ac)	(lb/bu)	(%)
13	Canola	HRSW	14.8B	56.2B	17.4A
22	Safflower	HRSW	29.9A	62.3A	16.6A

Note: Different letters within a column indicates a significant difference at a *p*-value of < 0.05.

There was a significant effect of crop rotation on pea yield and protein but not on test weight. Pea following safflower (Treatment 12) and durum (Treatment 19) had statistically similar yield (about 39.9 bu/ac), which was 8.7 bu/ac higher than the pea following canola (Treatment 8; Table 4). Pea following safflower had the highest grain protein (21.9%) which was statistically similar to the pea following durum. The pea following canola had the lowest grain protein.

Table 4. Yield, test weight, and protein content of field peas under different treatments.

Treatment	Crop		Yield	Test Weight	Protein
#	2019	2020	(bu/ac)	(lb/bu)	(%)
8	Canola	Pea	31.2B	64.5A	20.6B
12	Safflower	Pea	40.6A	64.3A	21.9A
19	Durum	Pea	39.2A	64.5A	20.9AB

Note: Different letters within a column indicates a significant difference at a *p*-value of < 0.05.

This year, the cover crop was swathed and baled and the averaged cover crop yield obtained by weighing the bales was 1487 lb/ac. This year, due to heavy weed infestation, sweet clover was not harvested.

Results – Plant Pathology

Foliar and head diseases of durum were monitored across the different crop rotation treatments. During the 2020 season, the primary foliar diseases of concern were the fungal leaf spotting diseases (tan spot, Septoria blotch). Foliar disease was rated at the initiation of tillering and at the flag leaf growth stage on 50 plants per plot. Data collected included severity (percent leaf area affected) and incidence (number of plants with disease). Fusarium head blight (FHB) severity and incidence was determined in a similar manner on 50 durum heads per plot at the soft dough stage and ergot incidence was recorded at maturity.

There was no significant difference among treatments in early season foliar disease and ergot was not observed. Late season foliar disease was highest in the durum/fallow (#2) and continuous durum (#3) rotations and lowest in the durum+sweet clover (#17) (Table 5). Given that the fungal leaf spot pathogens overwinter on durum residue, it is unsurprising that foliar disease was highest in the least diverse cropping systems. Fusarium head blight incidence was highest in the durum/fallow rotation (#2) (Table 5). Inclusion of a full season cover crop within the cropping system from 2016-2020 did not appear to mitigate foliar or head diseases of durum long term as there was no significant differences among treatments 5 and 10.

Table 5. Durum leaf spot incidence and severity rated on the flag leaf June 26th and Fusarium Head Blight (FHB) rated July 14th. SC = sweet clover.

Treatment #	Crops 2016 - 2020	Leaf Spot Incidence (%)	Leaf Spot Severity (%)	FHB Incidence (%)	FHB Severity (%)
2	Fallow/Durum	93.0 *a*	7.4 *a*	3.0 *ab*	0.755
3	Continuous Durum	94.5 *a*	5.4 *ab*	0.0 *b*	0
5	Safflower/Durum/Cover Crop/Pea/Durum	83.5 *ab*	3.4 *b*	0.0 *b*	0
10	Safflower/Durum/HRWW/Pea/Durum	87.5 *ab*	3.9 *b*	0.0 *b*	0
17	Durum/Lentil/HRWW/SC/Durum+SC	76.5 *b*	3.1 *b*	0.5 *ab*	0.33
	p-value (0.05)	0.0014	0.0075	0.0145	NS

Note: Different letters within a column indicates a significant difference at a *p*-value of < 0.05. NS = not significant.

Spring Canola Variety Evaluation in Eastern Montana EARC, Sidney, MT

Apurba Sutradhar, Chengci Chen, Simon Fordyce, Bill Franck, Thomas Gross, Ronald Brown, and W. Tanner Stevens

Summary: Eighteen canola varieties were evaluated at the Eastern Agricultural Research Center, Sidney, MT under irrigation in 2020. Significant differences in the growth and yield were observed on canola performance. Average seed yield and oil content across varieties were 2457 and 49.6%, respectively. The variety DKTFLL21SC produced the highest seed yield followed by StarFlex and DG 760TM. In terms of oil content, the variety StarFlex had the highest oil concentration followed by CP930RR and CP955RR.

Materials and Methods

Location:	Sidney	Previous crop:	Sugarbeet
Latitude:	47.7288 N	Soil type:	Savage Silty Clay Loam
Longitude:	104.1501 W	Harvested:	08/06/2020
Elevation:	1949	Plot size:	5'×20'
Planted:	04/22/2020	Harvest type:	Direct cut
Tillage:	Conventional	Replications:	4
Experimental design:	Randomized Complete Block	Fertilizers (obtained):	60 lb. N/ac and 30 lb. P_2O_5/ac blend applied before planting
# Varieties:	18	Herbicide:	Sonalan @ 2.5 pints/ac applied on 4/09/2020
Pesticide:	Sevin @ 16 oz./ac on 5/21/2020 Mustang Maxx sprayed @ 4 oz./ac on 5/27/2020 and 6/11/2020	Rainfall: Irrigation:	5.42" (April to September) 5.81"

Comments: Grain yield was adjusted to 8% moisture.

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
Inch		%		ppm	
0-12	8.4	1.8	10.5	15	186

Table 2. Summary of Agronomic Data of Canola Varieties Tested.

Cultivar	Distributor	Plant Stand (acre)	Plant Height (inch)	Lodging (%)	Test Weight (lb/Bu)	Grain Yield (lb/ac)	Oil (%)
BY19-6284CL	BrettYoung	404997	51.0	15	50.1	2049	49.2
BY 6204TF	BrettYoung	404997	52.1	8	52.3	2267	48.9
CP930RR	WinField United	532803	44.9	26	51.7	2639	51.6
CP955RR	WinField United	431554	49.9	13	52.2	2670	51.0
CP9919RR	WinField United	380099	42.3	20	46.9	2108	48.4
CP9978TF	WinField United	453131	47.3	16	52.5	2406	50.8
DG 200CL	Dyna-Grow-Seed	519524	54.5	11	50.9	2276	49.2
DG 760TM	Dyna-Grow-Seed	496287	49.9	9	51.8	2859	50.2
DG 761TM	Dyna-Grow-Seed	506246	54.4	13	52.0	2349	50.5
DKTF91SC	Dekalb/Bayer	677207	46.1	5	50.9	2537	50.5
DKTF96SC	Dekalb/Bayer	486328	48.4	3	52.0	2337	49.8
DKTFLL21SC	Dekalb/Bayer	537782	47.0	5	51.5	2902	49.2
Experimental#1	BASF	517865	52.8	70	50.7	2456	46.3
InVigor L233P	BASF	408316	50.1	6	51.5	2414	50.0
InVigor L345PC	BASF	614134	50.3	6	51.3	2372	48.5
NCC101S	Photosyntech	514545	43.0	10	51.5	2385	46.0
StarFlex	Star Speciality Seed	501266	49.3	5	51.3	2880	52.5
Stat 402	Star Speciality Seed	492967	50.3	11	51.8	2366	50.6
Mean		493336	49.1	14	51.3	2457	49.6
P > *F*		0.02	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD (*P* = 0.05)		144868	3.11	19.3	1.51	327	1.34
CV (%)		20.6	4.45	96.7	2.06	9.28	1.90

Spring Canola Yield and Quality as Affected by Planting Date, Variety, and Seed Rate under Dryland Management EARC, Sidney, MT

Apurba Sutradhar, Chengci Chen, Bill Franck, Thomas Gross, Ronald Brown, and W. Tanner Stevens

Materials and Methods:

Dryland

Location:	Sidney	Previous crop:	Pea
Latitude:	47.781239 N	Soil type:	Williams Clay Loam
Longitude:	104.241995 W	Harvesting dates:	Early: 08/05/2020
Elevation:	2254 ft.		Mid: 08/05/2020
Planting dates:	Early: 04/16/2020		Late: 08/12/2020
	Mid: 04/29/2020	Pesticide:	Sevin @ 16 oz./ac on 5/21/2020
	Late: 05/12/2020		Mustang Maxx sprayed @ 4 oz./ac
Seeding rate:	3 seeds/sq. ft.		on 5/27/2020 and 6/11/2020
	6 seeds/sq. ft.	Plot size:	5'×20'
	9 seeds/sq. ft.	Harvest type:	Direct cut
Tillage:	Conventional	Replications:	4
Experimental design:	Randomized Complete Block	Herbicide:	Sonalan @ 2.5 pints/ac on 4/09/2020
Cultivars:	45M35		Powermax 32 oz./ac pre-plant on
	46H75		4/29/2020
Rainfall:	5.42" (April to September)	Irrigation:	Dryland

Comments: Grain yield was adjusted to 8% moisture.

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

Depth	pH	OM	NO_3-N	P-Olsen	K
Inch		%		ppm	
0-12	7.9	1.9	10.5	21	162

Table 2. Summary of agronomic data of canola growth, yield and quality as affected by cultivar, planting date, and seeding rate.

Source of Variation	Plant Population (ac)	Plant Height (inch)	Test Weight (bu/ac)	Seed Yield (lb/ac)	Oil (%)
Cultivar					
45M35	226842	41.8 a	53.0	1719 a	46.6 a
46H75	234219	40.4 b	53.1	1371 b	44.7 b
Planting date					
Early	217713	43.5 a	54.1 a	1694 a	46.4 a
Mid	226842	42.7 a	52.5 b	1595 a	45.9 a
Late	247037	37.1 b	52.6 b	1345 b	44.5 b
Seed rate/sq. ft.					
3	120890 c	41.8 a	53.2	1372 b	45.7
6	220203 b	41.2 ab	53.3	1619 a	45.6
9	350499 a	40.3 b	52.8	1645 a	45.5
Statistics	----------	----------	***P* > F** ----------	----------	----------
Cultivar (C)	0.57	0.001	0.81	<0.0001	<0.0001
Planting date (D)	0.18	<0.0001	<0.0001	<0.0001	<0.0001
Seed rate (R)	<0.0001	0.02	0.26	<0.0001	0.82
C×D	0.31	0.0006	0.002	0.24	0.06
C×R	0.47	0.09	0.27	0.30	0.85
D×R	0.47	0.07	0.79	0.97	0.14
C×D×R	0.44	0.47	0.74	0.57	0.80

NDSU and MSU Spring Canola Variety Evaluation in Eastern Montana on Dryland and Irrigated Environments EARC, Sidney, MT

Apurba Sutradhar, Chengci Chen, Bill Franck, Thomas Gross, Ronald Brown, and W. Tanner Stevens

Materials and Methods

Dryland

Location:	Sidney	Previous crop:	Fallow
Latitude:	47.781239 N	Soil type:	Williams Clay Loam
Longitude:	104.241995 W	Harvested:	08/12/2020
Elevation:	1949	Plot size:	5'×20'
Planted:	04/29/2020	Harvest type:	Direct cut
Tillage:	Conventional	Replications:	4
Experimental design:	Randomized Complete Block	Herbicide:	Sonalan @ 2.5 pints/ac applied on 4/09/2020 PowerMax 32 oz/ac preplant on 4/29/2020
# Varieties:	18	Pesticide:	Sevin @ 16 oz/ac on 5/21/2020 Mustang Maxx sprayed @ 4 oz/ac on 5/27/2020 and 6/11/2020
Fertilizers (obtained):	50 lb N/ac and 30 lb P_2O_5/ac blend applied before planting	Rainfall:	5.42" (April to September)

Comments: Grain yield was adjusted to 8% moisture.

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

Depth	pH	OM	NO_3-N	P-Olsen	K
Inch		%		ppm	
0-12	7.9	1.9	10.5	21	162

Materials and Methods:

Irrigated

Location:	Sidney	Previous crop:	Sugar Beet
Latitude:	47.7288 N	Soil type:	Savage Silty Clay Loam
Longitude:	104.1501 W	Harvested:	08/06/2020
Elevation:	1949	Plot size:	5'×20'
Planted:	04/22/2020	Harvest type:	Direct cut
Tillage:	Conventional	Replications:	4
Experimental design:	Randomized Complete Block	Fertilizers (obtained):	60 lb N/ac and 30 lb P_2O_5/ac blend applied before planting
# Varieties:	18	Herbicide:	Sonalan @ 2.5 pints/ac applied on 4/09/2020
Pesticide:	Sevin @ 16 oz/ac on 5/21/2020 Mustang Maxx sprayed @ 4 oz/ac on 5/27/2020 and 6/11/2020	Rainfall: Irrigation:	5.42" (April to September) 5.81"

Comments: Grain yield was adjusted to 8% moisture.

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

Depth	pH	OM	NO_3-N	P-Olsen	K
Inch		%		ppm	
0-12	8.4	1.8	10.5	15	186

Table 2. Summary of Agronomic Data of Canola Varieties Tested.

Cultivar	Source	Plant Stand (acre)		Plant Height (inch)		Test Weight (lb/Bu)		Grain Yield (lb/ac)		Oil (%)	
		Dry†	Irr‡	Dry	Irr	Dry	Irr	Dry	Irr	Dry	Irr
45M35	Pioneer	313706	346903	42.8	50.6	52.3	51.7	1880	3204	45.7	51.3
46H75	Pioneer	318686	348563	44.5	52.7	52.4	50.8	1634	2383	45.0	48.3
NDSU-MSU-2020-01	NDSU	240674	315366	40.1	48.4	51.9	51.9	1160	1975	42.8	47.4
NDSU-MSU-2020-02	NDSU	210797	312047	43.0	48.1	53.7	51.7	1188	1903	43.6	46.5
NDSU-MSU-2020-03	NDSU	205818	326985	43.0	47.8	50.4	50.4	947	1805	43.0	46.6
NDSU-MSU-2020-04	NDSU	202498	305407	40.6	48.4	52.9	51.6	905	1477	39.2	44.8
NDSU-MSU-2020-05	NDSU	189220	303747	38.7	47.0	50.0	52.1	897	1835	42.1	47.6
NDSU-MSU-2020-06	NDSU	170962	355202	43.6	52.0	50.0	49.1	839	1641	42.8	47.0
NDSU-MSU-2020-07	NDSU	197519	247314	40.8	48.6	51.0	51.1	982	1591	42.7	46.5
NDSU-MSU-2020-08	NDSU	207478	303747	42.0	50.2	48.1	48.9	957	1697	44.9	48.3
NDSU-MSU-2020-09	NDSU	154363	262252	41.0	51.3	53.8	51.3	959	1616	41.8	46.3
NDSU-MSU-2020-10	NDSU	227396	310387	43.1	50.5	52.5	51.4	1042	1720	44.1	48.2
P501L	Pioneer	235695	343583	44.8	53.5	54.5	50.7	1746	2759	43.1	47.1
Mean		221139	313962	42.1	49.9	51.8	51.0	1155	1970	43.1	47.4
P > *F*		0.01	0.59	<0.0001	0.001	<0.001	0.002	<0.001	<0.0001	<0.0001	<0.0001
LSD (*P* = 0.05)		84440	99655	1.98	3.02	1.84	1.53	214	354	1.42	1.70
CV (%)		26.6	22.1	3.27	4.22	2.41	2.10	12.6	12.5	2.24	2.50

† Dryland
‡ Irrigated

Determining Soybean Planting Date and Soil Temperature for the No-Till Semi-Arid Conditions 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 he recommended that soybean be planted in North Dakota and Northwestern Minnesota when the soil temperature is >50°F. Western North Dakota has a cool semiarid 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, generally, the last spring freeze occurs in the last week of April and the first fall freeze in October. There is a lack of information on optimal soybean planting dates and soil temperature for the western part of North Dakota.

Objectives

- To find out the optimal soybean planting date for western ND.
- To determine an optimal soil temperature (at 4" depth) for planting soybean at western ND.

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, 8th, 15th, 22nd, and 29th of May, and 5th and 11th of June 2020 as main plots; two varieties: as subplots, and two seed treatments (treated with Obvious @ 4.6 oz/100 lb seed, 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). At maturity, plant height was measured, biomass was collected from nine square feet, and the crop was harvested using a plot combine.

Preliminary Results

- 2020 is an extremely drought year. We received annual precipitation of seven inches (from October 1st, 2019 to September 30th, 2020), which was half of the precipitation compared to an average of the last 63 years (Fig 1). This year, the first fall killing freeze occurred on September 8th, 2020, a month earlier than in 2019 (Fig. 1).
- When averaged across other treatments, there was a significant effect of seeding date on plant height, yield, oil, and protein content, and a significant effect of variety on yield, oil, and protein content. An interaction effect of seeding date × variety was evident on grain yield and oil content. There was no effect of applied treatments on test weight, the average test weight across the treatments was 56.8 lb/bu. The effect of seed treatment was not evident on soybean growth, yield, and quality.
- Averaged across variety and seed treatment, soybean seeded from May 2nd to 22nd, 2020 was about 18" tall. The plant height decreased drastically when seeding was delayed to May 29th or June 2020 (Fig. 2).

- Averaged across seed treatment, when soybean was seeded from May 2nd to May 22nd, 17009GT and 18008GT yielded about 11.4 and 10.1 bu/ac of grain, respectively. When seeding was delayed to May 29th, the yield of 17009GT decreased by 45% and that of 18008GT decreased by 24%. A further delay in seeding to June yielded no grain at all (Fig. 3). An early first fall freeze that occurred on September 8th killed all the plants and soybeans seeded in June could not produce grain.

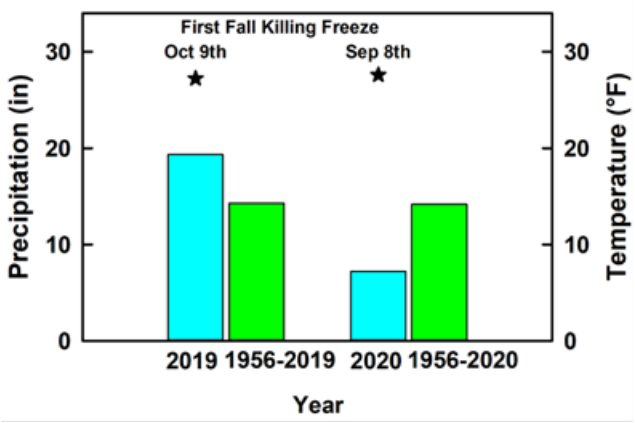


Figure 1. Precipitation and first fall killing freeze date and temperature.

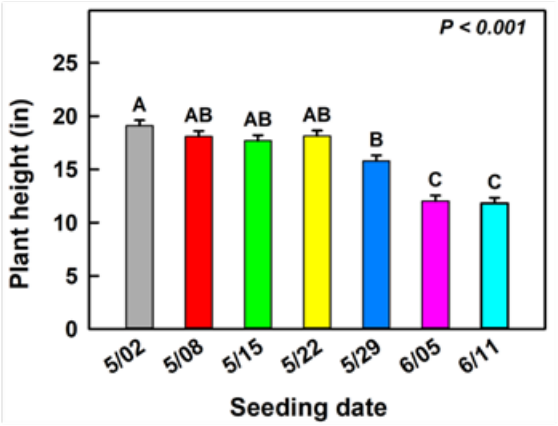


Figure 2. Effect of seeding date on plant height.

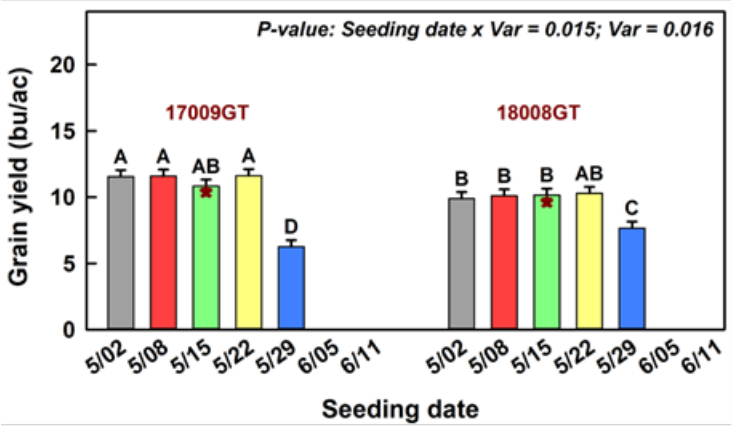


Figure 3. Differential responses of soybean varieties to seeding date for grain yield.

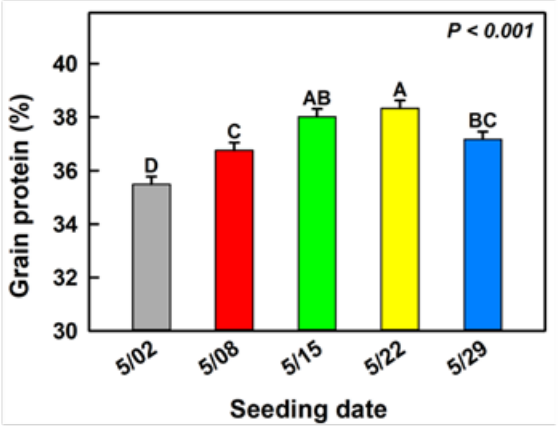


Figure 4. Effect of seeding date on grain protein content.

- Averaged across variety and seed treatment, soybean seeded from May 15th to 22nd had the highest grain protein content (~38%), which declined by 1 to 2.7% when the crop was seeded earlier or later in the month (Fig. 4). Averaged across other treatments, variety 17009GT had 1.8 % more grain protein content than the variety 18008GT (Fig. 5).
- Averaged across seed treatment, 17009GT and 18008GT had about 22.8% grain oil content, when the crop was seeded from May 2nd to May 8th. When seeding was delayed, the oil content decreased by 0.64 to 1.75 % in 17009GT, and by 0.28 to 0.86 % in 18008GT (Fig. 6).

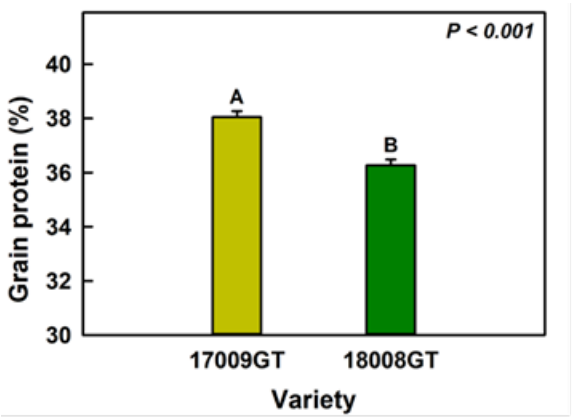


Figure 5. Effect of variety on grain protein content.

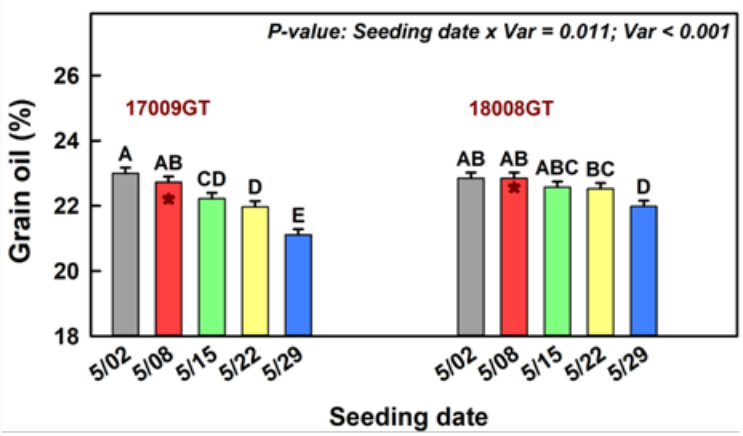


Figure 6. Differential responses of soybean varieties to seeding date for grain oil content.

Summary

this is a severe drought year with a historic early freeze that occurred on the first week of September. These abiotic stresses tremendously affected soybean growth, yield, and quality. Soybean seeded from May 2nd to 29th, 2020 produced only about 10-11 bushels of grains per acre. When seeding was delayed to May 29th, the yield decreased to 6-7 bu/ac. A further delay in seeding to June yielded no grain at all.

References

Kandel, Hans. 2013. Soybean production field guide for North Dakota and Northwestern Minnesota, A-1172.

Seeding soybean trial using a GPS based autosteered seven rows no-till plot seeder. (Photo by Gautam Pradhan)

Flax Seeding Date Has Minimal Effect on Water Use Patterns

Jim Staricka and Gautam Pradhan – Williston Research Extension Center

Water is the most common limiting factor for crop growth in semiarid areas such as the MonDak region (western North Dakota and eastern Montana). The effect on water use efficiency is an important consideration when selecting crop management practices. An on-going, multiyear, project aimed at determining the optimal seeding date and rate for flax was started at the Williston Research Extension Center in 2019. As part of this experiment, soil water content has been measured weekly throughout the growing season. This provided data to evaluate the effect of seeding date on the crop water use of flax.

Methods and Materials

In the experiment, six seeding dates (April 24, May 2, 8, 15, 22, and 29) and four seeding rates (15, 25, 35, and 45 lb/a) for flax were investigated. Additional agronomic details of the experiment are presented in another report of this publication. Soil water data were collected from a subset of the study plots, specifically the plots planted to Gold ND at the 25 or 45 lb/ac seeding rate. Soil water content was measured weekly using a non-destructive, minimal disturbance soil moisture gauge. Measurements were taken at depths of 6, 18, 30, 42, and 54 inches, representing 1-foot depth intervals of the 5-ft soil profile. The weekly measurements commenced 3 or 4 days after the seeding of each plot and continued in all plots until August 24 when water use of all seeding dates had ceased due to crop maturity or drought. Rainfall data was obtained from an NDAWN station located ½ mile northeast of the agronomic plots. Crop water use (i.e., the sum of the soil water depletion and rainfall) was determined for each interval between the soil water measurement dates. No water depletion from the 4-5 foot depth was observed, so soil water data from that depth was not included in the analysis. To provide additional information, the water source was partitioned into rainfall and each of the 1-ft soil increments. Crop water use amounts were accumulated over all the intervals to determine crop water use for the entire growing season. Water use efficiency was calculated as a ratio between flax yield and crop water use.

Results

Greater than normal precipitation occurred in September 2019, resulting in ample soil moisture at the start of the 2020 growing season. However, only 4.15 inches of rain occurred between April 24 and August 24. Crop water use was greatest for flax planted on April 24 and decreased fairly steadily as the seeding date was delayed (Table 1). This decrease was primarily due to rainfall missed by delayed seeding. However, the amount and the fraction of water obtained from the soil increased for the last two seeding dates (Table 1) suggesting a compensation for decreased rainfall. As seeding date was delayed, the fractional decrease in water use was less than the fractional decrease in growing season length, so that the water use per week increased as seeding date was delayed (Table 1).

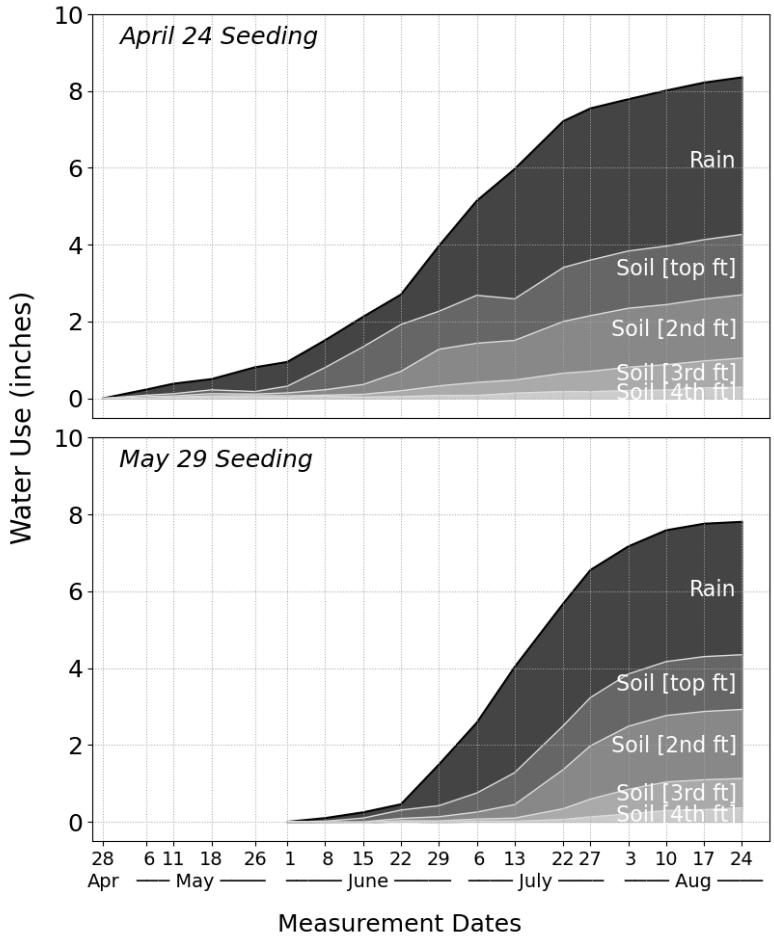
Table 1: Crop water use amount, source, and rate; and water use efficiency.

Seeding date	Crop water use	Water from rain	Water from soil	Fraction of water from soil	Water use per week	Flax yield	Water use efficiency
	---------- *inches* ----------				*inches*	*bu/a*	*bu/inch*
April 24	8.36	4.09	4.27	51%	0.50	19.7	2.4
May 1	7.97	3.94	4.03	51%	0.50	21.8	2.7
May 8	7.78	3.83	3.95	51%	0.52	23.4	3.0
May 15	7.86	3.81	4.05	52%	0.56	22.8	2.9
May 22	7.82	3.46	4.36	56%	0.61	22.5	2.9
May 29	7.81	3.46	4.35	56%	0.65	19.2	2.5

Daily water use increased greatly after June 22 for all seeding dates (Fig. 1). This was the first time water use exceeded 0.1 inch per day for any of the treatments. Water use remained greater than 0.1 inch per day until July 22 for all seeding dates. After July 22, daily water use decreased to less than 0.1 inch per day for the first three seeding dates, however, daily water use by the last three seeding dates remained greater than 0.1 inch per day for one week longer. There did not appear to be sufficient differences in the soil water content among the seeding dates to account for the earlier decrease in water use by the earlier seeding dates. The decreased water use after July 22 for the first three seeding dates was likely due to the crop reaching maturity whereas the later seeding dates had not.

Daily water use was influenced much more by calendar date than by the number of days after seeding. All seeding dates had water use exceeding 0.1 inch per day between the June 22 and July 22 measurement dates, even though this was 59 to 89 days after seeding for the first seeding date and only 24 to 54 days after seeding for the last seeding date. This suggests that daily water use may be influenced more by weather conditions than by crop growth stage.

Figure 1: Accumulative crop water use, partitioned by source. (Data presented only for the first and last seeding dates).



Flax yield first increased then decreased as seeding date was delayed (Table 1). Water use efficiency, in terms of bushels produced per inch of water used, followed a similar trend (Table 1).

The 2020 growing season was a drought year, with only 4.09 inches of rain between April 24 and August 24, the starting and ending dates of this study. The drought not only reduced the flax yield, it undoubtedly affected the water use patterns presented in this report. Greater rainfall likely would decrease the fraction of water obtained from the soil. However, greater rainfall also likely would have increased crop growth and thus increased water use, so that the amount of water obtained from the soil may have been similar to the amounts observed this year.

Other research conducted at the Williston Research Extension Center has found that, in the majority of years, spring wheat depletes all plant available water in the upper three feet of soil by the end of the growing season. This happens regardless of the soil moisture level at the beginning of the growing season and occurs every year except for those with extremely rainy growing seasons. This suggests that the patterns of soil water use by wheat also may not be affected by seeding date.

Soil water use by various crops and how it is influenced by crop management practices will remain an on-going research topic at the Williston Research Extension Center.

Quantifying Flax Phenology and Crop Health Using Unmanned Aircraft System

Gautam Pradhan and Paulo Flores
Funding: NDAES Precision Agriculture GRA Grant

Background

The ND Williston Research Extension Center, since its inception, has been evaluating varieties and breeding lines of >15 crop species for adaptation to the semiarid climate of western North Dakota and developing management practices suitable for this region. In these experiments, researchers have been using traditional methods (eye estimation, measurement with a ruler stick) to estimate plant stand, height, and heading/flowering date, which are time consuming and the accuracy depends upon the observers' skill and practice. Furthermore, due to resource constraints, researchers are seldom measuring physiological traits (NDVI, NDRE, CT) in these experiments. Therefore, there is a need for an application of Precision Agriculture. This year, two drones (DJI Matrice 600 Pro and DJI Mavic 2 Pro) were flown over 17 variety evaluation/breeding nursery trials on winter wheat, spring wheat, durum wheat, barley, oat, lentil, pea, chickpea, black gram, safflower, sunflower, canola, corn, and hemp. DJI Matrice 600 Pro was equipped with either a multispectral camera (MicaSense RedEdge M) or a thermal camera (DJI Zenmuse XT2), and Mavic 2 Pro had an inbuilt visual camera. The drones were also flown over four agronomic trials, namely, cropping sequence, pipeline reclamation, soybean planting date, and flax planting date and rate. Altogether, we flew the drones more than 100 times over experimental plots. In this article, we are reporting the outcomes of precision agriculture – unmanned aircraft systems – in quantifying phenology and crop health of flax seeding date and rate trial.

Objectives

- To determine flax phenology, days to flowering, as affected by seeding date, variety, and rate under no-till semiarid conditions of western North Dakota.
- To assess the flax crop health, Normalized Difference Vegetation Index (NDVI) and Normalized Difference RedEdge (NDRE), under different seeding dates, varieties, and rates.

Materials and Methods

- Flax was Seeded using a GPS based autosteered seven rows plot seeder: Row x Row = 7".
- The experimental design was a Split-split plot.
- The seeding date was the main plot: April 24, May 2, 8, 15, 22, and 29, 2020.
- The variety was subplot: Gold ND (V1) and ND Hammond (V2).
- Seeding rate was sub subplot: 15 (S1), 25 (S2), 35 (S3), and 45 (S4) lb pure live seeds/acre.
- Replications: Four.

Data Collection Processing and Analysis:

- Drones with RGB and multispectral cameras were flown over the research plots throughout the growing season.

Gold ND

ND Hammond

- The aerial images were processed using Agisoft Metashape Professional (Version 1.6.2) to generate Orthomosaics (Rater Images).
- ArcGIS Pro 2.5.0 was used to create NDVI/NDRE orthomosaics and polygons for each plot. The software was also used to extract NDVI from each plot.
- The NDVI Density was calculated as follows:

  dNDVI = Σ NDVI of a Plot / Plot Area

- SAS PROC GLIMMIX procedure was used to analyze data and the Tukey-Kramer adjustment was used to separate the treatment means.

Preliminary Results

(A) Phenology:

There was a significant effect of seeding date, variety, and seeding date × variety on days to flowering. The effect of seeding rate was not evident on this trait. Figure 1 showed that flax seeded on May 2 and May 15 had 70% and 30% flowers, respectively; but flax seeded on May 29 was still at the vegetative stage when observed on July 10, 2020.

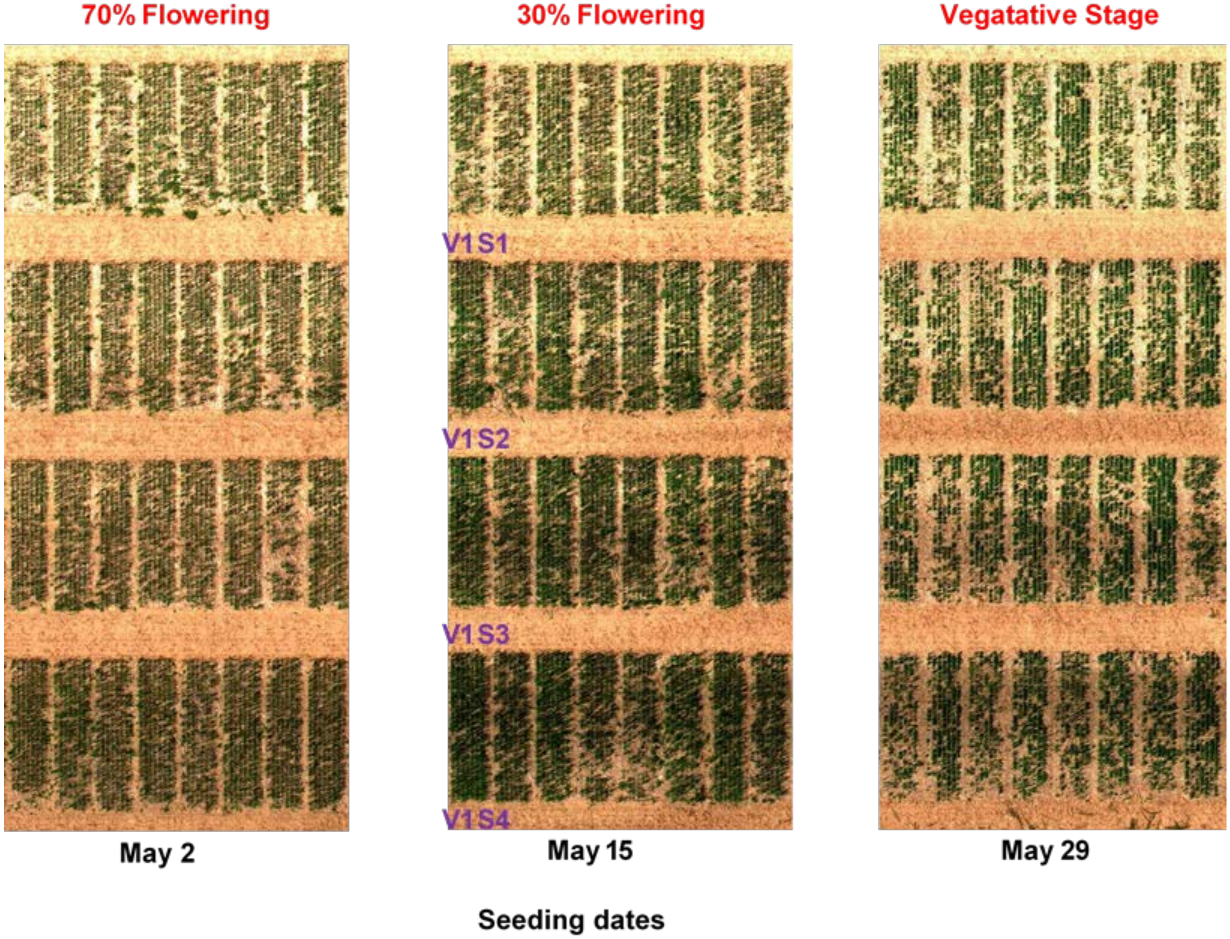


Figure 1. Raster image showing the effect of seeding dates on days to flowering. (Aerial Image Collected on July 10, 2020).

(B) Crop Health:

Figure 2 showed examples of plotwise NDVI and NDRE generated from aerial images collected on July 17, 2020. From raster images collected throughout the growing period, plotwise NDVI values were extracted and analyzed. Average across seeding rate, there was a significant effect of variety on dNDVI. Gold ND had higher dNDVI compared to ND Hammond when seeded on and after May 2nd, 2020 (Figure 3). Averaged across the variety, there was a significant effect of seeding rates on dNDVI. In general, the higher seeding rates of 39 and 50 lb/ac had greater NDVI compared to the lower seeding rates.

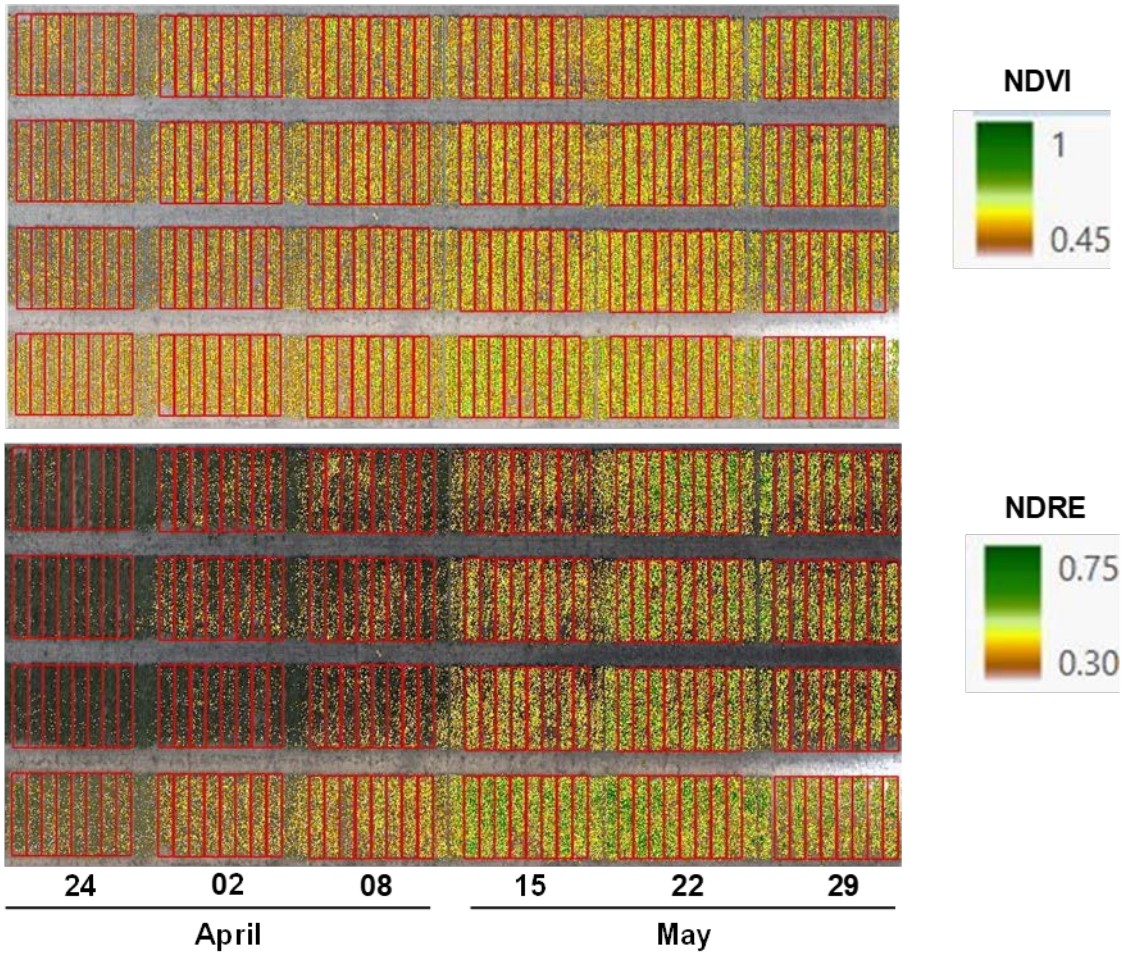


Figure 2. Examples of raster Images, NDVI (top) and NDRE (bottom), used to assess crop health (aerial images collected on July 17, 2020).

Summaries

This study shows that an unmanned aircraft system equipped with visual and multispectral cameras can be used to determine flax phenology and crop health as affected by seeding date, seeding rate, and variety. We are developing algorithms, protocols, and procedures to quantify these parameters quickly and easily.

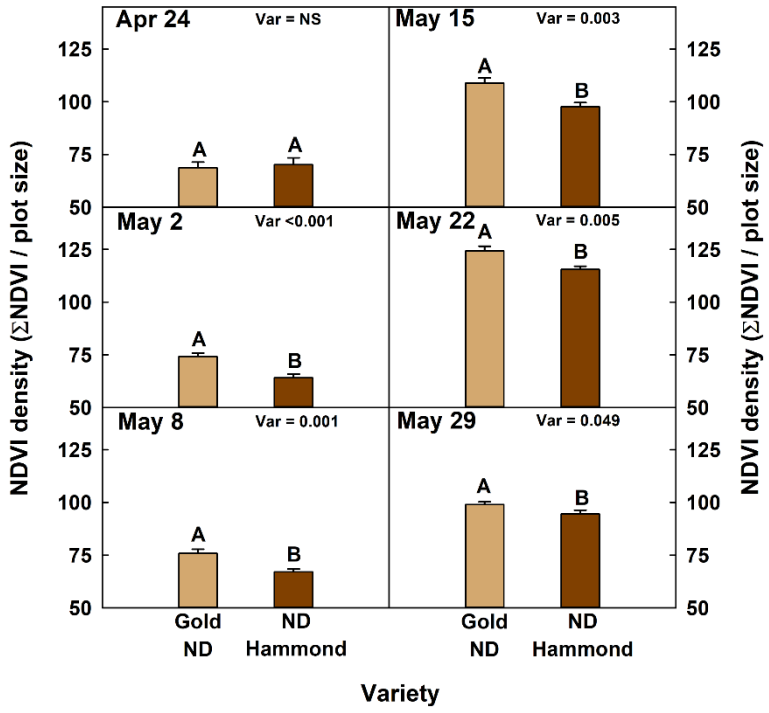


Figure 3. Effect of variety on dNDVI at different seeding dates.

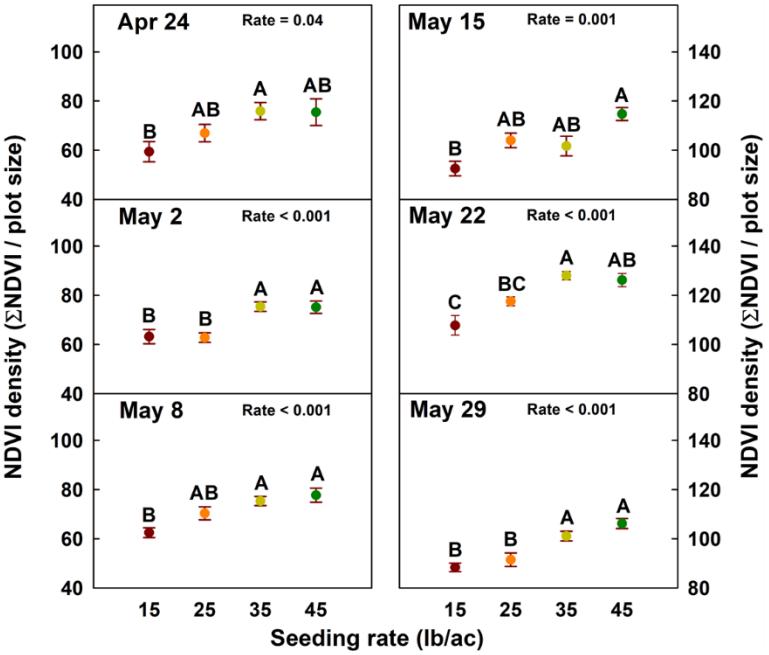


Figure 4. Effect of seeding rate on dNDVI at different seeding dates.

Acknowledgments

I would like to thank Andrew Wherley, a graduate research assistant, for his help in flying drones, maintaining plots, and collecting data. Mention of trademark or proprietary product does not constitute a guarantee or warranty of the product by North Dakota State University and does not imply its approval to the exclusion of other products which may also be suitable.

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 a cold semiarid climate and no-till production practices. There is a lack of information on suitable agronomic practices to 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 a 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.

Objectives

- To determine suitable flax seeding date and rate for no-till semiarid western ND.
- To understand the responses of flax varieties to different seeding dates and rates.

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 experiment was seeded using a GPS based autosteered seven rows plot seeder that maintained a row to row distance of 7". The treatment comprised of six seeding dates: Apr 24th, May 2nd, 8th, 15th, 22nd, and 29th as main plots; two Varieties: Gold ND and ND Hammond as subplots; and four seeding rates: 15, 25, 35, 45 lb/ac as sub-sub plots. During plant growth, 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, plant height was measured, biomass was collected from nine square feet, and the crop was harvested using a plot combine.

Preliminary Results

- 2020 is an extremely drought year. We received annual precipitation of seven inches (from October 1st, 2019 to September 30th, 2020), which is half of the precipitation compared to an average of the last 63 years (Fig. 1). This year, the first fall killing freeze occurred on September 8th, 2020, a month earlier than in 2019.
- There was a significant effect of seeding date, variety, and the interaction effect of seeding date × variety on days to flower. The trend for days to flower was similar to both varieties. Both Gold ND and ND Hammond took more days to flower when seeded on Apr 24th and May 2nd than on other seeding dates (Fig. 2). Comparing the same color bars, we found that Gold ND always needed more days to flower than ND Hammond irrespective of seeding dates.
- Averaged across other treatments, the effect of seeding date, variety, and seeding rate on plant height was highly significant. An advancement in seeding date increased plant height linearly. The rate of increase was 0.23 inches per day, with an R^2 value of 0.96 (Fig. 3). The Gold ND was about 1.7 inches taller than the ND Hammond (Fig. 3). An increase in seeding rate decreased plant height linearly. The rate of decrease was 0.07 inches for every lb of increase in seeding rate, with an R^2 value of 0.98 (Fig. 4).

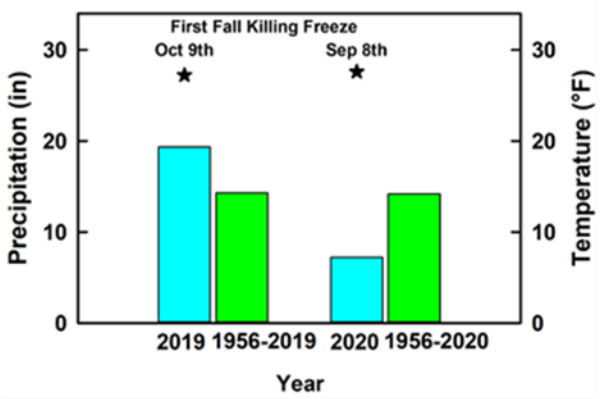


Figure 1. Precipitation and first fall killing freeze temperature and date.

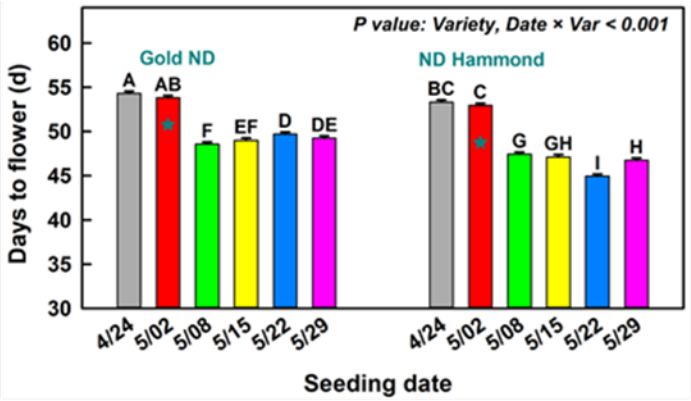


Figure 2. Effect of variety and seeding date × variety on days to flowering.

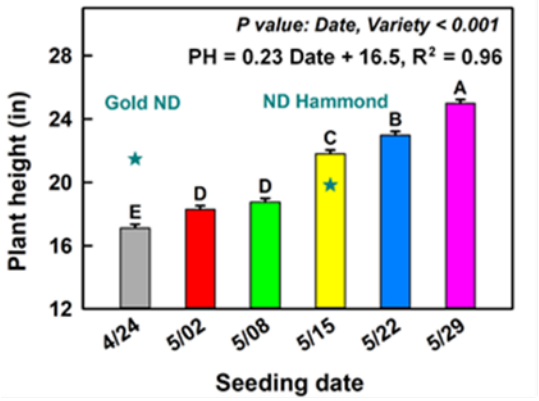


Figure 3. Effect of seeding date and variety on plant height.

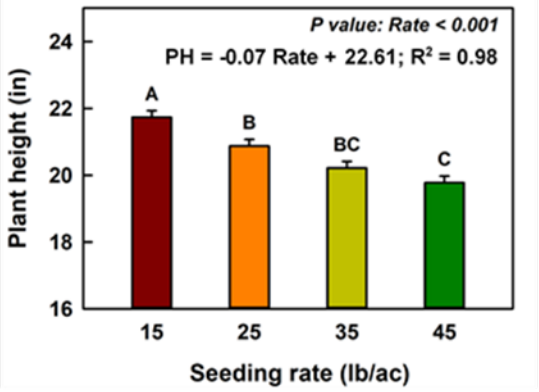


Figure 4. Effect of seeding rate on plant height.

- Averaged across other treatments, the effect of seeding rate on grain yield was highly significant. There was no difference among seeding rates of 25, 35, and 45 lb/ac for grain yield. These seeding rates produced about 20.8 bu/acre, which was 1 more bu/ ac of grain than a seeding rate of 15 lb/ac (Fig. 5).
- Averaged across other treatments, the effect of seeding date, variety, and the interaction effect of seeding date × variety on grain yield was highly significant. Comparing the same color bars, we found that Gold ND produced higher bushels of grain than ND Hammond at all seeding dates, except on May 22nd where the yield of two varieties was on par (Fig. 6). Gold ND, seeded from May 2nd to May 22nd produced a higher yield of up to 3.2 bu more grain than those planted on April 24th or May 29th. In the case of ND Hammond, seeding dates of May 22nd resulted in a yield of 22.2 bu/ac, which was 2 to 4.5 bushels more per acre than other seeding dates.
- Averaged across other treatments, the effect of seeding date and variety on test weight was highly significant. The seeding dates of May 22nd and 29th had higher test weight than other seeding dates with the exception that the April 24th seeded flax had a similar test weight as that of May 22nd seeded flax (Fig. 7). The variety Gold ND had a test weight of 48.6 lb/bu, which was about one lb more per bushel compared to ND Hammond.

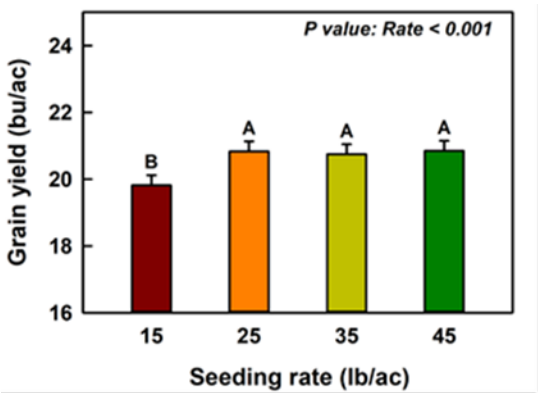


Figure 5. Effect of seeding rate on grain yield.

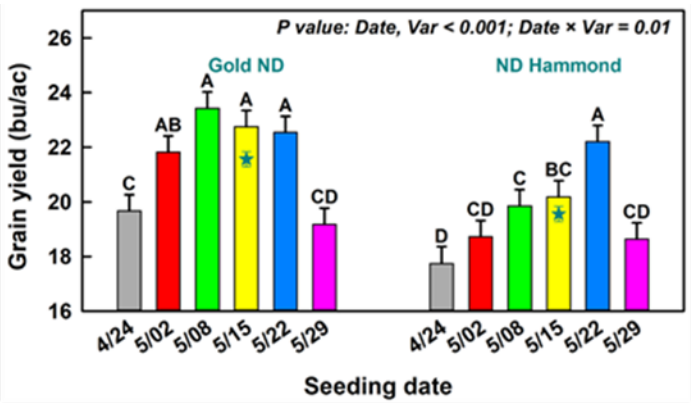


Figure 6. Effect of variety and seeding date × variety on grain yield.

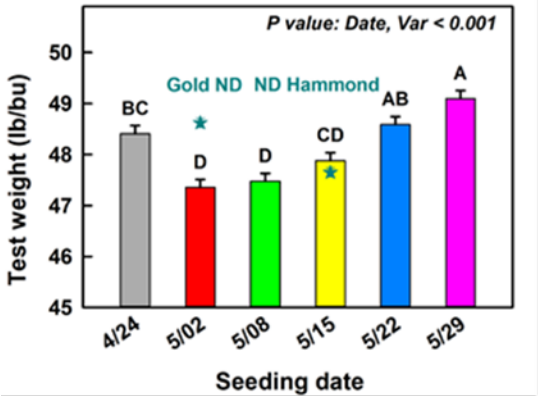
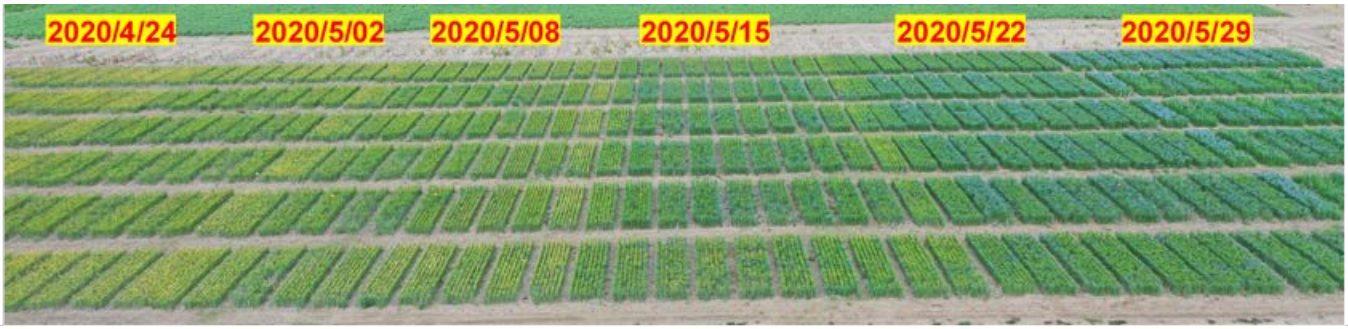


Figure 7. Effect of seeding date and variety on test weight.

Summary

2020 is an extremely drought year with about seven inches of annual precipitation. The preliminary results from the study indicated that, for no-till semiarid western North Dakota, the optimum flax seeding rate is 25 lb/ac. This seeding rate may enhance farm profit either by decreasing input cost compared to higher seeding rate or by increasing grain yield compared to lower seeding rate. The study also revealed that the optimum flax seeding date for western North Dakota may depend upon a variety. Gold ND may be seeded from May 2nd to May 22nd without a yield penalty; however, in the case of ND Hammond, seeding dates other than May 22nd may result in a significant yield loss.



Seeding date and flax at different stages of development (Photo taken by Gautam Pradhan).

Intercropping Chickpea and Flax

Clair Keene

Intercropping chickpea and flax continues to be a production practice of interest to chickpea growers in North Dakota and Montana. According to farmers who have tried intercropping, the main advantage observed is a reduction in the foliar disease Ascochyta blight of chickpea. Typically, 2-4 foliar fungicide applications are needed to control Ascochyta in chickpea and reducing the number of fungicide sprays is one of the most straight-forward ways to reduce chickpea production costs. Additionally, intercropping is an integrated pest management approach to controlling Ascochyta blight and reduces selection pressure on the pathogen for developing fungicide resistance.

This trial was conducted in 2020 at the WREC dryland farm. Kabuli-type Orion chickpea was treated with Obvious fungicide and was seeded targeting 4 seeds per foot at the same time as CDC Glas flax at varying rates using a small plot seeder. Chickpea seeding rate was held constant while flax seeding rate was 5, 10, 15, 20, or 40 lbs per acre. Each plot contained 3 rows of chickpea approximately 15" apart and 6 rows of flax with 2 rows of flax between the outer and inner chickpea rows and one flax row on each outside edge of the plot. Chickpea was seeded through the fertilizer banders and flax was seeded using the cone seeder. The trial was planted on May 12. Foliar fungicide applications were made on July 1, July 9, and July 24. The growing season started with subsoil moisture present from the wet fall of 2019, however, very little rain fell in May and June and the growing season was the 4th driest on record for Williams County. Total precipitation from planting through harvest on August 26 was 3.8".

Ascochyta blight incidence and severity

Ascochyta blight was monitored by observing incidence and severity at three dates. Incidence was measured by picking 20 chickpea plants at random in the plot and carefully observing for presence of Ascochyta lesions; incidence numbers are number of plants with lesions out of 20. Severity was measured by visual assessment of the whole plot and rating on a scale of 1-9 with 1 being no or very few lesions present up to 9 indicating very high severity with many wilting and/ or dead plants.

Ascochyta incidence (number of infected plants out of 20) and severity (scale 1-9).

	Ascochyta Jul-1		Ascochyta Jul-9		Ascochyta Jul-24	
Treatment	Incidence	Severity	Incidence	Severity	Incidence	Severity
Monocrop chickpea	7.1	1.3	10.5	2	15.3 A	4.8
Chickpea + 5 lb flax	5.3	1	8.3	1.5	11.8 AB	3.8
Chickpea + 10 lb flax	5.5	1.3	8.3	1.3	11.3 B	3.5
Chickpea + 15 lb flax	5.5	1	8.3	1.3	12 AB	3.5
Chickpea + 20 lb flax	4.8	1	7.3	1.3	11.5 B	3.8
Chickpea + 40 lb flax	5.5	1	6.8	1	13.3 AB	3.8
Significance	NS	NS	NS	NS	$p < 0.05$	NS

At each sampling date, Ascochyta incidence had a trend of being higher in the monocrop chickpea than in the intercrop treatments. A significant difference was observed on Jul-24 when the monocrop chickpea had higher Ascochyta incidence than the 10 and 20 lbs of flax treatments. Severity also had a trend of Ascochyta being more severe in the monocrop chickpea than intercrop treatments at the Jul-9 and 24 sampling dates, but the difference was not significant.

Chickpea dry down

Another potential advantage to intercropping chickpea and flax is more rapid and even chickpea dry down. I observed higher seeding rates of flax speeding up chickpea dry down when I conducted an intercropping trial in 2018. In 2020, the drought conditions caused chickpea to mature rapidly, but enhanced dry down with flax was still observed at earlier dates. This trial was not chemically desiccated prior to harvest and threshing went smoothly.

Chickpea dry down. Visual observation of % chickpea at dry, mature color.

Treatment	4-Aug	10-Aug	14-Aug	18-Aug
	---------- % chickpea dry color ----------			
Monocrop chickpea	30 C	65 B	77.5	93.3
Chickpea + 5 lb flax	42.5 B	71.3 AB	78.8	93.8
Chickpea + 10 lb flax	46.3 AB	70 AB	81.3	94.5
Chickpea + 15 lb flax	48.8 AB	73.8 A	81.3	95
Chickpea + 20 lb flax	48.8 AB	72.5 A	81.8	95
Chickpea + 40 lb flax	56.3 A	76.3 A	84	96
Significance	p < 0.01	p < 0.01	NS	NS

Yield, test weight, flax oil content, and chickpea seed size

In the drought conditions of 2020, intercropping significantly reduced chickpea yield compared to the monocrop chickpea. Chickpea yield decreased with increasing rates of flax. Interestingly, total yield in lbs per acre of chickpea plus flax did not decrease as flax seeding rate increased. Intercropping did not negatively affect chickpea test weight, flax test weight, or flax oil content. The monocrop chickpea test weight was similar to the intercrop 5, 15, and 20 lbs of flax treatments and intercropped chickpea + 40 lbs flax had the highest flax test weight. Flax oil content was similar across all treatments except the intercrop with 40 lbs of flax which had lower oil content. Chickpea seed size was not negatively affected by intercropping with the intercrop at 10, 15, and 40 lbs of flax having more seeds > 8.7 mm in diameter than the monocrop chickpea.

Treatment	Chickpea yield	Flax yield	Total yield	CP test weight	Flax test weight	Flax oil	Chickpea seed size	
	lb/a	lb/a	lb/a	lb/bu	lb/bu	%	%<8.7mm	%>8.7mm
Monocrop chickpea	1070	-	1070	60.7	-	-	87.1	12.9
CP + 5 lb flax	691	300	991	60	48.6	42.8	89.8	10.3
CP + 10 lb flax	528	424	952	59.8	50.4	42.8	84.3	15.7
CP + 15 lb flax	460	522	982	60.6	50.8	43.1	86.7	13.4
CP + 20 lb flax	439	507	946	60.4	50.6	43.2	90	10.1
CP + 40 lb flax	328	682	1010	59.6	51	41.2	86.6	13.4
Monocrop flax	-	779	779	-	50.6	42.6	-	-
Mean	586	536	961	60.2	50.3	42.6	87.4	12.6
LSD 5%	91	69	105	0.8	1.6	0.4	3.1	5
LSD 10%	70	53	81	0.6	1.2	0.3	2.3	3

Acknowledgements: Thank you to Christy Sperling and Cameron Wahlstrom for helping plant this trial, to Kyle Dragseth for applying fungicide, and to Christy Sperling again for help with harvest.

2020 Chickpea-Flax Intercropping under Dryland (Sidney) and Irrigated (Huntley) Environments EARC, Sidney, MT

Chengci Chen, William Franck, Qasim Khan, Kent McVay, and Sooyoung Franck

Materials and Methods:

Dryland at Sidney, MT

Location: EARC
Latitude: 47.781239 N; Longitude: 104.241995 W; Elevation: 2254 ft.
Planting Date: 4/21/2020
Tillage: No-till
Experimental design: Randomized Complete Block
Treatments: 100% chickpea, 100% flax, 70% chickpea-30% flax mixture, 50% chickpea-50% flax mixture, 50% chickpea-50% flax in alternate rows, 30% chickpea-70% flax mixture

Rainfall: April to September: 5.42”

Previous crop: Spring Wheat
Soil type: Williams Clay Loam
Harvesting Date: 8/25/2020
Plot size: 5’ x 20’
Replications: 4

Cultivars: CDC Leader and Royal chickpea, CDC Glas flax
Fertilizers: None
Herbicide: Panther SC @ 2 oz/ac applied 10/21/2019
Pesticide: None

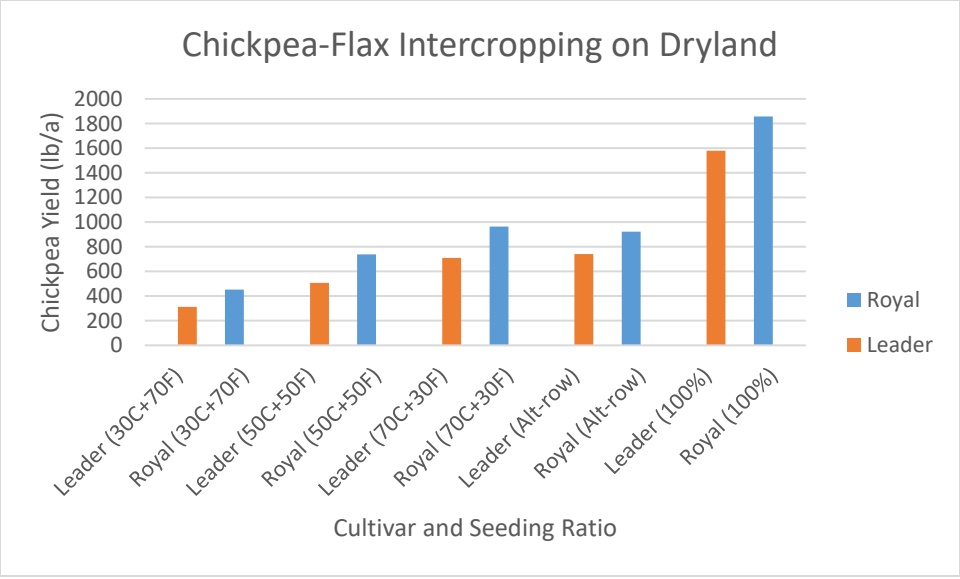
Irrigation: Dryland

Table 1. Initial dryland soil test results. A composite soil sample was collected prior to planting the intercrops.

Depth	pH	OM	NO_3-N	P-Olsen	K
Inch		%		ppm	
0-12	7.9	1.9	10.5	21	162

Results:

1. Chickpea and Flax Yields under Dryland Environment in Sidney, MT



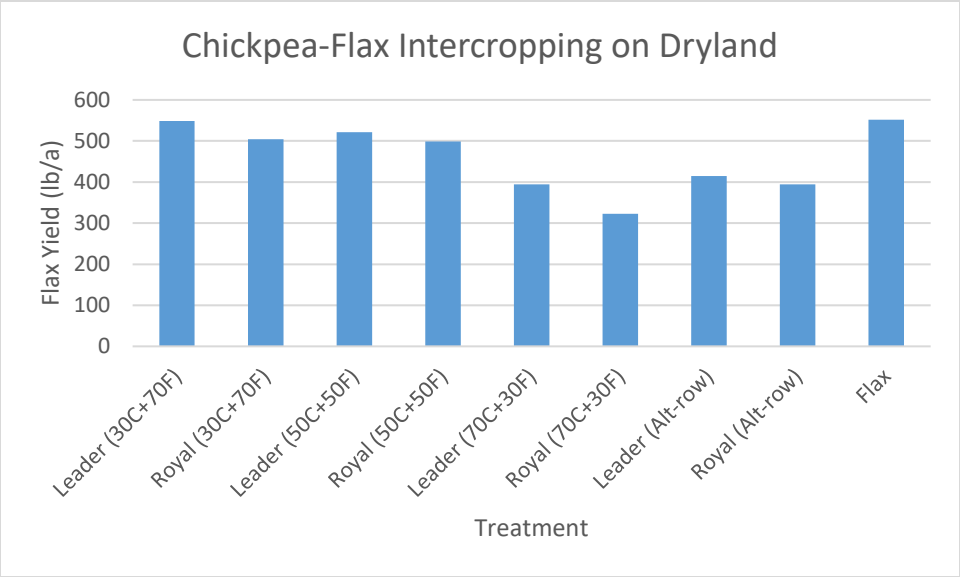


Fig. 1. The yield of chickpea (top) and flax (bottom) in a chickpea-flax intercropping with different chickpea and flax seeding ratios on a dryland environment in Sidney, MT in 2020.

Summary: Chickpea yield decreased with the increased flax proportion in the intercrops. Royal chickpea performed slightly better than leader under dryland environment. Flax yields were similar between 100% sole crop and 70% flax seeding rates, but decreased when the flax seeding rate was reduced to 30% of sole crop in chickpea-flax intercrops. The flax yield was lower in the 50%-50% mixture than in 50%-50% of flax and chickpea planted in alternate rows, which is opposite to the chickpea yield.

Materials and Methods:

Irrigated at Huntley, MT

Location: Huntley

Latitude: 45.92113 N; Longitude: 108.24462 W; Elevation: 3022 ft.

Planting Date: 4/27/2020

Tillage: Disc

Experimental design: Randomized Complete Block

Treatments: 100% chickpea, 100% flax, 70% chickpea-30% flax mixture, 50% chickpea-50% flax mixture, 50% chickpea-50% flax in alternate rows, 30% chickpea-70% flax mixture

Rainfall: April to September: 7.12”

Previous crop: Barley

Soil type: Lohmiller Silty Clay Loam

Harvesting Date: 8/24/2020

Plot size: 1.5 x 7 m

Replications: 4

Cultivars: CDC Leader and Royal chickpea, CDC Glas flax

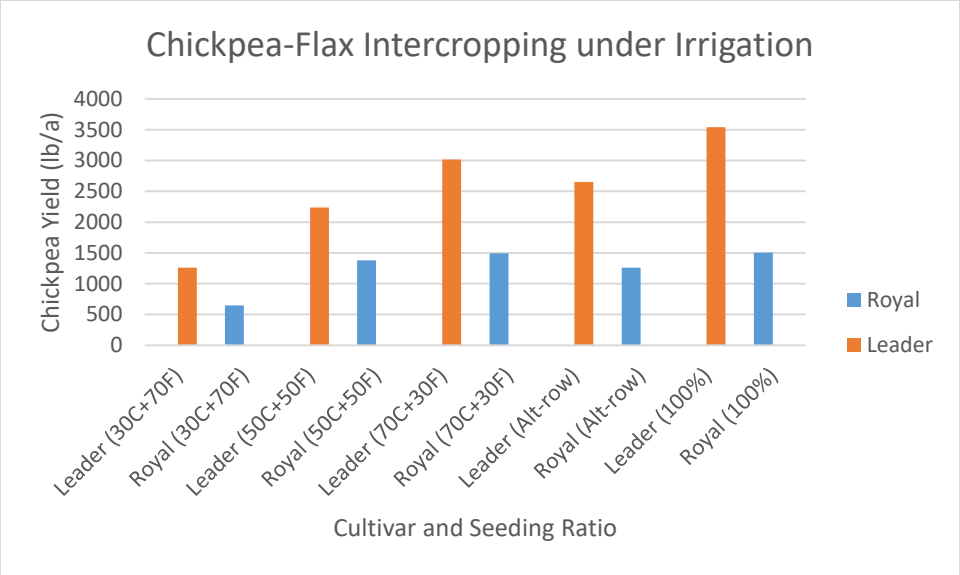
Fertilizers: None

Herbicide: Sprayed Spartan @ 4oz/a +rt3 32 oz/a pre-plant on 4/24/2020

Pesticide: None

Irrigation: 1.5” on 6/3; 1.5” on 6/22; 1.5” on 7/17

2. Chickpea and Flax Yield under Irrigated Environment in Huntley, MT.



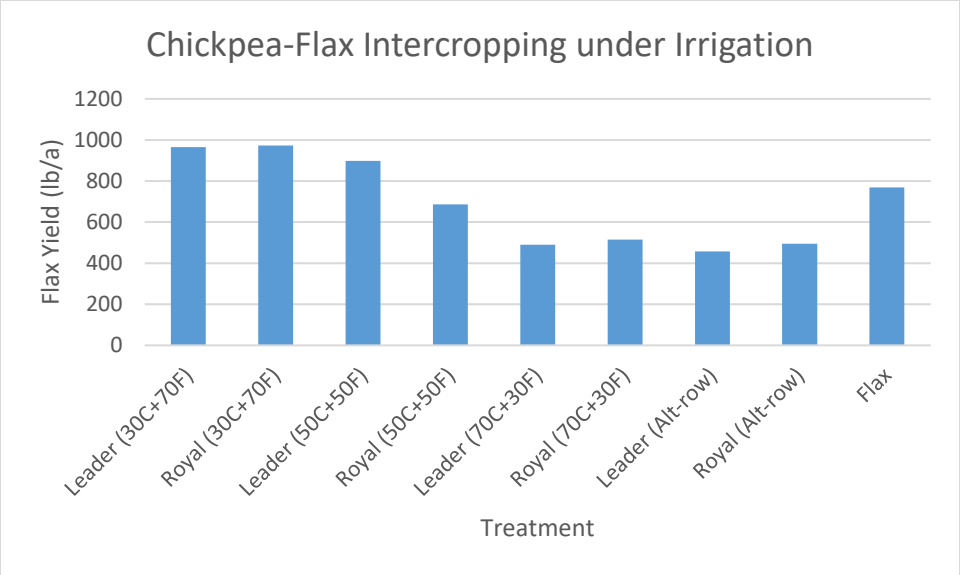


Fig. 1. The yield of chickpea (top) and flax (bottom) in a chickpea-flax intercropping with different chickpea and flax seeding ratios under an irrigated environment in Huntley, MT in 2020.

Summary: Leader yielded higher than Royal under irrigated condition at Huntley which is opposite to the results from dryland environment. The better performance of Leader at Huntley was partly attributed to better Ascochyta blight tolerance than Royal, and the Ascochyta disease pressure is very high under irrigated environment in Huntley. Leader yield decreased with the increased flax proportion in the intercrops, but the seeding ratio did not significantly affect Royal yield except the 30%-70% chickpea-flax ratio (Fig. 2). Flax yields were greater in 30%-70% chickpea-flax ratio than in other seeding ratios.

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

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

Summary

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

Experiment Design & Methods

A long-term experiment was designed with five annual crop rotations and two perennial covers in three different disturbance areas -the pipeline, the roadway and an undisturbed area (Figure 1). The final two years of the study all five rotations were planted to the same crops to compare yields across rotations and sub-treatments. In addition to the cropping rotations, sub-treatments were used to look at the effects of soil treatment methods- ripping and ripping with the edition of manure (Figure 2). Ripping was completed using an 18 inch deep ripping implement and manure was spread on the surface after ripping (Figure 3).

Each season, a variety of agronomic measurements were completed including stand counts, plant flowering and heading dates, and maturity dates. At harvest, biomass samples were collected and weighed and yields were calculated. Yields, test weights, and oil and protein content was analyzed for each plot, as well. The soil conditions were observed to measure the effects of the soil treatments and cropping rotations. Soil samples were collected and bulk density was measured and nutrient analysis completed for each plot every year. A truck mounted dynamic-cone penetrometer was used annually to measure penetration resistance, a way to quickly and easily measure soil compaction and resistance to roots.

Rotation	2015	2016	2017	2018	2019	2020
1	Durum	Durum	Durum	Durum	Durum	Safflower
2	Durum	Peas	Barley	Safflower	Durum	Safflower
3	Peas	Barley	Safflower	Durum	Durum	Safflower
4	Cover Crop	Durum	Cover Crop	Durum	Durum	Safflower
5	Durum	Cover Crop	Durum	Cover Crop	Durum	Safflower
6	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
7	Per. Grass	Per. Grass	Per. Grass	Per. Grass	Per. Grass	Per. Grass

Figure 1. Cropping Rotations. A total of seven cropping rotations were used, with five annual crop rotations and two perennial covers. The cover crop mix consists of 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. Design of each cropping sequence.

Figure 3. Deep ripping and manure was applied to individual plots.

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. In figure 4, the soil compaction is visible as a loss of the native soil structure, where plant roots are unable to penetrate downward. In figure 5, turnips from the cover crop planted in 2016 show how the roots are impacted by the compaction. The root from an undisturbed plot was able to grow deep, while the roadway and pipeline roots were unable to break through the compacted layer and the plants were much smaller.

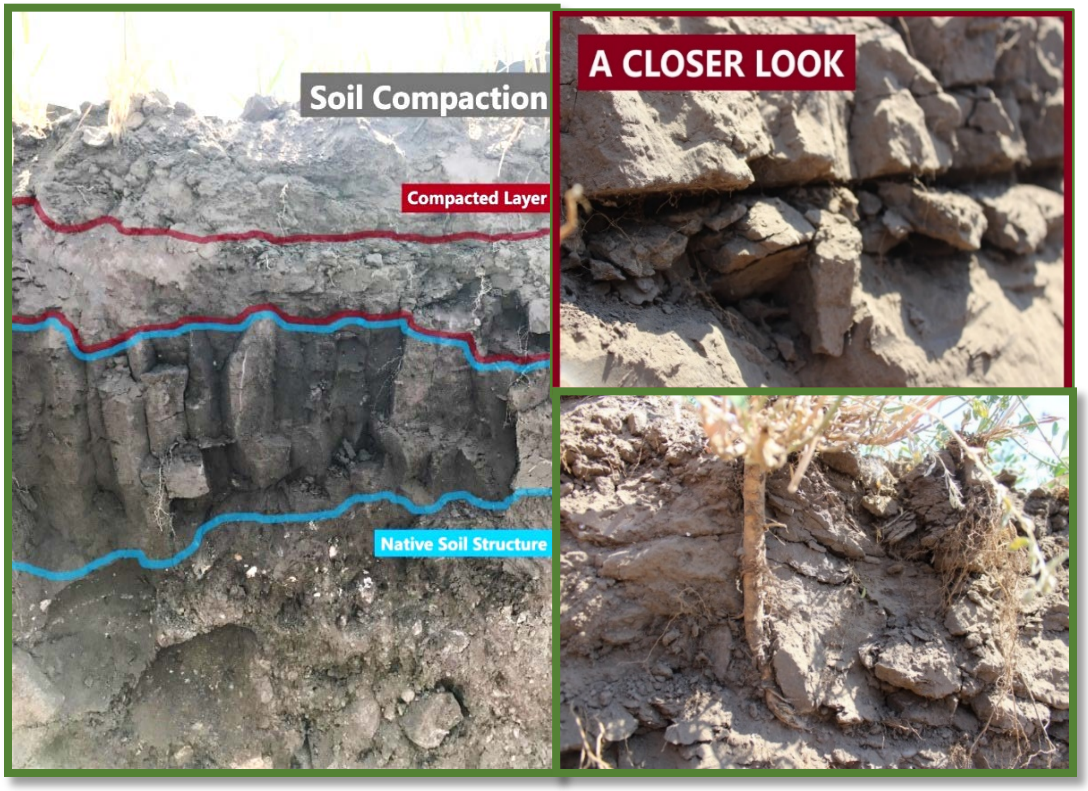


Figure 4. In the left image, the native soil structure is outlined in blue, while the compacted layer is shown above. The compacted layer doesn't have any of the structure of the native soil. The upper right image shows a close up of compacted soil in the roadway area of this project. The bottom right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

Figure 5. Soil compaction has a big impact on the ability of plants to grow and roots to penetrate to deeper depths.

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 (Figure 6). In 2018, we were not able to harvest the subsided plots, this demonstrates the potential impacts that similar occurrences could have on producer's yields.

Figure 6. Images of subsidence along the pipeline disturbance area. The upper two images were taken after the subsidence occurred in July 2018. The aerial image was taken in March of 2019, the sunken area is outlined in white.

A truck mounted dynamic cone penetrometer was used 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. These treatments appear to reduce compaction more effectively than full-season tap-rooted cover crops in the roadway disturbance area (the most compacted of the three areas).

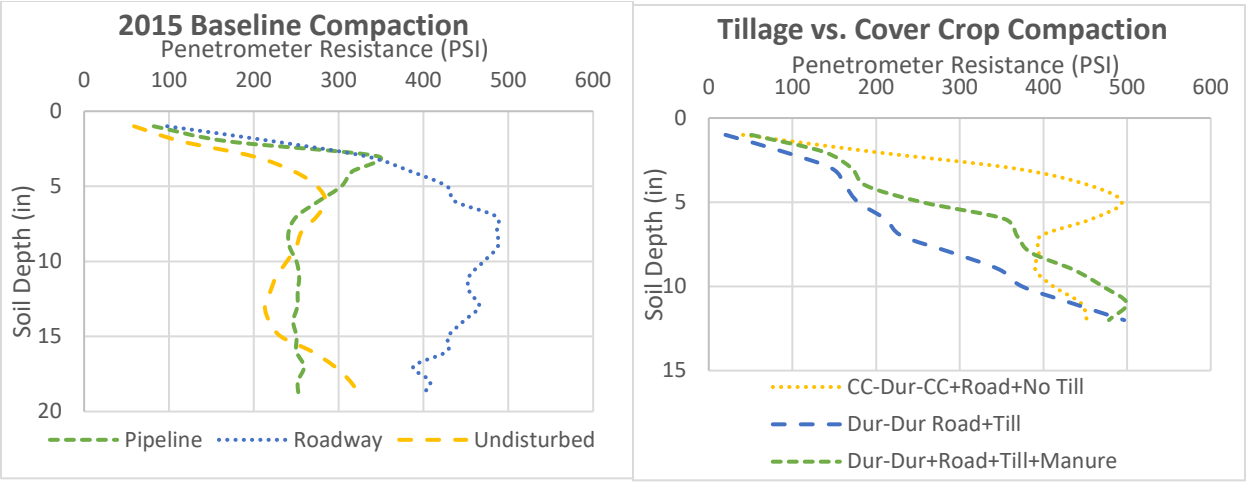


Figure 7. The baseline compaction in the first year of the study (2015) is on the left. The roadway is considerably more compacted than both the undisturbed and pipeline disturbance area. Any compaction in excess of 300 PSI is considered extremely compacted and begins to impact plant growth. The graph 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 .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 .05).
- In Year Three, alfalfa did not yield significantly different between disturbance areas (P .05).

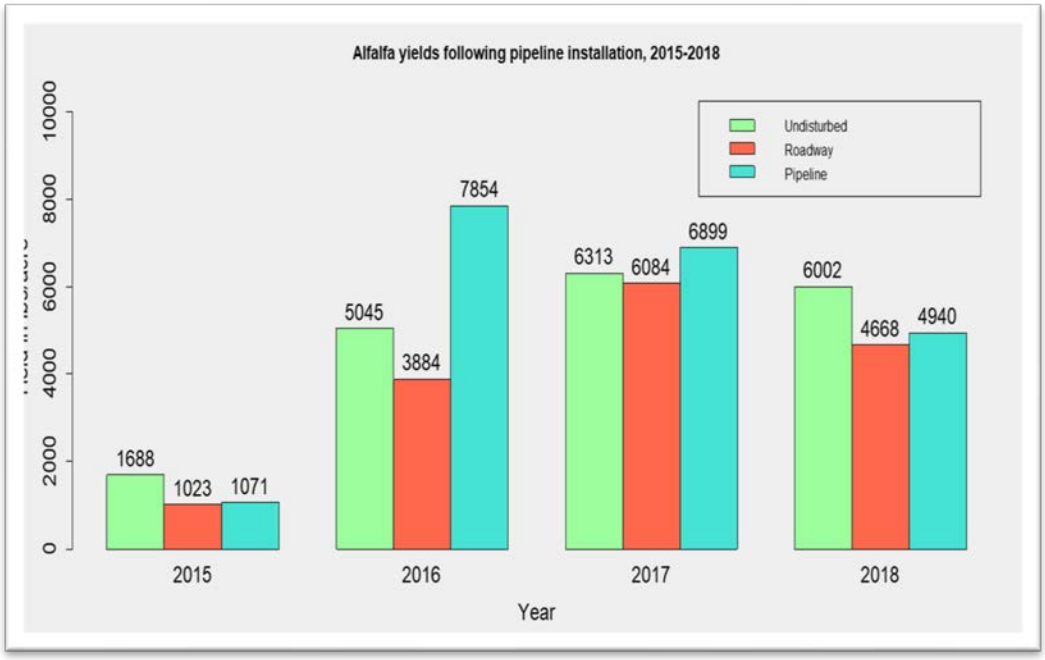


Figure 8. Alfalfa yields in the three disturbance areas from 2015 to 2018. In Year One, the alfalfa was just beginning to be established in all areas. In Year Two, the alfalfa yielded highest in the pipeline area and in Year Three, there was no significant difference in yields across the disturbance areas.

- In Year Five (2019), all annual crop plots were planted to durum. The roadway plots yielded less (40.3 bu/ac in the roadway vs. 52.5 bu/ac in undisturbed) than the pipeline or undisturbed plots. In all three disturbance areas, the deep-ripped and ripping with manure had higher yields than the plots without additional tillage treatments.

- In Year Six (2020), all cropping rotations plots were planted to safflower. The pipeline and roadway plots yielded 200 pounds/acre less than the undisturbed plots. In all treatment areas, the plots with additional soil treatments (ripping and ripping plus manure) had higher yields than the no till areas.

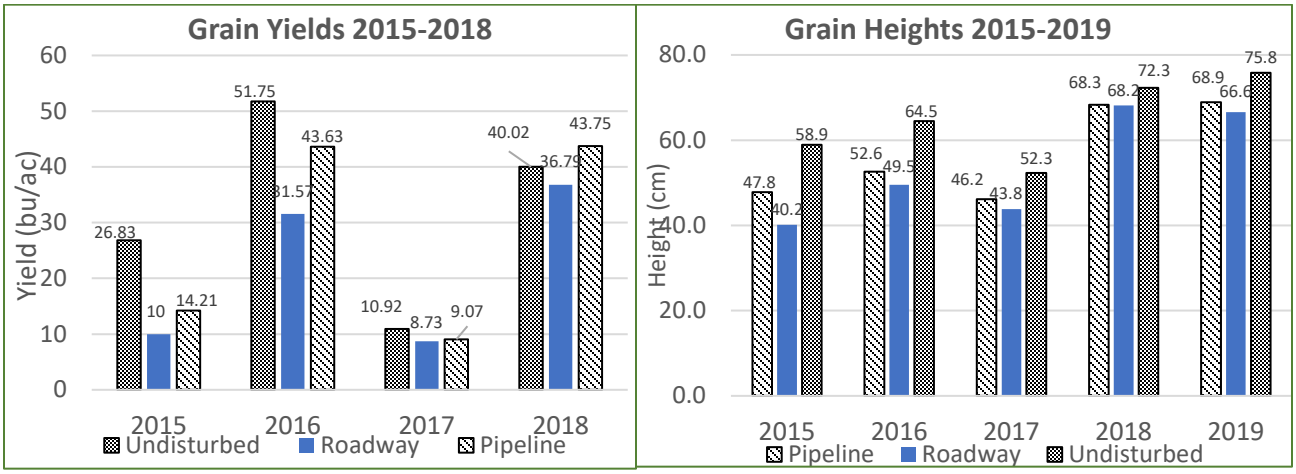


Figure 9. Grain Yields for Year One through Four (on the left) and Grain Heights for Years One through Five (on the right). In Year One (2017), spring wheat was planted, the other years durum was planted.

Conclusions and Future Work

Preliminary results show that the most important reclamation choice for croplands following pipeline construction is treating the soil to reduce compaction. Deep-ripping or tilling is essential for breaking up the compacted layer that occurs around 6 inches below the surface to allow roots to penetrate deeper. Adding manure also appears to be an effective reclamations step, as it restores organic matter to the soil. In this study, in both 2019 and 2020, the plots that were ripped had significantly higher yields than plots with no additional soil treatments. The plots that were ripped and had additional manure added, had even higher yields.

Cropping choices do not appear to have a significant impact on reducing compaction and restoring soil health following a pipeline, however crops that leave significant amounts of residue and are deep rooted seem to be good choices.

Future pipeline reclamation studies planned at WREC will be looking at other soil treatments for new pipeline installations, as well as looking for cost-effective ways for producers to improve yields on older pipelines.

Irrigated Canola Production: Population and Fertilizer

Justin Jacobs and Andrina Turnquist NDSU - Willston Research Extension Center

Objective

Canola is becoming an important crop in northwestern North Dakota. The majority of canola acres are grown on dryland, however there has been an increased interest in growing canola under irrigation. The Nesson Valley Irrigation Research and Development Project (NVIRDP) has been testing canola varieties in an annual variety trial since 2015 with an average yield of 2,891 lb/a. As a result of the ongoing variety trial testing, irrigated producers across North Dakota have contacted the NVIRDP regarding the best practices for growing canola under irrigation. Information regarding canola production in an irrigated system is not readily available and not pertinent to our region and environment. Canola planting populations and fertilizer rates have been well researched for dryland environments, but not for irrigated production in North Dakota.

Irrigation is not the dominant form of farm production in North Dakota, however northwestern North Dakota has the majority of the irrigated acres in the state. With the northwest increasing in canola production, several producers are seeking best management practices for irrigated production of canola. Will certain aspects of dryland canola production relate to irrigated production practices? What practices can be implemented in planting and fertilizer rates to increase yield?

Materials and Methods

Table 1. Planting populations in canola

Target Plant Pop	Pounds / Acre	Planted Pop	Actual Plant Pop
260,000	3	278,800	278,000
520,000	5	557,600	518,400
780,000	8	836,400	653,400
1,000,000	10	1,115,100	862,500

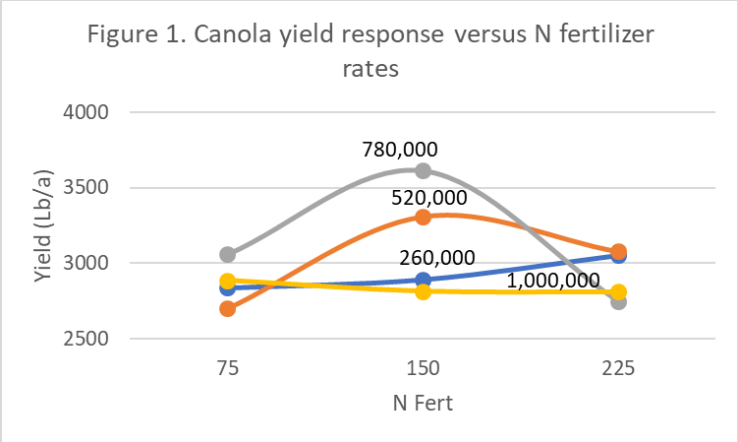
Table 2. Fertilizer rates for nitrogen and sulfur in canola

		Soil Residual = 29 lb N/a	
N Fert	S Fert	Urea Lb/a	AMS Lb/a
75	15	71	63
	30	43	125
150	15	234	63
	30	206	125
225	15	397	63
	30	369	125

Four populations were observed; 260,000, 520,000, 780,000, and 1,000,000 seeds/a. In order to account for percent emergence loss, higher populations were planted compared to the established stand (Table 1). The four planting rates were seeded into six different fertilizer ratios. Three rates of nitrogen (N) and two rates of sulfur (S) were investigated (Table 2). The N fertilizer rates were adjusted for the fall 2019 soil test of 29 pound per acre result of N. Ammonium Sulfate (AMS) was used as the source of sulfur. The amount of Urea was decreased to compensate for the N received from the AMS application. Previous research has shown that 150 pounds of nitrogen per acre is the recommended rate for dryland canola production in a cool, wet environment, with a recommended a planting rate of 520,000 seeds per acre.

The trial was planted May 6, 2020 using a precision plot planter. Seven rows were planted with a spacing of 7.5 inches between rows. Seed was planted 0.5 inches deep. HyClass 930RR was the canola variety used. Sonolan HFP was applied as a preemergent herbicide and Cornerstone Plus was applied for post emergent weed control. In-season measurements were taken on lodging, flowering date, plant height, and maturity date. Harvest occurred August 19, 2020. After harvest, yield, oil content, and test weight were recorded on the harvested seed.

Results and Discussion



Several visual observations were made within the growing season. The plots that were fertilized with highest rates of nitrogen displayed a darker green color than those fertilized with the lowest rates. In addition to the fertilizer being easily identifiable, the lowest population, 260,000 seeds/a, was the easiest to identify from the other planting rates, as a result of having fewer plants per square foot. As the planting rate surpassed 520,000 seeds/a the different populations were harder to distinguish from one another visually. The lowest population had less plants per acre, but had more branching per plant. As the population rate increased past 780,000 seeds/a, the stems became visually smaller, but very little lodging was observed across all populations and fertilizer rates.

Less than 5 inches of natural precipitation throughout the growing season resulted in a dry year. Irrigation began after planting and was stopped after plants started flowering. Nearly 10 inches of overhead irrigation was applied. No disease was identified in the trial, however an application of Priaxor D to control white mold was made during the flowering period. Flea beetle damage was noted during the growing season, however no application of insecticide was made, as it did not reach the economic threshold.

In previous research with dryland canola production, yield did not increase when N fertilizer rates exceeded 150 pounds. The treatment of 225 pounds of N decreased yield significantly compared to the 75-pound and 150-pound treatments (Figure 1).

Plant population also affected the yield. As the population increased from 260,000 to 780,000 the yield increased. However, as plant population exceeded 780,000, yield decreased. Similarily, plant populations showed an interaction with the fertilizer rate. The increase of nitrogen across populations showed an increase in yield as well. The 780,000 population responded the greatest to nitrogen and sulfur, and had the greatest yield at 150 pounds per acre (Table 3). Overall the addition of sulfur increased yields, however the effect was not consistent across plant population or N fertilizer rates (Table 4).

Table 3. Canola yield across populations and nitrogen fertilizer rate

	Population			
	260,000	520,000	780,000	1,000,000
N Fert	Lb/a	Lb/a	Lb/a	Lb/a
75	2,389	2,703	3,060	2,887
150	2,894	3,309	3,616	2,816
225	3,052	3,080	2,752	2,812

Table 4. Canola yield across populations, nitrogen, and sulfur fertilizer rate

		Population			
		260,000	520,000	780,000	1,000,000
N Fert	S Fert	Lb/a	Lb/a	Lb/a	Lb/a
75	15	2,790	2,720	3,115	2,647
	30	2,889	2,687	3,005	3,124
150	15	2,799	3,405	3,105	2,677
	30	2,989	3,213	4,126	2,956
225	15	2,863	3,049	2,878	2,688
	30	3,242	3,110	2,626	2,935

Summary

Additional years of testing need to be conducted in order to create a complete plant population and fertility rate recommendation, however some recommendations can be made based on the current research. For North Dakota, irrigated canola production, the optimal rates of actual N and S appear to be 150 pounds of N per acre and 30 pounds of S per acre. Since the soil test results for sulfur are not very dependable, a full rate of sulfur at 30 pounds is recommended for optimal yield. However, the applied nitrogen should be adjusted based on available soil N and previous crop history. Similarly, the data suggests that planting populations above 780,000 seeds per acre will not result in a higher yield. Further research will be conducted in order to test these recommendations.

DON Accumulation in Durum Varieties

Audrey Kalil, Taheni Jbir, Evana Somlyay,
Meridith Miller, Cameron Wahlstrom, Eric Eriksmoen
Funding provided by the ND Wheat Commission

Introduction

Fusarium Head Blight (FHB), or scab, is a disease of 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 resistant varieties of Hard Red Spring Wheat, however some varieties have slightly improved FHB tolerance. 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.

Methods

Variety trials were conducted at seven locations in 2020. Trials were set up in a randomized complete block design, with 5 x 14 ft. plots and three replicated plots per variety. Fungicides for the management of scab were applied at the Nesson Valley site. No other locations were treated with fungicides. 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 Mohall site. Among the varieties planted at that location, Tioga had the highest DON and Lebsock and Divide had the lowest. Low levels of DON were detected at the Keene site. At that location AAC Stronghold had the highest DON, while Divide and Joppa were among the varieties with the lowest DON. Data from the Keene site suggests that AAC Stronghold and AAC Spitfire perform according to their variety descriptions, S and MS respectively (Table 1). Low levels of DON were detected in varieties grown at Rugby and Corinth sites, however all varieties accumulated similar levels of DON at these sites. There was little to no DON detected in any durum varieties at the Nesson Valley, Williston, or Garrison locations.

Variety	Scab Rating (1-9)*	DON (ppm)							
		Corinth	Keene		Nesson Valley	Williston	Garrison	Rugby	Mohall	
Divide	5	0.5	0.2	*b*	<0.3	<0.3	<0.3	0.2	2.4	*b*
Joppa	5	0.6	0.3	*b*	<0.3	<0.3	<0.3	0.4	3.5	*ab*
Carpio	5	0.3	0.4	*b*	<0.3	<0.3	<0.3	0.2	2.9	*ab*
Lebsock	6	0.3	0.5	*b*	<0.3	<0.3	<0.3	0.2	2.0	*b*
ND Riveland	5	0.5	0.5	*b*	<0.3	<0.3	<0.3	0.2	3.1	*ab*
Alkabo	6	0.2	0.6	*b*	<0.3	<0.3	<0.3	0.2	4.1	*ab*
ND Grano	6	0.4	0.8	*ab*	<0.3	0.2	<0.3	0.2	4.2	*ab*
Grenora	6	0.2	0.9	*ab*	<0.3	<0.3	<0.3	0.2	3.6	*ab*
Tioga	6	0.5	1.0	*ab*	0.2	<0.3	<0.3	0.2	4.7	*a*
Mountrail	8	0.4	1.0	*ab*	<0.3	<0.3	<0.3	0.2	3.3	*ab*
AAC Stronghold	S*	1.0	1.8	*a*	<0.3	<0.3				
AAC Spitfire	MS*	0.4	0.7	*ab*		<0.3				
mean		0.4	0.7		< 0.3	<0.3	<0.3	0.2	3.4	
p-value (0.5)		NS	0.0020		NS	NS	NS	NS	0.0078	

Table 1. DON in durum varieties across sites in 2020. Different letters within columns (sites) indicate significant differences. Detection threshold was 0.3 ppm. NS = non-significant. *Scab rating scores from 1-9, with 1 = resistant and 9 = very susceptible. S*, MS* considered susceptible or moderately susceptible to scab but has not been given a rating on the 1-9 scale.

Resistance of Durum Varieties to Fusarium Head Blight EARC, Sidney, MT

Frankie Crutcher, Michael Giroux, Andrew Hogg, Amber Ferda and Samantha Hoesel

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

Materials and Methods:

Irrigated

Location: Sidney, MT
Variety: Misc.
Planted: 5/6/2020
Seeding Rate: 90 lbs/A
Residual Soil N to 3 ft: 37 lbs/A
Residual Soil P to 6 in: 21.3 ppm
Irrigated (sprinkler) on: 5/12, 5/22, 6/4, 6/13, 6/19, 6/29, 7/15
Precipitation April – September: 8.1”

Previous Crop: Wheat
Soil Type: Savage Silty Clay Loam
Harvested: 8/15/2020
Plot Size: 2.5’ x 10’
Applied Fertilizer: 100-30
Chemical Applications: Wolverine Advanced 1.7 pt/A, Proline 5.7 fl oz/A, Stinger 1 1/3 pt/A, Discover NG 16 fl oz/A
Vigor: 5/22/2020
Disease assessment(s): 7/29/2020

COMMENTS: Corn spawn inoculated with five isolates of *F. graminearum* was applied to the field on 6/3/2020.

RESULTS: Severe bird damage was experienced this year, with the taller varieties suffering the greatest damage. This has skewed the results considerably and there is no significant difference between the lines for yield. Yield from this study should not be used for future variety selections. Significant differences were found for all other categories, with Alzada having the highest for severity, incidence and disease index.

Table 1: Durum Variety Reponses to Fusarium Head Blight

Variety	Severity(%)[a]	Incidence(%)[b]	Index[c]	% FDK[d]	Yield (Bu/A)
Alzada	29.4 A	90.0 A	26.6 A	20.0 A-D	27.6
Carpio	9.8 G-J	63.3 B-E	6.3 I-L	26.7 A-D	6.3
Divide	13.7 D-J	70.0 A-E	9.8 D-L	23.3 A-D	5.8
Dynamic	19.1 B-G	82.2 A-C	15.7 B-I	28.3 A-D	16.2
Grano	14.3 D-J	80.0 A-C	11.5 D-L	20.0 A-D	30.0
Grenora	14.6 D-J	80.0 A-C	11.7 D-L	18.3 B-D	34.5
Joppa	16.1 C-I	78.9 A-D	13.4 C-K	21.7 A-D	26.0
Mountrail	22.2 A-D	77.8 A-D	17.3 A-G	16.7 CD	19.6
Riveland	10.0 G-J	70.0 A-E	7.0 I-L	18.3 B-D	7.5
Silver	28.2 AB	87.8 A	24.8 AB	41.7 AB	24.3
Tioga	11.5 F-J	71.1 A-E	8.4 F-L	28.3 A-D	25.8
Vivid	21.1 A-E	81.1 A-C	17.2 A-H	15.0 D	18.1
MTD16001	14.7 D-J	74.4 A-D	10.9 D-L	16.7 CD	15.9
MTD16002	10.8 G-J	68.9 A-E	7.5 H-L	23.3 A-D	14.9
MTD16005	19.2 B-G	77.8 A-D	15.0 C-J	25.0 A-D	24.5
MTD18067	13.1 D-J	74.4 A-D	9.7 D-L	43.3 A	15.8
MTD18091	8.4 H-J	67.8 A-E	5.8 J-L	25.0 A-D	11.0
MTD18148	20.9 A-F	86.7 AB	18.3 A-E	30.0 A-D	36.5
MTD18155	21.4 A-E	87.8 A	18.8 A-D	16.7 CD	26.9
MTD18172	12.4 E-J	70.0 A-E	8.7 E-L	43.3 A	7.2
MTD18179	22.3 A-D	81.1 A-C	18.2 A-F	20.0 A-D	17.7
MTD18181	17.6 C-H	74.4 A-D	13.1 C-K	30.0 A-D	7.9
MTD18213	7.5 IJ	55.6 DE	4.2 KL	26.7 A-D	5.1
MTD18217	8.9 H-J	62.2 C-E	5.7 J-L	43.3 A	2.1
MTD18256	12.8 D-J	67.8 A-E	8.7 E-L	38.3 A-D	8.2

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MTD18266	11.4 G-J	71.1 A-E	8.2 G-L	40.0 A-C	8.8
MTD18348	8.2 H-J	67.8 A-E	5.6 J-L	28.3 A-D	2.6
MTD18381	25.2 A-C	87.8 A	22.2 A-C	21.7 A-D	24.9
MTD18413	13.8 D-J	75.6 A-D	10.5 D-L	20.0 A-D	21.3
MTD18430	6.6 J	50.0 E	3.2 L	31.7 A-D	8.2
MTD18486	8.3 H-J	61.1 C-E	5.1 KL	33.3 A-D	12.8
Mean	15.29	74.01	11.90	26.94	16.58
% CV	43.18	15.34	55.07	39.00	81.44
HSD (0.05)	9.46	23.82	9.74	23.34	37.58

Letters in common did not differ significantly according to a Tukey's HSD 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]Index: Severity X Incidence / 100
[d]Fusarium diseased kernels.

May 2020 - EARC summer students Michael Stevens and Zava Zupan

Do your kids a big favor.
Don't be afraid to demand
they be responsible
and capable of work.

Cropping System Effects of Planting Scabby Seed

Effect of DON and Fungicide Seed Treatment on Durum Establishment and Yield and Disease in Subsequent Pea Crop

Audrey Kalil, Taheni Gargouri Jbir, Ariel Wertheim, Evan Herman, Kaleb Jimison, Kate Pearson, Makenna Girard, Darby Howat and Kyle Dragseth

Introduction

Fusarium head blight (head scab) of wheat, durum and barley is caused by the fungal pathogens *Fusarium graminearum, F. culmorum, and F. avenaceum.* These fungi infect the seed and, with the exception of *F. avenaceum*, produce a mycotoxin called deoxynivalenol (DON). The result is scabby seed which can potentially contain high levels of both pathogenic *Fusarium* species and DON. Planting such seed can result in poor stands due to low germination rates and seedling blight, however, recommendations on what levels of DON in the seed results in yield loss were not available. The objective of this research was to determine how DON and *Fusarium* contamination in the seed effects establishment and yield and if a seed applied fungicide can improve establishment and yield. Some of these pathogens have been associated with root rot on pea. Thus, pea was planted into the plots of this study to evaluate the effect of planting scabby seed on pea root rot the following year.

Experimental Design

In 2019, we obtained Alkabo durum with different levels of DON: 0.3ppm, 1.5 ppm, 3.1 ppm, 6.2 ppm and 11.2 and 19.5 ppm. Durum lots were split and each received a different fungicide treatment. One lot (control) did not receive fungicide seed treatment for control of *Fusarium*, and the other lot was treated with tebuconazole. Germination was assessed with and without fungicide treatment. Plots were planted 5/2/2019 using a no-till planter at a seeding rate of 1.6 million live seeds/ac. Stand count was performed 5/29/2019. Plots were harvested 8/9/2019.

In 2020, pea was planted onto the plots from 2019 to assess the effect of having planted scabby durum seed the previous year on pea root rot and yield. Mystique pea was planted at a rate of 375,000 PLS/ac on 4/25/20. Stand count was performed 5/18/20. Root rot ratings were conducted on 10-18 plants per plot using a severity scale of 0-5 where 0 is no disease and 5 is a competely rotten root. Above ground wilt (yellowing) was assessed 7/7/20. Plots were harvested 7/30/20.

Results

Figure 1. Photos taken on 5/30/19 of durum planted 5/2/2019. Levels of DON in the seed used is indicted below the image. Images are of the plots receiving the tebuconazole seed treatment.

Treatment	DON (ppm)	Fungicide Seed Treatment†	Germination
1	0.3	Control	82%
2		Tebuconazole	91%
3	1 .5	Control	80%
4		Tebuconazole	90%
5	3.1	Control	76%
6		Tebuconazole	72%
7	6.2	Control	78%
8		Tebuconazole	75%
9	11.2	Control	82%
10		Tebuconazole	89%
11	19.5	Control	59%
12		Tebuconazole	73%

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

2019 Durum				
Treatment (DON ppm)	Stand count (plants/ft^2)	Yield (bu/ac)	Protein (%)	DON ppm
0.3	28.5 a	65 a	13.3 a	0.3 a
1.5	25.7 ab	69 a	12.8 a	0.3 a
3.1	15.9 c	69 a	12.5 a	0.3 a
6.2	22.1 b	67 a	12.8 a	0.3 a
11.2	16.2 c	72 a	12.0 a	0.3 a
19.5	13.7 c	71 a	12.4 a	0.3 a

Table 2. Effect of DON in durum seed on durum stand count, yield, percent protein and DON in the harvested grain. Different letters indicate statistical differences (= 0.05).

2020 Pea						
Treatment (DON ppm)	Stand count (plant/sq ft)	Wilt IN (%)	Root Rot Severity	Root Rot Incidence	Protein (%)	Yield (bu/ac)
0.3 ppm	6.3	2.6	1.8	90.5	22.9	19.6
1.5 ppm	7.4	1.9	1.9	93.4	22.9	20.6
3.1 ppm	6.9	3.3	1.8	89.8	22.8	20.7
6.2 ppm	7.5	4.8	1.6	88.7	22.9	19.4
11.2 ppm	6.8	3.0	1.7	85.9	23.2	20.8
19.5 ppm	6.9	2.6	1.5	88.6	23.1	20.7
ANOVA (= 0.05)	NS	NS	NS	NS	NS	NS

Table 3. Effect of planting scabby durum seed on pea stand count, disease, protein and yield. NS = no significant effect

Conclusions

As expected, higher levels of *Fusarium*/DON contamination in the seed greatly reduced germination rates (Table 1). Plots were seeded so that all treatments received 1.6 million live seeds/ac to account for the poor germination rates of contaminated seed.

In 2017, 2018 and 2019, the use of tebuconazole seed treatment for control of *Fusarium* did not significantly improve durum establishment or yield. Therefore, it does not seem likely that fungicide seed treatment can act as a rescue for highly contaminated seed.

In 2017, stand count was slightly reduced when seed with 10.2 ppm DON was planted and reduced by half when seed with 19.9 ppm DON was planted. Yield was reduced only when seed with 19.9 ppm DON was planted. In 2018, there was no difference in stand count or yield among the different DON treatments. In 2019, seed contamination with DON above 3.1 ppm reduced stands compared to the 0.3 ppm control but there was no effect on yield (Table 2). In all three years, there was no effect of DON in the seed on protein, test weight or DON in the harvested grain.

The effect of seeding large quantities of DON contaminated seed on Fusarium root rot in peas grown following the durum was evaluated. Pea plots in 2020 were planted directly on top of the 2019 durum plots. There was no effect of having planted scabby durum seed on establishment, disease or yield of pea the following year. There was also no effect of having treated the scabby seed with tebuconazole on root disease in the subsequent pea crop.

These results suggest that scabby durum can be used as a seed source. Given the large reduction in seed germination with higher levels of DON, this will have to be taken into account when determining seeding rates. This practice does not appear to increase root disease in peas the subsequent year.

Comparing Chickpea Varieties for Resistance to Ascochyta Blight

Dr. Audrey Kalil, Taheni Gargouri-Jbir, Ariel Wertheim, Kate Pearson, Evan Herman, and Kaleb Jimison

Introduction

Ascochyta blight caused by the pathogen *Ascochyta rabiei* is a highly yield limiting disease of chickpea when not properly controlled. Fungicides are typically effective at controlling disease, however, fungicide resistance is a concern and fungicide applications present an additional expense. Chickpea varieties differ in their genetic resistance to this disease, and variety selection is an important tool in disease management. This study was initiated to compare some commercial varieties of large seeded Kabuli types grown in the US for resistance to Ascochyta blight and maintenance of yield under disease pressure.

Study Description

The study was a randomized complete block design with 5 ft x 19 ft plots, 4 replicates per treatment. The trial was planted May 5th. The seeding rate was 5 plants per square foot adjusted based on seed germination. The trial was not inoculated so disease pressure was from the enviornment. No fungicides were applied. Ascochyta disease assessments were made July 1st, July 17th and July 29th. The first disease assessment was made based the amount of disease symptoms on 10 plants per plot. For the second two assessments, disease was determined based on the amount of the crop canopy with disease symptoms in the first, middle and third portions of the plot. Examples of Ascochyta blight symptoms are below.

The trial was harvested August 24th. Rainfall from April to August was approximately 4 inches.

Study Treatments

The varieties evaluated in this study are listed below. The breeding program which produced these varieties is described. The seed source for this study is listed.

Variety	Breeding Program	Study Seed Source
CDC Orion	Crop Development Centre, University of Saskatchewan	Meridian Seed
CDC Leader		Great Northern Ag
CDC Frontier		Meridian Seed
ND Crown	North Dakota State University	WREC Foundation Seed
Royal	USDA-ARS, Pullman, WA	WREC Foundation Seed
Sierra		Washington State Crop Improvement
Sawyer		Washington State Crop Improvement

Results

Mean disease severity and yield are presented in the table below. Means are an average of the five replicated plots.

Table 1. Treatment means

Treatment	Ascochyta Severity (%) 7/1/2020	Ascochyta Severity (%) 7/17/2020	Ascochyta Severity (%) 7/19/2020	Yield (lb/ac)
CDC Frontier	1.0 b	4.9 c	23.7 b	1823 a
CDC Orion	1.1 b	9.7 bc	22.8 b	1710 a
ND Crown	2.1 ab	4.3 c	23.0 b	1605 a
CDC Leader	1.2 b	17.1 abc	27.0 ab	1468 a
Sawyer	1.5 b	8.3 bc	30.8 ab	1432 ab
Royal	1.1 b	27.1 a	34.4 ab	898 bc
Sierra	4.7 a	24.2 ab	39.6 a	839 c

Differences among treatments are indicated by different letters (0.05).

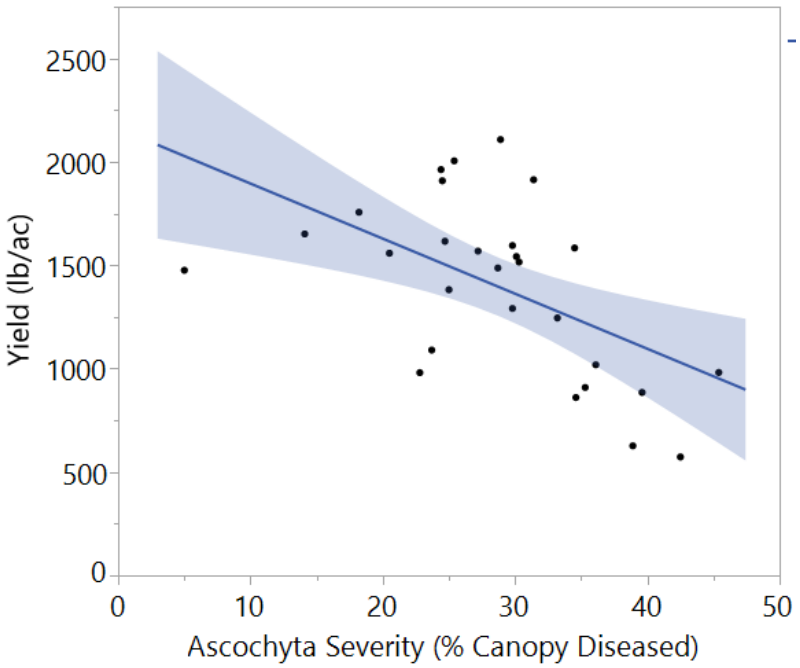

Figure 1. Relationship between Ascochyta blight severity and yield. An increase in disease is associated with a reduction in yield. Fit line (blue) R^2= 0.292, p = 0.003. Black dots are plot level data.

Conclusions

CDC Orion, CDC Frontier and ND Crown have comparable levels of disease resistance to Ascochyta blight and yield (Table 1). CDC Leader was comparable in terms of yield but appears to have slightly less disease resistance under these conditions. Sawyer was intermediate in disease susceptibility and yield. Sierra and Royal were highly susceptible with the highest levels of disease and lowest yield. Disease was yield limiting under these study conditions despite very low rainfall/disease suppressive conditions (Figure 1). While fungicides were not applied in this study to maximize disease pressure, that is not a recommended practice. Selection of the more resistant varieties will help protect yield under high levels of disease pressure, however.

Fungicide Programs for Ascochyta Blight Management in Chickpea

Dr. Audrey Kalil, Taheni Gargouri-Jbir, and Ariel Wertheim

Introduction

A study was initiated at the Nesson Valley Irrigated Research Site to evaluate fungicides within a four-spray program for control of Ascochyta Blight in chickpea. Previous research has found tank mixing Proline with chlorothalonil to be beneficial for the control of Ascochyta blight. Thus, some fungicides were applied with and without the addition of chlorothalonil (Bravo WS) to the tank mix.

Study Description

The study was a randomized complete block design with 5 ft x 18 ft plots, 5 replicates per treatment. Registered Sierra chickpea seed was purchased for this study. The trial was planted April 29th. Outside border plots were inocluated June 10th with one handful each of overwintered chickpea residue. Foliar fungicide applications were made on the following dates (20 gal/ac water, Induce NIS @ 0.25% v/v):

(A) June 19th at V11 to R1 growth stage
(B) July 2nd at R1-R2 growth stage
(C) July 16th at R3-R4 growth stage
(D) July 30th at R5-R6 growth stage

Ascochyta disease assessments were made July 2nd, July 16th and July 30th on 10 plants per plot. The trial was harvested August 30th.

Study Treatments

Timing and Fungicide Program
Untreated
A Provysol @ 3.75 fl oz/A + Bravo WS 24 oz/A + NIS
B Priaxor 6 fl oz/A + NIS
C Provysol @ 3.75 fl oz/A + Bravo WS 24 oz/A + NIS
D Priaxor 6 fl oz/A + NIS
A Propulse @ 10.3 fl oz/A + Bravo WS 24 oz/A + NIS
B Proline @ 5.7 fl oz/A + NIS
C Propulse @ 10.3 fl oz/A + Bravo WS 24 oz/A + NIS
D Proline @ 5.7 fl oz/A + NIS
A Miravis Neo @ 13.7 fl oz/A + Bravo WS 24 oz/A + NIS
B Miravis Neo @ 13.7 fl oz/A + NIS
C Miravis Neo @ 13.7 fl oz/A + Bravo WS 24 oz/A + NIS
D Miravis Neo @ 13.7 fl oz/A + NIS
A Miravis Top @ 13.7 fl oz/A + Bravo WS 24 oz/A + NIS
B Miravis Top @ 13.7 fl oz/A + NIS
C Miravis Top @ 13.7 fl oz/A + Bravo WS 24 oz/A + NIS
D Miravis Top @ 13.7 fl oz/A + NIS

Results

Mean disease severity and yield are presented in the table below. Means are an average of the five replicated plots.

Treatment	Ascochyta Severity (%) 7/2/2020	Ascochyta Severity (%) 7/16/2020	Ascochyta Severity (%) 7/30/2020	Yield (lb/ac)
Untreated	11 a	67 a	82 a	89 c
Provysol/Priaxor	8 a	21 b	36 b	1124 b
Propulse/Proline	3 a	11 b	19 c	1511 ab
Miravis Neo + Bravo	3 a	7 b	20 bc	1676 ab
Miravis Top + Bravo	6 a	8 b	16 c	1797 a

Differences among treatments are indicated by different letters (0.05).

Conclusions

As expected, the untreated treatment had the highest levels of disease as well as the lowest yield. The Miravis Top + Bravo WS, Miravis Neo + Bravo WS and the Propulse/Proline fungicide programs resulted in the lowest level of disease and the highest yield. The Provysol/Priaxor fungicide program had intermediate disease control and yield. I used a spray volume of 20 gal/ac and it should be noted that spray volume can impact fungicide performance.

The Ascochyta blight pathogen can rapidly develop fungicide resistance, so it is imperative that growers alternate fungicide modes of action. The use of chlorothalonil in a tank mix can also help manage fungicide resistance as it has broad spectrum activity. The table below shows the FRAC group and active ingredients in the fungicides evaluated. Please note that the FRAC 11 group has no activity on Ascochyta blight of chickpea in North Dakota as the pathogen has developed resistance.

Product Name	Active ingredients (FRAC Group)
Bravo WS	Chlorothalonil (M5)
Miravis Top	Pydiflumetofen (7) + Difenoconazole (3)
Miravis Neo	Pydiflumetofen (7) + Azoxystrobin (11) + Propiconazole (3)
Propulse	Fluopyram (7) + Prothioconazole (3)
Proline	Prothioconazole(3)
Provysol	Mefentrifluconazole (3)
Priaxor	Fluxapyroxad (7) + Pyraclostrobin (11)

COWBOY LOGIC

IF THE GATE'S OPEN, CLOSE IT. JUST MAKE SURE YOU'RE ON THE RIGHT SIDE OF IT BEFORE YOU DO.

Resistance of Chickpea Varieties to Rhizoctonia Root Rot

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

OBJECTIVE: Test the resistance of different chickpea varieties to *R. solani*.

Materials and Methods:

Not Irrigated

Location: Sidney, MT
Variety: Misc.
Planted: 4/30/2020
Seeding Rate: 4 LS/ft²
Residual Soil N to 3 ft: 30.2 lbs/A
Residual Soil P to 6 in: 20 ppm
Irrigated (sprinkler): None
Precipitation April – September: 8.1”

Previous Crop: Wheat
Soil Type: Savage Silty Clay Loam
Harvested: 9/4/2020
Plot Size: 5’ x 20’
Applied Fertilizer: None
Chemical Applications: Outlook 20 fl oz/A, Roundup 20 fl oz/A, Tough 5 EC 1 pt/A
Vigor and stand counts: 5/19/2020, 6/1/2020, 6/19/2020
Root disease assessment: 6/15/2020

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). *R. solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting. Seed was treated with Cruiser 5FS (1.28 fl oz/cwt) + Apron XL (0.64 fl oz/cwt). Root assessments were done on 6/15/2020. Foliar height and biomass were taken during this time as well. Trial was desiccated with Gramoxone (32 fl oz/A) on 08/24/2020.

RESULTS: Significant differences were found for root severity, with the susceptible control variety Sierra having the highest root severity for both treatments. There were also significant differences for plants/m^2 for all of the varieties compared to each treatment. The treatments without *Rhizoctonia* had a higher plants/m^2 than their counterparts with *Rhizoctonia*. Yield also showed significant differences. The treatments without *Rhizoctonia* yielded better than those with *Rhizoctonia*. Sierra had the lowest yield for both treatments, while Frontier yielded the best.

Table 1: Chickpea Variety Responses to Rhizoctonia Root Rot

Variety	Treatment	% Root Severity[a]	% Root Incidence[b]	Plants/m² [c]	Wet Weight (g)	Dry Weight (g)	Foliar Height (cm)	Yield (Bu/A)
CDC Frontier	None	9.13 C-F	100.00 A	38.00 A-D	103.38 FG	17.18 E-G	27.36 G-J	72.47 A
	Rhizoctonia	9.63 C-F	90.00 A	17.00 G-I	156.80 A-C	26.78 A-C	28.82 B-G	47.77 D-F
Sierra	None	9.50 C-F	95.00 A	36.50 B-D	108.13 D-G	18.18 D-G	27.87 E-J	33.00 HI
	Rhizoctonia	21.72 A	100.00 A	7.37 J	135.28 A-F	23.50 A-E	30.02 B-E	15.74 J
Myles	None	7.97 C-F	97.22 A	27.83 EF	125.95 B-G	21.65 B-G	26.15 I-K	48.41 D-F
	Rhizoctonia	13.18 B-D	100.00 A	9.45 IJ	126.10 B-G	21.45 B-G	24.82 K	27.14 I
Black Butte	None	6.38 D-F	97.50 A	43.00 AB	157.43 A-C	27.38 AB	27.93 D-J	59.52 BC
	Rhizoctonia	10.67 C-F	95.22 A	16.61 G-I	138.22 A-F	22.45 A-F	27.02 G-J	39.62 F-H
CDC Orion	None	8.11 C-F	92.17 A	39.50 A-D	112.53 D-G	18.43 D-G	28.21 C-I	62.21 BC
	Rhizoctonia	15.38 A-C	100.00 A	18.00 GH	149.40 A-D	25.45 A-D	28.89 B-G	37.53 GH
ND Crown	None	8.50 C-F	90.00 A	32.50 DE	133.60 A-G	23.13 A-E	33.69 A	60.16 BC
	Rhizoctonia	12.00 B-E	92.50 A	20.00 F-H	140.38 A-F	23.55 A-E	33.91 A	36.47 G-I
CDC Leader	None	5.00 EF	80.00 A	38.00 A-D	133.20 A-G	21.85 A-G	28.51 B-G	56.63 CD
	Rhizoctonia	19.38 AB	100.00 A	20.00 F-H	141.35 A-F	23.88 A-E	28.35 C-H	34.11 HI
CDC Palmer	None	8.52 C-F	100.00 A	42.50 A-C	135.38 A-F	22.45 A-F	30.64 B	63.12 A-C
	Rhizoctonia	12.88 B-D	95.00 A	22.50 FG	147.15 A-E	24.48 A-E	30.25 BC	41.59 F-H
CDC Alma	None	7.09 D-F	90.22 A	34.50 C-E	122.83 C-G	21.10 B-G	26.27 H-K	54.75 C-E
	Rhizoctonia	12.75 B-D	97.50 A	12.50 H-J	168.35 A	28.90 AB	27.91 E-J	32.04 HI
Black Sicilian	None	5.90 D-F	90.90 A	41.00 A-C	148.68 A-D	24.53 A-E	28.17 C-I	63.49 A-C
	Rhizoctonia	10.68 C-F	100.00 A	14.50 G-J	167.13 AB	29.55 A	27.69 F-J	39.32 F-H
CDC Anna	None	4.13 F	77.50 A	35.50 B-E	102.85 FG	14.55 G	25.91 JK	67.21 AB
	Rhizoctonia	8.68 C-F	100.00 A	13.01 H-J	127.90 A-G	19.13 C-G	27.45 G-J	39.74 F-H
Golden Dragon	None	6.03 D-F	85.00 A	45.00 A	91.83 G	15.03 FG	29.82 B-F	45.54 E-G
	Rhizoctonia	10.00 C-F	85.00 A	20.40 F-H	105.30 E-G	18.45 D-G	30.11 B-D	33.60 HI
Mean		10.13	93.78	26.88	132.46	22.21	28.57	46.29
% CV		28.18	13.34	48.33	24.92	28.18	8.82	33.56
LSD (0.05)		7.57	NS	8.40	41.92	7.89	2.18	9.96
Prob > F		.0032	.2925	<.0001	.0163	.0119	<.0001	<.0001

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 m² calculated by stand counts.

Effect of starter fertilizer and inoculation on chickpea nodulation and yield

Audrey Kalil, Taheni Gargouri Jbir, Ariel Wertheim,
Evan Herman, Kate Pearson, Kaleb Jimison

Introduction

Chickpea, like many legumes, derives the majority of its nitrogen needs from biological nitrogen fixation by rhizobia bacteria housed in root nodules. Achieving good nodulation through inoculation is therefore crucial to maximizing chickpea yield. Fertilization with phosphorous and sulfur at planting can improve chickpea yield and nitrogen fixation where they are deficient, however, sulfur soil tests are not considered reliable. Studies in other leguminous crops have shown sulfur fertilization can improve nodulation and nitrogen fixation, but the improvement plateaus at higher rates. The effect of fertilization at planting both with and without additional sulfur were evaluated to determine necessary rates to improve nodulation and yield in chickpea.

Methods

The trial was set up in a randomized complete block design, with 5 x 25 ft. plots and six replicates. Soil tests down to two feet found adequate levels of N (10 lbs/ac), P (42 ppm) and K (257 ppm). Soil pH was 5.4 and organic matter was 2.8%. The trial was planted May 5th and fertilizer was placed with the seed at a 2-inch depth. The chickpea variety was CDC Leader and seed was treated with Vibrance Maxx (1.54 fl oz/cwt). Uninoculated plots were planted first. Inoculated plots received 8.6 g each of Primo GX2 chickpea, lentil, pea and vetch granular inoculant (effective rhizobial species: *Mesorhizobium ciceri*). Starter fertilizer treatments were monoammonium phosphate (11-52-0-0) and Micro-Essentials S10 (MES) (12-40-0-10) at three rates: 20, 40 and 60 lbs. Nodulation was assessed June 23rd by digging plants, washing roots and counting nodules (growth stage V7-V13). The trial was harvested August 24th.

Results

Uninoculated treatments had little to no nodulation and yield was reduced by 600-800 lbs/ac. There was no yield response to starter fertilizer treatments as the inoculated, unfertilized treatment yielded similarly to the treatments where starter fertilizer was applied (Table 1). The lowest level of 11-52 (20 lbs/ac) resulted in the highest level of nodulation and nodulation decreased with higher rates. Nodulation levels were similar across levels of MES fertilization, thus there did not appear to be a nodulation response to sulfur fertilization. This trial will be repeated in 2021 to confirm these results.

Description	Nodule Number	Nodule Dry Weight (mg)	Yield (bu/ac)
Inoculated, Unfertilized	10.0 abc	23 ab	1694 a
MES @ 20 lbs/ac	7.6 abc	15 ab	1717 a
MES @ 40 lbs/ac	10.7 ab	21.7 ab	1660 a
MES @ 60 lbs/ac	11.6 ab	23.3 ab	1604 a
11-52 @ 20 lbs/ac	14.1 a	33.3 a	1739 a
11-52 @ 40 lbs/ac	4.9 abc	6.0 ab	1890 a
11-52 @ 60 lbs/ac	6.8 abc	15.0 ab	1728 a
Uninoculated, MES 40 lbs/ac	0.2 c	0.0 b	1123 b
Uninoculated, Unfertilized	1.3 c	0.3 b	1003 b
p-value ($\alpha < 0.05$)	0.0007	0.0043	< 0.0001

Table 1. Nodule number, nodule dry weight and yield of fertilizer and inoculant treatments. Different letters within columns (sites) indicate significant differences.

Resistance of Lentil Varieties to Rhizoctonia Root Rot EARC, Sidney, MT

Frankie Crutcher, Amber Ferda and Kevin McPhee

OBJECTIVE: Test the resistance of different lentil varieties to *R. solani*.

Materials and Methods:

Not Irrigated

Location: Sidney, MT
Variety: Misc.
Planted: 4/30/2020
Seeding Rate: 12 LS/ft²
Residual Soil N to 3 ft: 30.2 lbs/A
Residual Soil P to 6 in: 20 ppm
Irrigated (sprinkler): None
Precipitation April – September: 8.1”

Previous Crop: Wheat
Soil Type: Savage Silty Clay Loam
Harvested: 8/5/2020
Plot Size: 5’ x 20’
Applied Fertilizer: None
Chemical Applications: Outlook 20 fl oz/A, Roundup 20 fl oz/A
Vigor and stand counts: 5/19/2020, 6/1/2020, 6/19/2020
Root disease assessment: 6/15/2020

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). *R. solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting. Seed was treated with Cruiser 5FS (1.28 fl oz/cwt) + Apron XL (0.64 fl oz/cwt). Root assessments were done on 6/15/2020. Foliar height and biomass were taken during this time as well.

RESULTS: Significant differences were found for both root severity and root incidence, with the *Rhizoctonia* treatments showing more root rot than their counterparts without *Rhizoctonia*. Significant differences were also found for plants/m^2. The treatments that contained no *Rhizoctonia* had higher counts than the treatments with *Rhizoctonia*. The varieties Richlea, Viceroy, Avondale and Pennell had early pod shattering, which resulted in yield loss and were excluded from analysis for this reason.

Table 1: Lentil Variety Responses to Rhizoctonia Root Rot

Variety	Treatment	% Root Severity[a]	% Root Incidence[b]	Plants/m² [c]	Wet Weight (g)	Dry Weight (g)	Foliar Height (cm)	Yield (Bu/A)
Richlea	None	0.00 E	0.00 E	192.00 A	48.85 AB	5.28 A	23.53 AB	-
	Rhizoctonia	11.38 A-C	40.68 AB	109.50 EF	61.75 A	7.03 A	20.77 C-F	-
Viceroy	None	0.75 E	5.28 DE	205.50 A	42.48 B	4.40 A	21.50 CD	-
	Rhizoctonia	9.59 A-D	47.41 AB	141.00 CD	53.15 AB	4.85 A	19.68 D-G	-
Maxim	None	0.25 E	5.56 DE	181.50 AB	42.85 B	4.13 A	21.38 C-E	32.51 AB
	Rhizoctonia	13.94 AB	48.75 AB	92.00 FG	54.43 AB	6.13 A	19.47 E-G	27.40 BC
Avondale	None	0.13 E	2.50 E	181.00 AB	54.30 AB	5.85 A	24.28 A	-
	Rhizoctonia	4.14 DE	47.58 AB	114.50 D-F	58.03 AB	6.35 A	22.10 BC	-
ND Eagle	None	0.30 E	8.06 DE	137.00 C-E	57.60 AB	6.33 A	21.20 C-E	32.61 AB
	Rhizoctonia	5.80 C-E	37.07 A-C	72.00 FG	66.30 A	8.08 A	20.74 C-F	26.88 BC
Pennell	None	1.13 E	12.50 C-E	155.00 BC	58.78 AB	6.58 A	20.05 D-G	-
	Rhizoctonia	6.13 C-E	46.94 AB	94.00 FG	61.45 A	7.18 A	19.77 D-G	-
CDC Redberry	None	3.94 DE	29.14 B-D	118.00 D-F	50.55 AB	5.68 A	19.71 D-G	29.19 BC
	Rhizoctonia	15.29 A	61.88 A	97.00 FG	55.15 AB	6.50 A	19.21 FG	27.82 BC
CDC Rosetown	None	0.13 E	2.78 DE	150.00 C	57.73 AB	6.10 A	18.96 FG	40.96 A
	Rhizoctonia	6.83 B-E	24.07 B-E	100.00 FG	56.93 AB	6.38 A	18.26 G	35.96 AB
Mean		4.94	26.30	133.75	55.02	6.05	20.66	23.81
% CV		136.51	100.07	32.56	15.82	28.90	9.72	47.59
LSD (0.05)		7.24	26.56	29.58	17.62	NS	1.98	11.41
Prob > F		<.0001	<.0001	<.0001	.0005	0.1248	<.0001	<.0001

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 m² calculated by stand counts.

Resistance of Pea Varieties to Rhizoctonia Root Rot EARC, Sidney, MT

Frankie Crutcher, Amber Ferda and Kevin McPhee

OBJECTIVE: Test the resistance of different pea varieties to *R. solani*.

Materials and Methods:

Not Irrigated

Location: Sidney, MT	Previous Crop: Wheat
Variety: Misc.	Soil Type: Savage Silty Clay Loam
Planted: 4/30/2020	Harvested: 8/3/2020
Seeding Rate: 8 LS/ft²	Plot Size: 5' x 20'
Residual Soil N to 3 ft: 30.2 lbs/A	Applied Fertilizer: None
Residual Soil P to 6 in: 20 ppm	Chemical Applications: Outlook 20 fl oz/A, Roundup 20 fl oz/A, Varisto 18 fl oz/A
Irrigated (sprinkler): None	Vigor and stand counts: 5/19/2020, 6/1/2020, 6/19/2020
Precipitation April – September: 8.1"	Root disease assessment: 6/15/2020

COMMENTS: Seeds were inoculated with peat-based commercial Rhizobium N-Charge® (Verdesian Life Sciences, Cary, NC). *R. solani* AG 2-2 isolate R9 grown on barley was used to inoculate plots at planting. Seed was treated with Cruiser 5FS (1.28 fl oz/cwt) + Apron XL (0.64 fl oz/cwt). Powdery mildew was observed on some varieties close to harvest. Root assessments were done on 6/15/2020. Foliar height and biomass were taken during this time as well.

RESULTS: Significant differences were found for root severity, with the treatments containing *Rhizoctonia* having higher numbers than their counterparts without *Rhizoctonia*. Significant differences were also found for all other categories except root severity. Aragorn and Greenwood were excluded from the yield analysis, due to lodging and shattering before harvest.

Pea Rhizoctonia PM plot photo

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Table 1: Pea Variety Responses to Rhizoctonia Root Rot

Variety	Treatment	% Root Severity[a]	% Root Severity[b]	Plants/m² [c]	Wet Weight (g)	Dry Weight (g)	Foliar Height (cm)	% Protein	Yield (Bu/A)	Powdery Mildew
Carver	None	3.13 C-E	92.92 A	94.50 A-C	108.43 A-C	20.63 AB	34.01 AB	20.45 JK	68.58 A	No
	Rhizoctonia	9.65 A-E	97.50 A	88.50 B-D	107.30 A-C	20.35 AB	35.86 A	19.58 K	64.92 AB	No
DS Admiral	None	2.31 DE	82.50 A	84.00 C-E	93.05 C-E	17.78 B-F	31.87 B-D	22.90 E-H	59.11 BC	No
	Rhizoctonia	8.33 B-E	92.72 A	84.00 C-E	91.25 C-E	17.45 B-F	29.98 C-F	22.18 GH	54.63 C-E	No
Majoret	None	4.68 C-E	100.00 A	94.50 A-C	102.98 A-D	19.55 A-C	30.05 C-F	24.13 C	50.56 D-F	Yes
	Rhizoctonia	12.70 A-C	96.15 A	93.00 A-C	103.23 A-D	19.28 A-D	26.31 G	23.35 C-F	45.57 F	Yes
Shamrock	None	5.63 B-E	92.95 A	72.00 EF	101.20 A-D	17.83 B-F	26.99 FG	23.05 D-G	51.62 C-F	Yes
	Rhizoctonia	12.43 A-C	100.00 A	61.50 F	119.40 AB	18.50 B-E	27.56 E-G	22.60 F-H	47.28 EF	Yes
Aragorn	None	3.86 C-E	95.00 A	88.50 B-D	87.88 C-E	22.78 AB	34.15 AB	24.50 BC	-	Yes
	Rhizoctonia	12.01 A-D	100.00 A	88.00 B-D	96.90 A-E	18.55 B-E	29.86 C-F	23.85 C-E	-	Yes
Hampton	None	3.73 C-E	82.50 A	104.00 A	86.03 C-E	14.05 FG	25.95 G	22.33 GH	57.54 B-D	Yes
	Rhizoctonia	18.44 A	97.50 A	81.50 C-E	74.98 E	12.55 G	21.17 H	22.68 E-H	49.94 D-F	Yes
Greenwood	None	3.78 C-E	85.68 A	93.50 A-C	102.58 A-D	17.90 B-E	30.46 C-E	21.08 IJ	-	Yes
	Rhizoctonia	11.44 A-E	100.00 A	87.50 B-D	85.53 C-E	15.93 C-G	27.00 FG	20.00 K	-	Yes
Jetset	None	2.20 E	92.17 A	100.00 AB	103.20 A-D	19.33 A-C	35.36 A	24.18 C	49.26 D-F	Yes
	Rhizoctonia	15.38 AB	95.00 A	85.50 C-E	78.30 DE	15.43 E-G	33.22 A-C	24.28 C	49.30 D-F	Yes
Bridger	None	7.45 B-E	92.50 A	86.00 CD	83.60 C-E	15.45 D-G	28.27 E-G	23.43 C-F	49.44 D-F	Yes
	Rhizoctonia	9.93 A-E	92.72 A	83.00 C-E	86.63 C-E	15.98 C-G	27.81 E-G	21.98 HI	49.16 D-F	Yes
Orchestra	None	3.55 C-E	97.50 A	76.00 DE	95.05 B-E	17.38 B-F	28.91 D-G	26.65 A	50.13 D-F	Yes
	Rhizoctonia	9.98 A-E	95.45 A	75.50 DE	121.50 A	22.53 A	30.23 C-F	25.93 AB	45.13 F	Yes
Mean		8.03	94.04	86.05	96.45	17.86	29.75	22.87	44.14	
% CV		94.69	10.30	14.98	20.87	18.89	13.94	8.34	34.25	
LSD (0.05)		9.79	NS	13.90	25.82	3.84	3.45	0.99	8.44	
Prob > F		0.2309	.2309	<.0001	.0315	.0003	<.0001	<.0001	<.0001	

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 m² calculated by stand counts.

Resistance of Spring Wheat Varieties to Fusarium Head Blight

EARC, Sidney, MT

Frankie Crutcher, Phil Bruckner, Jason Cook, Amber Ferda and Samantha Hoesel

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

Materials and Methods:

Irrigated

Location: Sidney, MT	Previous Crops: Wheat
Variety: Misc.	Soil Type: Savage Silty Clay Loam
Planted: 5/6/2020	Harvested: 8/15/2020
Seeding Rate: 90 lbs/A	Plot Size: 2.5' x 10'
Residual Soil N to 3 ft: 37 lb/A	Applied Fertilizer: 100-30
Residual Soil P to 6 in: 21.3 ppm	Chemical Applications: Wolverine Advanced 1.7 pt/A, Proline 5.7 fl oz/A, Stinger 1 1/3 pt/A, Discover NG 16 fl oz/A
Irrigated (sprinkler) on: 5/12, 5/22, 6/4, 6/13, 6/19, 6/29, 7/15	Vigor: 5/22/2020
Precipitation April – September: 8.1"	Disease assessment(s): 7/28/2020

COMMENTS: Corn spawn inoculated with five isolates of *F. graminearum* was applied to the field on 6/3/2020.

RESULTS: Both experimental and popular lines had lower severity, incidence, FDK and disease index compared to the susceptible control McNeal and were also significantly different.

Table 1 Spring Wheat Variety Reponses to Fusarium Head Blight

Variety	Severity(%)[a]	Incidence(%)[b]	% FDK[c]	Index[d]	Yield (Bu/A)
MT 1716	1.2 G	15.6 GH	3.3 BC	0.2 DE	69.4 AB
MT 1743	21.4 A-C	65.6 AB	5.3 A-C	14.2 BC	63.5 A-D
MT 1750	6.9 D-G	35.6 B-H	6.0 A-C	2.5 DE	48.4 A-D
MT 1775	11.3 C-G	36.7 B-H	17.0 AB	4.4 DE	56.7 A-D
MT 1809	1.7 G	18.9 E-H	3.3 BC	0.4 DE	64.4 A-D
MT 1815	15.2 B-E	56.7 A-D	15.0 A-C	9.0 B-D	45.2 A-D
MT 1824	3.1 E-G	20.0 D-H	3.3 BC	0.8 DE	49.0 A-D
MT 1853	7.2 D-G	44.4 A-G	6.0 A-C	3.2 DE	54.1 A-D
MT 1855	5.2 D-G	30.0 B-H	6.0 A-C	1.7 DE	54.7 A-D
MT 1857	14.9 B-F	53.3 A-F	6.0 A-C	8.3 B-E	41.8 CD
MT 1862	12.2 B-G	41.1 B-H	16.7 AB	4.9 DE	52.3 A-D
MT 1866	3.0 E-G	21.1 C-H	5.3 A-C	0.8 DE	62.6 A-D
MT 1868	12.1 B-G	47.8 A-G	8.0 A-C	5.9 C-E	56.8 A-D
MT 1871	17.4 B-D	50.0 A-G	8.7 A-C	9.0 B-D	43.6 A-D
MT 1872	11.6 C-G	33.3 B-H	7.3 A-C	4.2 DE	50.3 A-D
MT 1902	12.6 B-G	42.2 A-H	8.0 A-C	5.6 C-E	63.6 A-D
MT 1904	12.2 B-G	54.4 A-F	8.7 A-C	7.2 B-E	55.7 A-D
MT 1905	9.9 C-G	47.8 A-G	12.7 A-C	4.4 DE	53.6 A-D
MT 1906	8.0 D-G	45.6 A-G	6.7 A-C	3.8 DE	56.7 A-D
MT 1922	11.9 C-G	45.6 A-G	4.7 A-C	5.4 DE	53.9 A-D
MT 1927	11.2 C-G	43.3 A-H	14.7 A-C	4.9 DE	53.6 A-D
MT 1931	4.2 E-G	22.2 C-H	9.7 A-C	0.9 DE	56.9 A-D
MT 1932	2.2 F-G	17.8 F-H	4.0 BC	1.0 DE	56.8 A-D
MT 1934	6.9 D-G	36.7 B-H	6.7 A-C	2.9 DE	65.7 A-D

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MT 1935	3.4 E-G	28.9 B-H	6.0 A-C	1.0 DE	46.1 A-D
MT 1936	2.7 E-G	18.9 E-H	2.7 C	0.5 DE	50.6 A-D
MT 1938	5.9 D-G	33.3 B-H	10.0 A-C	2.9 DE	54.3 A-D
MT 1939	10.2 C-G	38.9 B-H	14.3 A-C	4.1 DE	60.5 A-D
MT 1943	7.8 D-G	41.1 B-H	8.0 A-C	3.4 DE	55.2 A-D
MT 1951	7.6 D-G	36.7 B-H	12.0 A-C	2.8 DE	64.3 A-D
MT 1959	4.4 E-G	23.3 C-H	2.7 C	1.0 DE	62.9 A-D
MT 1961	5.8 D-G	30.0 B-H	4.7 A-C	1.9 DE	63.3 A-D
MT 2015	5.6 D-G	31.1 B-H	3.3 BC	1.7 DE	70.2 A
MT 2016	5.2 D-G	34.4 B-H	5.3 A-C	2.0 DE	58.3 A-D
MT 2017	6.9 D-G	38.9 B-H	3.3 BC	2.9 DE	63.2 A-D
MT 2065	2.3 E-G	20.0 D-H	3.3 BC	0.6 DE	52.6 A-D
MT 2066	5.1 D-G	31.1 B-H	4.0 BC	1.8 DE	68.6 A-C
MT 2067	7.2 D-G	55.6 A-E	13.3 A-C	4.2 DE	70.0 A
MT 2068	4.9 D-G	46.7 A-G	7.3 A-C	2.3 DE	62.9 A-D
MT 2071	10.7 C-G	43.3 A-H	10.0 A-C	4.7 DE	47.3 A-D
MT 2072	4.6 D-G	36.7 B-H	10.7 A-C	1.8 DE	45.0 A-D
MT 2073	7.7 D-G	33.3 B-H	10.7 A-C	2.8 DE	54.7 A-D
MT 2074	25.0 AB	57.8 A-C	10.3 A-C	14.9 B	40.3 D
MT 2075	11.8 C-G	46.7 A-G	6.0 A-C	5.7 C-E	54.3 A-D
MT 2076	3.6 E-G	31.1 B-H	6.7 A-C	1.2 DE	50.6 A-D
Dagmar	7.9 D-G	50.0 A-G	5.3 A-C	4.0 DE	64.1 A-D
Lanning	7.4 D-G	51.1 A-G	7.3 A-C	4.2 DE	65.2 A-D
McNeal	33.9 A	78.9 A	18.3 A	26.9 A	42.4 B-C
Reeder	3.2 E-G	25.6 C-H	4.7 A-C	0.8 DE	44.2 A-D
Ingmar	1.1 G	6.7 H	4.0 BC	0.1 E	62.0 A-D
Vida	5.2 D-G	34.4 B-H	6.0 A-C	2.0 DE	47.8 A-D
Mean	8.44	37.84	7.71	4.07	55.89
Prob>F	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
% CV	81.6	43.62	68.23	122.49	18.53
HSD (0.05)	12.9	37.2	13.95	8.85	27.35

Letters in common did not differ significantly according to a Tukey's 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.
[d]Disease index is calculated as (Severity X Incidence) / 100

New Sample Grain Cleaner purchased 2020.

Industrial Hemp – Planting Date Study of Two Selected Varieties
EARC, Sidney, MT

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

Objectives: To determine optimal seeding date of two selected industrial hemp varieties in eastern Montana.

Materials and Methods

Location:	EARC Irrigated Farm	Previous crop:	Sugarbeet
Planted:	Early Planting: 04/30/2020 Late Planting: 05/19/2020	Soil type:	Savage Silty Clay Loam
Tillage:	Conventional	Sampled for biomass and seed yield:	08/24/2020
Experimental design:	Randomized Complete Block	Plot size:	12’ width × 30’ length
Varieties:	CRS-1 and Katani	Replications:	4
Pesticide:	None	Herbicide:	None
Fertilizers:	100 lb N/ac and 30 lb P_2O_5/ac blend applied before planting	Rainfall: Irrigation:	5.81” 6.95”

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

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

Depth	pH	OM	NO_3-N	P-Olsen	K
Inch		%		ppm	
0-12	8.4	1.8	10.5	15	186

Table 2: Main effect of planting date and variety on industrial hemp height, biomass yield, and seed yield.

Effect	Treatments	Plant Height	Biomass	Seed Yield
		(inch)	(lb/ac)	(lb/ac)
Planting date	Early	61.4	6258	400 B
	Late	63.5	6229	1037 A
Variety	CRS-1	73.9 a	6902 a	770
	Katani	51.0 b	5584 b	667
Sources of variation				
Planting date (D)		0.07	0.96	0.002
Variety (V)		<0.0001	0.04	0.51
D×V		0.0002	0.07	0.11

† Wheat variety Elgin was planted.

Cole Roberts, Abbey Ries &
Becky Garza hoeing a hemp field at EARC.

Industrial Hemp – Performance of Experimental Lines and Varieties for Eastern Montana

EARC, Sidney, MT

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

Objectives: To evaluate the performance of experimental lines and varieties of industrial hemp across eastern Montana.

Materials and Methods

Location:	EARC Irrigated Farm	Previous crop:	Sugarbeet
Planted:	Early Planting: 06/03/2020	Soil type:	Savage Silty Clay Loam
Seeding rate	20 lb./ac	Sampled for biomass and seed yield:	Varied depending on the maturity.
Tillage:	Conventional	Plot size:	6' width × 30' length
Experimental design:	Randomized Complete Block	Replications:	4
# of varieties:	12	Herbicide:	PowerMax @ 24 oz/ac preplant.
Fertilizers:	100 lb. N/ac and 30 lb. P_2O_5/ac blend applied before planting	Rainfall:	5.81"
		Irrigation:	6.95"
Pesticide:	None		

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

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

Depth	pH	OM	NO_3-N	P-Olsen	K
Inch		%		ppm	
0-12	8.4	1.8	10.5	15	186

Table 2: Summary of Agronomic Data of Industrial Hemp Varieties Tested.

Cultivar	Plant Stand (acre)	Pre-flowering Plant Height (inch)	Post-flowering Plant Height (inch)	Stem Diameter (mm)	Biomass (lb/ac)	Seed Yield (lb/ac)
Altair	97390	73.8	74.0	11.8	7925	1892
Anka	133912	74.8	84.0	11.5	7291	1166
Bialobrzeskie	47588	85.0	94.5	12.5	6033	277
CFX-1	87983	55.8	52.8	10.3	6648	2285
Henola	120078	66.8	64.3	10.0	6586	1582
Hlesia (Glesia)	130592	79.8	83.5	10.5	5755	596
Hliana (Giliana)	56995	76.0	79.8	10.8	5371	399
Hlukhovskii 51	128931	76.5	81.3	10.3	5460	327
Katani	96837	49.8	43.0	10.0	4271	1743
NWG-2730	100710	72.8	83.5	13.3	8874	1054
NWG-452	148299	82.5	80.0	11.0	6563	953
X-59	74703	65.3	57.8	10.3	6697	2359
Mean	102001	71.5	73.2	11.0	6518	1219
P > *F*	0.0001	<0.0001	<0.0001	0.02	0.04	<0.0001
LSD (*P* = 0.05)	40444	7.14	10.2	1.90	2280	802
CV (%)	27.6	6.9	9.7	12.0	22.4	45.7

Note: CRS-1 was not included in this variety trial. CRS-1 was used in a separate planting date study. Average plant height, biomass, and seed yield were 73.9 inch, 6902 lb/ac, and 770 lb/ac, respectively. There was a severe bird damage in this trial, and lower yields in some of the varieties were likely due to bird damage and seed shattering.

Kernza® Variety Trials

Clair Keene

Kernza® variety trials continued at the WREC in 2020. The fall planted trial was seeded on Sept. 7, 2018 and the spring planted trial was seeded May 10, 2019. This year was the second grain harvest of the fall seeded trial and the first of the spring seeded trial. Both trials included the same 9 varieties: 2 old forage types (Rush and Oahe), 2 from The Land Institute (TLI), and 5 from the University of Minnesota (MN).

Forage quality

Forage quality samples were taken from all plots on June 1, oven dried, and sent to Minnesota Valley Testing Labs (New Ulm, MN) for analysis. At the time of sampling, the fall seeded trial was starting to head and the spring seeded trial was in the boot. Crude protein of all samples ranged from 9.1-15.7% with an over-all average of 10.8%. ADF ranged from 26.9-32.6% with an over-all average of 29.9%. Based on CP and ADF values, these Kernza samples would be considered good quality grass hay.

Quality analysis of the fall-seeded trial

Variety	% Ca	% P	% ADF†	% NDF‡	% CP§
Rush	0.23	0.21	30.7	53.9	11.2
Oahe	0.21	0.20	31.8	55.2	10.7
TLI-C3	0.28	0.19	29.4	51.4	10.1
TLI-C5	0.23	0.22	29.8	52.9	10.5
MN-1501	0.24	0.20	30.0	52.3	10.3
MN-1502	0.22	0.20	28.6	50.9	12.0
MN-1503	0.26	0.22	29.1	49.7	11.2
MN-1504	0.24	0.22	29.6	52.4	11.4
MN-1505	0.22	0.20	28.8	51.5	11.9
Mean	0.24	0.21	29.8	52.2	11.0
LSD 5%	NS	NS	1.3	2.1	1.1
LSD 10%	NS	NS	1.0	1.6	0.9

†ADF = Acid Detergent Fiber. ADF measures the least digestible plant cell components including cellulose and lignin. Forages with low ADF are usually higher in energy.

‡NDF = Neutral Detergent Fiber. Generally low NDF values are desired because NDF increases as forages mature and higher values indicate more mature plants; also, as % NDF increases, dry matter intake generally decreases.

§CP = Crude Protein. Higher protein feeds have higher energy values.

Flowering, height, and lodging

The fall-seeded (older) plots flowered about one week earlier than the spring-seeded plots. Fall-seeded plots flowered the last week of June and were done flowering by July 6, whereas spring-seeded plots flowered the first week of July and finished flowering by July 10. MN-1501 and MN-1502 were the latest flowering varieties in both the fall and spring trials.

Height was measured in mid-July after flowering. No significant differences in height were observed in the fall-seeded trial while a significant difference in height was observed in the spring-seeded trial.

In the spring trial, the forage types Rush and Oahe were significantly taller than any of the Kernza grain types and MN-1504 was the shortest variety.

Very little lodging was observed in any of the plots. The forage types exhibited a little more lodging than grain types but not enough to interfere with harvest.

Yield

The fall-seeded trial was combined on July 31 and the spring-seeded trial on August 5. The fall trial dried down a little earlier than the spring trial, which was expected following its earlier flowering. Plots were cut high to minimize the amount of straw passing through the small-plot combine. After harvest of the spring trial, a full size combine was used to cut the remaining residue short, about 5" tall, pulverize the straw, and spread the chaff evenly over the field. In Kernza grain production, residue needs to be removed from the field to promote heading the following year.

	Fall-seeded trial				Spring-seeded trial		
	Height	Lodging	Yield† lbs/ac		Height	Lodging	Yield†
Variety	in	0-10	2020	2019	in	0-10	lbs/ac
Rush	47	2	289	228	49	1	253
Oahe	46	1	276	216	49	2	207
TLI-C3	45	0	402	372	45	1	396
TLI-C5	46	1	536	375	44	0	419
MN-1501	46	1	383	309	45	1	351
MN-1502	46	0	347	270	46	1	400
MN-1503	45	1	343	272	44	0	319
MN-1504	44	0	370	302	43	1	324
MN-1505	44	1	387	393	46	0	348
Mean	45		370	308	46		335
LSD 5%	NS		100	125	3		55
LSD 10%	3		77	80	2		42

†Yield data presented is for hulled grain. Hulls are estimated to account for approximately 30% of harvested weight.

The fall-seeded trial had higher yields than the spring-seeded trial. It is too soon to say whether this reflects an increase in grain production in the 2nd year of a stand, however it is an interesting observation. It could also reflect the older (fall) stand being more productive during the severely dry conditions of the 2020 growing season. TLI-C5 was the highest yielding variety in both the 2020 fall and spring trials and was the second-highest yielding variety in 2019 as well. Interestingly, collaborators in Minnesota have seen MN-1504 do better than TLI-C5 while here in Williston, TLI-C5 is establishing itself as the highest-yielding variety. As a reminder, the yields in the table above are hulled yields. Cleaned, de-hulled Kernza grain yields will be lower. Hull weight varies by variety, but hulls are roughly estimated to account for 30% of harvested weight.

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

Herbicide Safety in Kernza®

Clair Keene

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 by The Land Institute of Salina, Kansas. Kernza is a new perennial grain crop with approximately 2,000 acres in production in the US in 2020. The Land Institute and the University of Minnesota have a goal of doubling the number of Kernza acres in production each year for the next 10 years. As Kernza acres expand, more management options are needed for this crop. At this time, there are no herbicides labeled for use in Kernza destined for the human food-grade market. This study was conducted in collaboration with the University of Minnesota, the University of Wisconsin-Madison, and Cornell University to generate data needed for IR4 registration of broadleaf herbicides in food-use Kernza.

The Kernza stand used in this study was seeded August 26, 2019 with a John Deere 750 15 foot no-till drill on the WREC dryland farm. Kernza was seeded at 10 lbs pure live seed per acre along with 25 lbs of barley per acre as a nurse crop and to facilitate Kernza seed flow through the drill. In September 2019, the site received approximately 8" of rainfall, a record-high for the month. First frost occurred October 2, less than 6 weeks after planting. October 2019 was fairly cold so limited growth occurred before winter. Fall herbicide application was made on October 17, 2019 and spring application occurred on May 29, 2020. Kernza over-wintered with 3-4 leaves and 0 or 1 tiller on most plants. Spring 2020 warmed up slowly and started with good soil moisture after the wet fall, but almost all moisture was gone by late May. Very little rain fell in May and June and the 2020 growing season was the 4th driest on record for Williams County. Despite these challenges, the Kernza stand survived and produced grain.

Overall, very little injury was observed from 2,4-D and clopyralid. Lodging was minimal in all treatments and no differences were observed in maturity. There were no significant differences in either whole plant biomass or head weight sampled at harvest among the treatments. These data suggest that 2,4-D and clopyralid have low injury potential for Kernza and support their registration for broadleaf weed control in this new crop. 2,4-D is expected to be labeled for use in Kernza grain crops in 2021 but the label for clopyralid will likely be later, possibly in 2022.

Visual assessment of injury (scale 0-10) at different times following fall or spring application.

Product	Rate oz/ac	Timing	Fall application			Spring application		
			Injury 2WAA†	Injury 4WAA	Injury 7MAA‡	Injury 2WAA	Injury 4WAA	Injury Hrvst
Untreated		None	1	0.3	0	0	0	0
2,4-D amine	32	Fall	1	1	0	.	.	0
2,4-D amine	64	Fall	2.7	2	0.3	.	.	0
Clopyralid	3.8	Fall	1	1.3	0.3	.	.	0
Clopyralid	7.6	Fall	1.3	1.3	0.3	.	.	0
2,4-D amine	32	Spring	.	.	.	0	0	0
2,4-D amine	64	Spring	.	.	.	0.3	0	0
Clopyralid	3.8	Spring	.	.	.	0	0	0
Clopyralid	7.6	Spring	.	.	.	0	0	0

†WAA = weeks after application

‡MAA = months after application

Injury Hrvst = injury observed 3 weeks prior to harvest

Effect of Nitrogen Rate on Kernza® in the MonDak

Clair Keene

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 by The Land Institute of Salina, Kansas. Old forage types of intermediate wheatgrass have been grown in the western United States for over 50 years and have done well in our semi-arid, short season conditions. Most agronomic trials to date with Kernza have been conducted in Kansas, Minnesota, and Wisconsin, but no work has been done on best production practices in the semi-arid Northern Great Plains. This trial is one of a series at the Williston REC to inform management strategies for Kernza in our region.

The Kernza stand used in this study was seeded August 26, 2019 with a John Deere 750 15 foot no-till drill on the WREC dryland farm. Kernza was seeded at 10 lbs pure live seed per acre along with 25 lbs of barley per acre as a nurse crop and to facilitate Kernza seed flow through the drill. Kernza seed is hulled and can bridge or clog in seed cups and hoses so it is important to monitor equipment while seeding. It should be noted that in September 2019, the site received approximately 8" of rainfall, a record-high for the month. First frost occurred October 2, less than 6 weeks after planting. Kernza over-wintered with 3-4 leaves and 0 or 1 tiller on most plants. Spring 2020 warmed up slowly and started with good soil moisture after the wet fall, but almost all moisture was gone by late May. Hardly any rain fell in May and less than 1.5" fell in June with most of it at the very end of the month. The 2020 growing season was the 4th driest on record for Williams County. Despite these challenges, the Kernza stand survived and produced grain. Tillering was limited by the dry conditions and the rows did not fully close.

Nitrogen study

Soil sampling in April 2020 found that nitrate nitrogen in the field ranged from 7-9 lbs per acre in the top 0-6" and from 6-27 lbs per acre at the 6-24" depth. A randomized complete block design with 4 replications was used to investigate the effects of nitrogen application on Kernza biomass production, lodging, and yield. Plots were 30 feet wide by 120 feet long and established by spreading urea at rates equivalent to 0, 25, 50, and 75 lbs of nitrogen with a Barber pull-type drop spreader. Urea was broadcast on May 14. It is likely that much of the nitrogen was lost to volatilization as the first 24-hour period with more than 0.5" of precipitation after application was June 28, 6 weeks later.

Data collected included height at flowering, lodging, and whole plant biomass at harvest. There was no significant difference in height or biomass at harvest among the treatments. Very little lodging was observed. A small amount of lodging was seen in the 75 lb N treatment but it did not affect harvest. Nitrogen was likely lost due to lack of moisture and drought conditions stressed the stand, regardless of N rate. This study will be repeated in 2021 to determine how Kernza responds to broadcast urea application in our region.

lbs N applied	Height (inches)	Biomass (lbs/ac)
0	36	1968
25	36	2199
50	36	2170
75	36	2030
Mean	36	2092

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

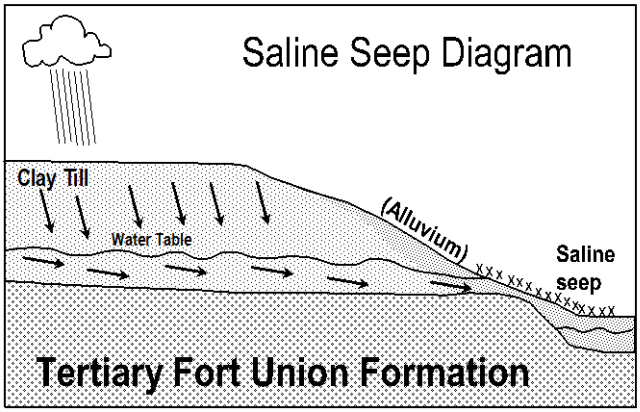
The WREC and Montana Salinity Control Association (MSCA) partnered to monitor and reclaim a saline seep at the WREC dryland research farm. The project is located in T154N R102W Section 36 of the Fifth Principle Meridian Public Land Survey System (PLSS).

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.

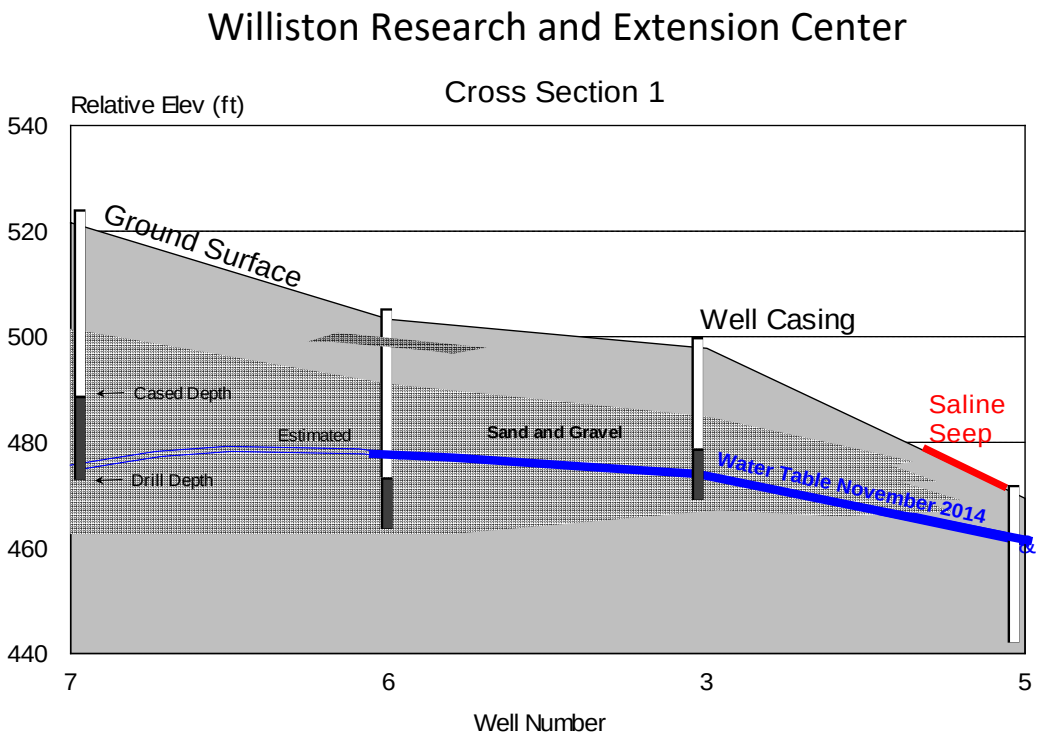
Soils: In the investigated area, the soil texture in the upper 0- to 5-foot soil profile is predominantly Clay or Sandy Clay Loam derived from Glacial Till left behind from the previous glacial periods. Glacial till in this area is mainly clay and clay loam soils.



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.

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

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



Perennial plants:

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

To assist area producers with future forage variety selection and evaluate currently available alfalfa varieties side-by-side in northwestern North Dakota, WREC partnered with forage seed company Alforex Seeds to establish a salt-tolerant forage variety trial in the area of the saline seep. One June 9, 2016, four varieties of alfalfa and two perennial grasses were seeded in a replicated trial in the most intense part of the saline seep. Check strips were planted to the north of the variety trial in non-saline conditions. Alfalfa varieties planted were Rugged, Magnum Salt, AFX 457, and PGI 427. Perennial grasses planted were AC Saltlander mix (50% AC Saltlander green wheatgrass, 24% slender wheatgrass, and 26% tall fescue) and Garrison creeping foxtail, a flood-tolerant species.

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. The site received 8” of rain in September 2019, a record-high for the month, and went into winter with saturated soils. The wet soil and quick, hard freeze that occurred in October 2019 was hard on many perennials in the region. Jane Holzer of the Montana Salinity Control Association noted that there was a lot of winter kill of shrubs and trees across central and eastern Montana for the same reason. In spring 2020, winter kill was observed in the lowest and wettest part of the seep. Unfortunately, these low-lying plots tended to be the highest yielding in previous years, so over-all alfalfa biomass production from the seep is expected to decline. In 2020, alfalfa biomass was sampled from areas with surviving alfalfa plants in plots exhibiting winter kill; care was taken to approximate biomass production representative of the whole plot.

The variety trial plots were cut once in the seeding year and twice each year since. With the exception of spots that winter-killed, the plots were in good to very good condition in early June 2020 following the wet fall of 2019. However, the stand matured quickly and regrew slowly after first cutting as less than 1” of total rainfall occurred April through late June. Less than 2” of rain occurred in July and the field looked drought stressed by late July. By the end of the growing season, Williams County was designated as being in a severe drought.

Saline seep alfalfa yields 2016 – 2020 in Tons/ acre. Note, tons per acre were calculated from oven dry biomass samples.

	2016	2017			2018			2019			2020		
	12 WAP†	1st cut	2nd cut	**Total**	1st cut	2nd cut	**Total**	1st cut	2nd cut	**Total**	1st cut	2nd cut	**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**	0.9	1.3	**2.2**
PGI 427	0.6	1.9	1.2	**3.1**	2.7	2.1	**4.8**	2.3	1.2	**3.5**	1.7	1.2	**2.9**
Rugged	0.7	1.7	1.9	**3.6**	2.3	2.2	**4.5**	1.4	0.7	**2.1**	1.0	1.0	**2.0**
Magnum Salt	0.7	1.7	1.3	**3.0**	2.0	1.8	**3.8**	1.7	1.1	**2.8**	1.3	1.1	**2.4**
Mean	0.7			3.4			4.3			2.7			2.4

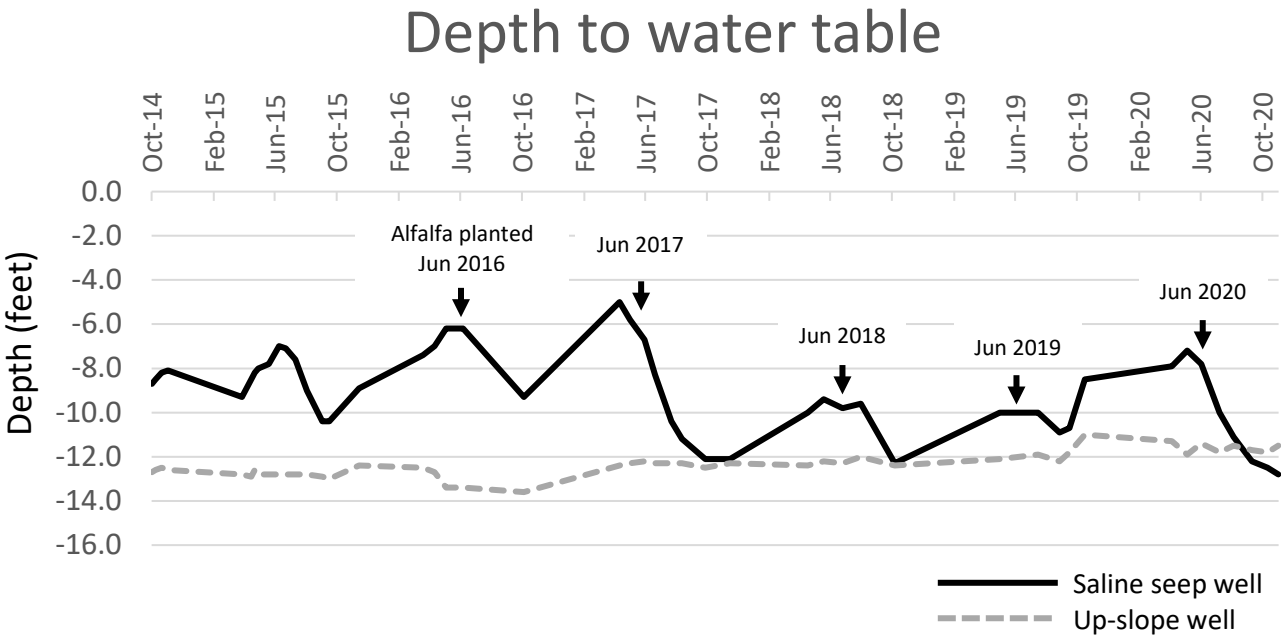
†WAP = Weeks after planting

Soil Salinity Monitoring

Fall soil sampling was conducted 2016-2019 and documented a decrease in electrical conductivity (EC) in the top 0-3" of the soil profile. Unfortunately, in fall of 2020, we were unable to take soil cores for EC sampling due to the extremely dry conditions. We plan to soil sample and measure EC in the saline seep in 2021 if environmental conditions allow. As in the past two years, we also took a series of deep soil cores with a truck-mounted hydraulic soil sampler to check salinity in deeper layers of the soil profile. However, at the time of writing this report, lab results were not available to report. These results will be provided in the next project update.

Water Table Management

Planting 40 acres of alfalfa in the recharge area of the seep has been critical to managing the water table at this site. Depth to water table has been monitored using shallow ground water wells since 2014. Below is a figure of measurements taken at two wells at the site from 2014-2020. 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 prevented a spike in the groundwater after a snowy 2018-2019 winter. The sharp increase in the water table observed in October 2019 is a result of the 8" of rain received the month before. The water table under the seep rose to its shallowest depth in three years in May 2020, but began receding in June. The alfalfa drew down the water table during the severely dry 2020 growing season to its lowest-ever reading in November 2020. These observations show that the alfalfa used enough water to prevent the water table from rising to levels observed before it was established in spring of 2017. These data also suggest that even though the ground water at this site is very responsive to changes in precipitation, the alfalfa is able to keep a rising water table in check and draw it down by the end of the growing season.



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

Irrigation Research at Nesson Valley 2020

Justin Jacobs, NDSU – Williston Research Extension Center

Weather Summary - Nesson Valley, ND+					
	Precipitation		Temperature		
Month	2020	Avg‡	2020	Avg	Days above 89^0
	-inches-		-------degrees F^0-------		
Oct-Dec. 2018	0.59	1.18			
April	0.13	.73	36.5	40.7	0
May	0.45	2.10	52.5	53.7	0
June	2.22	2.9	64.0	63.5	1
July	1.73	2.18	68.5	69.4	3
August	0.76	1.45	69.5	67.4	11
September	.21	2.19	56.5	57.6	0
April-July	4.53	7.92	55.4	56.8	4
April-Sept	5.5	11.56	57.9	58.7	15
Total- (Oct 2019 - September 2020)	6.09	12.75			
Last spring frost = May 15, 2020 (28.5°)					
First fall frost = September 7, 2020 (31.5°)					
+ NDAWN Hofflund site ‡ Average since January 1, 2006					

Different. The word doesn't even begin to encompass what the year two-thousand and twenty felt like. To start, we were not certain what lay ahead as far as field work was concerned in the spring. The potential for a shut-down loomed over the spring as we prepared to start the new field season. The late season moisture from 2019 also looked to make an early start impossible. However, neither factor delayed planting like was previously feared. Instead, we were able to get our first trials planted on the 27th of April.

To begin the year, we hired a new Research Specialist, Andrina Turnquist, to help with field and trial maintenance. She graduated in 2020 with a Bachelor's in Crop and Weed Science from NDSU. She was a great help to the Nesson Valley team as she assisted in everything from seed increase work to variety trial maintenance.

A total of 17 variety trials in 14 different crop were planted in 2020. The yields were lower in winter wheat and spring wheat than in previous years and were higher in all other crops than on average. As a result of no rainfall, nearly 12 inches of water were applied to the small grain crops. Several new and experimental varieties were tested in the spring wheat trial, thus bringing the average down compared to previous years. Testing newly released lines allows for the opportunity to see what varieties have the potential to perform well in an irrigated environment and which varieties will not. Long term data is being analyzed to determine variety performance over time. The early-season broadleaf crops; canola, field pea, flax, canola, and safflower received nearly 10 inches of irrigation. The corn and late-season broadleafs crops; dry bean, soybean, and sunflower received nearly 18 inches of irrigation. An early killing frost in September effectively ended the growth of corn, sunflower, dry bean, and soybean before reaching full maturity. The averages for each crop/trial are listed below. As a result of the early frost, the soybean trial was severly impacted and therefore will not be reported for 2020. The crop variety information can be found throughout this Ag Research Update.

Crop (# of varieties)	2020 Average	Crop	2020 Average
Winter Wheat (24)	**95 bu/a**	Field Pea (7)	**67 bu/a**
Spring Wheat (48)	**76 bu/a**	Flax (15)	**43 bu/a**
Durum Wheat (21)	**74 bu/a**	Safflower (22)	**1,371 lb/a**
Barley (12)	**132 bu/a**	Canola (11)	**2,408 lb/a**
Oat (12)	**196 bu/a**	Sunflower (16)	**2,798 lb/a**
Corn (15)	**160 bu/a**	Dry Bean (18)	**3,031 lb/a**

One of the major projects at Nesson this year was a trial looking at optimal planting population and fertilization for canola under irrigation. Four planting rates were planted with six fertilizer rate treatments. Canola has not traditionally been a crop grown under irrigation. However, variety trial results have shown a significant increase in canola yield when grown under irrigation. While research and data exists for dryland canola production practices in North Dakota, there is no research for irrigated canola production. The highest yield results were observed in the 780,000 population when fertilized with 150 pounds of Nitrogen and 30 pounds of Sulfur. The report can be read in this Ag Research Update.

We look forward to what 2021 holds. If there are any projects that you think we need to look at, please let us know. We will strive to continue to provide you with the best possible data for variety selection and producton management in an irrigated system.

Improving Efficiency Using Intercropping: 2020 Intercropping under Irrigation

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

Introduction

Farmers have sometimes previously utilized 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. However, the idea of "intercropping", of growing two cash crops together to be separated as individual cash crops, is a relatively new and emerging idea. Very few management recommendations are available for intercropping in general. Intercropping presents the ability to increase our land use efficiency by growing two cash crops in one season. The ability to harvest two crops in one field allows the farmer a potential source of extra income.

In order for intercropping to work to the best of its potential, it should be thought out in all aspects from planting, harvest, post-harvest separation, and crop sales. One of the key concepts of intercropping is to have varying seed sizes to allow the two crops to be separated easily after harvest. Another important factor is to make sure the crops have similar maturities. As with all farm production, the overall economic impact should be considered first. What are the markets currently doing for each individual crop? Is one crop outperforming the other at the market? In intercropping it is important to have a targeted crop in mind. Choose a crop that can be catered to with management practices favoring economic and infrastructure suitability.

With these strategies in place, what management practices need to happen? For example, in a field pea and canola system, if canola is your target crop, then fertilizer with nitrogen and sulfur is recommended. In a chickpea and flax system, if chickpea is your target crop, then nitrogen fertilizer may not be necessary. With these goals in mind, intercropping decisions become easier to make.

This was the third year of intercropping research conducted at Nesson Valley. Two systems have been tested: field pea and canola, and flax and chickpea. While in 2019 excellent yields were obtained for both pea and canola, 2020 presented new challenges.

Materials and Methods

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

Ratio (Field Pea: Canola)	Planting Rate (lb/a)	Planting Population (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

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	

A field pea and canola trial was planted with the goal of looking at the potential to reduce field pea lodging when intercropped with canola. The trial focused on six planting ratios (Table 1) in alternating rows with peas and canola across three fertilizer rates (Table 2). The nitrogen (N) fertilizer rates were adjusted according to the soil test results obtained the previous fall. A potassium sulfate fertilizer (0-0-53-17S) 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 in each of the fertilizer rates being tested. These combinations were replicated four times. Additionally the trial was replicated as an irrigated and a non-irrigated trial.

The trial was planted on May 20, 2020. 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 wider control of broadleaf weeds that would be tougher to control with a conventional canola variety. Cornerstone Plus was used as a pre-plant burn-down for any existing weeds. Sonolan HFP was used as a pre-emergent herbicide, Section 3EC was applied for grass control, and Beyond was used at a reduced rate for broadleaf control. The rate was reduced to minimize the damage potential for field pea. 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 26, 2020. After harvest, yield, oil content, and protein content were measured on the harvested grain.

A chickpea and flax trial were planted with the goal of looking at disease reduction in chickpea. The trial was seeded on May 21, 2020. However, the chickpeas did not emerge uniformly, so the trial was abandoned in early July. The chickpea and flax combination will be examined again in 2021.

Results and Discussion

The results from 2020 were less favorable than hoped. One management strategy in a pea/canola intercrop is the use of a Clearfield canola variety. The active ingredient, Imazamox is registered for field pea and canola application. However, it is recommended to have a solution, such as Bentazon, in the tank mix when applying on peas. In 2019 an application of 4 ounces per acre of Imazamox was made and no visual injury seen on the field pea. In 2020 a 3-ounce per acre application of Imazamox was made, and visual injury and stunting were apparent in the field pea. As a result, the harvested field pea had a significantly reduced yield compared to 2019. The injury was seen in both the irrigated and non-irrigated trials.

The addition of canola to a field pea system did not result in a reduction of lodging as has been seen in previous years. This appears to be a result of the field pea injury as the plants were stunted in height. The canola did not act a natural trellis system for the field pea in 2020. Additionally, the field pea was shaded out in the plant ratios that had higher concentration of canola. As a result of the plant competition in 2020, the field pea yields were reduced. The canola suffered as a result of low emergence, reduced plant establishment, and high temperatures.

Table 3. Irrigated Peaola yield and LER values

(Field Pea:Canola)	Field Pea (Lb/a)	Canola (Lb/a)	LER
0:100	-	1,935	1.00
100:0	2,187	-	1.00
33:66	663	1,349	1.00
50:50	811	1,137	0.96
66:33	893	1,143	1.00
66:66	1,052	955	0.97

Table 4. Non-Irrigated Peaola yield and LER values

(Field Pea: Canola)	Field Pea (lb/a)	Canola (lb/a)	LER
0:100	-	1,762	1.00
100:0	1,948	-	1.00
33:66	409	1,203	0.89
50:50	536	1,113	0.91
66:33	753	878	0.88
66:66	652	861	0.82

Despite the poor appearance and results of the trial, several important observations were made. One observation was the continued interaction of fertilizer rate on pea and canola yield. As the nitrogen fertilizer rate was increased the field pea yield decreased, while the canola yield increased. This trend was noticed in both the irrigated and non-irrigated trials.

Most intercropped ratios did not achieve a Land Efficiency Ratio (LER) above 1.0 in 2020. However, three treatments in the irrigated trial had LER values equal to or greater than 1.0 (Tables 3 and 4). LER values above 1.0 indicate a greater land use efficiency. A high land use efficiency occurs when the combination of the two crops on one field out-yields what the potential of a monocrop on that field would yield. The plant ratios that resulted in the best LER value for irrigated pea/canola intercrop was the 33:66 and 66:33 treatments across fertilizer treatments. While over-yielding did not occur the majority of the time, the combined yields maintained near a 1.0 LER value. While yield was lost in some of the crops, in those cases the other crop compensated for the loss of yield, the combined yield helped maintain the overall yield and production of the field.

Summary

While herbicide injury hampered the overall potential of the trial, several key observations were gleaned. For a second straight year, field pea yield decreased as the fertilizer rate increased. Meanwhile, the canola behaved inversely, the yield increased as the fertilizer rate increased. While yields were significantly decreased in 2020, the LER values remained near 1.0 indicating little loss in overall field efficiency. Work will continue in 2021 to provide a better set of data to understand interactions seen in field pea intercropped with canola.

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

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

Material and Methods:

Irrigated

Location: EARC
Planting date: 4-22-2020; replanted: 5-11-2020 due to frost damage
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: 5.81 inch

Previous crop: Spring Wheat
Harvested: 9-21-2020

Soil type: Savage Silty Clay Loam
Row spacing: 2 ft.
Replications: 4
N rates: 0, 120, 160, and 200 lb. N/ac applied in fall 2019 and in spring 2020
Herbicide: Powermax @ 24 oz/ac on 5/29/2020, 6/07/2020, and 6/11/2020.
Irrigation: 13.2"

Table 1. Sugarbeet stand, root yield, sugar concentration, and extractable sugar yield as affected by tillage, N application time, and fertilizer treatments.

Sources of Variation	Treatments	Stand	Root yield	Sugar	IV	SLM	Extractable sugar
		(ac)	(T/ac)	(%)			(T/ac)
Tillage	Conventional	44277	34.9	19.4	0.54	0.80	6.43
	No-till	43996	29.3	19.4	0.49	0.74	5.46
N application Time	Fall	44186	31.4	19.4	0.51	0.77	5.82
	Spring	44086	32.8	19.4	0.51	0.77	6.07
Fert. Treatment	Check	42290	26.0	19.7	0.47	0.69	4.89
	120 N	44377	30.4	19.6	0.48	0.73	5.73
	120 N + Mg	43016	30.5	19.7	0.50	0.76	5.71
	120 N + Zn	44331	32.9	19.5	0.51	0.76	6.17
	160 N	45103	33.1	19.3	0.53	0.80	6.11
	160 N + Mg	44195	33.5	19.2	0.52	0.79	6.11
	160 N + Zn	44604	34.4	19.3	0.52	0.79	6.30
	200 N	45375	33.5	19.2	0.55	0.83	6.15
	200 N + Mg	41654	32.2	19.0	0.54	0.81	5.91
	200 N + Zn	46419	34.6	19.2	0.50	0.75	6.40
Statistics		----------	----------	***P* > F**	----------	----------	----------
Tillage		0.71	<0.0001	0.90	0.0005	0.0005	<0.0001
Time		0.89	0.01	0.70	0.95	0.95	0.02
Treatment		0.07	<0.0001	0.002	0.004	0.004	<0.0001
Tillage*Time		0.36	0.85	0.59	0.13	0.13	0.93
Tillage*Treatment		0.28	0.87	0.24	0.09	0.09	0.98
Time*Treatment		0.47	0.54	0.83	0.06	0.06	0.57
Tillage*Time*Treatment		0.93	0.62	0.98	0.99	0.99	0.78

Horticulture Program

Rojee Chipalu Pradhan

"Gardening is the art that uses flowers and plants as paint, and the soil and the sky as canvas." - Elizabeth Murray

This year the Horticulture program experienced a decline in manpower. However, we could able to keep the WREC horticulture garden and landscapes at their absolute best. We appreciate the volunteers (two 4-H kid groups and one individual) to transplant flowers and vegetable seedlings in the display garden. When it comes to the weather, the pattern is different than last year. We had severe drought with seasonal total rainfall of 4.56 inches only. The last spring frost was on May 11 and the first fall killing frost occurred on September 8, 2020.

All-America Selection Display Garden

I started stem cuttings of Begonia and different varieties of Geranium from the beginning of November 2019 and seeded flower and vegetable seeds in the Horticulture lab under the light shelves from the beginning of March to the first week of May 2020. The seeding date was based on the growing requirements of a variety given in a seed packet. Some varieties require at least 10 weeks before they become suitable for planting outside. This year, we planted 28 All-America Selection flower varieties and 15 vegetable varieties mostly tomatoes and peppers. There were one variety of beans, cucumber, peas, potato, and strawberry. Besides the All-America Selection variety, there were 18 varieties of pollinator-friendly annual flowers. We harvested around 311 lbs. of produce from the garden including small fruits. WREC All-America Selection garden has been a public display garden for more than a decade. Every year we are receiving previous and recent award winners of flower and vegetable seeds from All-America Selections around September/ October and live plants (flower) in April. People who are interested in gardening can visit their website (https://allamericaselections.org) for cultivar information, gardening tips, latest winners as well as recipes and landscape ideas.

All-America Selection flowers Petunia Tidal Wave Red Velour, Nasturtium Baby Rose, 'and 'Big Duck Orange' Marigold. Photo taken by Rojee Chipalu Pradhan.

Haskap

Haskap or Honeyberry (*Lonicera caerulea* L.*)* belongs to the Honeysuckle family. The haskap trial was established in 2017 at the Williston REC dryland station in collaboration with Dr. Harlene Hatterman-Valenti, Professor, High-Value Crop Production, NDSU, Fargo. There are 12 different varieties with four replications and each plot has four plants. The information on cultivars used in the WREC trial is listed in

Table 1. Some of the plants did not survive, so we replanted them in September 2018. This year we just evaluated the survival and maintained the growth of shrubs by regular drip irrigation, hand weeding, and spraying preen (a weed preventer) during summer. This year, some varieties started producing fruits but we did not harvest them.

Garlic

Three different varieties of garlic were planted last fall on September 27, 2019. The garlic was harvested on July 17th, 2020. The total harvested weight was 9 lbs. including tops.

Variety	# of cloves planted	Total Production (lb)
Cheshok Red	35	4.6
Silver Rose	30	2.2
Inchelium Red	34	2.2

Master Gardener Pollinator Garden

The objectives of Master Gardener Pollinator Garden is to provide Master Gardeners with volunteering 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. It is believed that the activities will encourage members of the general public to build home pollinator gardens. Like every year, this year also we planted a lot of pollinator-friendly annual flowers in the pollinator garden. During the growing season, the garden was maintained by regular hand weeding and watering.

Master Gardener Certified Pollinator Garden sign on display at the WREC gardens. Photo taken by Rojee Chipalu Pradhan.

Daylily Collection

The WREC dryland station established The World Collection of Daylilies bed in 2004. Over the years different cultivars of Daylilies have been added to the collection bed. The Daylilies cultivars have grown vigorously and started encroaching each other and also there were a lot of weeds in the beds. Therefore, we started relocating the Daylily plants in 2018 to another area to maintain plant distance and used landscape fabric to reduce weed infestation. We received some varieties of Daylily from Fargo in the fall

of 2019 and transplanted them from May 4 to 8, 2020, and relocated some Daylilies from the old bed in June 2020. The relocation was completed this year. The Daylily area has been maintained by watering once a week and hand weeding. There are around 125 different cultivars of Daylily in our collection.

Daylily collection bed. Photo taken by Rojee Chipalu Pradhan.

Collaboration and Outreach Activities

- 2020 North Dakota Exotic Woodboring/Bark Beetle Survey:
  Every year the North Dakota Department of Agriculture conducts a North Dakota Exotic Woodboring/Bark Beetle Survey in the Trees of WREC dryland station. There were seven different traps on seven trees (four/five different cultivar). The traps were installed on May 29, 2020, and removed on September 28, 2020. Every two weeks we collected insects, changed the lure according to schedule instruction, and shipped the collection to the ND Department of Agriculture.

- Spring Tree and Garden Workshop:
  Williston Research Extension Center, in collaboration with the City of Williston, hosted a Spring Tree and Garden Workshop on March 14, 2020. The objective of the workshop was to help gardeners, homeowners, and horticulture professionals to better understand and troubleshoot problems on trees, common lawns, and gardens. There were six presentations, and three hands-on sessions: Floral display design, Composting Q and A and Demo, and Tree pruning. Around 50 people participated in this workshop. We appreciate the City of Williston for the collaboration and financial supports and all the presenters from different organizations for giving their valuable time and sharing their expertise with the participants.

- This year we gave away around 150 seedlings of flowers, tomatoes, and peppers (sweet and hot) to the community members.

- Participants of the Leadership Williston Ag Day group took a garden tour on September 16, 2020.

Table 1. Williston haskap cultivar information.

Cultivar	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	Sweet/ Tart	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.

WREC Foundation Seed Increase Update

Kyle Dragseth, David Weltikol, Kelly Stehr, NDSU Williston Research Extension Center

Well another year came and went and the best way to describe this year at the WREC was dry We only had 4.02 inches of rain during the growing season and no shortage of wind. With the future outlook for agriculture 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. The NDSU plant breeders are being very progressive to produce varieties to help the bottom line. We also increased spring wheat and winter wheat varieties from the Montana State university breeding program and also will be offering some Canadian genetics of durum, oats, and barley.

A new NDSU chickpea (Crown) is on the horizon for availability in 2021.

Listed below are the varieties available for sale.

HRSW	**Durum**	**Lentil**	**Soybean**
Bolles	ND Riveland	Avondale	ND17009GT
ND Vit-pro	AAC Spitfire		
ND Frohberg	Lebsock		
ND Mott			
ND Lanning			

Oat	**Barley**	**Winter Wheat**	**Pea**
Paul (hulless oat)	CDC Maverick (forage and feed)	MT Ray (grain or hay)	ND Dawn (yellow)
CDC Haymaker (forage)		ND Noreen	Hampton (green)

Please contact either the WREC at 701-774-4315 or Kyle Dragseth at 701-770-1652, with any questions, availability, and prices.

Today we give thanks,
for the food on our tables
and the clothes on our backs
and the farmers who make it all possible.
Amen

The Capital Campaign
Invest in the Future of Agriculture

Jerald Bergman and Tom Wheeler

A capital fundraising campaign authorized by the North Dakota Legislative Assembly and currently underway will 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. Cropping patterns in the region have exploded in the last 10-15 years with a phenomenal increase in pulse crops and oilseed crops. 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 currently under construction and 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.

Your gift to the seed conditioning plant facility 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.

A 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

NOTES

MSU-EARC FACULTY & STAFF—2020

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Dr. Frankie Crutcher
Assistant Professor

Cherie' Gatzke
Administrative Assistant

Ron Brown
Farm Manager
Foundation Seedstock

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Dr. Apurba Sutradhar
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Becky Garza
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Calla Kowatch-Carlson
Research Assistant

Thomas Gross
Research Assistant

Samantha Hoesel
Research Assistant

Tanner Stevens
Ag Field Technician

Employees Not Pictured:
Maggie Brazier and Yi Zhou
Graduate Research Assistants

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