



Langdon Research Extension Center

NORTH DAKOTA
STATE UNIVERSITY



**Annual Research
Report No. 95**

December 2020

NDSU NORTH DAKOTA
STATE UNIVERSITY

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The 2020 annual research report is intended to provide producers information to aid in selecting varieties and/or hybrids. Variety information and research reports on crop disease and production can also be found on our website www.ag.ndsu.edu/langdonrec/. Variety trial results from all NDSU Research Extension Centers and the Main Station at Fargo, along with crop extension bulletins, can be accessed on the web at www.ag.ndsu.edu/varietytrials/.

Choosing a variety is one of the most important decisions a producer makes in successful crop production. Characteristics to consider in selecting a variety may include yield potential, disease resistance, protein content, straw strength, plant height, test weight, yield stability across years and locations, quality and economic profitability. A variety's performance may differ from year to year and from location to location within a year due to varying environmental conditions. When selecting a variety to grow, it is best to consider a variety's performance over several years and locations.

The agronomic data presented in this publication are from replicated research plots using experimental designs that enable the use of statistical analysis. The trials are designed so that "real" yield and agronomic differences can be statistically separated from differences that occur by chance. The least significant difference (LSD) values given in the report are used for this purpose. If the difference between two varieties exceeds the LSD value, it means that with 95% or 90% confidence (LSD probability 5 or 10%), the higher-yielding variety has a significant yield advantage. When the difference between two varieties is less than the LSD value, no significant difference was found between those two varieties under those growing conditions.

NS is used to indicate no significant difference for that trait among any of the varieties at the 95% or 90% level of confidence. The CV stands for coefficient of variation and is expressed as a percentage. The CV is a measure of variability in the trial. Large CVs mean that a large amount of variation could not be attributed to differences in the varieties or agronomic characteristic.

The NDSU Langdon Research Extension Center, in addition to its on-station research program, conducted variety research trials at several locations in 2020. Trial locations were at Cavalier, Park River, Pekin, and Cando. These locations are in cooperation with a local farmer, NDSU Extension, and the County Crop Improvement Association.

2020 Weather Summary

Fall recharge at Langdon for September through October 2019 was 10.18 inches, 6.82 inches above normal. Precipitation from November 2019 through March 2020 was 2.57 inches, 0.68 inches below normal. Snowfall for 2019-2020 was 54.3 inches, 18.7 inches above normal. December-February temperatures averaged 8.1°F, 5.4°F above normal. The 2020 growing season in NE ND started with above normal subsoil moisture in the region, a result of above average precipitation in September and October of 2019. The 2020 growing season precipitation averaged 90 percent of normal across NE North Dakota from April-September. April-May precipitation was generally 2 inches below normal except for an area in Ramsey and Benson Counties that received above normal rainfall. June rainfall was spottier with most areas 100-125 percent of normal with higher amounts along the Red River and in Ramsey County. July rainfall was nearly twice the normal in most areas while August was generally 75 percent of normal and September generally 30 percent of normal. Accumulated growing degree-days averaged 71 and 100 above normal for corn (May 1 - Sept. 30) and small grains (May 1 - Aug 31), respectively, across NDAWN locations in the region. Disease levels were generally lower this year with the drier conditions. Bacterial Leaf Streak was the prominent disease in wheat. A fall frost/freeze across the region on September 8-9 likely reduced yields of soybeans and corn.

2020 Crop Management - Langdon					
Field Trial	Previous Crop	Seeding Rate Unit/Acre	Planting Date	Harvest Date	Row Spacing
Barley	soybean	1.25 million pls	May 20	Aug. 26	6
Canola - LL, CL, Conv.	field pea	610,000 pls	May 27	Sept. 10	6
Canola – RR	field pea	610,000 pls	May 27	Sept. 10	6
Corn	wheat	28,000 thinned	May 21	Oct. 9	30
Durum	soybean	1.50 million pls	May 20	Sept. 3	6
Dry Bean	soybean	70,000-90,000 pls	May 20	Sept. 25	30
Faba Bean	soybean	192,000 pls	May 19	Sept. 28	6
Field Pea	soybean	300,000 pls	May 19	Aug. 24	6
Flax	soybean	2.8 million pls	May 20	Sept. 22	6
HRSW	soybean	1.50 million pls	May 20	Sept. 2	6
HRWW	flax strips	1.25 million pls	Sept. 18, 2019	Aug. 11	6
Hemp	soybean	522,000 pls	May 29	Sept. 14	12
Oats	soybean	1.0 million pls	May 20	Aug. 31	6
Rye	flax strips	1.0 million pls	Sept. 18, 2019	Aug. 11	6
Soybean – Conv.	soybean	200,000 pls	May 22	Sept. 29	6
Soybean – RR, Xtend, E3	soybean	200,000 pls	May 22	Sept. 29	6
Sunflower - Confection	wheat	17,000 thinned	May 22	Oct. 12	30
Sunflower - Oil	wheat	20,000 thinned	May 22	Oct. 12	30

pls=pure live seed emergence

Special thanks to our local cooperators and Extension Agents for their efforts in our off-station variety testing.

Darin Weisz - Cando
Lindy Berg - Towner County Extension Agent
Dave Hankey - Park River
Brad Brummond - Walsh County Extension Agent
Kent Schluchter – Cavalier
Madeleine Smith – Pembina County Extension Agent
Doug Stein - McVile

2020 Crop Management – Off-Station					
Location (County/Field Trial)	Previous Crop	Seeding Rate Unit/Acre	Planting Date	Harvest Date	Row Spacing
Cavalier (Pembina)					
HRSW	canola	1.50 million pls	May 18	Sept. 9	6
Soybean	canola	200,000 pls	May 18	Oct. 6	6
Park River (Walsh)					
HRSW	fallow	1.50 million pls	May 12	Aug. 12	6
Soybean	wheat	200,000 pls	May 16	Sept. 24	6
Pekin (Nelson)					
HRSW	soybean	1.50 million pls	May 28	Sept. 9	6
Soybean	wheat	200,000 pls	May 28	Oct. 5	6
Cando (Towner)					
HRSW	canola	1.50 million pls	May 8	Aug. 17	6
Location	Soil Type				
Cavalier	Fargo silty clay				
Park River	HRSW- Glyndon silt loam, Soybean – Fairdale silt loam				
Pekin	Lankin loam				
Cando	Egeland-Embden fine sandy loam				

pls = pure live seeds



Record of Climatological Observation Langdon, ND

	Precipitation		Dep. from		Temperature		Dep. from
	Normal*	2020	Normal		Normal*	2020	Normal
April	1.23	1.67	+0.44	April	38.0	33.4	-4.6
May	2.27	1.24	-1.03	May	51.6	50.3	-1.3
June	3.25	1.95	-1.30	June	60.9	65.2	+4.3
July	2.93	6.68	+3.75	July	66.2	68.9	+2.7
August	2.58	1.36	-1.22	August	64.5	65.9	+1.4
September	2.08	0.57	-1.51	September	54.5	54.6	+0.1
Total	14.34	13.47	-0.87	Total	56.0	56.4	+0.4

*119 year average

Monthly Growing Degree Days and Normals-Langdon

	Wheat Growing Degree Days			Corn Growing Degree Days			Sunflower Growing Degree Days		
	2020	Normal	Deviation	2020	Normal	Deviation	2020	Normal	Deviation
April	215	274	-59	--	--	--	--	--	--
May	574	613	-39	202	219	-17	310	314	-4
June	952	875	+77	475	356	+119	646	519	+127
July	1053	1018	+35	552	499	+53	738	685	+53
August	977	962	+15	466	457	+9	643	642	+1
September	644	671	-27	247	255	-8	351	358	-7
Total	4415	4413	+2	1942	1786	+156	2688	2518	+170

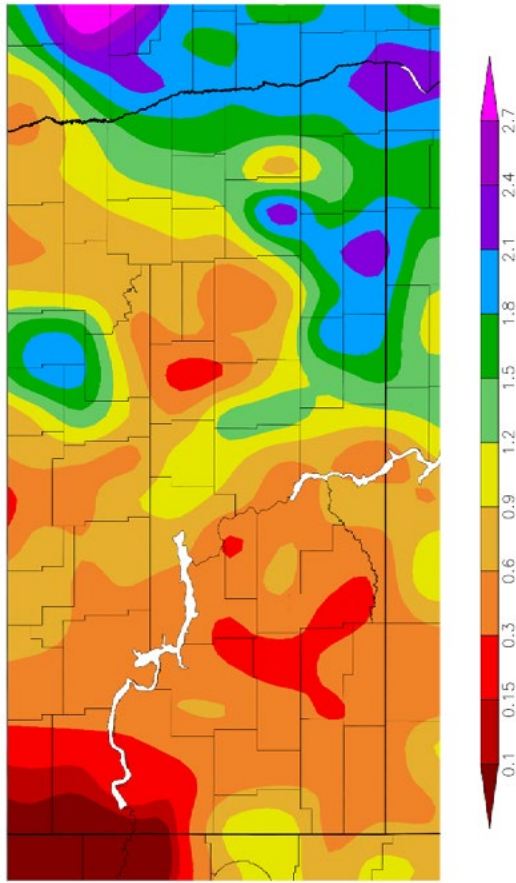
Frost Dates-Langdon and Selected Cities

	Last		First		Frost Free Days	
	Spring Frost		Fall Frost			
	32°F	28°F	32°F	28°F	32°F	28°F
Langdon						
Normal	20-May	9-May	19-Sep	29-Sep	122	143
2020	30-May	12-May	8-Sep	2-Oct	101	143
Cavalier						
Normal	16-May	5-May	24-Sep	5-Oct	131	153
2020	15-May	12-May	16-Sep	1-Oct	124	142
Park River						
Normal	8-May	30-Apr	30-Sep	10-Oct	145	163
2020	15-May	12-May	8-Sep	2-Sep	116	113
Pekin						
Normal	18-May	3-May	22-Sep	30-Sep	127	150
2020	12-May	12-May	9-Sep	9-Sep	120	120

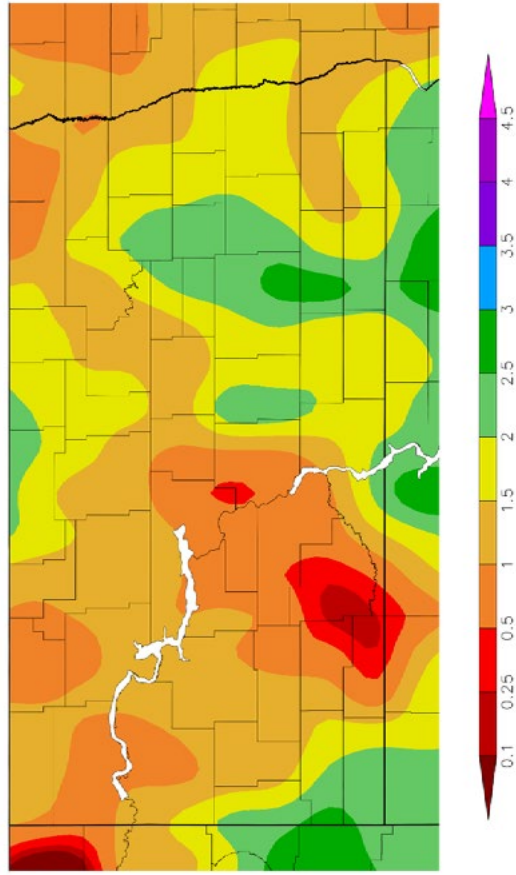
Normals are from the NWS. The 2020 frost dates are from the nearest reporting NDAWN station.

North Dakota 2020 Precipitation (inches) Maps

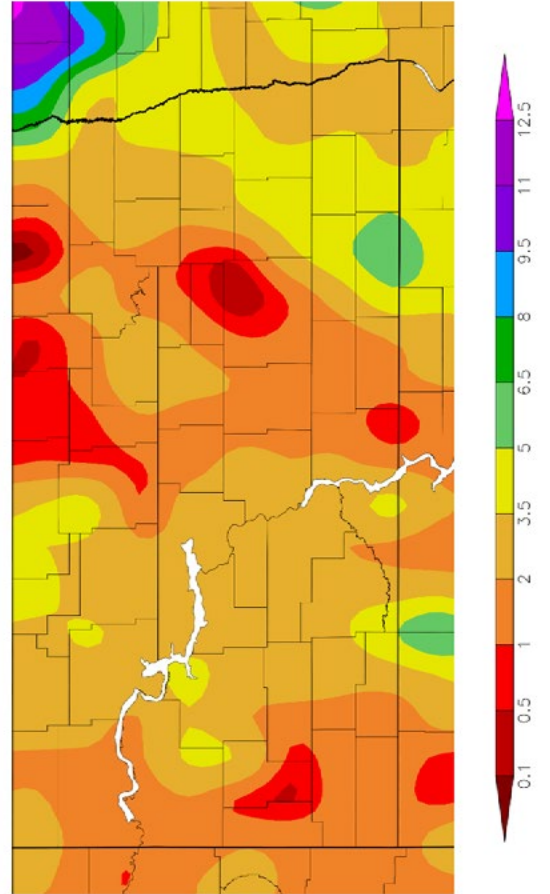
4/1/20 – 4/30/20



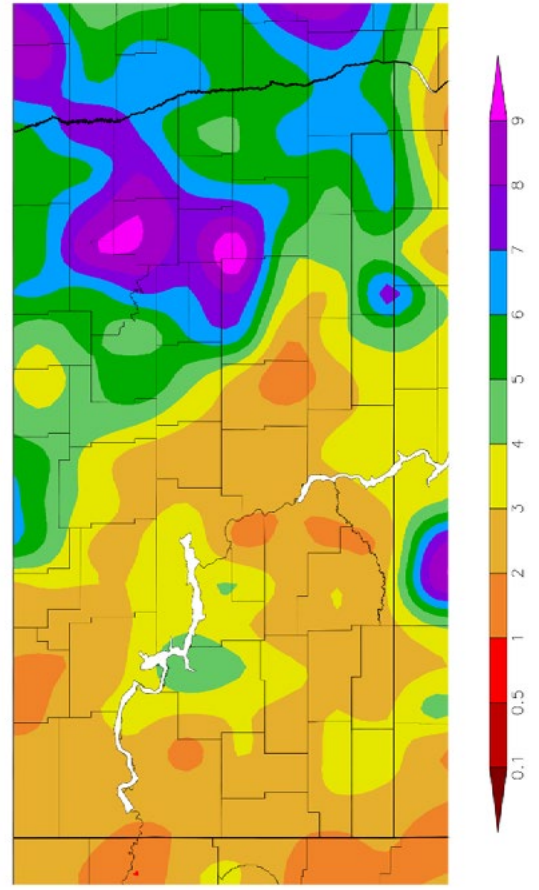
5/1/20 – 5/31/20



6/1/20 – 6/30/20

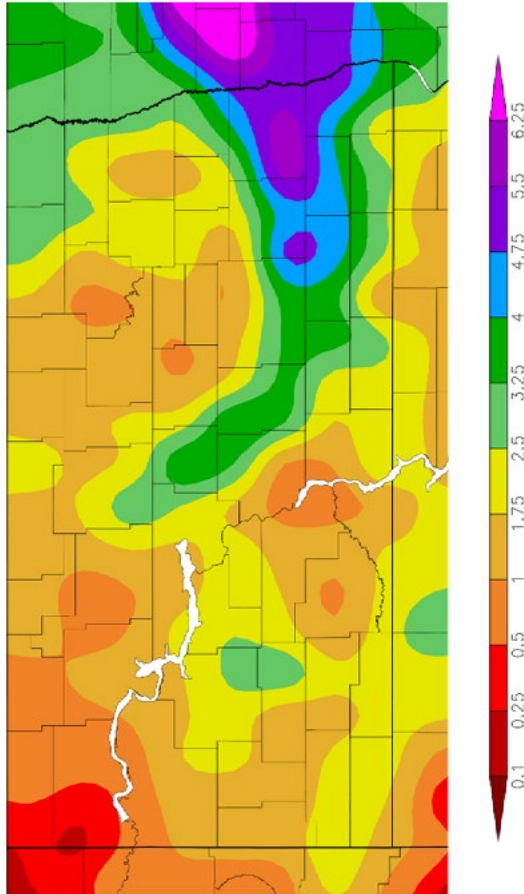


7/1/20 – 7/31/20

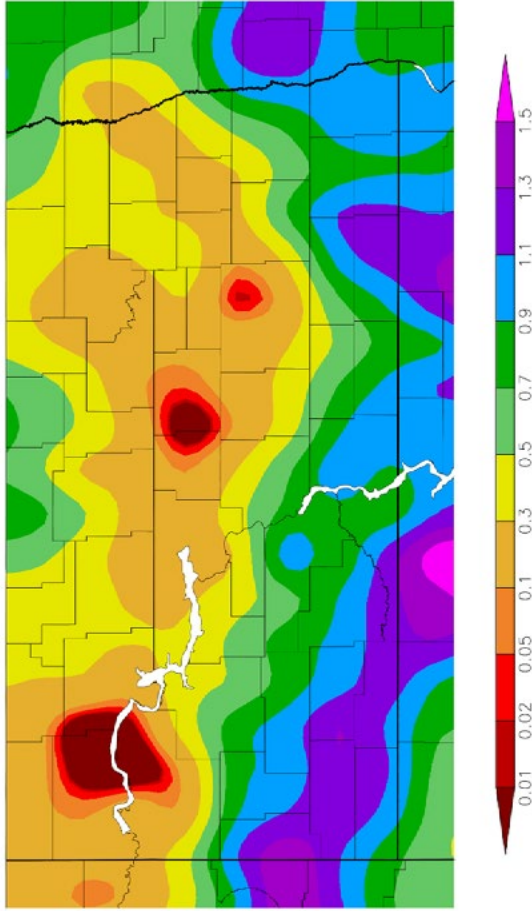


North Dakota 2020 Precipitation (inches) Maps Continued

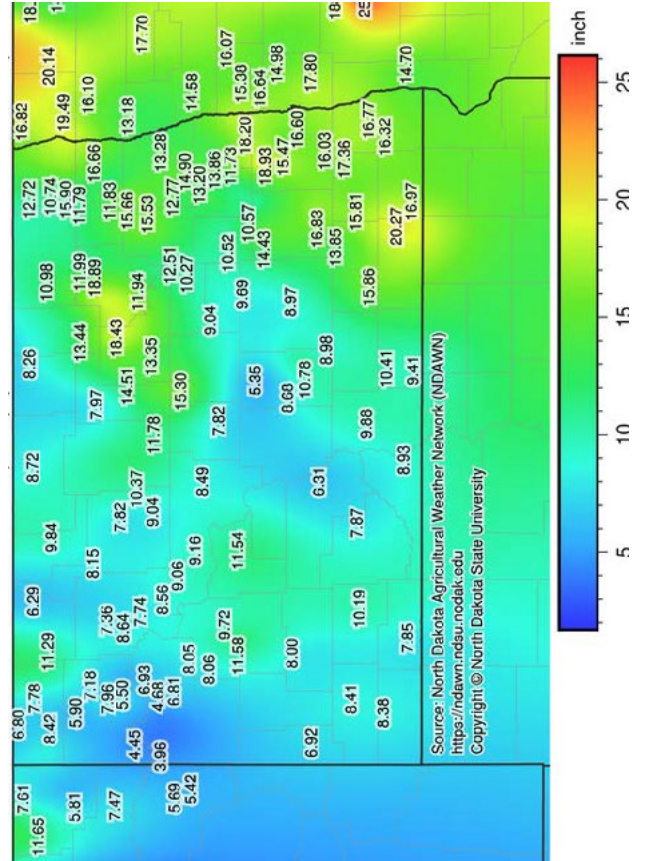
8/1/20 – 8/31/20



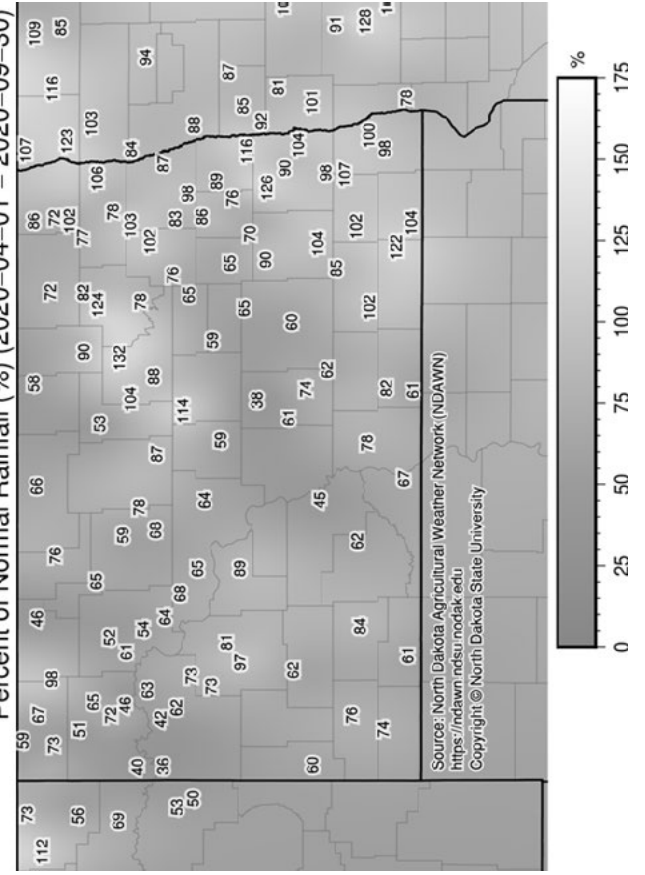
9/1/20 – 9/30/20



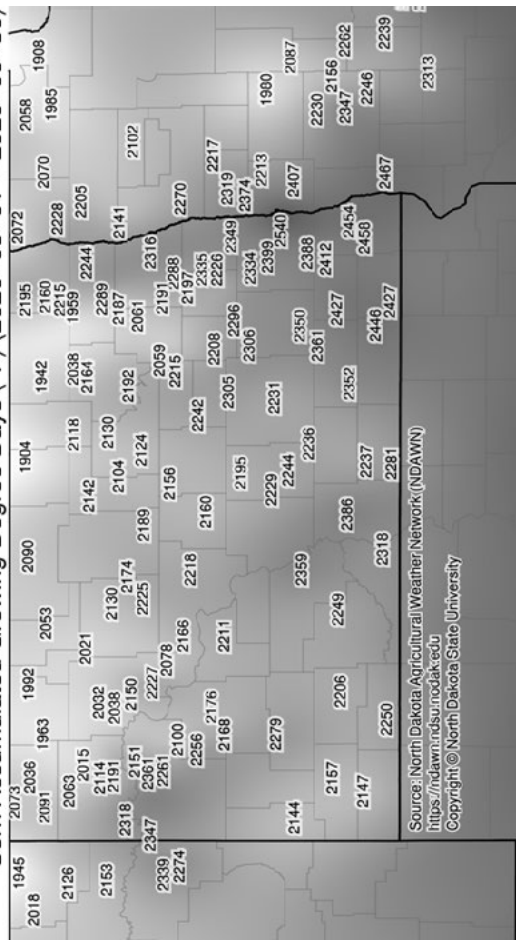
Growing Season 4/1/20 – 9/30/20



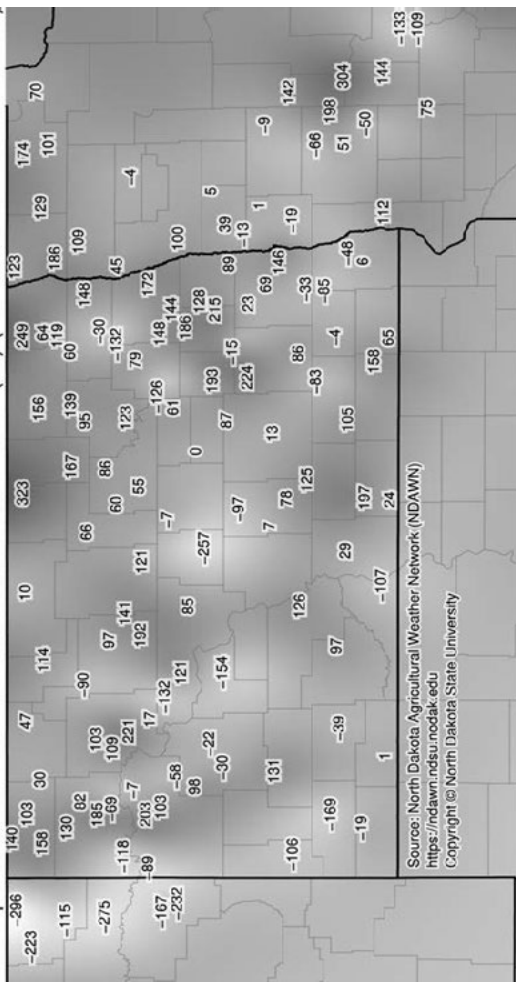
Percent of Normal Rainfall (%) (2020-04-01 – 2020-09-30)



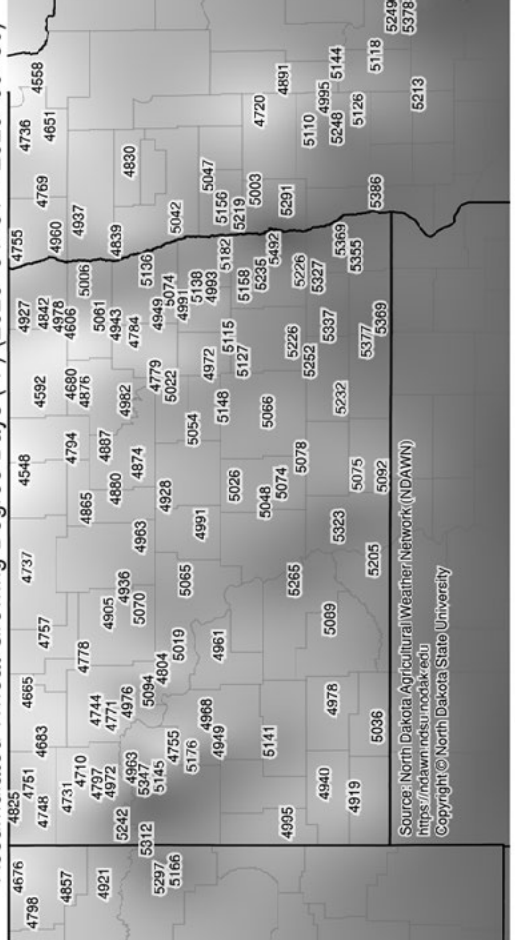
Corn Accumulated Growing Degree Days (°F) (2020-05-01 - 2020-09-30)



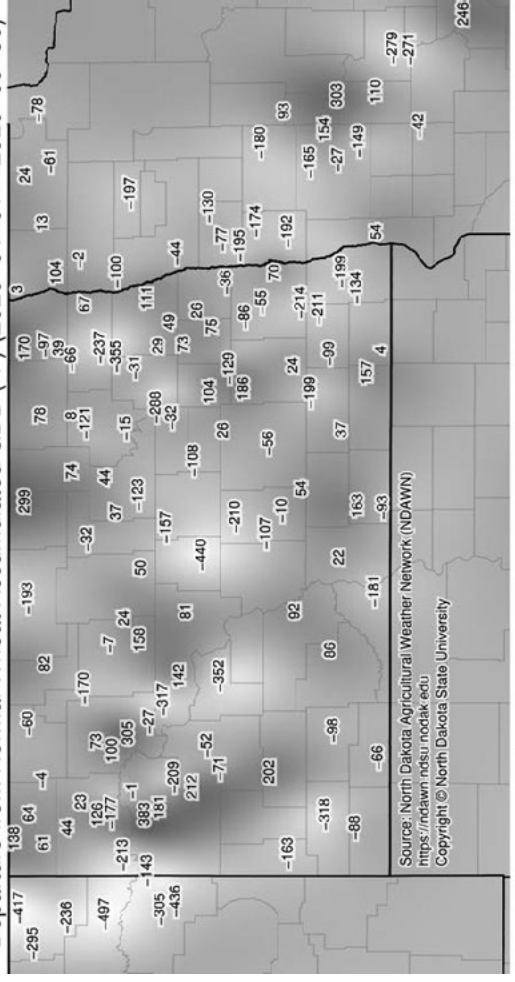
Departure from Normal Corn Accumulated GDD (°F) (2020-05-01 - 2020-09-30)



Accumulated Wheat Growing Degree Days (°F) (2020-04-01 - 2020-09-30)



Departure from Normal Wheat Accumulated GDD (°F) (2020-04-01 - 2020-09-30)



Durum Summary, Langdon 2016-2020

Variety	Yield (bu/a)				Test Weight (lbs/bu)				Lodging (0-9)				Height (in)				Days to Head										
	16	17	18	19	20	5yr	16	17	18	19	20	5yr	15	16	17	20	4yr	17	18	19	20	4yr					
AC Commander	45	70	75	65	59	63	52.5	57.8	61.0	58.8	54.7	57.0	1.0	3.8	1.8	0.4	1.8	37	28	30	30	31	61	53	57	49	55
Alkabo	51	71	81	67	80	70	56.6	61.0	61.4	60.2	59.8	59.8	0.5	5.8	1.3	0.1	1.9	43	35	34	37	37	61	56	57	49	56
Ben	45	66	76	68	75	66	55.3	60.3	62.3	60.7	59.5	59.6	2.3	6.2	4.0	3.5	4.0	46	36	35	37	39	60	52	57	49	55
Grenora	41	69	87	70	84	70	54.2	59.7	62.1	59.1	58.4	58.7	0.8	6.7	5.8	4.3	4.4	43	33	32	35	36	60	52	56	48	54
Lebsock	53	78	77	70	75	70	57.2	61.3	63.0	61.1	60.4	60.6	3.8	5.7	3.8	2.0	3.8	45	33	33	35	37	60	52	56	48	54
Maier	37	77	80	69	62	65	53.7	60.5	61.5	60.9	56.0	58.5	0.5	5.0	4.8	2.6	3.2	44	33	34	38	37	61	52	57	49	55
Mountrail	38	81	87	68	70	69	54.4	60.0	62.3	58.5	57.4	58.5	2.0	7.2	5.0	3.8	4.5	44	34	34	36	37	60	52	58	49	55
Pierce	41	76	91	70	76	71	56.7	61.5	62.7	60.9	59.1	60.2	3.0	6.6	5.3	3.7	4.7	46	35	33	36	38	60	52	57	49	55
Strongfield	33	63	77	64	62	60	53.2	58.9	61.5	60.1	56.2	58.0	3.8	6.4	4.5	5.5	5.1	43	33	34	35	36	61	52	58	50	55
Tioga	37	70	89	69	77	69	53.2	60.3	62.2	60.5	58.4	58.9	0.3	6.4	6.0	4.0	4.2	48	37	36	39	40	61	54	57	50	56
Carpio	43	79	93	70	77	72	55.6	61.7	62.6	61.1	59.5	60.1	1.0	7.6	6.5	2.7	4.5	45	36	34	38	38	62	54	59	52	57
Alzada	37	47	55	59	48	49	51.4	55.3	59.9	58.7	54.1	55.9	0.0	3.0	0.3	0.4	0.9	36	28	29	31	31	56	52	56	48	53
Joppa	43	75	90	75	76	72	55.4	60.5	62.3	60.9	58.3	59.5	0.5	6.9	6.8	3.5	4.4	44	35	34	39	38	61	52	58	49	55
Divide	35	78	89	68	78	70	53.6	60.7	61.6	59.9	58.6	58.9	1.8	6.9	6.3	2.9	4.5	47	37	34	38	39	61	54	58	51	56
CDC Verona	36	72	80	67	61	63	55.5	60.8	61.7	60.2	54.9	58.6	0.8	5.7	6.0	4.8	4.3	45	34	34	35	37	62	53	58	50	56
Rugby	32	61	76	63	63	59	54.3	60.2	61.8	60.3	57.1	58.7	4.0	7.0	8.0	7.0	6.5	48	38	36	38	40	60	53	57	49	55
VT Peak	55	85	82	72	80	75	58.6	62.4	62.4	61.7	59.6	60.9	0.5	4.3	4.3	0.8	2.5	45	34	35	38	38	60	52	57	50	55
ND Grano	41	78	84	70	75	69	55.6	61.0	62.1	60.7	58.2	59.5	0.8	6.4	5.0	1.9	3.5	45	34	35	39	38	62	54	59	50	56
ND Riveland	53	88	89	71	79	76	56.4	61.5	62.0	60.3	58.7	59.8	1.8	5.9	3.3	3.1	3.5	46	36	35	40	39	61	53	58	50	56
TCG Webster	--	--	69	71	55	--	--	--	62.0	59.8	57.7	--	--	--	--	0.2	--	--	27	28	31	--	--	50	54	47	--
AC Navigator	35	69	--	--	--	--	52.9	59.9	--	--	--	--	0.8	4.1	2.8	--	--	41	--	--	--	--	61	--	--	--	--
Trial Mean	40	74	84	70	74		55.1	60.7	62.2	60.5	58.3		1.7	6.1	5.9	3.3		45	35	34	37		62	53	58	50	
C.V. %	11.1	7.0	8.4	5.6	8.6		1.5	1.1	0.8	0.8	1.8		114	14.9	31.8	52.6		4.0	5.1	3.5	4.2		1.6	2.9	1.0	1.3	
LSD 5%	6.3	7.2	9.8	5.5	8.8		1.2	0.9	0.7	0.7	1.5		NS	1.3	2.6	2.4		2.5	2.5	1.7	2.2		1.4	2.2	0.8	0.9	
LSD 10%	5.3	6.0	8.2	4.6	7.4		1.0	0.8	0.6	0.6	1.3		2.2	1.1	2.2	2.0		2.1	2.1	1.4	1.8		1.2	1.8	0.7	0.7	

2016 trial was severely damaged by Fusarium head blight.

HRSW Summary, Langdon 2016-2020																		
Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)					
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr
Barlow	60	74	85	76	68	76	60.0	61.5	62.6	62.3	59.3	61.4	14.8	13.8	14.2	14.4	15.6	14.7
Elgin-ND	65	81	89	81	66	79	59.2	61.1	61.7	60.7	59.1	60.5	14.9	13.5	13.6	13.9	14.7	14.1
Faller	79	82	98	84	81	87	60.8	61.5	62.3	60.4	59.7	60.8	13.6	11.7	12.7	13.7	14.1	13.5
Glenn	64	71	76	75	74	75	63.0	63.8	62.9	63.2	62.5	62.9	14.7	14.3	14.4	15.0	15.2	14.9
SY Soren	69	76	80	78	71	76	60.6	61.3	61.5	61.5	59.5	60.8	14.5	13.6	13.4	14.4	15.1	14.3
Bolles	63	74	82	73	68	74	60.2	61.2	61.3	60.3	58.8	60.1	15.9	15.0	14.9	15.3	16.6	15.6
SY Ingmar	70	74	91	81	77	83	60.9	61.1	62.9	61.5	60.6	61.7	15.1	14.1	14.2	14.2	15.2	14.5
Linkert	63	64	75	69	69	71	59.7	60.8	61.0	60.5	59.8	60.4	15.1	14.7	14.3	15.1	15.8	15.1
MS Chevelle	68	86	94	85	75	85	58.5	61.3	62.3	61.0	58.1	60.5	13.4	12.2	12.6	12.6	14.3	13.2
Boost	61	79	88	75	71	78	58.5	60.7	61.9	60.1	59.7	60.6	15.0	13.3	13.7	14.2	14.8	14.2
SY Valda	78	85	100	80	79	86	60.5	60.3	62.3	60.6	59.9	60.9	13.9	12.8	13.1	13.0	14.2	13.4
CP3530	78	79	99	78	83	87	60.8	61.3	62.2	60.1	60.1	60.8	14.3	12.7	13.0	14.2	15.3	14.2
Shelly	71	81	88	82	58	76	59.7	61.9	62.2	61.1	55.5	59.6	14.0	13.0	13.1	13.5	16.1	14.2
TCG-Spitfire	58	76	92	79	80	83	59.0	59.8	61.7	60.2	60.1	60.7	14.2	13.2	12.9	13.6	14.0	13.5
ND VitPro	63	72	78	73	76	76	62.1	62.7	63.2	63.0	62.2	62.8	15.1	14.2	14.1	14.8	15.1	14.7
Lang-MN	60	78	79	77	73	76	61.0	63.3	61.9	61.4	59.8	61.0	15.5	14.7	14.3	15.0	14.1	14.5
LCS Rebel	--	84	93	81	76	83	--	62.4	63.1	61.7	61.5	62.1	--	13.2	13.6	14.4	15.4	14.5
LCS Trigger	--	98	110	87	81	92	--	62.3	62.6	60.5	60.2	61.1	--	11.0	11.1	11.9	12.6	11.9
DG Ambush	--	72	88	76	68	77	--	61.5	63.2	61.5	59.6	61.4	--	13.8	14.2	14.9	15.6	14.9
SY McCloud	--	--	83	78	76	79	--	--	62.9	61.8	61.2	62.0	--	--	13.7	14.7	15.1	14.5
SY611CL2	--	--	84	83	78	82	--	--	61.6	62.3	60.4	61.4	--	--	13.3	13.6	14.9	13.9
MS Barracuda	--	--	93	83	66	81	--	--	62.9	61.3	57.9	60.7	--	--	14.2	14.3	14.8	14.4
LCS Cannon	--	--	90	81	73	81	--	--	63.5	61.8	59.8	61.7	--	--	13.7	13.8	14.8	14.1
MN-Washburn	--	--	85	76	78	80	--	--	61.2	60.7	60.0	60.6	--	--	13.4	14.3	14.4	14.0
CP3910	--	--	--	76	70	--	--	--	--	60.9	58.6	--	--	--	--	13.7	15.1	--
CP3915	--	--	--	78	80	--	--	--	--	61.7	61.1	--	--	--	--	14.3	14.9	--
DG Ballistic	--	--	--	90	73	--	--	--	--	60.7	56.7	--	--	--	--	13.5	15.1	--
DG Commander	--	--	--	80	74	--	--	--	--	61.2	59.2	--	--	--	--	13.7	14.7	--
TCG-Heartland	--	--	--	75	67	--	--	--	--	61.9	59.8	--	--	--	--	14.7	15.7	--
SY Longmire	--	--	--	79	78	--	--	--	--	61.5	59.4	--	--	--	--	14.0	15.2	--
SY Rockford	--	--	--	81	55	--	--	--	--	59.3	54.9	--	--	--	--	13.9	15.8	--
AP Murdock	--	--	--	82	87	--	--	--	--	60.5	59.7	--	--	--	--	14.1	14.0	--
MN-Torgy	--	--	--	84	70	--	--	--	--	61.2	59.1	--	--	--	--	14.6	15.5	--
Allegiant 822	--	--	--	--	72	--	--	--	--	--	61.4	--	--	--	--	--	14.4	--
Allegiant 834	--	--	--	--	42	--	--	--	--	--	53.0	--	--	--	--	--	16.3	--
Allegiant 8432	--	--	--	--	74	--	--	--	--	--	58.8	--	--	--	--	--	15.2	--
CP3055	--	--	--	--	61	--	--	--	--	--	53.1	--	--	--	--	--	14.2	--
CP3903	--	--	--	--	77	--	--	--	--	--	62.1	--	--	--	--	--	14.9	--
Dagmar	--	--	--	--	66	--	--	--	--	--	58.9	--	--	--	--	--	16.2	--
DG Velocity	--	--	--	--	70	--	--	--	--	--	60.3	--	--	--	--	--	16.1	--
Driver	--	--	--	--	73	--	--	--	--	--	60.0	--	--	--	--	--	14.5	--
Lanning	--	--	--	--	57	--	--	--	--	--	55.1	--	--	--	--	--	16.6	--
LCS Buster	--	--	--	--	73	--	--	--	--	--	57.0	--	--	--	--	--	12.8	--
MS Ranchero	--	--	--	--	62	--	--	--	--	--	54.6	--	--	--	--	--	15.4	--
ND Frohberg	--	--	--	--	73	--	--	--	--	--	61.0	--	--	--	--	--	14.7	--
TCG-Wildcat	--	--	--	--	74	--	--	--	--	--	60.5	--	--	--	--	--	15.2	--
LCS Breakaway	71	75	85	76	--	--	61.7	61.8	63.0	62.1	--	--	14.1	13.2	14.0	14.4	--	--
CP3504	73	77	92	82	--	--	58.2	59.0	61.4	59.5	--	--	13.4	12.8	12.9	13.0	--	--
CP3616	66	76	81	77	--	--	59.4	61.5	61.2	60.3	--	--	15.3	14.3	14.4	14.9	--	--
Surpass	59	80	91	79	--	--	59.4	60.9	62.2	60.5	--	--	14.2	12.9	13.6	14.0	--	--
MS Camaro	--	67	77	82	--	--	--	61.6	62.0	61.2	--	--	--	13.6	13.7	14.4	--	--
TCG-Climax	--	72	82	69	--	--	--	62.8	63.8	61.8	--	--	--	15.1	14.6	15.9	--	--
CP3888	--	--	87	82	--	--	--	--	61.6	60.1	--	--	--	--	13.8	14.0	--	--
CP3939	--	--	--	76	--	--	--	--	--	61.5	--	--	--	--	--	14.9	--	--
TCG-Stalwart	--	--	--	71	--	--	--	--	--	59.5	--	--	--	--	--	14.9	--	--
Mott	--	--	--	80	--	--	--	--	--	60.7	--	--	--	--	--	14.5	--	--
Prosper	78	83	98	--	--	--	60.9	60.8	62.7	--	--	--	13.8	11.9	13.2	--	--	--
Rollag	71	76	78	--	--	--	61.3	62.4	62.0	--	--	--	14.8	14.4	14.2	--	--	--
Trial Mean	67	76	87	79	71		60.2	61.3	62.2	61.2	59.1		14.4	13.4	13.7	14.2	15.1	
C.V. %	8.7	5.9	4.1	4.7	8.1		1.1	0.9	0.7	0.8	1.8		2.8	2.9	2.8	2.4	3.0	
LSD 5%	8.1	6.3	4.9	5.2	8.1		1.0	0.8	0.6	0.7	1.5		0.6	0.5	0.5	0.5	0.6	
LSD 10%	6.8	5.3	4.1	4.4	6.8		0.8	0.7	0.5	0.6	1.2		0.5	0.5	0.4	0.4	0.5	

HRSW Summary, Langdon 2016-2020															
Variety	Days to Head						Height (in)						Lodging (0-9)		
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	17	20	2yr
Barlow	55	56	46	55	45	49	35	41	34	32	34	33	1.8	3.8	2.8
Elgin-ND	57	58	48	55	45	49	39	43	36	33	36	35	0.0	2.8	1.4
Faller	57	59	50	57	48	52	38	39	33	31	34	33	0.0	2.0	1.0
Glenn	53	55	46	55	45	49	37	42	35	33	35	34	0.5	1.3	0.9
SY Soren	56	58	48	55	46	50	33	34	28	27	30	28	0.0	0.0	0.0
Bolles	59	61	50	58	50	53	35	37	33	30	33	32	0.0	0.6	0.3
SY Ingmar	58	59	49	56	47	51	34	34	29	28	31	29	0.0	0.0	0.0
Linkert	57	58	50	56	47	51	32	31	29	27	29	28	0.0	0.1	0.1
MS Chevelle	54	57	46	55	45	49	34	37	31	31	31	31	0.0	0.8	0.4
Boost	59	60	51	59	48	53	35	38	33	31	35	33	0.0	2.7	1.4
SY Valda	57	58	49	56	47	51	35	35	30	27	32	30	0.0	0.5	0.3
CP3530	58	60	50	57	48	52	39	39	34	33	36	34	0.0	1.2	0.6
Shelly	59	59	51	58	48	52	34	36	30	28	31	30	0.0	0.1	0.1
TCG-Spitfire	61	60	51	59	50	53	33	34	31	30	33	31	0.0	0.3	0.2
ND VitPro	56	57	48	55	46	50	35	37	33	31	34	33	0.0	0.7	0.4
Lang-MN	--	60	51	58	50	53	--	41	35	33	35	34	0.0	2.5	1.3
LCS Rebel	--	57	46	55	45	49	--	41	34	31	35	33	0.0	5.4	2.7
LCS Trigger	--	62	53	61	53	56	--	39	35	32	35	34	0.0	3.7	1.9
DG Ambush	--	56	47	54	46	49	--	36	31	30	32	31	0.0	0.2	0.1
SY McCloud	--	--	49	55	47	50	--	--	29	29	33	30	--	0.0	--
SY611CL2	--	--	49	55	47	50	--	--	29	28	30	29	--	0.2	--
MS Barracuda	--	--	45	54	44	48	--	--	29	28	29	29	--	0.1	--
LCS Cannon	--	--	44	53	43	47	--	--	30	29	30	30	--	0.0	--
MN-Washburn	--	--	51	57	49	52	--	--	32	29	31	31	--	0.0	--
CP3910	--	--	--	54	45	--	--	--	--	27	32	--	--	0.1	--
CP3915	--	--	--	55	46	--	--	--	--	29	32	--	--	0.0	--
DG Ballistic	--	--	--	56	47	--	--	--	--	31	34	--	--	1.9	--
DG Commander	--	--	--	55	46	--	--	--	--	30	31	--	--	0.0	--
TCG-Heartland	--	--	--	54	46	--	--	--	--	28	31	--	--	0.0	--
SY Longmire	--	--	--	56	46	--	--	--	--	29	31	--	--	0.0	--
SY Rockford	--	--	--	58	49	--	--	--	--	31	32	--	--	0.0	--
AP Murdock	--	--	--	56	47	--	--	--	--	28	31	--	--	0.6	--
MN-Torgy	--	--	--	56	49	--	--	--	--	30	34	--	--	2.4	--
Allegiant 822	--	--	--	--	46	--	--	--	--	--	31	--	--	0.5	--
Allegiant 834	--	--	--	--	48	--	--	--	--	--	28	--	--	0.0	--
Allegiant 8432	--	--	--	--	45	--	--	--	--	--	32	--	--	0.0	--
CP3055	--	--	--	--	53	--	--	--	--	--	35	--	--	1.3	--
CP3903	--	--	--	--	46	--	--	--	--	--	34	--	--	0.0	--
Dagmar	--	--	--	--	46	--	--	--	--	--	32	--	--	3.7	--
DG Velocity	--	--	--	--	47	--	--	--	--	--	31	--	--	0.0	--
Driver	--	--	--	--	48	--	--	--	--	--	34	--	--	0.6	--
Lanning	--	--	--	--	49	--	--	--	--	--	32	--	--	0.2	--
LCS Buster	--	--	--	--	53	--	--	--	--	--	35	--	--	2.7	--
MS Rancho	--	--	--	--	51	--	--	--	--	--	34	--	--	5.8	--
ND Frohberg	--	--	--	--	47	--	--	--	--	--	35	--	--	1.2	--
TCG-Wildcat	--	--	--	--	47	--	--	--	--	--	32	--	--	0.2	--
LCS Breakaway	55	56	46	54	--	--	33	35	30	27	--	--	0.0	--	--
CP3504	58	60	50	57	--	--	32	34	30	29	--	--	0.0	--	--
CP3616	57	58	49	56	--	--	34	35	31	30	--	--	0.0	--	--
Surpass	52	54	45	54	--	--	34	40	32	30	--	--	3.0	--	--
MS Camaro	--	58	48	54	--	--	--	33	28	27	--	--	0.0	--	--
TCG-Climax	--	63	52	60	--	--	--	38	31	31	--	--	0.0	--	--
CP3888	--	--	49	55	--	--	--	--	31	29	--	--	--	--	--
CP3939	--	--	--	55	--	--	--	--	--	30	--	--	--	--	--
TCG-Stalwart	--	--	--	56	--	--	--	--	--	30	--	--	--	--	--
Mott	--	--	--	56	--	--	--	--	--	35	--	--	--	--	--
Prosper	57	58	50	--	--	--	36	38	33	--	--	--	0.3	--	--
Rollag	56	58	49	--	--	--	35	35	29	--	--	--	0.0	--	--
Trial Mean	57	58	49	56	47		36	37	31	30	33		0.1	1.1	
C.V. %	1.2	1.7	1.7	1.4	1.2		4.4	3.7	3.3	3.9	3.3		350	88	
LSD 5%	0.9	1.3	1.1	1.1	0.8		2.2	1.9	1.5	1.7	1.5		0.7	1.4	
LSD 10%	0.8	1.1	1.0	0.9	0.7		1.8	1.6	1.2	1.4	1.3		0.6	1.1	

Disease levels were minimal.

HRSW Summary, Nelson County 2016-2020

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)		
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr	18	19	2yr
Faller	71	94	93	86	51	77	57.2	62.1	61.5	58.1	55.3	58.3	14.0	13.1	13.9	14.1	15.0	14.3	0.8	5.2	3.0
Linkert	66	73	72	64	52	62	56.8	61.5	60.6	56.5	57.7	58.3	14.3	14.7	14.9	15.1	15.8	15.3	0.0	0.0	0.0
SY Ingmar	74	79	82	76	57	72	59.0	61.8	61.7	58.5	58.5	59.6	14.4	14.1	14.8	14.6	15.6	15.0	0.0	0.0	0.0
Bolles	64	81	74	73	49	65	56.2	61.8	60.7	57.4	56.5	58.2	15.9	15.3	15.5	15.6	16.9	16.0	0.0	3.3	1.7
SY Valda	79	91	96	79	65	80	59.1	61.6	61.2	58.4	58.7	59.4	14.0	13.1	13.8	13.9	14.6	14.1	0.0	3.2	1.6
Shelly	72	90	91	82	46	73	56.6	62.4	61.2	57.4	53.9	57.5	14.4	13.3	13.5	13.8	16.1	14.5	0.0	2.8	1.4
ND VitPro	66	71	80	71	52	68	60.4	62.9	62.9	60.2	59.3	60.8	14.5	14.5	14.9	15.4	15.7	15.3	0.0	2.2	1.1
Lang-MN	--	71	73	71	54	66	--	62.5	60.9	58.9	58.5	59.4	--	14.9	15.3	15.9	15.6	15.6	2.0	6.3	4.2
LCS Rebel	--	85	85	76	64	75	--	63.4	62.4	58.5	60.3	60.4	--	14.1	14.1	15.1	15.4	14.9	0.0	5.0	2.5
LCS Trigger	--	--	91	91	71	84	--	--	61.4	58.7	58.3	59.5	--	--	11.7	12.3	12.2	12.1	0.5	3.5	2.0
MS Barracuda	--	--	90	81	42	71	--	--	61.0	57.7	55.1	57.9	--	--	14.6	14.8	16.3	15.2	0.0	2.0	1.0
TCG-Spitfire	--	--	86	74	59	73	--	--	60.6	56.6	57.3	58.2	--	--	13.7	13.9	14.3	14.0	0.0	0.0	0.0
SY611CL2	--	--	84	76	54	71	--	--	61.1	58.6	57.4	59.0	--	--	14.3	14.3	15.9	14.8	0.0	0.5	0.3
DG Ambush	--	--	--	72	53	--	--	--	--	57.7	58.6	--	--	--	--	15.0	15.6	--	--	0.3	--
DG Ballistic	--	--	--	87	46	--	--	--	--	57.1	54.4	--	--	--	--	13.9	15.0	--	--	4.0	--
DG Commander	--	--	--	80	55	--	--	--	--	58.2	57.8	--	--	--	--	13.9	15.0	--	--	0.0	--
LCS Cannon	--	--	--	83	50	--	--	--	--	58.5	56.8	--	--	--	--	14.0	14.9	--	--	1.5	--
MN-Washburn	--	--	--	67	49	--	--	--	--	58.1	57.6	--	--	--	--	15.0	15.4	--	--	0.0	--
SY McCloud	--	--	--	74	53	--	--	--	--	58.7	59.4	--	--	--	--	14.9	15.5	--	--	0.0	--
TCG-Heartland	--	--	--	68	50	--	--	--	--	58.8	56.3	--	--	--	--	15.0	15.8	--	--	0.0	--
AP Murdock	--	--	--	83	69	--	--	--	--	57.3	58.6	--	--	--	--	13.8	14.5	--	--	2.5	--
CP3055	--	--	--	--	42	--	--	--	--	--	49.5	--	--	--	--	--	14.9	--	--	--	--
CP3915	--	--	--	--	51	--	--	--	--	--	56.8	--	--	--	--	--	14.8	--	--	--	--
DG Velocity	--	--	--	--	51	--	--	--	--	--	58.0	--	--	--	--	--	16.5	--	--	--	--
LCS Buster	--	--	--	--	60	--	--	--	--	--	54.9	--	--	--	--	--	12.9	--	--	--	--
MN-Torgy	--	--	--	--	56	--	--	--	--	--	57.4	--	--	--	--	--	16.1	--	--	--	--
MS Ranchero	--	--	--	--	43	--	--	--	--	--	53.2	--	--	--	--	--	15.2	--	--	--	--
ND Frohberg	--	--	--	--	53	--	--	--	--	--	58.8	--	--	--	--	--	15.3	--	--	--	--
TCG-Wildcat	--	--	--	--	65	--	--	--	--	--	59.0	--	--	--	--	--	14.9	--	--	--	--
CP3530	80	92	93	79	--	--	58.6	62.2	61.0	57.6	--	--	14.2	14.4	13.6	15.2	--	--	0.0	4.0	2.0
CP3888	--	--	82	62	--	--	--	--	60.3	55.9	--	--	--	--	13.8	15.1	--	--	0.8	1.0	0.9
TCG-Climax	--	--	72	66	--	--	--	--	62.4	59.4	--	--	--	--	15.6	16.0	--	--	0.0	0.0	0.0
CP3939	--	--	--	69	--	--	--	--	--	57.6	--	--	--	--	--	15.5	--	--	--	1.0	--
TCS-Stalwart	--	--	--	51	--	--	--	--	--	53.6	--	--	--	--	--	15.8	--	--	--	0.5	--
LCS Breakaway	73	79	--	69	--	--	58.8	63.0	--	58.6	--	--	14.4	13.8	--	14.8	--	--	--	3.0	--
MS Chevelle	--	88	--	74	--	--	--	61.8	--	56.5	--	--	--	12.7	--	13.8	--	--	--	4.0	--
Prosper	75	86	92	--	--	--	58.0	61.9	61.5	--	--	--	13.9	13.1	14.0	--	--	--	1.3	--	--
Rollag	63	78	74	--	--	--	57.9	62.6	61.0	--	--	--	15.0	14.6	15.1	--	--	--	0.0	--	--
CP3419	71	86	88	--	--	--	56.3	61.8	60.0	--	--	--	14.4	12.9	13.1	--	--	--	0.0	--	--
CP3504	72	81	86	--	--	--	56.1	60.7	59.7	--	--	--	13.9	13.4	13.0	--	--	--	0.0	--	--
CP3616	69	78	85	--	--	--	56.9	60.6	60.7	--	--	--	14.7	15.0	14.5	--	--	--	0.0	--	--
WB9590	--	90	95	--	--	--	--	62.0	61.5	--	--	--	--	14.2	14.0	--	--	--	0.0	--	--
MS Camaro	--	76	77	--	--	--	--	61.5	61.0	--	--	--	--	14.3	13.9	--	--	--	0.0	--	--
WB9479	--	88	88	--	--	--	--	62.8	62.0	--	--	--	--	14.8	14.6	--	--	--	0.0	--	--
WB9719	--	--	87	--	--	--	--	--	63.8	--	--	--	--	--	13.6	--	--	--	0.0	--	--
SY Soren	72	78	--	--	--	--	58.0	61.4	--	--	--	--	13.6	14.0	--	--	--	--	--	--	--
WB Mayville	66	79	--	--	--	--	57.0	61.6	--	--	--	--	14.3	14.6	--	--	--	--	--	--	--
Elgin-ND	64	76	--	--	--	--	57.0	61.5	--	--	--	--	14.7	13.9	--	--	--	--	--	--	--
SY Rowyn	78	85	--	--	--	--	59.2	61.7	--	--	--	--	13.7	13.2	--	--	--	--	--	--	--
CP3100	73	85	--	--	--	--	56.9	60.6	--	--	--	--	13.6	13.5	--	--	--	--	--	--	--
Boost	72	78	--	--	--	--	58.8	61.1	--	--	--	--	15.0	14.2	--	--	--	--	--	--	--
Surpass	75	81	--	--	--	--	57.8	61.4	--	--	--	--	14.0	13.4	--	--	--	--	--	--	--
LCS Prime	75	89	--	--	--	--	58.9	62.1	--	--	--	--	13.1	12.6	--	--	--	--	--	--	--
Trial Mean	71	82	84	74	54		57.8	61.9	61.3	57.8	57.0		14.2	14.0	14.2	14.7	15.2		0.2	2.0	
C.V. %	5.7	5.7	5.8	4.9	7.8		1.0	0.5	0.8	1.1	1.8		1.7	1.5	4.4	2.0	2.8		349	45	
LSD 5%	5.7	6.6	6.9	5.1	5.9		0.8	0.5	0.7	0.9	1.4		0.3	0.4	0.9	0.4	0.6		1.0	1.3	
LSD 10%	4.8	5.5	5.7	4.3	5.0		0.6	0.4	0.6	0.7	1.2		0.3	0.3	0.7	0.4	0.5		0.8	1.1	

HRSW Summary, Pembina County 2015-2020

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)		
	15	16	17	19	20	3yr	15	16	17	19	20	3yr	15	16	17	19	20	3yr	17	19	2yr
Faller	50	61	96	88	75	86	56.0	60.1	62.5	61.0	59.2	60.9	14.8	13.8	13.0	14.2	13.1	13.4	0.6	0.5	0.6
Linkert	53	56	69	72	60	67	56.9	59.3	61.0	61.9	59.4	60.8	14.9	14.7	14.3	15.8	14.9	15.0	0.1	0.0	0.1
SY Ingmar	56	55	78	75	69	74	57.9	59.9	61.3	61.8	59.6	60.9	14.8	14.9	14.1	14.5	14.3	14.3	0.0	0.0	0.0
Bolles	44	48	76	73	62	71	56.0	57.9	61.4	61.2	58.7	60.4	15.9	15.9	15.3	17.0	15.6	16.0	0.0	0.0	0.0
SY Valda	47	59	86	78	71	78	55.6	59.2	60.6	60.9	59.5	60.3	15.0	13.9	13.3	13.7	13.6	13.5	1.3	0.0	0.7
Shelly	--	51	88	80	71	80	--	58.8	62.7	61.5	58.5	60.9	--	13.8	13.2	14.6	13.5	13.8	0.1	0.0	0.1
ND VitPro	--	50	73	80	62	72	--	61.4	63.0	62.5	61.1	62.2	--	15.0	14.4	15.9	14.7	15.0	0.1	2.3	1.2
Lang-MN	--	--	80	78	67	75	--	--	63.0	61.7	59.6	61.4	--	--	14.6	15.5	14.7	14.9	0.2	1.3	0.8
LCS Rebel	--	--	83	78	71	77	--	--	62.1	62.0	60.9	61.7	--	--	13.8	14.8	14.5	14.4	1.6	0.5	1.1
DG Ambush	--	--	--	77	70	--	--	--	--	62.0	60.2	--	--	--	--	15.2	14.6	--	--	0.0	--
DG Ballistic	--	--	--	88	79	--	--	--	--	63.2	58.5	--	--	--	--	14.1	13.5	--	--	0.0	--
DG Commander	--	--	--	83	70	--	--	--	--	61.7	59.3	--	--	--	--	14.2	13.8	--	--	0.0	--
LCS Cannon	--	--	--	85	70	--	--	--	--	62.2	59.6	--	--	--	--	14.2	13.7	--	--	0.0	--
LCS Trigger	--	--	--	87	78	--	--	--	--	61.1	60.3	--	--	--	--	12.2	11.5	--	--	0.5	--
MN-Washburn	--	--	--	72	71	--	--	--	--	60.7	59.6	--	--	--	--	14.7	14.0	--	--	0.0	--
MS Barracuda	--	--	--	85	68	--	--	--	--	61.4	58.7	--	--	--	--	14.7	15.1	--	--	0.0	--
SY McCloud	--	--	--	75	70	--	--	--	--	62.5	60.0	--	--	--	--	15.2	14.6	--	--	0.0	--
SY611CL2	--	--	--	80	72	--	--	--	--	62.4	60.1	--	--	--	--	14.4	14.3	--	--	0.0	--
TCG-Heartland	--	--	--	77	58	--	--	--	--	62.2	59.0	--	--	--	--	15.4	15.0	--	--	0.0	--
TCG-Spitfire	--	--	--	79	69	--	--	--	--	60.5	58.4	--	--	--	--	13.9	13.4	--	--	0.0	--
AP Murdock	--	--	--	80	74	--	--	--	--	60.7	59.1	--	--	--	--	14.3	13.4	--	--	0.0	--
CP3055	--	--	--	--	74	--	--	--	--	--	56.2	--	--	--	--	12.6	--	--	--	--	--
CP3915	--	--	--	--	75	--	--	--	--	--	60.8	--	--	--	--	14.1	--	--	--	--	--
DG Velocity	--	--	--	--	60	--	--	--	--	--	59.7	--	--	--	--	15.2	--	--	--	--	--
LCS Buster	--	--	--	--	79	--	--	--	--	--	57.9	--	--	--	--	11.4	--	--	--	--	--
MN-Torgy	--	--	--	--	77	--	--	--	--	--	59.8	--	--	--	--	14.3	--	--	--	--	--
MS Ranchero	--	--	--	--	67	--	--	--	--	--	57.6	--	--	--	--	14.2	--	--	--	--	--
ND Frohberg	--	--	--	--	65	--	--	--	--	--	60.1	--	--	--	--	13.7	--	--	--	--	--
TCG-Wildcat	--	--	--	--	73	--	--	--	--	--	59.9	--	--	--	--	14.0	--	--	--	--	--
LCS Breakaway	44	46	74	73	--	--	55.5	60.0	61.6	61.9	--	--	15.3	14.7	13.8	15.1	--	--	0.0	0.0	0.0
CP3530	62	57	88	78	--	--	57.8	59.3	61.3	60.5	--	--	14.0	14.4	14.0	15.3	--	--	0.0	0.5	0.3
MS Chevelle	--	--	84	86	--	--	--	--	61.1	60.8	--	--	--	--	12.5	13.3	--	--	0.5	0.0	0.3
CP3888	--	--	--	81	--	--	--	--	--	60.7	--	--	--	--	--	14.7	--	--	--	0.0	--
CP3939	--	--	--	75	--	--	--	--	--	61.5	--	--	--	--	--	15.8	--	--	--	0.0	--
TCG-Climax	--	--	--	69	--	--	--	--	--	62.2	--	--	--	--	--	16.2	--	--	--	0.0	--
TCG-Stalwart	--	--	--	73	--	--	--	--	--	59.5	--	--	--	--	--	15.6	--	--	--	0.0	--
Prosper	49	57	93	--	--	--	55.7	59.3	62.1	--	--	--	14.8	13.9	13.3	--	--	--	1.5	--	--
Rollag	50	58	82	--	--	--	57.6	60.4	62.4	--	--	--	15.6	14.6	14.3	--	--	--	0.0	--	--
SY Soren	46	54	78	--	--	--	56.8	59.4	61.3	--	--	--	15.0	14.8	13.7	--	--	--	0.0	--	--
WB Mayville	45	43	67	--	--	--	54.7	57.0	59.4	--	--	--	15.1	14.9	13.8	--	--	--	0.0	--	--
SY Rowyn	53	56	86	--	--	--	57.5	59.9	61.7	--	--	--	14.3	14.2	12.9	--	--	--	1.0	--	--
Elgin-ND	44	53	80	--	--	--	55.0	58.5	61.1	--	--	--	15.0	14.6	13.8	--	--	--	0.5	--	--
CP3419	60	68	94	--	--	--	56.0	58.8	60.7	--	--	--	13.2	13.1	12.5	--	--	--	0.0	--	--
CP3504	51	57	75	--	--	--	55.2	57.9	59.6	--	--	--	13.7	13.2	13.1	--	--	--	0.0	--	--
Boost	--	44	78	--	--	--	--	58.2	60.0	--	--	--	--	14.6	14.1	--	--	--	2.7	--	--
Surpass	--	46	79	--	--	--	--	59.0	61.6	--	--	--	--	14.1	13.6	--	--	--	2.5	--	--
LCS Prime	--	46	86	--	--	--	--	59.4	62.5	--	--	--	--	13.1	12.6	--	--	--	0.0	--	--
CP3616	--	50	79	--	--	--	--	58.0	60.6	--	--	--	--	15.5	14.6	--	--	--	0.0	--	--
CP3100	--	61	79	--	--	--	--	58.6	59.9	--	--	--	--	13.7	12.9	--	--	--	0.0	--	--
WB9590	--	--	79	--	--	--	--	--	60.6	--	--	--	--	--	13.8	--	--	--	0.0	--	--
WB9479	--	--	77	--	--	--	--	--	60.6	--	--	--	--	--	14.4	--	--	--	0.0	--	--
MS Camaro	--	--	73	--	--	--	--	--	61.3	--	--	--	--	--	13.6	--	--	--	0.1	--	--
Prevail	47	55	--	--	--	--	55.1	58.3	--	--	--	--	14.5	13.7	--	--	--	--	--	--	--
Trial Mean	49	53	80	79	70	--	56.2	59.0	61.4	61.6	59.3	--	14.6	14.3	13.7	14.9	14.0	--	0.4	0.2	--
C.V. %	10.3	7.8	3.3	5.2	5.0	--	1.8	1.1	0.7	1.3	0.8	--	3.8	1.9	1.7	1.1	2.2	--	89.4	375	--
LSD 5%	7.2	5.9	3.7	5.8	5.0	--	1.5	0.9	0.6	1.1	0.7	--	0.8	0.4	0.3	0.2	0.4	--	1.1	NS	--
LSD 10%	6.0	4.9	3.1	4.8	4.2	--	1.2	0.7	0.5	0.9	0.5	--	0.7	0.3	0.3	0.2	0.4	--	0.9	0.9	--

No trial data from 2018.

HRSW Summary, Towner County 2016-2020

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)		
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	19	2yr
Faller	88	59	66	77	59	67	60.2	57.1	61.0	57.0	58.3	58.8	13.7	14.3	15.0	13.8	15.7	14.8	2.9	0.5	1.7
SY Ingmar	76	43	63	75	54	64	59.2	54.4	61.8	57.9	60.0	59.9	15.3	15.4	15.3	14.2	16.7	15.4	1.2	0.0	0.6
Linkert	75	48	58	64	54	59	59.4	55.7	61.9	56.7	59.6	59.4	14.9	15.5	15.3	15.1	16.2	15.5	0.0	0.0	0.0
Bolles	77	50	60	66	37	54	59.9	55.6	60.7	56.3	54.0	57.0	16.0	16.3	16.9	15.7	17.9	16.8	2.5	0.0	1.3
SY Valda	83	54	66	75	65	69	59.7	56.3	60.8	56.4	60.2	59.1	14.6	14.7	14.4	13.6	15.6	14.5	1.4	2.3	1.9
Shelly	87	63	67	67	58	64	59.8	59.4	62.1	56.3	59.8	59.4	14.1	14.3	14.7	14.2	16.0	15.0	1.4	0.7	1.1
ND VitPro	73	49	58	73	58	63	61.1	59.0	62.1	60.4	60.8	61.1	15.0	15.0	15.6	15.0	16.7	15.8	2.2	0.0	1.1
Lang-MN	--	58	68	72	67	69	--	60.4	61.8	59.4	59.8	60.3	--	15.4	15.1	15.2	15.8	15.4	--	1.3	--
LCS Rebel	--	60	64	78	60	67	--	59.5	61.5	58.7	60.8	60.3	--	14.0	15.4	14.3	16.4	15.4	--	0.5	--
LCS Trigger	--	--	66	84	65	72	--	--	61.4	57.4	60.8	59.9	--	--	13.6	12.4	13.9	13.3	--	0.0	--
MS Barracuda	--	--	62	74	62	66	--	--	60.9	56.2	60.2	59.1	--	--	15.3	14.5	17.0	15.6	--	0.0	--
TCG-Spitfire	--	--	63	79	63	68	--	--	61.6	56.9	59.3	59.3	--	--	14.7	13.6	15.1	14.5	--	0.1	--
AP Murdock	--	--	--	77	58	--	--	--	--	55.2	58.4	--	--	--	--	14.2	16.1	--	--	1.0	--
DG Commander	--	--	--	75	59	--	--	--	--	57.2	59.5	--	--	--	--	14.2	15.4	--	--	0.0	--
DG Ambush	--	--	--	69	57	--	--	--	--	57.6	59.9	--	--	--	--	15.1	17.1	--	--	0.0	--
DG Ballistic	--	--	--	77	58	--	--	--	--	55.2	58.4	--	--	--	--	14.2	16.1	--	--	1.0	--
LCS Cannon	--	--	--	67	62	--	--	--	--	56.1	61.4	--	--	--	--	14.5	15.8	--	--	0.0	--
MN-Washburn	--	--	--	67	50	--	--	--	--	57.6	58.4	--	--	--	--	14.1	15.9	--	--	0.0	--
SY McCloud	--	--	--	75	54	--	--	--	--	59.0	59.6	--	--	--	--	14.4	16.3	--	--	0.0	--
SY611CL2	--	--	--	76	57	--	--	--	--	58.4	60.5	--	--	--	--	14.2	15.6	--	--	0.0	--
TCG-Heartland	--	--	--	68	56	--	--	--	--	58.2	60.8	--	--	--	--	14.9	16.9	--	--	0.0	--
AP Murdock	--	--	--	74	57	--	--	--	--	55.7	59.8	--	--	--	--	14.1	16.4	--	--	0.0	--
CP3055	--	--	--	--	68	--	--	--	--	--	58.1	--	--	--	--	13.9	--	--	--	--	--
CP3915	--	--	--	--	60	--	--	--	--	--	61.1	--	--	--	--	15.4	--	--	--	--	--
DG Velocity	--	--	--	--	58	--	--	--	--	--	60.6	--	--	--	--	16.8	--	--	--	--	--
LCS Buster	--	--	--	--	66	--	--	--	--	--	59.7	--	--	--	--	14.1	--	--	--	--	--
MN-Torgy	--	--	--	--	61	--	--	--	--	--	60.0	--	--	--	--	16.9	--	--	--	--	--
MS Ranchero	--	--	--	--	62	--	--	--	--	--	57.7	--	--	--	--	15.5	--	--	--	--	--
ND Frohberg	--	--	--	--	59	--	--	--	--	--	60.1	--	--	--	--	16.5	--	--	--	--	--
TCG-Wildcat	--	--	--	--	51	--	--	--	--	--	60.5	--	--	--	--	17.4	--	--	--	--	--
CP3530	92	51	62	71	--	--	60.5	55.5	60.4	57.7	--	--	14.5	15.0	15.6	14.5	--	--	2.5	0.3	1.4
CP3888	--	--	64	69	--	--	--	--	60.1	55.6	--	--	--	--	15.0	14.2	--	--	--	0.0	--
TCG-Climax	--	--	60	58	--	--	--	--	63.1	58.6	--	--	--	--	15.8	15.9	--	--	--	0.0	--
LCS Breakaway	78	49	--	72	--	--	61.5	56.8	--	58.5	--	--	14.5	15.2	--	14.4	--	--	1.5	0.0	0.8
MS Chevelle	--	68	--	75	--	--	--	57.3	--	56.5	--	--	--	13.5	--	13.4	--	--	--	0.0	--
CP3939	--	--	--	73	--	--	--	--	--	57.9	--	--	--	--	--	15.0	--	--	--	0.0	--
TCG-Stalwart	--	--	--	55	--	--	--	--	--	52.2	--	--	--	--	--	15.7	--	--	--	0.0	--
Prosper	83	58	67	--	--	--	59.8	57.2	61.4	--	--	--	14.0	14.3	14.8	--	--	--	2.7	--	--
Rollag	73	49	58	--	--	--	60.2	57.6	61.8	--	--	--	15.3	15.7	15.8	--	--	--	1.0	--	--
CP3419	93	48	70	--	--	--	59.8	54.5	60.1	--	--	--	13.5	14.3	14.2	--	--	--	0.3	--	--
CP3504	75	43	66	--	--	--	57.1	51.8	60.0	--	--	--	13.8	14.7	14.1	--	--	--	0.6	--	--
CP3616	77	58	64	--	--	--	58.8	56.1	60.2	--	--	--	15.9	15.4	16.2	--	--	--	3.0	--	--
WB9590	--	42	63	--	--	--	--	54.1	61.2	--	--	--	--	15.9	15.3	--	--	--	--	--	--
WB9479	--	57	60	--	--	--	--	55.9	61.6	--	--	--	--	15.7	16.0	--	--	--	--	--	--
MS Camaro	--	48	61	--	--	--	--	57.5	61.3	--	--	--	--	14.7	15.1	--	--	--	--	--	--
WB9719	--	--	65	--	--	--	--	--	64.1	--	--	--	--	--	14.7	--	--	--	--	--	--
SY Soren	82	42	--	--	--	--	60.0	54.8	--	--	--	--	14.8	15.5	--	--	--	--	2.1	--	--
WB Mayville	69	43	--	--	--	--	57.6	53.8	--	--	--	--	14.7	15.3	--	--	--	--	0.4	--	--
Elgin-ND	76	61	--	--	--	--	60.1	57.3	--	--	--	--	14.9	14.3	--	--	--	--	2.3	--	--
SY Rowyn	81	47	--	--	--	--	60.1	55.8	--	--	--	--	14.3	15.0	--	--	--	--	2.2	--	--
Boost	68	60	--	--	--	--	59.1	58.4	--	--	--	--	15.7	14.8	--	--	--	--	4.1	--	--
Surpass	82	57	--	--	--	--	60.0	58.6	--	--	--	--	14.1	13.9	--	--	--	--	3.1	--	--
LCS Prime	80	55	--	--	--	--	60.3	58.3	--	--	--	--	13.6	13.2	--	--	--	--	3.9	--	--
CP3100	79	51	--	--	--	--	57.3	53.8	--	--	--	--	14.1	14.6	--	--	--	--	0.8	--	--
Trial Mean	79	53	63	71	58	--	59.6	56.7	61.4	57.3	59.7	--	14.5	14.9	15.1	14.5	16.0	--	1.8	0.2	--
C.V. %	6.1	10.3	6.2	5.4	8.3	--	1.1	2.3	0.7	1.0	0.8	--	2.3	2.0	1.9	2.4	2.4	--	59.7	282	--
LSD 5%	6.9	11.3	5.5	5.4	6.8	--	0.9	2.8	0.6	0.8	0.7	--	0.5	0.6	0.4	0.5	0.5	--	1.5	1.0	--
LSD 10%	5.7	9.4	4.6	4.5	5.7	--	0.8	2.3	0.5	0.7	0.6	--	0.4	0.5	0.3	0.4	0.5	--	1.3	0.8	--

HRSW Summary, Walsh County 2016-2020

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)						
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr	14	15	16	17	19	3yr	
Faller	81	89	85	91	80	85	58.9	60.3	62.5	61.0	60.3	61.3	13.0	12.5	12.8	13.6	14.0	13.5	0.0	6.5	2.2	1.1	2.5	1.9	
Linkert	71	82	67	75	66	69	58.3	61.3	62.2	61.2	61.7	61.7	14.2	14.7	14.9	15.2	14.8	15.0	0.0	0.0	0.0	0.0	0.0	0.0	
SY Ingmar	74	80	61	82	67	70	59.2	61.6	62.6	61.2	61.5	61.8	14.1	14.6	14.8	14.3	15.2	14.8	0.0	0.9	1.2	0.1	0.2	0.5	
Bolles	69	86	64	82	61	69	58.3	60.9	61.5	60.8	58.5	60.3	14.9	14.9	14.6	15.7	16.3	15.5	--	5.7	0.4	0.0	0.3	0.2	
SY Valda	78	90	81	86	73	80	58.4	61.7	62.1	61.0	59.8	61.0	13.3	13.5	12.9	13.5	13.5	13.3	--	3.8	2.0	0.0	0.8	0.9	
Shelly	82	87	73	85	75	78	58.7	61.1	62.9	61.1	60.8	61.6	13.1	13.4	13.1	13.8	14.1	13.7	--	--	0.3	0.1	0.2	0.2	
ND VitPro	69	80	66	76	66	69	61.1	62.8	63.8	62.5	62.0	62.8	14.3	14.9	14.0	15.0	15.2	14.7	--	--	0.8	0.0	0.0	0.3	
Lang-MN	--	82	74	74	72	73	--	62.9	62.8	61.5	61.3	61.9	--	15.0	14.4	15.2	14.9	14.8	--	--	--	0.0	3.2	--	
LCS Rebel	--	84	71	84	66	74	--	62.5	63.3	62.5	61.0	62.3	--	13.7	13.2	14.3	14.8	14.1	--	--	--	1.7	2.7	--	
LCS Trigger	--	--	83	95	80	86	--	--	62.4	61.3	60.0	61.2	--	--	10.9	11.7	11.1	11.2	--	--	--	--	1.5	--	
MS Barracuda	--	--	70	80	69	73	--	--	62.7	61.3	60.9	61.6	--	--	13.6	13.9	14.6	14.0	--	--	--	--	0.5	--	
SY McCloud	--	--	68	84	60	71	--	--	63.1	61.8	61.7	62.2	--	--	14.8	14.7	15.9	15.1	--	--	--	--	1.3	--	
SY611CL2	--	--	71	82	71	75	--	--	62.6	61.9	60.8	61.8	--	--	13.5	13.6	14.7	13.9	--	--	--	--	0.1	--	
TCG-Spitfire	--	--	74	82	74	77	--	--	61.4	60.4	58.2	60.0	--	--	14.1	13.8	13.8	13.9	--	--	--	--	0.0	--	
DG Ambush	--	--	--	80	70	--	--	--	--	61.2	61.3	--	--	--	--	14.9	15.1	--	--	--	--	--	--	1.7	--
DG Ballistic	--	--	--	98	74	--	--	--	--	60.5	59.9	--	--	--	--	13.7	14.8	--	--	--	--	--	--	0.7	--
DG Commander	--	--	--	89	74	--	--	--	--	61.2	60.6	--	--	--	--	14.1	14.3	--	--	--	--	--	--	0.7	--
LCS Cannon	--	--	--	85	73	--	--	--	--	61.5	62.9	--	--	--	--	13.7	14.0	--	--	--	--	--	--	0.8	--
MN-Washburn	--	--	--	81	65	--	--	--	--	61.1	60.5	--	--	--	--	14.5	13.9	--	--	--	--	--	--	0.3	--
TCG-Heartland	--	--	--	77	63	--	--	--	--	62.1	61.4	--	--	--	--	14.9	15.3	--	--	--	--	--	--	0.0	--
AP Murdock	--	--	--	84	76	--	--	--	--	59.7	61.1	--	--	--	--	13.8	13.4	--	--	--	--	--	--	2.0	--
CP3055	--	--	--	--	76	--	--	--	--	--	--	57.4	--	--	--	--	12.0	--	--	--	--	--	--	--	--
CP3915	--	--	--	--	69	--	--	--	--	--	--	61.3	--	--	--	--	13.9	--	--	--	--	--	--	--	--
DG Velocity	--	--	--	--	64	--	--	--	--	--	--	61.9	--	--	--	--	15.8	--	--	--	--	--	--	--	--
LCS Buster	--	--	--	--	82	--	--	--	--	--	--	58.4	--	--	--	--	11.5	--	--	--	--	--	--	--	--
MN-Torgy	--	--	--	--	77	--	--	--	--	--	--	60.5	--	--	--	--	14.5	--	--	--	--	--	--	--	--
MS Ranchero	--	--	--	--	75	--	--	--	--	--	--	59.5	--	--	--	--	13.3	--	--	--	--	--	--	--	--
ND Frohberg	--	--	--	--	70	--	--	--	--	--	--	61.4	--	--	--	--	15.2	--	--	--	--	--	--	--	--
TCG-Wildcat	--	--	--	--	69	--	--	--	--	--	--	60.9	--	--	--	--	15.6	--	--	--	--	--	--	--	--
CP3530	80	94	77	82	--	--	59.8	61.7	62.3	60.6	--	--	13.5	13.4	14.0	15.1	--	--	--	7.2	2.7	0.1	2.7	1.8	
TCG-Climax	--	--	67	73	--	--	--	--	63.5	62.4	--	--	--	--	15.0	15.5	--	--	--	--	--	--	--	0.0	--
CP3888	--	--	73	83	--	--	--	--	61.6	60.0	--	--	--	--	13.1	14.2	--	--	--	--	--	--	--	0.1	--
LCS Breakaway	75	83	--	80	--	--	60.0	62.2	--	62.1	--	--	13.6	13.9	--	14.0	--	--	0.0	4.3	1.0	0.1	1.7	0.9	
MS Chevelle	--	88	--	90	--	--	--	59.4	--	60.6	--	--	--	12.9	--	13.1	--	--	--	--	--	--	0.8	3.8	--
CP3939	--	--	--	79	--	--	--	--	--	61.0	--	--	--	--	--	14.9	--	--	--	--	--	--	--	0.2	--
TCG-Stalwart	--	--	--	79	--	--	--	--	--	59.5	--	--	--	--	--	15.4	--	--	--	--	--	--	--	2.5	--
Prosper	79	91	80	--	--	--	59.1	60.7	62.8	--	--	--	13.1	12.7	13.0	--	--	--	0.3	7.4	1.7	2.5	--	--	
Rollag	74	81	67	--	--	--	59.9	62.2	62.7	--	--	--	14.3	14.4	15.1	--	--	--	0.0	2.1	0.4	0.0	--	--	
CP3419	83	98	87	--	--	--	58.1	60.6	61.9	--	--	--	12.5	12.5	12.2	--	--	--	0.0	0.6	0.0	0.0	--	--	
CP3504	69	82	76	--	--	--	55.6	58.3	61.2	--	--	--	13.2	13.3	12.4	--	--	--	--	2.6	0.5	0.0	--	--	
CP3616	73	86	69	--	--	--	57.8	59.7	62.4	--	--	--	14.8	15.1	14.5	--	--	--	--	--	2.2	0.1	--	--	
WB9590	--	84	70	--	--	--	--	60.9	62.6	--	--	--	--	13.9	14.4	--	--	--	--	--	--	--	0.1	--	
WB9479	--	83	60	--	--	--	--	61.5	62.9	--	--	--	--	14.4	16.0	--	--	--	--	--	--	--	0.1	--	
MS Camaro	--	86	64	--	--	--	--	59.9	62.2	--	--	--	--	12.7	13.8	--	--	--	--	--	--	--	1.1	--	
WB9719	--	--	68	--	--	--	--	--	64.3	--	--	--	--	--	14.0	--	--	--	--	--	--	--	--	--	--
SY Rowyn	76	89	--	--	--	--	58.3	60.9	--	--	--	--	13.3	13.6	--	--	--	--	0.3	5.0	2.3	2.1	--	--	
SY Soren	76	82	--	--	--	--	58.9	61.4	--	--	--	--	13.9	14.5	--	--	--	--	0.2	1.1	1.8	0.2	--	--	
WB Mayville	65	83	--	--	--	--	57.1	61.3	--	--	--	--	14.2	14.4	--	--	--	--	0.0	0.4	0.2	0.0	--	--	
Elgin-ND	77	90	--	--	--	--	59.1	61.9	--	--	--	--	13.6	14.3	--	--	--	--	0.5	6.5	0.4	2.3	--	--	
Boost	69	86	--	--	--	--	58.2	61.2	--	--	--	--	14.2	14.1	--	--	--	--	--	--	2.5	0.0	--	--	
Surpass	73	89	--	--	--	--	57.8	60.1	--	--	--	--	13.0	14.5	--	--	--	--	--	--	4.6	0.7	--	--	
LCS Prime	76	94	--	--	--	--	59.1	62.0	--	--	--	--	12.6	12.5	--	--	--	--	--	--	2.6	0.5	--	--	
CP3100	71	83	--	--	--	--	56.4	59.9	--	--	--	--	13.0	13.2	--	--	--	--	--	--	0.9	0.0	--	--	
Trial Mean	74	86	72	82	71		58.4	61.2	62.5	61.2	60.6		13.5	13.9	13.8	14.4	14.3		0.5	4.4	1.5	0.5	1.1		
C.V. %	4.9	4.8	8.5	4.2	6.9		0.9	0.9	0.7	0.6	1.2		2.3	2.6	5.4	2.6	3.1		110	28.3	88	190	87		
LSD 5%	5.1	5.8	8.6	4.8	6.9		0.8	0.8	0.6	0.5	1.0		0.5	0.5	1.1	0.5	0.6		0.8	1.7	1.9	1.2	1.4		
LSD 10%	4.3	4.8	7.2	4.0	5.7		0.7	0.7	0.5	0.4	0.8		0.4	0.4	0.9	0.4	0.5		0.7	1.5	1.5	1.0	1.2		

HRWW Summary, Langdon 2016-2020*

Variety	Yield (bu/a)					Test Weight (lbs/bu)					Winter	Julian	Height	Protein (%)				
	16	17	19	20	3yr	16	17	19	20	3yr	Survival	Days to	(in)	16	17	19	20	3yr
											20	Head	20					
AC Emerson	86	90	87	41	73	59.3	60.2	60.4	59.5	60.0	47	173	24	10.9	11.9	11.5	14.7	12.7
Ideal	74	16	86	43	48	56.2	44.3	59.7	59.2	54.4	63	172	21	10.4	12.4	11.0	13.3	12.2
Jerry	65	17	84	44	48	56.0	46.7	59.1	58.9	54.9	75	171	25	10.7	12.9	11.2	14.3	12.8
Peregrine	81	80	90	44	71	58.8	57.0	60.3	60.2	59.2	71	173	27	10.8	10.8	10.4	13.2	11.5
SY Wolf	92	67	87	41	65	58.7	53.3	59.5	59.5	57.4	67	168	20	11.3	12.5	11.5	14.3	12.8
Northern	93	83	90	43	72	54.0	55.0	59.2	58.3	57.5	69	172	20	11.3	11.6	11.1	14.3	12.3
SY Monument	98	81	85	36	67	56.5	54.4	58.3	56.3	56.3	71	169	19	11.1	12.1	11.0	35.8	19.6
SY Sunrise	100	86	82	24	64	57.3	56.6	59.4	57.9	58.0	43	170	17	11.2	11.6	11.4	13.4	12.1
Oahe	--	105	83	39	76	--	60.7	59.7	59.3	59.9	66	169	20	--	11.3	11.5	14.0	12.3
Keldin	--	84	89	36	70	--	56.8	60.5	58.5	58.6	52	173	21	--	11.2	10.9	14.0	12.0
SY Wolverine	--	--	85	39	--	--	--	59.7	58.9	--	73	166	18	--	--	11.5	14.4	--
Thompson	--	--	90	40	--	--	--	59.9	58.6	--	56	170	22	--	--	10.9	13.8	--
TCG-Boomlock	--	--	79	41	--	--	--	60.3	59.9	--	66	171	21	--	--	11.6	14.2	--
WB4462	--	--	80	35	--	--	--	60.0	58.1	--	76	167	19	--	--	11.8	13.8	--
WB4595	--	--	89	21	--	--	--	61.8	59.4	--	34	172	20	--	--	10.3	13.5	--
ND Noreen	--	--	87	48	--	--	--	59.7	61.6	--	64	172	24	--	--	11.6	14.1	--
AAC Wildfire	--	--	--	45	--	--	--	--	58.7	--	80	173	23	--	--	--	14.0	--
CP7017AX	--	--	--	40	--	--	--	--	57.7	--	83	166	18	--	--	--	13.0	--
CP7050AX	--	--	--	32	--	--	--	--	59.6	--	79	165	18	--	--	--	14.9	--
CP7909	--	--	--	27	--	--	--	--	59.2	--	63	167	18	--	--	--	13.8	--
Loma	76	72	78	--	--	52.9	53.7	58.3	--	--	--	--	--	10.9	11.9	11.3	--	--
AC Broadview	87	25	--	--	--	56.8	43.9	--	--	--	--	--	--	10.1	11.6	--	--	--
Accipiter	75	43	--	--	--	56.3	51.8	--	--	--	--	--	--	10.5	11.2	--	--	--
Decade	74	28	--	--	--	54.2	45.5	--	--	--	--	--	--	10.6	12.2	--	--	--
Flourish	90	75	--	--	--	57.4	54.9	--	--	--	--	--	--	11.3	11.5	--	--	--
Lyman	81	35	--	--	--	58.1	47.3	--	--	--	--	--	--	11.6	12.7	--	--	--
Moats	83	96	--	--	--	59.8	60.6	--	--	--	--	--	--	11.8	12.3	--	--	--
Overland	88	44	--	--	--	58.1	51.1	--	--	--	--	--	--	10.8	11.5	--	--	--
WB Matlock	73	20	--	--	--	57.1	47.3	--	--	--	--	--	--	10.9	12.9	--	--	--
AC Gateway	88	59	--	--	--	56.5	53.6	--	--	--	--	--	--	11.3	12.3	--	--	--
CDC Chase	90	96	--	--	--	59.9	60.3	--	--	--	--	--	--	11.6	12.1	--	--	--
Redfield	82	53	--	--	--	58.0	50.7	--	--	--	--	--	--	11.1	12.2	--	--	--
Ruth	81	85	--	--	--	56.9	56.1	--	--	--	--	--	--	10.7	11.2	--	--	--
WB4614	88	57	--	--	--	52.6	54.7	--	--	--	--	--	--	11.5	12.5	--	--	--
Trial Mean	80	63	84	39		56.8	53.3	59.7	58.9		68	170	21	11.2	11.9	11.3	14.0	
C.V. %	8.6	9.8	3.6	12.4		1.9	2.7	0.6	1.1		20.9	0.7	6.8	3.0	3.2	1.9	2.4	
LSD 5%	11.3	8.7	4.3	6.8		1.8	2.0	0.5	1.0		20.0	1.8	2.0	0.5	0.5	0.3	0.5	
LSD 10%	9.5	7.2	3.6	5.7		1.5	1.7	0.4	0.8		16.7	1.5	1.7	0.5	0.4	0.3	0.4	

No lodging in the 2019 and 2020 trials.

Snowfall on October 11-12, 2019 was 20 inches.

Air temperatures were 6.6° lower than average for October 2019.

Overwinter leaf stage ranged from 1.5 to 2 leaf.

Fungicides were not used in any of the trials above.

Severe stripe rust infections resulted in reduced yields in susceptible varieties in 2017.

*The 2018 trial was lost due to winter kill.

Corn Grain, Langdon 2020

Brand	Hybrid	RM ¹	Hybrid Traits ¹	Days to Silk	Harvest Moisture (%)	Test Weight (lbs/bu)	Yield (bu/a)
Dyna-Gro	D15VC77	77	VT DoublePro	74	20.4	52.7	78.0
Dyna-Gro	D21VC81	81		76	26.2	47.5	86.3
Integra	2508	75	VT2	74	21.3	52.7	73.9
Integra	3009	79		74	22.9	49.8	87.6
Legacy Seeds	L-1818 VT2P	78	VT2P	74	20.7	50.5	98.9
Legacy Seeds	L-2019 RR2	78		74	23.1	49.4	94.5
Legacy Seeds	L-2019 VT2P	80	VT2P	74	23.0	48.4	87.0
Legacy Seeds	LC311-20 VT2P	81	VT2P	76	27.0	46.6	78.8
Mission Seed Solutions	A7837VT2P RIB	78	VT2P	77	25.3	48.7	72.0
Mission Seed Solutions	A7988VT2P RIB	79	VT2P	74	20.4	50.1	92.7
Peterson Farm Seeds	22C74	74		74	20.8	53.2	95.6
Peterson Farm Seeds	71V81	81	VT2P	77	23.1	48.6	69.5
Pioneer	P7417AM	74	AM	73	18.4	50.2	101.3
Pioneer	P7632AM	76	AM	74	22.4	48.8	89.0
Pioneer	P7861AM	78	AM	74	25.8	49.2	74.8
Pioneer	P7940AM	79	AM	74	24.3	50.5	95.8
Proseed	1974RR	74	VT2P	75	20.3	53.2	98.2
Proseed	1980VT2P	80		75	23.8	48.4	84.2
Proseed	2078GT	78		80	19.9	45.8	78.0
REA Hybrids	1B710	71	VT2	74	19.9	52.2	84.9
REA Hybrids	1B720	72	VT2	70	18.2	54.4	96.0
REA Hybrids	1B750	75	VT2	74	22.2	52.4	90.1
REA Hybrids	1B780	79	VT2	79	28.4	45.5	74.8
Thunder Seed	T4072 RR	72		73	19.6	50.8	73.7
Thunder Seed	T6074 VT2P	74	VT2P	74	21.5	52.6	87.1
Thunder Seed	6079 VT2P	79	VT2P	75	24.2	48.2	77.9
Thunder Seed	6181 VT2P	81	VT2P	75	26.4	47.1	88.4
Trial Mean				75	22.2	50.2	86.2
C.V. %				1.4	7.4	1.6	9.1
LSD 5%				1.7	2.7	1.4	12.9
LSD 10%				1.4	2.3	1.1	10.8

¹Relative maturity and hybrid traits as submitted by the company.

Yield and test weight reported at 15.5% moisture.

Corn was in late milk to early dent on September 8, which recorded a freezing temperature of 28° F.

GDD from May 21 to Sept 8 were 1664. Normal is 1486.

GDD to reach RM for 75 day corn is 1800, 80 day corn is 1920.



Barley Summary, Langdon 2016-2020

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)				Plump (%)					
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	17	19	20	3yr	16	17	18	19	20	3yr
Tradition*	108	122	131	121	119	124	46.8	48.8	49.8	48.3	46.4	48.2	2.3	0.0	0.2	0.8	89	94	96	92	90	93
Pinnacle	106	133	130	127	106	121	47.9	50.8	52.0	50.6	45.3	49.3	0.0	0.0	0.1	0.0	96	98	99	99	85	94
ND Genesis	105	129	139	123	131	131	47.3	49.1	50.4	48.7	46.7	48.6	0.0	0.3	0.5	0.3	96	96	97	97	92	95
AAC Synergy	113	131	147	123	132	134	48.0	49.5	51.2	50.1	46.2	49.2	3.5	1.3	2.7	2.5	94	94	97	97	86	93
Explorer	--	131	125	123	99	116	--	47.7	51.0	49.1	43.6	47.9	0.0	0.0	0.1	0.0	--	91	96	96	76	89
Conlon	--	--	111	110	109	110	--	--	51.7	51.0	48.4	50.4	--	1.8	0.3	--	--	--	98	98	90	95
AAC Connect	--	--	--	120	127	--	--	--	--	49.7	45.5	--	--	0.5	2.0	--	--	--	--	97	77	--
CDC Bow	--	--	--	--	130	--	--	--	--	--	48.6	--	--	--	0.3	--	--	--	--	--	92	--
ABI Balster	92	117	142	124	--	--	43.7	46.4	50.5	49.5	--	--	3.3	0.0	--	--	84	85	93	94	--	--
Lacey*	116	135	133	124	--	--	46.9	49.4	50.4	48.9	--	--	0.3	0.0	--	--	91	94	98	95	--	--
Stellar-ND*	104	131	135	--	--	--	48.8	48.8	48.8	--	--	--	0.0	--	--	--	95	97	98	--	--	--
Celebration*	111	128	128	--	--	--	47.1	47.7	49.5	--	--	--	4.5	--	--	--	92	91	98	--	--	--
Quest*	107	115	126	--	--	--	45.9	47.2	49.6	--	--	--	5.5	--	--	--	85	82	94	--	--	--
Innovation*	113	121	118	--	--	--	46.3	48.6	49.9	--	--	--	2.5	--	--	--	91	93	98	--	--	--
Sirish	88	126	126	--	--	--	44.1	48.7	48.9	--	--	--	0.3	--	--	--	85	95	97	--	--	--
ABI Growler	94	118	133	--	--	--	45.4	45.7	50.6	--	--	--	3.8	--	--	--	84	82	97	--	--	--
LCS Genie	77	116	128	--	--	--	43.5	47.9	51.0	--	--	--	0.3	--	--	--	83	93	95	--	--	--
CDC Meredith	90	114	--	--	--	--	44.7	46.9	--	--	--	--	4.3	--	--	--	86	89	--	--	--	--
LCS Odyssey	71	129	--	--	--	--	39.9	47.3	--	--	--	--	0.8	--	--	--	82	95	--	--	--	--
Rawson	107	--	--	--	--	--	46.8	--	--	--	--	--	--	--	--	--	97	--	--	--	--	--
Trial Mean	100	124	130	123	124		46.4	48.4	50.1	49.4	46.3		1.7	0.5	0.5		91	93	96	97	89	
C.V. %	6.4	6.3	6.0	3.4	4.2		2.6	1.7	2.3	0.7	0.9		122	149	126		4.2	3.4	1.5	1.3	2.4	
LSD 5%	9.1	11.1	11.0	5.9	7.5		1.7	1.2	1.6	0.5	0.6		2.8	1.0	0.9		5.4	4.4	2.0	1.8	3.0	
LSD 10%	7.6	9.3	9.2	4.9	6.2		1.4	1.0	1.4	0.4	0.5		2.4	0.9	0.7		4.5	3.7	1.7	1.5	2.5	

*6-row

Conlon suffered damage from rodents in 2016 and 2017. Data is not presented.



Barley Summary, Langdon 2016-2020																		
Variety	Height (in)						Protein (%)						Days to Head					
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr
Tradition*	34	38	27	28	28	28	13.9	12.9	14.3	12.8	12.9	13.3	55	56	50	55	47	51
Pinnacle	34	39	27	29	27	28	12.5	12.0	12.8	12.1	11.5	12.1	55	57	51	56	49	52
ND Genesis	30	38	29	29	28	29	10.9	11.3	11.9	11.3	10.6	11.3	57	57	51	57	50	53
AAC Synergy	31	37	29	28	27	28	11.9	11.9	13.1	12.4	12.1	12.5	58	58	52	59	51	54
Explorer	--	32	24	24	24	24	--	11.5	13.4	12.4	12.4	12.7	--	58	50	57	50	52
Conlon	--	--	27	25	28	27	--	--	13.8	13.0	11.9	12.9	--	--	47	54	47	49
AAC Connect	--	--	--	27	26	--	--	--	--	13.1	12.5	--	--	--	--	58	50	--
CDC Bow	--	--	--	--	28	--	--	--	--	--	12.5	--	--	--	--	--	52	--
ABI Balster	31	35	28	25	--	--	12.8	12.4	13.4	12.2	--	--	59	59	51	59	--	--
Lacey*	32	41	28	29	--	--	13.9	12.7	14.3	12.7	--	--	54	55	50	55	--	--
Stellar-ND*	34	40	25	--	--	--	13.3	12.5	13.2	--	--	--	54	56	50	--	--	--
Celebration*	32	39	28	--	--	--	13.9	13.7	15.2	--	--	--	55	56	50	--	--	--
Quest*	33	39	27	--	--	--	13.0	13.5	14.1	--	--	--	55	57	50	--	--	--
Innovation*	32	40	25	--	--	--	13.5	13.5	14.7	--	--	--	55	56	51	--	--	--
Sirish	30	33	26	--	--	--	13.0	11.9	13.4	--	--	--	60	60	53	--	--	--
ABI Growler	32	36	26	--	--	--	12.4	13.1	13.4	--	--	--	60	59	54	--	--	--
LCS Genie	29	32	25	--	--	--	12.4	11.0	12.9	--	--	--	62	61	54	--	--	--
CDC Meredith	31	36	--	--	--	--	12.2	12.3	--	--	--	--	59	60	--	--	--	--
LCS Odyssey	31	33	--	--	--	--	12.0	10.7	--	--	--	--	61	61	--	--	--	--
Rawson	33	--	--	--	--	--	12.2	--	--	--	--	--	54	--	--	--	--	--
Trial Mean	32	37	26	27	27		12.5	12.3	13.4	12.1	11.5		56	57	51	56	49	
C.V. %	6.4	5.8	6.3	5.5	4.1		5.3	4.6	3.4	3.5	3.6		1.3	1.4	2.1	1.5	1.4	
LSD 5%	2.9	3.0	2.3	2.1	1.6		0.9	0.8	0.6	0.6	0.6		1.0	1.1	1.5	1.2	0.9	
LSD 10%	2.4	2.5	2.0	1.8	1.3		0.8	0.7	0.5	0.5	0.5		0.8	0.9	1.3	1.0	0.4	

*6-row

Conlon suffered damage from rodents in 2016 and 2017. Data is not presented.



Oat Summary, Langdon 2016-2020

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Days to Head					
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr
Beach	146	201	164	152	185	167	37.0	41.2	41.6	40.6	39.9	40.7	61	60	51	58	47	52
CDC Dancer	132	192	182	189	192	187	36.3	39.5	41.0	39.5	36.9	39.1	61	61	52	59	49	53
HiFi	139	191	179	155	188	174	35.8	40.9	40.8	38.5	36.5	38.6	62	60	52	59	50	53
Hyttest	102	142	139	160	181	160	38.5	41.5	42.5	40.5	38.9	40.6	57	56	51	57	47	52
Killdeer	154	192	192	185	199	192	35.9	38.6	39.8	38.0	36.3	38.0	58	58	51	57	48	52
Otana	100	185	192	175	181	183	34.3	37.9	41.0	39.5	35.1	38.5	62	61	53	59	50	54
Rockford	125	192	178	168	170	172	36.8	42.5	41.7	40.4	37.7	39.9	63	60	52	59	50	54
Souris	136	189	165	166	186	173	34.8	39.9	39.9	38.5	36.7	38.4	61	60	51	58	48	52
Stallion	107	169	183	165	170	173	35.9	40.9	42.1	40.8	38.3	40.4	60	60	53	58	48	53
CDC Minstrel	145	219	181	177	199	186	33.2	37.7	40.2	37.2	34.5	37.3	59	59	52	58	49	53
Newburg	139	179	178	167	195	180	33.7	40.0	40.0	37.8	34.9	37.6	60	59	52	58	50	53
Leggett	157	194	195	189	193	193	37.1	40.7	41.2	39.5	36.6	39.1	61	60	52	59	49	53
Jury	128	176	208	192	191	197	34.9	41.0	40.3	37.6	35.4	37.8	60	60	52	61	49	54
Paul*	99	165	149	129	146	141	44.2	46.2	47.4	44.1	44.0	45.2	65	63	52	61	51	55
Deon	162	204	182	184	223	196	35.5	39.9	40.4	38.0	36.6	38.3	63	61	52	60	51	54
Hayden	134	195	169	177	181	175	38.3	43.2	41.2	40.3	38.0	39.8	59	59	52	58	48	53
CS Camden	174	229	208	188	209	202	34.1	37.5	38.7	36.3	33.6	36.2	61	61	52	59	49	53
ND Heart	132	178	171	157	194	174	36.6	40.8	40.7	39.5	37.3	39.2	60	59	51	58	48	52
Warrior	--	--	--	163	179	--	--	--	--	38.7	35.8	--	--	--	--	56	46	--
AC Pinnacle	151	191	184	151	--	--	34.9	37.6	40.9	38.9	--	--	63	62	52	58	--	--
GM 423	123	193	--	--	--	--	33.5	38.6	--	--	--	--	65	62	--	--	--	--
Furlong	152	--	--	--	--	--	37.0	--	--	--	--	--	65	--	--	--	--	--
Goliath	132	--	--	--	--	--	36.2	--	--	--	--	--	63	--	--	--	--	--
Trial Mean	136	186	181	170	192		35.8	40.7	41.0	39.2	37.2		61	60	52	59	49	
C.V. %	12.4	6.6	5.8	4.1	3.7		3.1	2.4	1.1	1.1	1.6		1.5	1.1	1.2	1.0	1.5	
LSD 5%	23.8	17.2	17.2	11.5	11.7		1.5	1.3	0.7	0.7	1.0		1.3	0.9	1.0	1.0	1.2	
LSD 10%	19.9	14.4	14.3	9.6	9.8		1.3	1.1	0.6	0.6	0.8		1.1	0.8	0.8	0.8	1.0	

*Hull-less variety



Oat Summary, Langdon 2016-2020																
Variety	Height (in)						Protein (%)					Lodging (0-9)				
	16	17	18	19	20	3yr	16	17	18	19	3yr	16	17	19	20	3yr
Beach	47	53	35	38	42	38	9.5	10.1	13.3	13.6	12.3	4.0	3.4	0.2	2.5	2.0
CDC Dancer	44	52	36	40	44	40	7.9	7.9	9.9	9.3	9.0	5.7	5.0	0.0	2.3	2.4
HiFi	43	52	36	42	40	39	8.6	10.2	11.5	11.1	10.9	5.5	3.4	0.0	2.6	2.0
Hyttest	45	51	37	41	44	41	11.4	12.8	14.2	14.1	13.7	7.2	4.3	0.8	1.6	2.2
Killdeer	40	46	32	35	38	35	8.2	9.3	11.5	10.9	10.6	5.5	5.2	0.0	2.4	2.5
Otana	42	51	38	42	42	41	8.4	9.7	12.3	11.5	11.2	6.7	6.1	1.3	5.3	4.2
Rockford	44	52	37	39	44	40	9.4	10.6	12.3	12.3	11.7	4.7	5.4	0.2	2.4	2.7
Souris	43	47	34	37	39	37	8.0	9.3	11.2	11.3	10.6	3.0	2.6	0.1	0.0	0.9
Stallion	43	52	38	39	43	40	10.1	10.9	12.8	12.9	12.2	8.0	5.1	0.1	2.7	2.6
CDC Minstrel	43	50	33	36	42	37	7.3	7.4	9.2	9.3	8.6	3.7	3.4	0.1	0.2	1.2
Newburg	47	55	38	42	43	41	7.7	9.3	11.4	10.8	10.5	7.5	6.3	1.1	4.3	3.9
Leggett	46	49	35	37	40	37	10.0	11.7	12.8	12.4	12.3	4.3	5.4	0.2	2.5	2.7
Jury	45	55	38	40	45	41	8.0	9.9	10.5	9.6	10.0	6.5	5.3	0.7	4.8	3.6
Paul*	43	55	38	40	47	42	13.4	13.8	17.1	16.7	15.9	6.0	5.0	0.1	1.7	2.3
Deon	42	52	36	39	47	41	8.7	10.0	12.7	11.9	11.5	4.3	3.6	0.0	0.9	1.5
Hayden	44	52	35	40	41	39	8.3	10.5	11.8	11.9	11.4	6.0	4.3	0.1	2.3	2.2
CS Camden	40	49	35	36	42	38	8.9	9.5	11.4	10.6	10.5	2.5	0.5	0.0	0.5	0.3
ND Heart	42	51	37	39	42	39	9.6	11.1	12.6	12.3	12.0	4.7	6.3	0.5	3.6	3.5
Warrior	--	--	--	35	39	--	--	--	--	13.3	--	--	--	0.0	1.0	--
AC Pinnacle	44	51	40	42	--	--	7.9	8.5	11.9	11.2	--	5.5	6.7	1.0	--	--
GM 423	44	52	--	--	--	--	8.8	9.4	--	--	--	5.8	6.6	--	--	--
Furlong	45	--	--	--	--	--	9.1	--	--	--	--	3.2	--	--	--	--
Goliath	45	--	--	--	--	--	9.1	--	--	--	--	5.3	--	--	--	--
Trial Mean	43	52	37	40	42		--	--	--	--		5.1	4.4	0.2	2.1	
C.V. %	6.3	2.7	4.3	4.1	4.3		--	--	--	--		35.2	37.6	234	76	
LSD 5%	3.8	1.9	2.6	2.6	3.0		--	--	--	--		2.5	2.3	0.8	2.6	
LSD 10%	3.2	1.6	2.1	2.2	2.5		--	--	--	--		2.1	2.0	0.7	2.2	

*Hull-less variety

2020 oat proteins were not available at time of printing.

Flax Summary, Langdon 2016-2020

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)						Height (in)						Days to Flower					
	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr	16	17	18	19	20	3yr
Carter*	40	48	38	42	43	41	52.1	53.0	53.0	53.2	53.1	53.1	0.5	0.0	0.3	0.3	0.2	0.3	27	27	24	25	25	25	50	57	49	53	47	50
CDC Glas	41	54	43	42	50	45	50.8	51.1	51.8	50.6	52.0	51.5	0.2	0.1	0.2	0.2	0.2	0.2	26	25	27	22	25	25	51	58	49	53	51	51
Omega*	33	46	39	39	40	39	52.2	52.5	53.4	53.4	53.2	53.3	1.0	0.4	0.7	0.4	0.7	0.4	24	26	22	23	20	22	51	57	48	54	45	49
Prairie Thunder	39	53	43	43	44	43	52.2	52.2	52.4	52.1	53.2	52.6	0.4	0.1	0.3	0.4	0.1	0.3	28	29	27	26	28	27	51	57	53	54	50	52
Webster	40	52	44	42	46	44	52.6	52.0	52.9	52.5	53.7	53.0	0.8	0.6	0.7	0.8	0.6	0.7	28	28	27	24	26	26	50	57	50	52	50	51
York	41	50	42	43	48	44	51.7	52.2	52.5	51.7	53.4	52.5	0.3	0.0	0.2	0.3	0.0	0.2	26	27	25	28	25	26	49	56	48	52	47	49
Bison	37	49	40	40	41	40	52.2	52.3	52.7	52.7	53.3	52.9	0.3	0.1	0.2	0.3	0.1	0.2	28	28	25	27	26	26	50	57	49	52	46	49
Gold ND*	38	52	43	41	48	44	52.1	52.2	53.1	52.7	53.4	53.1	0.7	0.1	0.4	0.7	0.1	0.4	26	28	27	25	23	25	52	57	52	53	49	51
CDC Neela	37	46	38	43	43	41	51.4	52.4	52.4	51.4	53.0	52.3	1.6	0.0	0.8	1.6	0.0	0.8	26	26	23	23	24	23	50	57	49	51	50	50
ND Hammond	--	49	39	38	40	39	--	51.1	52.5	51.5	52.9	52.3	--	0.0	--	--	0.0	--	--	26	25	24	23	24	--	56	48	52	46	49
CDC Plava	31	46	--	40	39	--	51.4	50.7	--	51.6	52.1	--	4.0	0.0	2.0	4.0	0.0	2.0	25	24	--	22	26	--	49	56	--	52	46	--
CDC Buryu	--	--	--	42	40	--	--	--	--	52.9	53.1	--	--	--	--	--	--	--	--	--	--	24	26	--	--	--	--	52	48	--
AAC Bright	--	--	--	38	51	--	--	--	--	48.9	51.1	--	--	--	--	--	--	--	--	--	--	23	25	--	--	--	--	52	49	--
CDC Dorado	--	--	--	--	38	--	--	--	--	--	52.8	--	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	43	--	--
CDC Melyn	--	--	--	--	35	--	--	--	--	47.4	--	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	54	--	--
CDC Bethune	39	49	42	--	--	--	52.2	52.9	52.7	--	--	--	0.5	0.0	0.3	0.5	0.0	0.3	28	28	26	--	--	--	50	57	48	--	--	--
CDC Sanctuary	33	54	44	--	--	--	51.0	49.7	52.4	--	--	--	1.7	1.2	1.5	1.7	1.2	1.5	25	26	23	--	--	--	50	58	48	--	--	--
CDC Sorrel	34	49	41	--	--	--	51.2	51.9	52.7	--	--	--	2.0	1.1	1.6	2.0	1.1	1.6	26	29	25	--	--	--	51	58	49	--	--	--
Nekoma	38	52	42	--	--	--	52.1	52.9	52.7	--	--	--	0.6	0.2	0.4	0.6	0.2	0.4	27	28	23	--	--	--	49	57	50	--	--	--
Pembina	38	52	43	--	--	--	51.2	53.0	53.0	--	--	--	0.3	0.2	0.3	0.3	0.2	0.3	27	27	24	--	--	--	50	57	49	--	--	--
Prairie Blue	40	51	39	--	--	--	51.4	52.0	52.4	--	--	--	0.4	0.0	0.2	0.4	0.0	0.2	25	26	25	--	--	--	50	57	49	--	--	--
Prairie Sapphire	35	54	46	--	--	--	50.8	51.3	51.9	--	--	--	2.1	0.0	1.1	2.1	0.0	1.1	28	28	24	--	--	--	51	57	50	--	--	--
Rahab 94	40	51	43	--	--	--	51.5	49.7	52.3	--	--	--	0.4	0.0	0.2	0.4	0.0	0.2	26	27	25	--	--	--	49	56	50	--	--	--
Prairie Grande	42	50	--	--	--	--	51.6	52.3	--	--	--	--	0.8	0.0	0.4	0.8	0.0	0.4	25	27	--	--	--	--	49	55	--	--	--	--
Shape	44	53	--	--	--	--	51.4	52.3	--	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	28	27	--	--	--	--	50	56	--	--	--	--
Trial Mean	38	51	42	41	45		51.7	52.0	52.6	52.2	53.1		0.8	0.2		0.8	0.2		27	27	25	25	25	25	50	57	50	53	48	
C.V. %	7.3	6.6	7.9	5.8	5.2		0.8	1.8	0.5	0.8	0.5		124	340		6.3	5.0	6.2	5.0	6.9	1.7	0.8	2.2	1.3	1.8					
LSD 5%	4.0	4.7	NS	3.9	3.9		0.6	1.3	0.4	0.6	0.4		1.5	1.1		2.4	1.9	2.5	2.0	2.8	1.2	0.7	1.8	1.1	1.4					
LSD 10%	3.3	3.9	NS	3.2	3.3		0.5	1.1	0.3	0.5	0.4		1.2	0.9		2.0	1.6	2.1	1.7	2.4	1.0	0.6	1.5	0.9	1.2					

*Yellow seeded.

Canola - Liberty Link, Clearfield and Conventional Varieties, Langdon 2019-2020

Company/Brand	Variety	Type ¹	Blackleg Rating ²		Status ³	Clubroot Resistant ⁶	Days to First Flower		Days to End Flower		Days to Mature		% Cover ⁴					
			19	20			19	20	19	20	19	20	19	20				
			20	2yr			20	2yr	19	20	19	20	19	20				
BASF	InVigor L233P	H,LL,TR	R	CA	No		47	39	43	62	57	60	94	87	91	92	88	90
BASF	InVigor L255P	H,LL,TR	R	CA	Yes		49	42	46	64	64	64	97	91	94	92	79	86
Canterra Seeds	CS2500 CL	H,CL,TR	R	CA	No		47	40	44	60	59	60	95	90	93	89	75	82
Dyna-Gro	DG 200CL	H,CL,TR	R	CA	No		49	44	47	65	67	66	96	93	95	88	75	82
CROPLAN ⁵	CP955RR	H,RR,TR	R	CA	Yes		46	39	43	62	60	61	95	88	92	95	70	83
BASF	InVigor L345PC	H,LL,TR	R	CA	Yes		48	41	45	63	64	64	95	92	94	91	88	90
BASF	InVigor L234PC	H,LL,TR	R	CA	Yes		47	39	43	62	57	60	94	86	90	86	89	88
BASF	InVigor L340PC	H,LL,TR	R	EXP	Yes		--	41	--	--	64	--	--	92	--	--	85	--
BASF	InVigor L357P	H,LL,TR	R	EXP	No		--	43	--	--	66	--	--	92	--	--	80	--
BASF	InVigor LR344PC	H,LL,TR	R	EXP	Yes		--	40	--	--	61	--	--	91	--	--	91	--
BrettYoung	BY19-6284CL	H,CL,TR	R	EXP	Yes		--	42	--	--	62	--	--	91	--	--	66	--
Canterra Seeds	CS2700 CL	H,CL,TR	R	EXP	Yes		--	44	--	--	68	--	--	93	--	--	68	--
Canterra Seeds ⁵	CS2300	H,RR,TR	R	CA	No		--	44	--	--	69	--	--	92	--	--	64	--
Dekalb	DKTFLL21SC	H,TF,LL,TR	R	CA	No		--	39	--	--	59	--	--	89	--	--	69	--
Dekalb	DKLL82SC	H,LL,TR	R	CA	No		--	38	--	--	58	--	--	89	--	--	80	--
Photosyntech	PST SCI 226 CL	H,CL,TR	MR	CA	No		--	50	--	--	72	--	--	93	--	--	74	--
Photosyntech	NCC101S	H,Conv,TR	MR	CA	No		--	38	--	--	56	--	--	83	--	--	89	--
Photosyntech	PST SCJ 701	H,Conv,TR	MR	CA	No		--	43	--	--	67	--	--	93	--	--	78	--
Pioneer	P502CL	H,CL,TR	R	CA	No		--	38	--	--	57	--	--	88	--	--	83	--
Pioneer	P501L	H,LL,TR	R	CA	Yes		--	41	--	--	63	--	--	92	--	--	79	--
Trial Mean							48	41		64	63		96	90		90	78	
C.V. %							1.2	2.6		1.5	2.2		1.7	1.0		4.5	10.7	
LSD 5%							0.8	1.5		1.4	1.9		2.4	1.2		5.8	11.7	
LSD 10%							0.7	1.3		1.2	1.6		2.0	1.0		4.8	9.8	

¹H-Hybrid, LL-Liberty Link, CL-Clearfield System, Conv-Conventional, TR-Traditional Oil Type.

²Blackleg Rating: MR-Moderately Resistant, R-Resistant. Rating provided by company.

³Status: CA-Commercially available, EXP-Experimental.

⁴% Cover-Visual rating of percent area of plot covered by plant growth. This is a measure of stand and vigor. Plants were at 5-6 leaf stage.

⁵Roundup Ready check variety.

⁶Has clubroot resistance gene.

Canola - Liberty Link, Clearfield and Conventional Varieties, Langdon 2018-2020

Company/Brand	Variety	Lodging													
		Height (in)				Oil ¹ (%)				Yield ¹ (lbs/a)					
		19	20	2yr	19	20	2yr	19	20	2yr	2018	2019	2020	2yr	3yr
BASF	InVigor L233P	46	43	45	5.5	5.8	5.7	44.2	42.0	43.1	3198	3528	3565	3546	3430
BASF	InVigor L255P	48	47	48	2.0	4.8	3.4	47.1	43.5	45.3	3749	3937	2961	3449	3549
Canterra Seeds	CS2500 CL	47	48	48	1.8	5.0	3.4	46.6	42.3	44.5	3563	3234	2665	2949	3154
Dyna-Gro	DG 200CL	50	47	49	4.3	6.8	5.6	43.7	41.0	42.4	3448	3216	2644	2930	3103
CROPLAN ²	CP955RR	42	44	43	4.8	5.5	5.2	47.5	44.0	45.8	3477	3469	2932	3201	3293
BASF	InVigor L345PC	49	51	50	4.0	6.3	5.2	44.4	40.6	42.5	--	3947	3135	3541	--
BASF	InVigor L234PC	43	48	46	6.5	6.0	6.3	44.3	41.6	43.0	--	3394	3195	3295	--
BASF	InVigor L340PC	--	46	--	--	5.3	--	--	40.9	--	--	--	3414	--	--
BASF	InVigor L357P	--	46	--	--	5.5	--	--	39.9	--	--	--	3031	--	--
BASF	InVigor LR344PC	--	50	--	--	6.5	--	--	41.4	--	--	--	3020	--	--
BrettYoung	BY19-6284CL	--	48	--	--	5.0	--	--	42.4	--	--	--	2603	--	--
Canterra Seeds	CS2700 CL	--	49	--	--	4.0	--	--	42.6	--	--	--	2722	--	--
Canterra Seeds ²	CS2300	--	51	--	--	4.5	--	--	42.1	--	--	--	2745	--	--
Dekalb	DKTFL21SC	--	45	--	--	4.8	--	--	42.2	--	--	--	3327	--	--
Dekalb	DKLL82SC	--	42	--	--	4.5	--	--	42.2	--	--	--	3169	--	--
Photosyntech	PST SCI 226 CL	--	54	--	--	0.3	--	--	41.1	--	--	--	2653	--	--
Photosyntech	NCC101S	--	41	--	--	5.0	--	--	40.3	--	--	--	2812	--	--
Photosyntech	PST SCJ 701	--	50	--	--	6.3	--	--	39.2	--	--	--	2571	--	--
Pioneer	P502CL	--	46	--	--	5.3	--	--	43.4	--	--	--	2887	--	--
Pioneer	P501L	--	46	--	--	5.5	--	--	43.0	--	--	--	3066	--	--
Trial Mean		47	47		3.1	5.2		44.8	41.7		3322	3432	2881		
C.V. %		6.3	6.6		56.4	18.4		2.8	1.4		6.3	8.2	8.2		
LSD 5%		4.2	4.3		2.5	1.3		1.8	0.8		294	396	331		
LSD 10%		3.5	3.6		2.1	1.1		1.5	0.7		245	331	277		

¹8.5% moisture

²Roundup Ready check variety.

Canola - Roundup Ready, Langdon 2019-2020

Company	Variety	Type ¹	Blackleg Rating ²		Status ³	Clubroot Resistant		Days to First Flower		Days to End Flower		Days to Mature		% Cover ⁴				
			RR	R		CA	Yes	19	20	19	20	19	20	19	20			
			2yr	19		20	2yr	19	20	2yr	19	20	2yr	19	20			
BrettYoung	6090RR	RR	R	R	CA	Yes	49	45	47	64	69	67	95	93	94	95	88	92
Canterra Seeds	CS2100	RR	R	R	CA	No	47	40	44	63	63	63	95	91	93	97	87	92
Canterra Seeds	CS2300	RR	R	R	CA	No	47	43	45	65	70	68	96	93	95	97	81	89
CROPLAN	CP930RR	RR	R	R	CA	No	45	36	41	61	56	59	94	84	89	97	90	94
CROPLAN	CP955RR	RR	R	R	CA	Yes	45	39	42	62	60	61	94	89	92	98	88	93
CROPLAN	CP9919RR	RR	R	R	CA	No	44	38	41	58	56	57	89	84	87	93	86	90
CROPLAN	CP9978TF	TF	R	R	CA	No	46	39	43	63	60	62	95	90	93	95	85	90
CROPLAN	CP9982RR	RR	R	R	CA	Yes	48	44	46	64	70	67	97	95	96	97	98	98
Canterra Seeds	CS2600 CR-T	TF	R	R	CA	Yes	45	39	42	62	59	61	94	88	91	97	83	90
Pioneer	45CM39	RR	R	R	CA	Yes	46	39	43	61	58	60	95	90	93	99	92	96
Star	StarFlex	TF	R	R	CA	No	46	39	43	61	62	62	93	92	93	95	96	96
BrettYoung	BY 6204TF	TF	R	R	CA	Yes	--	42	--	--	68	--	--	93	--	--	83	--
Dekalb	DKTF96SC	TF	R	R	CA	No	--	41	--	--	66	--	--	91	--	--	96	--
Dyna-Gro	DG 760TM	TF	R	R	EXP	No	--	38	--	--	58	--	--	86	--	--	96	--
Dyna-Gro	DG 761TM	TF	R	R	EXP	No	--	40	--	--	63	--	--	92	--	--	92	--
Integra	7361RC	TF	R	R	CA	Yes	--	39	--	--	60	--	--	90	--	--	93	--
Nusced	NC355 TF	TF	R	R	EXP	No	--	42	--	--	65	--	--	92	--	--	88	--
Nusced	NC401 TF	TF	R	R	CA	No	--	40	--	--	64	--	--	92	--	--	88	--
Proseed	EXP#TF1	TF	R	R	EXP	No	--	44	--	--	69	--	--	93	--	--	47	--
Trial Mean							46	40		63	63		94	90		96	87	
C.V. %							1.6	1.5		1.4	2.6		1.2	1.2		2.1	8.2	
LSD 5%							1.0	0.9		1.2	2.3		1.6	1.5		2.9	10.3	
LSD 10%							0.8	0.8		1.0	1.9		1.3	1.3		2.4	8.5	

¹ All varieties are Hybrids and Traditional Oil Types. RR-Roundup Ready, TF-Roundup Ready TruFlex.

² Blackleg Rating: R-Resistant. Rating provided by company.

³ Status: CA-Commercially available, EXP-Experimental.

⁴ % Cover-Visual rating of percent area of plot covered by plant growth. This is a measure of stand and vigor. Plants were at 5-6 leaf stage.

Canola - Roundup Ready, Langdon 2018-2020																
Company	Variety	Height (in)						Lodging (0-9)			Oil ¹ (%)			Yield ¹ (lbs/a)		
		19	20	2yr	19	20	2yr	19	20	2yr	18	19	20	2yr	3yr	
BrettYoung	6090RR	47	49	48	1.4	5.5	3.5	45.3	41.2	43.3	3214	3986	3478	3732	3559	
Canterra Seeds	CS2100	47	44	46	1.9	6.6	4.3	47.4	42.0	44.7	3312	3971	3206	3589	3496	
Canterra Seeds	CS2300	48	50	49	1.1	4.6	2.9	47.0	42.1	44.6	3382	4273	2938	3606	3531	
CROPLAN	CP930RR	44	46	45	1.6	5.3	3.5	49.0	41.5	45.3	3189	3710	3381	3546	3427	
CROPLAN	CP955RR	47	46	47	1.3	6.1	3.7	48.3	42.7	45.5	3161	3837	2954	3396	3317	
CROPLAN	CP9919RR	45	42	44	1.3	6.1	3.7	44.4	42.2	43.3	--	3477	3325	3401	--	
CROPLAN	CP9978TF	44	44	44	1.2	5.9	3.6	47.0	41.6	44.3	--	4060	3543	3802	--	
CROPLAN	CP9982RR	49	49	49	0.1	3.1	1.6	44.5	42.7	43.6	--	4136	3276	3706	--	
Canterra Seeds	CS2600 CR-T	47	46	47	4.1	6.5	5.3	47.2	42.2	44.7	--	4003	3325	3664	--	
Pioneer	45CM39	44	46	45	0.4	5.4	2.9	48.6	43.2	45.9	--	4274	3159	3717	--	
Star	StarFlex	43	44	44	1.9	5.6	3.8	47.5	42.7	45.1	--	3874	3076	3475	--	
BrettYoung	BY 6204TF	--	44	--	--	5.0	--	--	43.0	--	--	--	2870	--	--	
Dekalb	DKTF96SC	--	47	--	--	5.6	--	--	43.0	--	--	--	2830	--	--	
Dyna-Gro	DG 760TM	--	45	--	--	5.0	--	--	42.3	--	--	--	3307	--	--	
Dyna-Gro	DG 761TM	--	50	--	--	5.1	--	--	43.0	--	--	--	3013	--	--	
Integra	7361RC	--	45	--	--	6.6	--	--	41.2	--	--	--	3249	--	--	
Nuseed	NC355 TF	--	46	--	--	6.1	--	--	41.6	--	--	--	3157	--	--	
Nuseed	NC401 TF	--	48	--	--	5.6	--	--	42.7	--	--	--	3552	--	--	
Proseed	EXP#TF1	--	44	--	--	5.8	--	--	42.5	--	--	--	3016	--	--	
Trial Mean		45	46		1.5	5.5		46.8	42.3		3198	3931	3209			
C.V. %		5.7	7.2		64.3	13.7		1.8	2.4		6.6	5.1	8.4			
LSD 5%		3.6	4.7		1.3	1.1		1.2	1.5		297	284	384			
LSD 10%		3.0	3.9		1.1	0.9		1.0	1.2		248	238	320			

¹ 8.5% Moisture

Dry Bean Summary, Langdon 2018-2020									
Variety	Type	Days to Maturity	Plant Height	100 Seed Weight	Yield				
					2018	2019	2020	2 yr Avg.	3 yr Avg.
			(in.)	(g)	(lbs/a)				
LaPaz	Pinto	101	15	34	2741	2564	3693	3129	2999
Lariat	Pinto	105	16	37	2861	2516	3455	2986	2944
Stampede	Pinto	102	14	36	3202	2415	3899	3157	3172
Windbreaker	Pinto	99	15	37	2552	2291	3876	3084	2906
ND Palomino	Pinto	105	15	35	2864	2239	3020	2630	2708
Monterrey	Pinto	101	16	33	3068	2442	3807	3125	3106
ND Falcon	Pinto	109	18	33	--	2280	3114	2697	--
Vibrant	Pinto	101	18	37	--	2693	4033	3363	--
Torreon	Pinto	101	17	36	--	2553	3804	3179	--
HMS Medalist	Navy	104	18	18	2567	2346	3891	3119	2935
T9905	Navy	104	15	21	2781	2065	3781	2923	2876
Blizzard	Navy	104	19	19	--	2327	3321	2824	--
Shock	Navy	104	15	23	--	--	3065	--	--
Argosy	Navy	110	17	22	--	--	3313	--	--
Nautica	Navy	108	16	18	--	--	2367	--	--
Eclipse	Black	103	17	20	2679	2181	3634	2908	2831
Black Tails	Black	104	16	21	--	2112	3759	2936	--
ND Twilight	Black	101	16	21	--	--	3205	--	--
Merlot	Small Red	108	16	35	2284	2205	3089	2647	2526
Viper	Small Red	109	15	27	--	2854	3329	3092	--
Dynasty	Dark Red Kidney	108	17	55	--	--	2717	--	--
ND Pegasus	Great Northern	105	16	35	--	2811	4124	3468	--
Trial Mean		105	17	29	2802	2385	3470		
C.V. %		2.4	7.4	4.1	8.2	10.8	7.8		
LSD 5%		4.2	2.0	2.0	385	427	446		
LSD 10%		3.5	1.6	1.7	319	355	371		



Field Pea, Langdon 2018-2020

Variety	Days to 1st Flower	Canopy			1000 KWT (g)	Test Weight (lbs/bu)	Protein ² (%)	Yield				
		Mature (days)	Ht. at Harvest (in)	Harvest Ease ¹ (0-9)				2018	2019	2020	2 yr Avg.	3 yr Avg.
Yellow Cotyledon Type												
Agassiz	47	87	14	6.2	232	61.9	25.5	92.3	64.3	76.3	70.3	77.6
DS Admiral	46	79	17	5.7	220	63.2	23.9	84.4	61.2	73.0	67.1	72.9
Mystique	48	87	23	2.9	255	62.6	24.2	94.7	65.4	71.5	68.5	77.2
Nette 2010	45	79	17	6.1	207	63.4	23.9	90.2	64.8	70.7	67.8	75.2
CDC Amarillo	50	89	22	3.2	213	62.5	25.0	88.1	68.1	70.4	69.3	75.5
CDC Saffron	48	84	13	7.7	214	63.1	25.4	86.5	71.8	80.9	76.4	79.7
AAC Carver	48	82	20	5.3	211	62.7	23.7	94.5	74.0	68.2	71.1	78.9
Jetset	46	77	15	6.6	220	61.9	25.6	91.9	67.2	65.5	66.4	74.9
CDC Inca	49	87	23	2.8	213	63.0	25.4	96.6	70.6	74.4	72.5	80.5
AAC Profit	48	90	21	5.3	205	62.9	25.7	99.9	69.5	74.5	72.0	81.3
Durwood	47	88	29	1.3	248	63.7	25.3	91.3	60.6	75.6	68.1	75.8
Hyline	47	86	18	5.6	245	62.6	25.3	94.2	68.7	62.1	65.4	75.0
LG Sunrise	45	90	23	2.3	248	63.1	24.4	83.9	63.7	72.4	68.1	73.3
Salamanca	48	85	25	2.9	278	62.9	27.5	90.2	61.2	74.5	67.9	75.3
CDC Spectrum	48	89	20	5.5	215	61.9	26.1	--	69.6	55.9	62.8	--
Majestic	47	86	29	1.6	229	62.7	26.0	--	67.4	58.8	63.1	--
AAC Asher	48	80	10	7.9	228	62.2	25.5	--	77.1	64.2	70.7	--
DL Apollo	47	80	22	3.7	223	63.0	25.8	--	64.0	59.6	61.8	--
AAC Chrome	49	89	13	7.3	223	62.5	24.0	--	76.8	76.7	76.8	--
CDC Dakota	50	88	12	7.3	163	62.6	29.5	--	63.6	56.7	60.2	--
Korando	42	81	18	5.9	249	61.9	27.5	--	61.5	53.4	57.5	--
ND Dawn	47	78	11	8.5	207	62.5	24.2	--	--	59.7	--	--
Orchestra	47	84	13	6.6	292	62.8	27.2	--	--	72.4	--	--
093-7410	47	84	14	7.4	188	62.3	24.4	--	--	53.9	--	--
133-6243	43	78	15	5.9	270	62.1	25.0	--	--	63.0	--	--
143-6230	47	84	11	8.4	166	62.0	26.6	--	--	45.6	--	--
143-6220	48	86	11	8.6	180	62.3	26.2	--	--	42.8	--	--
153-7409	44	76	9	8.4	207	61.3	25.3	--	--	60.7	--	--
Cronos	43	77	16	6.4	248	62.0	26.8	--	--	58.2	--	--
LGPN 4915	46	82	21	4.9	209	62.6	28.6	--	--	61.1	--	--
LG Equator	45	85	24	3.7	198	63.0	26.6	--	--	64.3	--	--
MS-19YP3	47	82	16	6.8	221	63.1	25.1	--	--	69.7	--	--
MS-20YP4	49	91	19	4.8	212	62.6	26.8	--	--	70.8	--	--
Green Cotyledon Type												
CDC Striker	48	83	13	5.4	213	63.0	26.2	89.0	66.1	59.6	62.9	71.6
Arcadia	47	80	9	9.4	203	62.6	24.1	84.0	65.4	64.6	65.0	71.3
Hampton	49	85	5	8.7	195	62.0	28.4	--	59.3	44.7	52.0	--
Greenwood	46	78	12	8.2	162	62.8	25.2	--	--	48.7	--	--
Aragorn	45	78	11	8.3	185	62.3	26.6	--	--	53.2	--	--
Empire	49	89	24	3.2	226	63.5	24.2	--	--	73.3	--	--
Shamrock	50	89	19	5.3	245	62.4	24.7	--	--	58.9	--	--
Bluemoon	48	84	16	6.3	242	62.8	26.2	--	--	60.5	--	--
Trial Mean	47	84	17	5.8	218	62.6	25.7	89.0	66.1	64.0		
C.V. %	1.5	1.9	17.6	17.9	6.9	0.8	2.3	6.3	5.8	8.7		
LSD 5%	1.1	2.6	4.9	1.7	24.7	0.8	1.0	7.9	5.4	9.1		
LSD 10%	0.9	2.1	4.1	1.4	20.6	0.6	0.8	6.6	4.5	7.6		

¹ Harvest Ease: 0=plants standing erect, 9=plants laying horizontal.

² 0% moisture basis

Faba Bean, Langdon 2020

Variety	Plant Stand		Days to 1st Flower (DAP) ¹	Days to Mature (DAP) ¹	Plant Height (in)	1000 KWT (g)	Protein ² (%)	Test Weight (lbs/bu)	Chocolate Brown Spot Severity (%)		Seed Yield ² (bu/a)	
	Seedling (ft ²)	Flower (DAP) ¹							2020	2-yr Avg.	3-yr Avg.	
Boxer	4.9	43	122	48	525	26.6	64.6	4.0	85.5	68.4	68.9	
Fabelle	5.7	43	111	38	453	28.1	64.9	6.5	74.7	64.2	69.4	
Tiffany	4.8	44	111	41	488	27.7	64.7	3.8	85.6	70.3	--	
Victus	6.3	42	113	39	536	27.1	64.9	6.3	94.7	--	--	
LG Cartouche	5.5	43	111	38	513	27.7	65.1	3.0	91.9	--	--	
PUSA 2001	4.7	43	108	37	483	26.3	62.6	13.8	65.2	--	--	
PUSA 2002	5.9	44	109	39	428	25.6	65.0	26.3	62.6	--	--	
Trial Mean	5.4	43	112	40	489	27.0	64.5	9.1	80.0	--	--	
C.V. %	12.7	1.1	1.4	4.4	3.8	2.3	0.7	39.6	8.5	--	--	
LSD 5%	1.0	0.7	2.3	2.6	27.4	0.9	0.6	5.3	10.1	--	--	
LSD 10%	0.8	0.6	1.9	2.2	22.6	0.8	0.5	4.4	8.4	--	--	

¹ DAP - Days after planting

² Yield and protein at 16% moisture.

Targeted plant stand was 4.5 plants/ft².



Soybean - Enlist, GT, RR and Xtend, Langdon 2020 (page 1 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant					Yield		
				Maturity date ³	Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	2020	2 yr Avg.	2-site Avg. ⁴
Biogene	BG8000	RR2XT	00.9	9/14	34	0.3	34.0	15.2	58.4	55.9	57.2
Biogene	BG8007	RR2XT	00.7	9/11	35	2.0	32.9	15.7	57.4	51.3	57.8
Biogene	BG8008	RR2XT	00.8	9/11	31	0.6	33.2	15.6	57.4	52.0	58.2
Dahlman	1102E3N	E3	0.2	9/19	30	1.4	33.3	14.9	62.4	--	62.7
Dahlman	68008XN	RR2XT	00.8	9/13	34	0.7	32.4	15.9	56.9	--	57.4
Dyna-Gro	S007XT27	RR2XT	00.7	9/12	29	0.7	32.9	15.7	57.1	54.6	56.0
Dyna-Gro	S009XT49	RR2XT	00.9	9/14	35	1.1	33.0	15.5	64.1	58.3	63.7
Dyna-Gro	S009XT68	RR2XT	00.9	9/16	36	1.0	34.9	14.3	63.4	58.8	64.3
Dyna-Gro	SX203007X	RR2XT	00.7	9/10	36	2.0	31.9	15.6	59.6	--	61.8
Golden H.	GH00833E3	E3	00.8	9/14	30	1.2	32.9	15.7	57.0	--	58.0
Golden H.	GH0145X	RR2XT	0.1	9/13	34	0.9	33.0	15.4	61.4	55.8	62.5
Integra	20097	RR2Y	00.9	9/14	35	1.5	34.0	16.0	63.8	59.2	63.1
Integra	40089N	E3	00.8	9/14	29	1.8	32.8	15.8	55.8	56.1	59.0
Integra	50060N	RR2XT	00.6	9/11	34	0.6	33.6	15.4	58.6	--	56.9
Integra	50081N	RR2XT	00.8	9/8	30	0.1	34.7	15.2	57.4	--	58.1
Legacy	LS 012--20	E3	0.1	9/17	31	1.6	34.3	15.2	65.6	--	64.2
Legacy	LS-00639N RR2X	RR2XT	00.6	9/10	35	1.4	33.8	15.3	60.5	55.3	59.4
Legacy	LS-00930 RR2X	RR2XT	00.9	9/16	29	0.6	34.9	14.8	54.3	54.9	57.0
Legacy	LS-0239N RR2X	RR2XT	0.2	9/18	33	1.8	33.9	14.4	64.5	60.7	63.9
Legend	LS 005E953N	E3	00.5	9/14	31	1.5	32.9	15.5	53.3	50.4	--
Legend	LS 009E955N	E3	00.9	9/17	31	0.8	33.8	15.2	50.1	47.5	--
Legend	LS 009X852N	RR2XT	00.9	9/11	33	0.1	32.8	15.9	60.7	56.2	--
LG Seeds	LGS00663RX	RR2XT	00.6	9/10	32	1.1	33.4	15.8	63.0	56.8	61.7
LG Seeds	LGS00899RX	RR2XT	00.8	9/14	34	0.6	32.8	15.7	59.0	55.4	59.1
LG Seeds	LGS0111RX	RR2XT	0.1	9/18	37	1.6	34.2	15.1	62.8	59.6	60.4
Mission Seed	A00918X	RR2XT	00.9	9/16	38	0.7	34.6	14.8	61.6	--	56.5
Mission Seed	A00979X	RR2XT	00.9	9/17	29	0.9	34.5	15.0	61.7	--	61.6
NDSU	ND17009GT	GT	00.9	9/12	35	2.2	35.7	15.9	55.3	50.7	55.1
PFS	18X008N	RR2XT	00.8	9/13	33	0.0	33.1	16.0	60.4	56.0	63.2
PFS	19EN008	E3	00.8	9/14	33	1.6	33.2	15.9	57.7	55.8	59.0
PFS	21X007	RR2XT	00.7	9/9	34	0.9	32.0	15.8	59.3	--	59.4
Pioneer	P00A49X	RR2XT	0.0	9/12	32	0.8	32.8	16.0	58.0	55.7	57.7
Pioneer	P00A75X	RR2XT	0.0	9/17	31	0.5	32.4	16.0	56.1	--	58.7
Pioneer	P03A17X	RR2XT	0.2	9/17	30	0.4	32.8	16.1	53.3	49.8	55.3
Pioneer	P01A84X	RR2XT	0.1	9/17	33	2.1	33.6	15.5	53.2	53.0	55.4

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our northern region. Langdon REC and Pembina County (Cavalier).

Yield, oil and protein reported at 13% moisture.

Soybean - Enlist, GT, RR and Xtend, Langdon 2020 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant					Yield		
				Maturity date ³	Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	2020	2 yr Avg.	2-site Avg. ⁴
Proseed	50-10RR2Y	RR2Y	0.1	9/16	38	1.1	34.0	15.7	59.2	56.2	60.2
Proseed	EL80-093	E3	00.9	9/17	32	2.1	33.8	15.0	50.9	--	53.7
Proseed	XT20-07	RR2XT	00.7	9/11	33	1.7	32.5	15.3	57.8	--	57.2
Proseed	XT60-09	RR2XT	00.9	9/16	38	1.0	34.9	14.2	62.0	58.4	61.3
Proseed	XT70-09N	RR2XT	00.9	9/14	34	0.6	33.1	15.7	58.5	--	59.8
REA	RX00749	RR2XT	00.7	9/15	38	1.1	34.4	14.9	60.9	53.1	--
Stine	003EB62	E3	00.8	9/16	30	1.5	32.8	15.6	53.6	--	--
Stine	01EA63	E3	0.1	9/17	31	0.6	34.5	14.6	60.8	55.8	--
Syng NK	S006-R7X	RR2XT	00.6	9/7	31	0.5	33.5	16.2	63.8	55.6	--
Syng NK	S008-E3	E3	00.8	9/13	30	1.4	32.9	15.2	58.2	--	61.7
Thunder	39005 RR2Y	RR2Y	00.5	9/10	29	0.0	34.0	15.8	61.8	--	61.7
Thunder	SB8001	RR2XT	0.1	9/16	30	2.2	34.6	15.2	54.0	54.1	57.7
Thunder	SB81006	RR2XT	00.6	9/8	34	1.6	31.7	16.1	58.8	--	60.8
Thunder	SB87009	RR2XT	00.9	9/15	39	1.3	34.3	14.7	61.7	--	59.5
Thunder	SB88007N	RR2XT	00.7	9/14	33	0.0	33.1	15.6	56.3	53.5	54.7
Thunder	TE71008N	E3	00.8	9/12	33	2.2	33.8	15.6	59.2	--	60.8
Trial Mean				9/14	33	1.1	33.5	15.4	57.3		
C.V. %				1.3	6.3	76.2	1.3	1.4	7.8		
LSD 5%				2.1	2.9	1.2	0.9	0.4	6.2		
LSD 10%				1.8	2.4	1.0	0.7	0.4	5.2		

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our northern region. Langdon REC and Pembina County (Cavalier).

Yield, oil and protein reported at 13% moisture.



Soybean - Enlist, GT, RR and Xtend, Pembina County 2020 (page 1 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity date ³	Plant Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	Yield		
									2020	2 yr Avg.	2-site Avg. ⁴
Biogene	BG8000	RR2XT	00.9	9/17	40	1.7	34.1	15.6	56.0	--	57.2
Biogene	BG8007	RR2XT	00.7	9/13	34	0.1	33.8	15.7	58.1	--	57.8
Biogene	BG8008	RR2XT	00.8	9/15	33	0.1	34.0	15.5	59.0	--	58.2
Dahlman	1102E3N	E3	0.2	9/21	31	0.0	33.5	15.6	63.0	--	62.7
Dahlman	68008XN	RR2XT	00.8	9/16	36	0.7	33.7	16.2	57.8	--	57.4
Dyna-Gro	S007XT27	RR2XT	00.7	9/16	36	0.2	33.6	15.8	54.8	45.4	56.0
Dyna-Gro	S009XT49	RR2XT	00.9	9/15	38	2.2	34.3	15.8	63.2	51.7	63.7
Dyna-Gro	S009XT68	RR2XT	00.9	9/16	41	1.1	34.3	14.9	65.2	53.4	64.3
Dyna-Gro	SX203007X	RR2XT	00.7	9/13	37	2.2	33.0	15.3	64.0	--	61.8
Golden H.	GH00833E3	E3	00.8	9/14	33	0.5	32.8	16.2	58.9	--	58.0
Golden H.	GH0145X	RR2XT	0.1	9/17	39	0.9	33.5	15.3	63.5	51.3	62.5
Integra	20097	RR2Y	00.9	9/17	40	2.0	34.2	16.3	62.3	50.5	63.1
Integra	40089N	E3	00.8	9/15	36	1.1	33.4	16.0	62.2	51.2	59.0
Integra	50060N	RR2XT	00.6	9/13	35	0.1	33.9	15.7	55.2	--	56.9
Integra	50081N	RR2XT	00.8	9/13	36	0.6	34.8	15.5	58.7	--	58.1
Legacy	LS 012--20	E3	0.1	9/19	33	0.4	34.1	15.6	62.7	--	64.2
Legacy	LS-00639N RR2X	RR2XT	00.6	9/12	35	0.0	33.8	15.8	58.3	48.9	59.4
Legacy	LS-00930 RR2X	RR2XT	00.9	9/20	32	0.2	35.1	15.6	59.7	48.8	57.0
Legacy	LS-0239N RR2X	RR2XT	0.2	9/21	36	2.0	33.3	15.2	63.2	54.4	63.9
LG Seeds	LGS00663RX	RR2XT	00.6	9/13	35	0.0	34.2	15.6	60.3	48.3	61.7
LG Seeds	LGS00899RX	RR2XT	00.8	9/15	37	1.8	33.2	16.0	59.2	49.1	59.1
LG Seeds	LGS0111RX	RR2XT	0.1	9/21	38	1.6	34.5	15.5	58.0	51.4	60.4
Mission Seed	A00918X	RR2XT	00.9	9/18	39	0.8	34.6	14.9	51.4	--	56.5
Mission Seed	A00979X	RR2XT	00.9	9/18	29	0.0	35.3	15.3	61.4	--	61.6
NDSU	ND17009GT	GT	00.9	9/16	38	1.0	36.3	15.9	54.9	46.0	55.1
PFS	18X008N	RR2XT	00.8	9/16	36	1.5	34.0	15.9	66.0	53.3	63.2
PFS	19EN008	E3	00.8	9/16	34	0.9	33.1	16.3	60.2	48.0	59.0
PFS	21X007	RR2XT	00.7	9/12	35	0.7	33.1	15.2	59.5	--	59.4
Pioneer	P00A49X	RR2XT	0.0	9/16	35	0.5	33.7	16.2	57.3	47.0	57.7
Pioneer	P00A75X	RR2XT	0.0	9/18	35	0.2	32.5	16.4	61.3	--	58.7
Pioneer	P03A17X	RR2XT	0.2	9/20	34	0.2	33.7	16.0	57.3	48.3	55.3
Pioneer	P03A26X	RR2XT	0.3	9/21	37	0.2	34.0	15.2	51.8	--	--
Pioneer	P01A84X	RR2XT	0.1	9/20	36	1.6	33.2	16.3	57.5	48.1	55.4
Proseed	50-10RR2Y	RR2Y	0.1	9/18	41	1.5	33.5	16.8	61.1	51.7	60.2
Proseed	EL80-093	E3	00.9	9/20	33	0.7	33.6	15.8	56.4	--	53.7

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our northern region. Langdon REC and Pembina County (Cavalier).

Yield, oil and protein reported at 13% moisture.

Soybean - Enlist, GT, RR and Xtend, Pembina County 2020 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Maturity date ³	Plant Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	Yield		
									2020	2 yr Avg.	2-site Avg. ⁴
Proseed	XT20-07	RR2XT	00.7	9/16	35	1.4	32.9	15.4	56.5	--	57.2
Proseed	XT60-09	RR2XT	00.9	9/17	39	1.5	35.2	14.3	60.5	50.0	61.3
Proseed	XT70-09N	RR2XT	00.9	9/17	36	1.1	33.5	16.1	61.1	--	59.8
REA	RX0228	RR2XT	00.7	9/18	42	1.4	35.0	15.4	57.7	49.9	--
REA	RX0327	RR2XT	00.8	9/21	36	0.0	35.5	15.2	62.1	--	--
Syng NK	S008-E3	E3	00.8	9/15	36	1.5	32.8	16.5	65.1	--	61.7
Syng NK	S01-C4X	RR2XT	0.1	9/18	37	1.4	33.8	14.8	62.0	52.2	--
Syng NK	S02-F9X	RR2XT	0.2	9/20	35	0.3	32.8	15.9	66.0	54.5	--
Syng NK	S03-E3	E3	0.3	9/21	35	0.5	33.7	15.4	65.4	--	--
Thunder	39005 RR2Y	RR2Y	00.5	9/12	32	0.8	33.8	16.5	61.5	--	61.7
Thunder	SB8001	RR2XT	0.1	9/20	31	0.0	35.3	15.5	61.3	48.5	57.7
Thunder	SB81006	RR2XT	00.6	9/14	38	1.1	33.1	15.5	62.8	--	60.8
Thunder	SB87009	RR2XT	00.9	9/17	38	1.2	35.3	14.7	57.3	49.4	59.5
Thunder	SB88007N	RR2XT	00.7	9/16	37	1.5	33.7	16.0	53.1	46.0	54.7
Thunder	TE71008N	E3	00.8	9/15	34	1.1	33.5	16.0	62.3	--	60.8
Trial Mean				9/16	36	0.9	34.0	15.7	58.4		
C.V. %				1.1	6.0	91.0	1.3	2.1	7.7		
LSD 5%				1.9	3.0	1.2	0.9	0.7	6.3		
LSD 10%				1.6	2.5	1.0	0.7	0.6	5.3		

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our northern region. Langdon REC and Pembina County (Cavalier).

Yield, oil and protein reported at 13% moisture.

Soybean - Enlist, GT, RR and Xtend, Walsh County 2020 *(page 1 of 2)*

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant					Yield			
				Maturity date ³	Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	2020	2 yr Avg.	2-site Avg. ⁴	
										----- bu/a -----		
Biogene	BG8000	RR2XT	00.9	9/4	42	2.9	32.1	17.4	66.2	--	--	
Biogene	BG8007	RR2XT	00.7	9/1	41	1.7	33.1	16.8	65.3	--	--	
Biogene	BG8008	RR2XT	00.8	9/5	40	1.2	31.9	16.8	71.7	--	--	
Dahlman	6004XN	RR2XT	0.4	9/11	39	1.8	33.8	16.5	72.9	--	--	
Dahlman	6903XN	RR2XT	0.3	9/10	41	3.9	32.9	16.4	67.0	52.5	61.6	
Dairyland	DSR-0119E	E3	0.1	9/9	42	5.4	32.7	16.9	69.3	--	62.5	
Dairyland	DSR-0577E	E3	0.5	9/11	43	4.0	34.8	16.6	66.9	--	61.4	
Dairyland	E8-201E	E3	00.8	9/8	43	5.1	32.9	16.6	67.9	--	62.1	
Dairyland	E9-201E	E3	00.9	9/9	41	4.1	33.9	16.4	63.8	--	57.2	
Dyna-Gro	S02EN71	RR2XT	0.2	9/8	36	0.7	33.4	15.8	78.0	--	68.4	
Dyna-Gro	S03XT29	RR2XT	0.3	9/9	43	4.9	32.7	16.1	69.7	53.3	63.2	
Dyna-Gro	S04XT91	RR2XT	0.4	9/9	41	0.3	33.4	16.6	73.0	--	68.2	
Golden H.	GH0145X	RR2XT	0.1	9/6	42	1.8	32.6	16.7	70.2	51.0	--	
Golden H.	GH0325E3	E3	0.3	9/7	41	0.7	32.9	16.2	75.8	--	67.2	
Hefty	H04X8	RR2XT	0.4	9/11	41	2.2	33.3	16.5	70.5	--	66.2	
Integra	40089N	E3	00.8	9/5	42	4.0	32.8	17.0	68.3	--	59.9	
Integra	40201N	E3	0.2	9/10	35	1.3	33.1	16.7	73.7	--	65.3	
Integra	50081N	RR2XT	00.8	9/3	38	1.5	34.0	15.7	67.1	--	61.6	
Integra	50309N	RR2XT	0.3	9/8	43	3.9	33.8	16.0	69.6	52.3	63.2	
Legacy	LS-0239N RR2X	RR2XT	0.2	9/8	42	4.5	33.5	15.8	73.6	55.8	64.9	
Legacy	LS-0320N E3	E3	0.3	9/8	40	1.4	33.0	16.3	74.7	--	66.3	
Legacy	LS-0429 E3	E3	0.4	9/12	42	4.2	34.3	16.4	69.8	52.3	62.9	
Legacy	LS-0438	RR2XT	0.4	9/11	40	2.9	34.2	16.5	72.9	53.4	66.9	
LG Seeds	LGS00663RX	RR2XT	00.6	9/1	40	1.9	32.6	16.4	71.1	48.2	64.4	
LG Seeds	LGS00899RX	RR2XT	00.8	9/5	41	3.6	32.0	17.5	69.5	49.1	63.7	
LG Seeds	LGS0111RX	RR2XT	0.1	9/10	46	3.8	33.8	16.6	70.5	53.0	63.7	
LG Seeds	LGS0355RX	RR2XT	0.3	9/10	41	4.5	33.3	15.7	63.4	50.2	60.1	
LG Seeds	LGS0400RX	RR2XT	0.4	9/11	42	2.6	32.3	16.7	76.8	58.1	69.9	
NDSU	ND17009GT	GT	00.9	9/5	45	5.0	35.4	17.0	65.3	45.8	58.8	
PFS	19EN008	E3	00.8	9/7	43	4.7	32.8	17.0	66.3	48.3	--	
P3 Genetics	2002E	E3	0.2	9/8	37	3.7	33.5	16.2	69.9	50.9	64.5	
P3 Genetics	2003E	E3	0.3	9/8	39	1.5	32.4	16.7	76.2	52.5	66.6	
Pioneer	P00A75X	RR2XT	0.0	9/5	39	1.6	33.0	17.6	72.1	--	--	
Pioneer	P03A17X	RR2XT	0.2	9/7	37	0.6	31.8	17.6	67.1	51.4	--	
Pioneer	P03A26X	RR2XT	0.3	9/10	42	2.7	32.7	16.8	69.5	--	--	

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8-9 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our southern region, Walsh County (Park River) and Nelson County (Pekin).

Yield reported at 13% moisture.

Soybean - Enlist, GT, RR and Xtend, Walsh County 2020 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant					Oil (%)	2020	2 yr Avg.	2-site Avg. ⁴
				Maturity date ³	Height (in)	Lodging (0-9)	Protein (%)					
Pioneer	P01A84X	RR2XT	0.1	9/8	41	2.5	33.5	17.0	69.7	50.9	--	
Proseed	50-10RR2Y	E3	0.1	9/8	43	3.8	31.8	17.8	71.1	52.8	63.8	
Proseed	EL80-093	E3	00.9	9/7	41	4.5	34.5	16.1	71.1	--	60.0	
Proseed	XT20-07	RR2XT	00.7	9/4	42	3.8	31.6	16.7	71.5	--	62.0	
Proseed	XT60-09	RR2XT	00.9	9/5	45	3.2	33.2	15.8	73.3	54.0	67.3	
Proseed	XT70-09N	RR2XT	00.9	9/4	45	2.1	32.4	17.1	62.3	--	59.8	
REA Hybrids	RX0228	RR2XT	0.2	9/7	45	2.3	33.0	16.7	66.6	47.3	--	
REA Hybrids	RX0411	RR2XT	0.4	9/10	47	2.4	32.0	16.6	76.6	--	67.9	
Syng NK	S01-C4X	RR2XT	0.1	9/7	44	3.1	32.4	16.3	72.1	52.2	65.4	
Syng NK	S02-F9X	RR2XT	0.2	9/7	39	0.3	32.3	16.7	77.1	54.6	68.5	
Syng NK	S03-E3	E3	0.3	9/9	40	1.3	32.4	16.7	81.3	--	--	
Syng NK	S03-S6X	RR2XT	0.3	9/9	44	3.7	31.9	16.7	69.6	48.9	63.7	
Thunder	SB8001	RR2XT	0.1	9/5	39	1.2	33.7	16.3	80.3	55.3	69.4	
Thunder	SB8104N	RR2XT	0.4	9/9	39	0.7	33.0	17.0	76.3	--	69.9	
Thunder	SB8903N	RR2XT	0.3	9/10	42	5.2	32.7	16.1	65.9	50.8	61.5	
Thunder	TE7003N	E3	0.3	9/8	40	1.4	32.6	16.6	70.7	50.8	63.4	
Thunder	TE7101N	E3	0.1	9/8	36	1.1	32.9	16.1	78.8	--	68.1	
Trial Mean				9/8	41	2.8	33.1	16.6	68.5			
C.V. %				1.5	5.5	36.6	1.5	1.9	9.1			
LSD 5%				2.3	3.1	1.4	1.0	0.6	8.7			
LSD 10%				2.0	2.6	1.2	0.8	0.5	7.3			

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8-9 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our southern region, Walsh County (Park River) and Nelson County (Pekin).

Yield reported at 13% moisture.

Soybean - Enlist, GT, RR and Xtend, Nelson County 2020 *(page 1 of 2)*

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant					Yield			
				Maturity date ³	Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	2020	2 yr Avg.	2-site Avg. ⁴	
										----- bu/a -----		
Dahlman	6004XN	RR2XT	0.4	9/21	34	0.1	35.1	15.1	60.1	--	66.5	
Dahlman	6903XN	RR2XT	0.3	9/19	36	2.7	34.1	14.6	56.1	53.9	61.6	
Dairyland	DSR-0119E	E3	0.1	9/18	33	1.0	32.2	15.9	55.6	--	62.5	
Dairyland	DSR-0577E	E3	0.5	9/22	37	0.3	34.9	16.0	55.9	--	61.4	
Dairyland	EC8-201E	E3	00.8	9/14	33	1.8	33.1	16.0	56.2	--	62.1	
Dairyland	EC9-201E	E3	00.9	9/16	34	1.7	33.5	15.9	50.5	--	57.2	
Dyna-Gro	S02EN71	RR2XT	0.2	9/19	29	0.0	33.9	15.0	58.7	--	68.4	
Dyna-Gro	S03XT29	RR2XT	0.3	9/17	36	2.2	33.9	14.8	56.7	55.0	63.2	
Dyna-Gro	S04XT91	RR2XT	0.4	9/19	32	0.0	33.9	15.6	63.3	--	68.2	
Golden H.	GH0325E3	E3	0.3	9/16	31	0.0	33.6	15.4	58.5	--	67.2	
Golden H.	GH0443X	RR2XT	0.4	9/18	34	0.2	35.0	15.3	59.8	--	--	
Hefty	H04X8	RR2XT	0.4	9/21	35	0.3	35.0	15.6	61.9	--	66.2	
Integra	40089N	E3	00.8	9/13	34	0.9	33.3	16.0	51.5	--	59.9	
Integra	40201N	E3	0.2	9/19	30	0.2	33.8	15.2	56.9	--	65.3	
Integra	50081N	RR2XT	00.8	9/6	33	0.1	35.1	15.4	56.1	--	61.6	
Integra	50309N	RR2XT	0.3	9/16	36	2.7	33.9	15.1	56.8	53.0	63.2	
Legacy	LS-0239N RR2X	RR2XT	0.2	9/17	36	2.7	34.1	14.8	56.2	57.1	64.9	
Legacy	LS-0320N E3	E3	0.3	9/17	32	0.1	33.7	15.1	57.9	--	66.3	
Legacy	LS-0429 E3	E3	0.4	9/21	35	1.2	35.8	15.5	56.0	53.4	62.9	
Legacy	LS-0438	RR2XT	0.4	9/19	36	0.3	35.0	15.6	60.8	58.6	66.9	
LG Seeds	LGS00663RX	RR2XT	00.6	9/8	34	0.0	33.4	15.9	57.6	51.2	64.4	
LG Seeds	LGS00899RX	RR2XT	00.8	9/11	37	0.9	33.5	16.4	57.9	54.4	63.7	
LG Seeds	LGS0111RX	RR2XT	0.1	9/16	38	0.8	34.7	15.6	56.8	54.3	63.7	
LG Seeds	LGS0355RX	RR2XT	0.3	9/16	36	1.1	33.8	14.7	56.8	56.1	60.1	
LG Seeds	LGS0400RX	RR2XT	0.4	9/19	37	0.4	33.5	15.5	62.9	57.7	69.9	
NDSU	ND17009GT	GT	00.9	9/14	37	2.5	36.3	15.6	52.3	48.7	58.8	
P3 Genetics	2002E	E3	0.2	9/17	33	2.4	35.0	14.9	59.1	--	64.5	
P3 Genetics	2003E	E3	0.3	9/16	31	0.2	34.0	15.2	57.0	--	66.6	
Proseed	50-10RR2Y	RR2Y	0.1	9/16	41	2.5	33.6	16.3	56.5	55.0	63.8	
Proseed	EL80-093	E3	00.9	9/16	32	0.4	33.2	15.9	48.9	--	60.0	
Proseed	XT20-07	RR2XT	00.7	9/11	35	0.4	32.6	15.8	52.5	--	62.0	
Proseed	XT60-09	RR2XT	00.9	9/15	41	0.6	34.7	14.8	61.2	57.7	67.3	
Proseed	XT70-09N	RR2XT	00.9	9/12	36	0.5	33.3	16.3	57.2	--	59.8	
REA	RX0327	RR2XT	0.3	9/15	34	0.1	34.7	15.5	59.6	--	--	
REA	RX0411	RR2XT	0.4	9/19	45	2.1	33.2	15.3	59.1	--	67.9	
Stine	01EA63	E3	0.1	9/15	30	1.0	34.9	15.1	56.8	--	--	
Stine	05EA23	E3	0.5	9/23	31	1.1	33.4	15.6	57.2	--	--	
Syng NK	S01-C4X	RR2XT	0.1	9/16	36	0.0	33.5	15.5	58.6	55.3	65.4	
Syng NK	S02-F9X	RR2XT	0.2	9/16	33	0.2	32.7	16.2	59.8	55.6	68.5	

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 9 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our southern region, Walsh County (Park River) and Nelson County (Pekin).

Yield, oil and protein reported at 13% moisture.

Soybean - Enlist, GT, RR and Xtend, Nelson County 2020 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity date ³	Plant Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	Yield		
									2020	2 yr Avg.	2-site Avg. ⁴
Syng NK	S03-S6X	RR2XT	0.3	9/17	37	0.6	33.3	15.3	57.7	54.8	63.7
Syng NK	S04-Q7X	RR2XT	0.4	9/17	34	0.0	35.0	15.1	60.5	--	--
Syng NK	S05-N5X	RR2XT	0.5	9/19	31	0.1	33.7	15.5	59.7	59.9	--
Thunder	SB8001	RR2XT	0.1	9/14	31	0.0	34.6	15.9	58.4	52.0	69.4
Thunder	SB8104N	RR2XT	0.4	9/17	32	0.2	34.0	15.8	63.5	--	69.9
Thunder	SB8903N	RR2XT	0.3	9/17	36	1.8	33.8	14.9	57.0	55.7	61.5
Thunder	TE7003N	E3	0.3	9/16	32	0.5	33.3	15.4	56.0	52.0	63.4
Thunder	TE7101N	E3	0.1	9/19	29	0.0	34.2	15.0	57.4	--	68.1
Trial Mean				9/16	34	0.9	34.1	15.5	57.2		
C.V. %				1.4	4.2	96.0	1.1	1.4	6.6		
LSD 5%				2.1	2.0	1.2	0.8	0.4	5.3		
LSD 10%				1.8	1.7	1.0	0.7	0.4	4.4		

¹Herbicide Trait - RR2XT= RR2Xtend, GT= Glyphosate Tolerant, E3=Enlist

²Maturity Group provided by company.

³Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 9 with varying degrees of damage to the tops of the plants.

⁴A 2-site average of our southern region, Walsh County (Park River) and Nelson County (Pekin).

Yield, oil and protein reported at 13% moisture.

Rye, Langdon 2020							
Variety	Winter Survival	Julian Days to Head	Plant Height (in)	Test Weight (lbs/bu)	Yield		
					2020 (bu/a)	2 yr avg. (bu/a)	3 yr avg. (bu/a)
Aroostok	84	157	37	52.0	38.9	46.1	47.3
Dacold	24	164	32	51.9	31.4	45.1	51.7
ND Gardner	94	155	38	52.6	49.0	52.4	53.6
ND Dylan	91	159	37	53.2	59.5	65.6	67.3
Rymin	84	161	36	53.1	54.4	60.2	64.4
Spooner	83	158	36	52.4	44.7	53.0	53.4
Brasetto	86	160	31	51.4	68.3	75.5	79.9
Hazlet	59	161	37	53.4	54.9	63.4	64.1
Bono	48	161	28	53.0	51.8	70.8	--
Danko	20	161	30	52.0	27.7	--	--
Trial Mean		75	165	43	54.1	61.5	--
C.V. %		21.7	0.5	5.8	1.2	11.7	--
LSD 5%		23.5	1.3	3.6	1.0	10.4	--
LSD 10%		19.5	1.1	3.0	0.8	8.6	--

No lodging in 2020.

Snowfall on October 11-12, 2019 was 20 inches.

Air temperatures were 6.6° F lower than average for October 2019.

Overwinter leaf stage ranged from 1.5 to 2 leaf.

Soybean - Conventional, Langdon 2020

Brand	Variety	Maturity Group ¹	Maturity date ²	Plant			Yield			
				Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	2020	2 yr Avg.	2-site Avg. ³
Conventional:										
Legacy	LS 0070-20	00.7	9/8	35	1.3	35.4	15.6	50.0	--	55.2
Legacy	LS 0080-20	00.7	9/8	31	1.0	35.8	15.0	46.7	--	52.6
Legacy	LS 0090-20	00.8	9/11	32	0.8	38.7	14.6	52.1	--	53.8
Legacy	LS 020-20	0.2	9/11	35	1.3	35.0	15.0	52.7	--	56.1
NDSU	ND Benson	0.4	9/18	31	1.3	33.8	15.4	46.6	43.9	54.0
NDSU	ND Rolette	00.9	9/13	32	1.8	33.1	15.9	49.6	46.6	59.6
Prograin	Hana	0.1	9/12	30	1.0	37.5	14.7	49.3	--	57.2
Prograin	Maya	00.7	9/12	32	0.0	38.0	14.0	46.9	--	52.8
PROSeeds	Astor	0.2	9/18	32	0.5	36.6	15.5	46.7	43.7	54.3
Richland IFC	MK0249	0.2	9/15	21	1.3	32.6	15.0	41.4	37.9	48.2
Roundup Ready Check Varieties:										
	RR2Y Check #1	00.5	9/6	28	0.5	33.2	15.7	48.2	--	56.6
	RR2Y Check #2	00.8	9/8	29	0.8	32.9	15.6	54.6	50.9	60.5
	RR2Y Check #3	00.9	9/11	33	1.3	33.7	15.3	58.1	52.0	67.4
Trial Mean										
			9/13	31	0.9	34.6	15.4	47.6		
C.V. %										
			1.3	11.4	75.7	0.9	1.6	8.4		
LSD 5%										
			2.1	5.1	1.0	0.7	0.5	5.7		
LSD 10%										
			1.0	3.3	0.7	0.6	0.4	3.7		

¹Maturity Group provided by company.

²Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8 with varying degrees of damage to the tops of the plants.

³A 2-site average of conventional trials at Langdon REC and Walsh County (Park River).

Yield, oil and protein reported at 13% moisture.

Soybean - Conventional, Walsh County 2020

Brand	Variety	Maturity Group ¹	Maturity date ²	Plant Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	Yield	
								2020	2 yr Avg. ³
Conventional:									
Legacy	LS 0070-20	00.7	9/6	37	4.8	35.7	16.6	60.3	--
Legacy	LS 0080-20	00.7	9/3	38	1.5	35.2	15.8	58.4	--
Legacy	LS 0090-20	00.8	9/5	36	2.8	36.8	16.1	55.5	--
Legacy	LS 020-20	0.2	9/4	44	3.8	34.3	16.4	59.4	--
NDSU	ND Benson	0.4	9/11	43	4.0	34.0	16.7	61.3	43.0
NDSU	ND Rolette	00.9	9/5	38	1.3	32.5	17.4	69.5	45.3
Prograin	Hana	0.1	9/6	38	1.3	37.7	15.4	65.1	--
Prograin	Maya	00.7	9/7	41	2.0	37.4	14.5	58.7	--
PROSeeds	Astor	0.2	9/10	37	2.8	36.3	16.9	61.9	47.4
Richland IFC	MK0249	0.2	9/11	36	5.5	32.6	16.1	55.0	--
Roundup Ready Check Varieties:									
	RR2Y Check #1	00.5	9/1	36	1.3	32.2	16.6	65.0	--
	RR2Y Check #2	00.8	8/30	39	0.8	32.8	16.6	66.4	49.8
	RR2Y Check #3	00.9	9/1	42	1.0	32.4	16.7	76.7	57.1
Trial Mean			9/7	38	2.3	34.3	16.5	62.0	
C.V. %			2.2	4.6	61.4	1.5	1.9	9.3	
LSD 5%			3.5	2.5	2.0	1.1	0.6	8.1	
LSD 10%			2.9	2.1	1.6	0.9	0.5	6.8	

¹Maturity Group provided by company.

²Days to physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

First frost/freeze was Sept. 8-9 with varying degrees of damage to the tops of the plants.

³ A 2-site average of conventional trials at Langdon REC and Walsh County (Park River).

Yield, oil and protein reported at 13% moisture.

Hemp, Langdon 2020

Company ¹	Variety	Plant Stand (/ft ²)	PLSE ² (%)	Seedling Mortality (%)	Plant Height (in)	Test Weight (lbs/bu)	TKW (g)	Oil ³ (%)	Grain Yield				4 yr. Avg.
									2017	2018	2019	2020	
HGI	CFX-2	8.3	52	48	54	42.8	17.0	33.8	1949	1031	1361	1440	1445
HGI	CRS-1	9.5	59	41	65	42.6	18.2	33.4	1891	1135	1400	1535	1490
HGI	Katani	10.3	64	36	49	42.8	15.9	33.1	1820	1164	1151	1419	1389
HGI	Grandi	11.0	69	31	48	42.3	17.0	33.1	1729	1157	1256	1447	1397
PIHG	Canda	11.3	70	30	71	41.6	19.9	30.7	2005	802	1361	1461	1407
PIHG	Joey	9.6	60	40	68	42.2	19.0	31.2	1991	905	1190	1307	1348
Legacy Hemp	X-59	8.1	51	50	59	43.3	19.0	30.4	2022	979	1554	1471	1506
IH	Henola	12.1	76	24	60	40.8	14.1	30.1	--	--	--	1115	--
IH	Bialobrzescie	12.5	78	22	88	40.9	13.5	32.1	--	--	--	690	--
Trial Mean		9.7	61	39	67	42.0	16.4	31.8	1907	1031	1293	1179	
C.V. %		14.3	14.3	22.1	6.3	1.3	3.0	1.5	8.7	10.6	11.8	13.6	
LSD 5%		2.0	12.5	12.5	6.1	0.8	0.7	0.7	240	158	218	232	
LSD 10%		1.7	10.4	10.4	5.1	0.6	0.6	0.6	199	131	182	193	

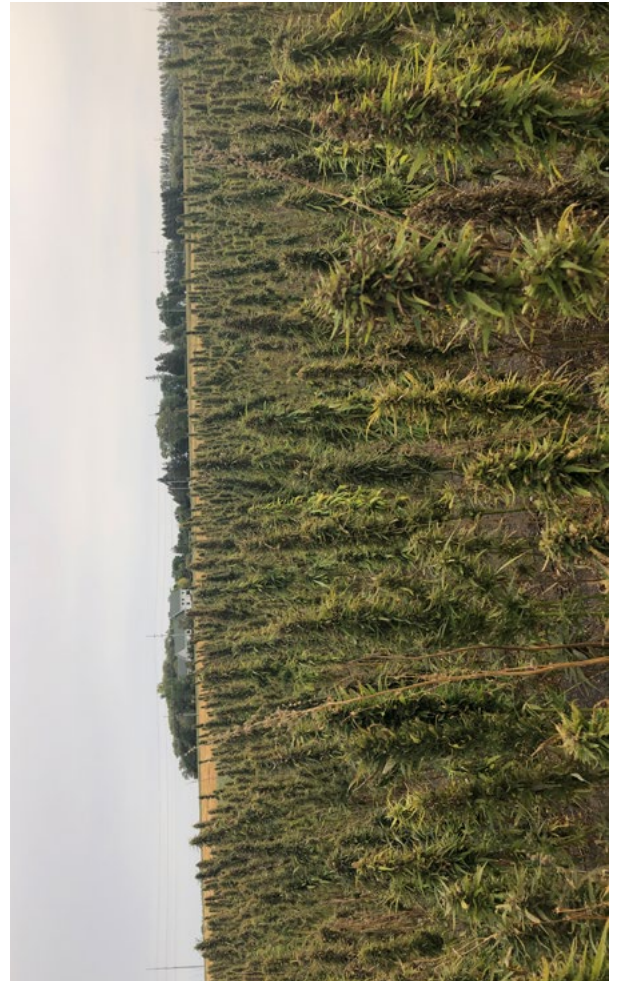
¹HGI-Hemp Genetics International, PIHG-Parkland Industrial Hemp Growers, IH-International Hemp

²Pure live seed emergence

³Oil content reported as is basis (uniformly dried to approximately 3% moisture).

Target seeding rate was 16 PLS/ft² which includes 25% extra for expected mortality loss.

Previous Crop: Soybean



Oil Sunflower, Langdon 2020 (page 1 of 2)

Brand	Hybrid	Hybrid Type ¹	Status ²	Days to Days to		Plant	Oil	Test	Harvest	Yield			
				Flower	Mature					Height	Moist.	2017	2018
				(days) ³	(days) ³	(in)	(%)	(lbs/bu)	(%)				
Caussade Semences	Kaledonia	HO,CL	Exp	74	111	69	40.5	30.8	8.5	--	--	3037	--
CROPLAN	CP3845	NS,Trad	CA	75	110	63	46.5	31.4	6.8	3209	2557	3269	2913
CROPLAN	CP432E	NS,EX,DM	CA	70	107	63	44.0	31.1	7.2	3193	2570	3414	2992
CROPLAN	CP450E	HO,EX,DM	CA	75	114	69	43.2	29.6	10.5	3394	2824	3785	3305
CROPLAN	CP455E	HO,EX,DM	CA	73	112	71	43.7	30.0	8.1	3801	2818	3426	3122
CROPLAN	CP4909E	NS,EX	CA	74	111	66	45.2	33.3	9.6	--	--	3201	--
CROPLAN	CP545CL	NS,CL,DM	CA	75	113	64	44.3	30.3	8.7	3365	2451	3386	2918
CROPLAN	CPX40419E	HO,CL	Exp	74	112	64	45.4	31.5	9.1	--	--	3046	--
CROPLAN	CPX57919CLP	HO,CL	Exp	61	106	45	44.4	34.3	6.2	--	--	2767	--
CROPLAN	CPX5012CL	HO,CL	CA	73	111	65	43.5	30.5	8.7	--	--	3494	--
Dairyland	D643HO	HO,EX,DM	CA	73	112	72	43.5	30.2	7.2	--	--	3767	--
Dairyland	D683MO	Trad,EX,DM	CA	73	113	70	45.0	30.9	9.6	--	--	3485	--
Dairyland	D684HO	HO,EX,DM	CA	74	114	73	44.5	32.5	12.6	--	--	3541	--
Dairyland	D690MO	Trad,EX,DM	CA	75	114	72	43.8	29.7	8.3	--	--	3716	--
Dyna-Gro	H42HO18CL	HO,CL,DM	CA	72	111	60	44.5	32.3	7.1	--	--	3209	--
Dyna-Gro	H44HO12CL	HO,EX,DM	CA	69	109	64	45.4	30.9	7.2	--	--	2623	--
Dyna-Gro	H45HO10EX	HO,EX,DM	CA	73	112	64	44.5	29.4	8.8	--	--	3235	--
Dyna-Gro	H45NS16CL	NS,CL,DM	CA	70	109	59	47.5	32.9	7.1	--	--	3616	--
Dyna-Gro	H49HO19CL	HO,CL,DM	CA	75	112	64	45.1	29.9	10.3	--	--	3524	--
Dyna-Gro	XH01H56CL	HO,CL,DM	Exp	61	106	45	43.0	34.1	6.5	--	--	2716	--
Dyna-Gro	XH82H63EX	HO,EX,DM	Exp	74	114	75	44.2	31.6	12.2	--	--	3513	--
Dyna-Gro	XH82H65EX	HO,EX,DM	Exp	72	110	71	43.0	29.6	6.6	--	--	3263	--

¹Type: HO = High Oleic, NS = NuSun, Trad. = Traditional (linoleic), CL = Clearfield, CP = Clearfield Plus, EX = ExpressSun, DM = Downy Mildew Resistant, CON = ConOil

²Status: CA=Commercially available, Exp-Experimental

³Days after planting

Oil, harvest yield and test weight were adjusted to 10% moisture.

Sunflower trial in 2019 was unharvestable due to damage from 20 inch snowfall.

Oil Sunflower, Langdon 2020 (page 2 of 2)

Brand	Hybrid	Hybrid Type ¹	Status ²	Days to Maturity		Plant Height (in)	Oil (%)	Test Weight (lbs/bu)	Harvest Moist. (%)	Yield @ 10% moisture				
				Flower (days) ³	Mature (days) ³					2017	2018	2020	Average	
Nuseed	Badger DMR	NS,CL,DM,CON	CA	70	109	69	37.4	30.1	6.5	3728	1942	3806	2874	3159
Nuseed	Camato II	NS,CL,DM	CA	74	112	67	45.2	32.1	9.7	3457	2504	3560	3032	3174
Nuseed	Falcon	NS,EX	CA	75	111	65	45.6	32.8	9.9	2888	2090	2956	2523	2645
Nuseed	Hornet	HO,CL,DM	CA	76	114	63	46.4	30.2	13.5	--	--	3778	--	--
Nuseed	N4H302 E	HO,EX	CA	73	111	71	42.5	27.1	7.5	--	2611	3078	2845	--
Nuseed	N4H422 CL	HO,CL,DM	Exp	73	111	65	43.7	30.5	8.5	--	--	3161	--	--
Nuseed	N4H470 CLP	HO,CP,DM	CA	75	112	68	46.9	30.9	11.5	--	2733	3124	2929	--
Nuseed	N4HM354	NS,CL,DM	CA	71	109	63	46.2	33.6	6.5	3066	2572	3409	2990	3016
Nuseed	N5LM307	NS,CL,DM,CON	CA	69	112	60	40.1	28.7	7.1	--	2380	3056	2718	--
Pioneer	P63HE501	HO,EX,DM	CA	73	111	63	42.6	30.8	6.2	--	--	3293	--	--
Pioneer	P64HE101	HO,EX,DM	CA	75	113	72	43.3	29.9	10.7	--	--	3718	--	--
Proseed	E-91E	HO,EX,DM	CA	74	112	73	44.8	31.8	8.1	--	--	3213	--	--
Proseed	I2G25CL	HO,CL	CA	73	110	66	44.8	30.1	6.8	3364	2781	3088	2934	3078
Proseed	E-50016	HO,CL,DM	CA	73	112	69	44.8	29.4	6.8	3425	2640	2805	2723	2957
Proseed	E-93E	NS,EX,DM	CA	73	111	70	42.5	30.3	6.9	--	--	3340	--	--
S&W Seed Company	SF110	HO,CL,DM	CA	72	112	61	44.2	31.7	8.3	--	--	2746	--	--
USDA	894 ⁴	Trad		72	109	65	43.4	30.5	6.7	2841	2607	3062	2835	2837
Mat Check	8N270 ⁵	NS,CL,DM		67	107	57	44.2	32.5	6.8	--	--	3085	--	--
Mat Check	559CL ⁵	NS,CL,DM		75	112	72	44.7	29.9	9.4	--	--	3400	--	--
Mat Check	HoneyComb ⁵	NS		64	106	53	42.0	31.6	6.0	2085	2888	3089	2988	2687
Trial Mean				72	111	65	44.1	31.0	8.3	3177	2578	3281		
C.V. %				1.2	1.1	3.5	2.7	2.5	17.6	9.9	15.2	11.5		
LSD 5%				1.4	2.1	3.7	1.9	1.3	2.4	514	637	617		
LSD 10%				1.9	1.7	3.1	1.6	1.1	2.0	430	533	516		

¹Type: HO = High Oleic, NS = NuSun, Trad. = Traditional (linoleic), CL = Clearfield Plus, EX = ExpressSun, DM = Downy Mildew Resistant, CON = ConOil

²Status: CA-Commercially available, Exp-Experimental

³Days after planting

⁴Long-term hybrid check ⁵Maturity check

Oil, harvest yield and test weight were adjusted to 10% moisture.

Sunflower trial in 2019 was unharvestable due to damage from 20 inch snowfall.

Confection (non-oil) Sunflower, Langdon 2020

Brand	Hybrid	Status ⁴	Days to		Plant	Test	Harvest	Seed over screen				Yield					
			Flower	Mature				Height	Weight	Moist.	22/64	20/64	18/64	2017	2018	2020	2 yr
		(days) ⁶	(days) ⁶	(in)	(lbs/bu)	(%)											
CanSun	EX35957 ^{2,3}	Exp	71	110	60	24.6	9	85	93	95	--	--	3333	--	--	--	--
RRC	2215 ¹	CA	73	113	64	22.3	11	55	87	94	2861	2502	3091	2797	2818	--	--
RRC	2310 ¹	CA	74	111	70	21.6	10	80	91	94	--	2179	3364	2771	--	--	--
RRC	2414 ¹	CA	77	114	73	20.9	13	85	93	95	--	2075	3163	2619	--	--	--
RRC	2319 ¹	CA	74	114	68	21.3	11	89	94	96	--	--	3033	--	--	--	--
USDA	924 ⁵		72	111	59	23.5	10	31	63	84	2440	2510	2627	2568	2526	--	--
Trial Mean			73	112	66	22.4	11				2983	2386	3102				
C.V. %			1.5	1.4	4.3	3.0	8.8				9.7	11.3	10.3				
LSD 5%			1.6	2.3	4.2	1.0	1.4				514	NS	479				
LSD 10%			1.3	1.9	3.5	0.8	1.2				421	NS	394				

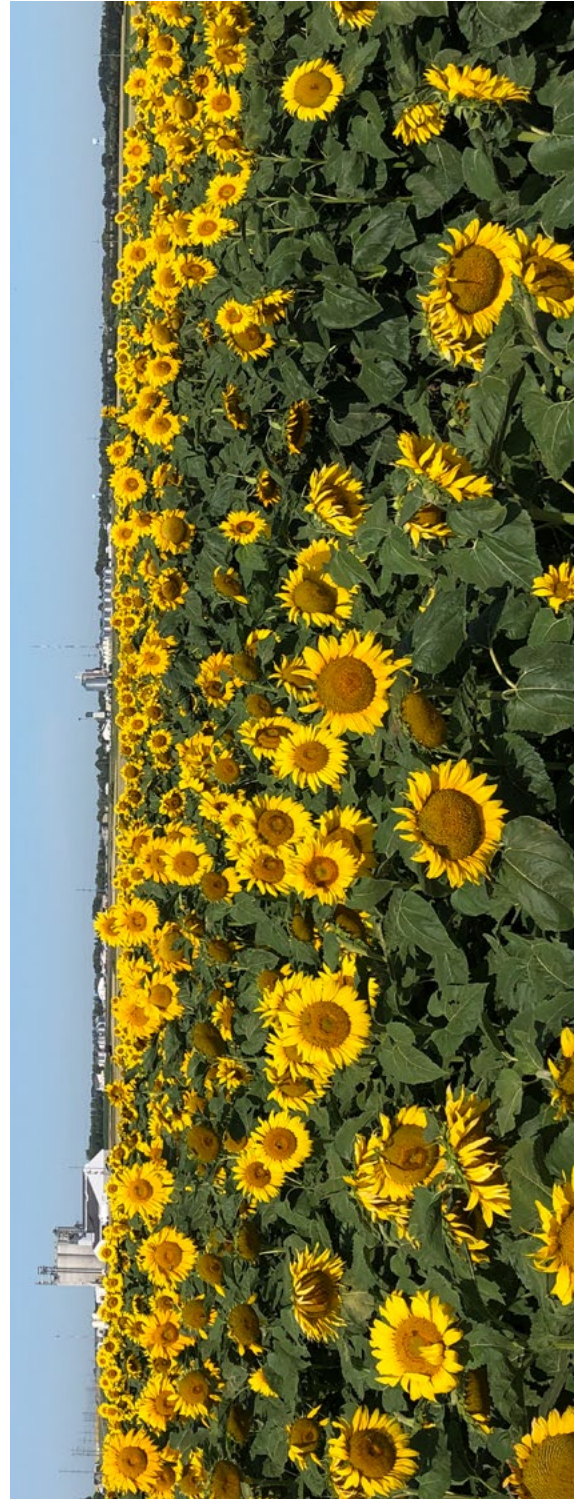
¹Traditional - no herbicide tolerance trait, ²ExpressSun, ³Downy Mildew Resistant.

⁴Status: CA-Commercially available, Exp-experimental, ⁵Long term hybrid check.

⁶Days after planting

Harvest yield and test weight were adjusted to 10% moisture.

Sunflower trial in 2019 was unharvestable due to damage from 20 inch snowfall.



Seeding Date and Cultivar Influence on Soybean Performance in Northeastern North Dakota

Bryan Hanson and Lawrence Henry

Soybeans have become an important crop in the northeast region of North Dakota. Seeding date and cultivar selection are two important production decisions that producers make in order to maximize yields. The objective of this study was to determine the relationship between cultivar maturity and seeding date on yield and agronomic traits.

Methodology:

The field design was a randomized complete block in a split-plot arrangement with four replications. Seeding dates were May 21, May 29, June 5, June 12, and June 19. Three Roundup Ready cultivars were used with maturity ratings of 00.5, 00.9 and 0.1. An established stand density of 180,000 plants/a was the target. Plot size was 3.5' x 22' with seven six-inch rows. Net Return \$/a = yield x \$10.83 bu/a.

Results:

Plant stands were uniform across all seeding dates and maturity groups. A frost/freeze of 29°F occurred on September 8. All varieties planted on the May 21 seeding dates had matured prior to the frost/freeze. Varieties planted on subsequent dates had varying degrees of plant damage on the upper portion of the leaves and stems while little damage was observed on the lower leaves and stems. The next freeze of 27°F occurred on October 2, at which point all varieties had been called mature prior to that date. Percent grain protein increased and oil content decreased at later planting dates with differences among varieties the smallest at the latest seeding date. There were significant interactions between seeding dates and cultivar maturity groups for yield and net return. Yields were the greatest at the earliest seeding date and decreased at each of the subsequent dates (Figure 1). Yields were similar among varieties at the May 19 seeding date. On subsequent dates the 00.5 cultivar always had the highest yield followed by the 00.9 cultivar. Yield differences between the varieties varied at each seeding date. Net Return \$/a results followed the same trends as yield (Figure 2).

Table 1. Seeding date effects on various agronomic traits averaged over cultivars.

Seeding Date	Plant Stand plt/ft ²	Plant Height inches	Days to Mature DAP ¹	Grain Protein %	Oil %	1000 KWT g	Test Weight lbs/bu
May 21	5.2	34.2	108.2	33.4	15.3	171.0	57.2
May 29	4.6	36.2	107.8	34.4	14.6	181.1	57.7
June 5	4.7	35.0	105.2	34.7	14.1	175.1	57.9
June 12	4.6	36.8	100.9	35.2	13.6	184.1	57.9
June 19	4.7	35.1	100.1	35.6	13.3	175.3	57.8
Mean	4.7	35.5	104.4	34.7	14.2	177.3	57.7
C.V. %	13.3	6.0	1.3	1.2	1.8	6.0	0.6
LSD 5%	NS	NS	1.3	0.8	0.4	NS	0.4

Cultivar effects on various agronomic traits averaged over seeding dates.

Cultivar Maturity	Plant Stand plt/ft ²	Plant Height inches	Days to Mature DAP ¹	Grain Protein %	Oil %	1000 KWT g	Test Weight lbs/bu
00.5	4.5	37.3	102.2	34.1	14.6	186.5	57.9
00.9	5.0	33.5	104.2	34.8	14.2	167.6	57.5
0.1	4.7	35.6	106.9	35.1	13.7	177.8	57.7
LSD 5%	NS	1.4	0.9	0.3	0.2	6.9	0.2

¹Days after planting. This research was funded by the North Dakota Soybean Council.

Figure 1. Seeding date and cultivar effect on soybean yield.

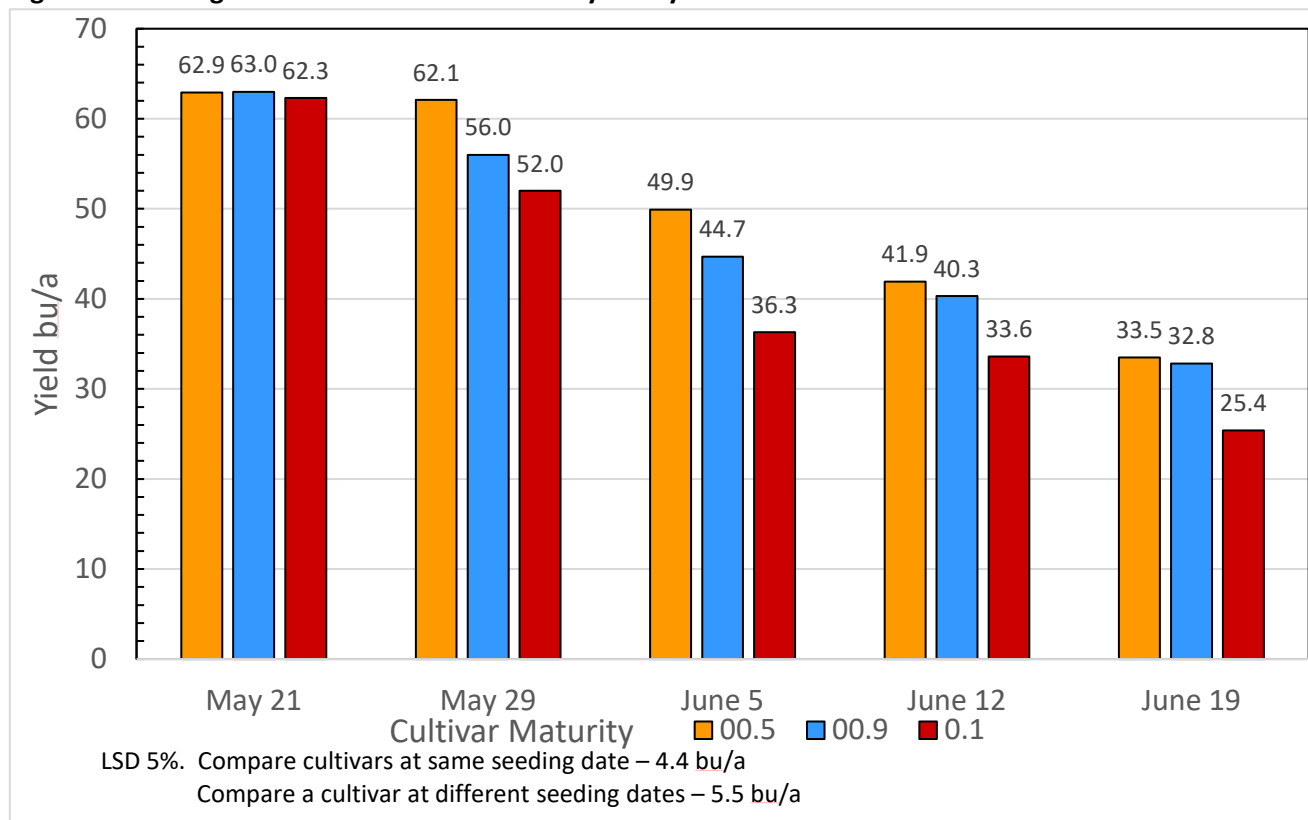
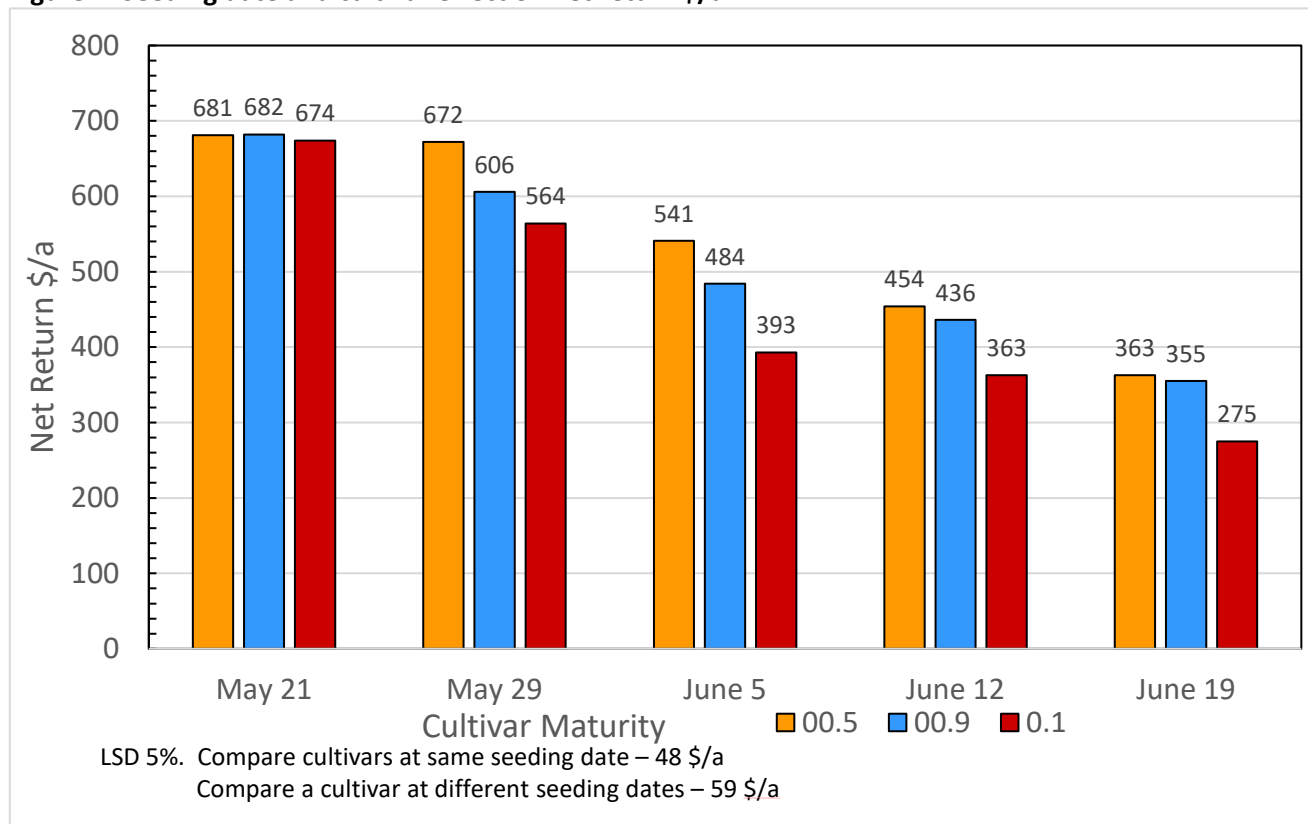


Figure 2. Seeding date and cultivar effect on net return \$/a.



Pinto Bean Response to Row Spacing and Plant Population, 2020

NDSU Langdon Research Extension Center

Bryan Hanson and Lawrence Henry

The field trial was conducted at the NDSU Langdon Research Extension Center in cooperation with the NDSU Carrington Research Extension Center with support from Northarvest Dry Bean Growers Association to examine the response of pinto bean to row spacing and plant population. Experimental design was a randomized complete block split plot (whole plots = row spacing, sub-plot = plant population) with four replications. 'ND Palomino' was planted on May 29 on a conventionally tilled Svea-Barnes loam soil in 30- and 18-inch rows and 6-inch paired rows (centered at 30 inches) with planting rates of 60,000, 85,000, and 105,000 pure live seeds/acre to establish targeted stands of 50,000, 70,000 and 90,000 plants/acre, respectively. The trial was sprayed for white mold, none was observed in the trial. After maturity, plants were knifed into windrows and seed was harvested with a plot combine on September 29.

There was no significant row spacing x plant population interactions among the agronomic traits. The paired 6-inch rows had greater plant stands compared to the other row spacings. The 30-inch spacing matured four days earlier compared to the 18-inch and paired rows. Test weight, seed count, and yield were similar among row types.

Ratio of established plants compared to seeding rates was 62, 61 and 59%, for 60, 85 and 105K planting rates, respectively. This low percentage may have been due to drier and slightly lumpy seedbed conditions at planting and possibly lower seed vigor. There was no significant difference between test weight, seed count, or yield between plant populations although the yield did trend up as planting rate increased.

Table 1. Pinto Bean response to row spacing averaged over planting rates.

Row Spacing	Plant Stand	Flower	Full Maturity ²	Plant Height	Test Weight	Seed Count	Yield
inches	plt/a	DOY ¹	DOY	inches	lbs/bu	seeds/lb	lbs/a
30	45,592	198	254	13.9	58.9	1266	3319
18	49,791	197	258	14.3	59.2	1243	3423
paired 6	55,772	198	258	14.9	59.1	1227	3326
C.V. %	14.5	0.2	0.4	6.1	0.5	2.4	10.5
LSD 10%	4,498	NS	2	NS	NS	NS	NS

Pinto Bean response to plant population averaged over row spacing.

Planting Rate	Plant Stand	Flower	Full Maturity ²	Plant Height	Test Weight	Seed Count	Yield
pls/acre	plt/a	DOY ¹	DOY	inches	lbs/bu	seeds/lb	lbs/a
60,000	37,486	198	256	14.4	59.1	1232	3251
85,000	51,796	198	257	14.3	59.1	1247	3346
105,000	61,814	197	257	14.4	59.0	1256	3470
LSD 10%	5,159	0.2	NS	NS	NS	NS	NS

¹DOY (day of year): 197=July 18; 254=September 11.

²R9 - at least 80% of pods ripening, 30% of leaves still green.

Cultivar and other Brassica Host Evaluation to Manage Clubroot on Canola

Venkat Chapara

Objective: To evaluate the resistance potential of commercial canola cultivars and other brassica hosts against the clubroot pathogen in field conditions.

Canola cultivars/varieties: Twelve commercial canola varieties along with other brassica hosts were planted to determine the level of resistance against clubroot (Table 1). The canola variety 'DKL 30-42' was used as the check.

Planted: First week of June (Hand planted after thorough tillage with a rototiller).

Field design: Randomized complete block design (RCBD) with four replications.

Plot size: 3 ft. x 5ft.

Table 1: Commonly cultivated canola cultivars/varieties in Cavalier County.

Cultivar	Description
6076CR	BrettYoung Seeds
4187RR	BrettYoung Seeds
INVIGOR L255PC	BASF
INVIGOR L234P	BASF
CP9919RR	Croplan Genetics
DKL 30-42	Cargill
45CS40	Pioneer (Corteva)
45H33	Pioneer (Corteva)
CP955RR	Croplan Genetics
CP9978TF	Croplan Genetics
CP9982RR	Croplan Genetics
CS2600TFR	Canterra Seeds
Camelina	Winter Variety 'Joelle'
Rutabaga	Variety 'Laurentian'
Carinata	Unknown Variety
Turnip	Variety 'Purple Top White Globe'

Clubroot Evaluated: Early August (59 days after planting).

Clubroot Disease Index (CRDI):

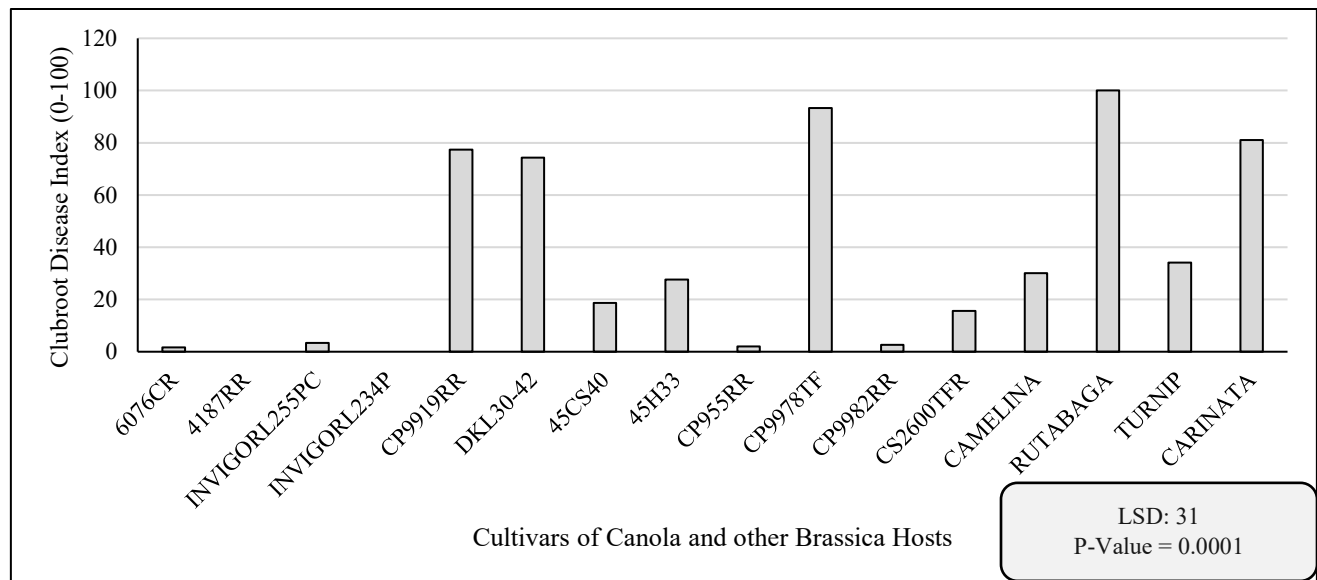
CRDI: <30% of Susceptible Check = Resistant (R)

CRDI: 30-69% = Intermediate (I)

CRDI: ≥70% = Susceptible (S)

Note: To validate a clubroot research trial, the susceptible check should have > 60% disease index.

Figure 1: Mean clubroot disease index (%) recorded on various commercial cultivars of canola, camelina, rutabaga, turnip and carinata tested in 2020.



Results: Canola cultivars 6076CR, 4187RR, InVigor L255PC, InVigor L234P, 45H33, 45CS40 CP955RR, CP9982RR and CS2600TFR showed resistance to clubroot and were significantly different from the other varieties tested. Among the other brassica hosts tested, Camelina has the lowest CRDI followed by turnip.

Future research: Testing more commercial cultivars of canola will be helpful to growers and to monitor the clubroot resistance breakdown in commercially available resistant varieties.

Canola Council of Canada’s Monitoring Clubroot in Resistant Varieties:

“Growers using clubroot-resistant varieties in clubroot-infested fields may experience some infected plants, which can be attributed to susceptible volunteers and off-types. Volunteer canola seed can germinate many years after it was last grown, and if this comes from a susceptible canola crop, then the volunteers will be susceptible. Off-types are a normal part of hybrid canola production – no canola hybrid is 100% pure, so there may be a small proportion (1 to 4%) of the seed that is susceptible.

When scouting, if more than 10% of seeded plants (do not count volunteers) are infected, that may indicate that the clubroot resistance is no longer functional against the pathogen population in the field. These infected plants may be restricted to a small patch which indicates a recent pathogen change.”

Ideal Recommendation: Practice crop rotation (one canola crop using a clubroot resistant variety in three years in endemic areas).

Evaluation of Fungicides to Manage White Mold in Canola

Venkat Chapara and Amanda Arens

A research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of fungicides to manage white mold in canola. The trial was planted on May 21, 2020 with the Roundup Ready canola variety ‘Nexera 1024RR’ in a randomized complete block design replicated four times. The trial followed state recommended practices for land preparation, fertilization, seeding rate and weed control. The plot size was 5 ft. wide x 16 ft. long with a canola border on either side of each plot. The trial was irrigated with an overhead sprinkler system set at one hour each day beginning one week before the start of bloom to four weeks after bloom to help increase disease infection levels. Fungicides were applied at 20% bloom using a CO₂-pressurized backpack style sprayer with a three-nozzle boom (XR-8002) at 20 GPA. The amount of white mold infection obtained in the research plots was natural. Fifty plants were rated within each plot and the levels of incidence and severity were recorded for each plant prior to swathing (August 18) on a 0-5 scale, where 1 = superficial lesions or small branch infected; 2 = large branch(es) dead; 3 = main stem at least 50% girdled; 4 = main stem girdled but plant produced good seed; 5 = main stem girdled, much reduced yield. A white mold disease severity index (DSI) was calculated with weighted mean of incidence and the number of plants in each severity rating.

Table 1: Efficacy of commercially available fungicides in managing white mold and their influence on yield and test weight.

Treatments	Rate	Incidence (%)	Disease Severity Index (0-5)	Yield (lbs/a)	Test Weight (lbs/bu)
Non-Treated	Check	13	1.28	1463	52
Miravis Neo	13.7 fl oz./a	6	1.15	1598	52
Proline	5 fl oz./a	3	0.5	1491	51
Priaxor	6 fl oz./a	3	1	1505	51
Topsin	1 lb/a	4	1.35	1753	52
Quash	3 lbs/a	3	0.88	1487	52
Mean		5	1	1550	52
CV %		105	73	21	1
LSD		NS	NS	NS	NS
P-Value (0.05)		0.13	0.64	0.8	0.74

Non-Ionic Surfactant (NIS) was added to all the fungicide treatments at 0.25% V/V.

NS: Statistically Non-significant

Results: No significant differences in white mold incidence, disease severity index (DSI), test weight, or yield were observed among the fungicides tested and the non-treated check (p-value non-significant).

Acknowledgements: Brett Miller (Syngenta), Bryan Hanson, Carmen Ewert and Lawrence Henry for their technical support.

Alert! Sudden Death Syndrome on Soybeans in Cavalier County!!

Anitha Chirumamilla, Sam Markell, Berlin Nelson and Venkat Chapara

Sudden Death Syndrome (SDS) is one of the leading soybean diseases that is known to cause yield-losses in North America. The disease is caused by the soil borne fungus *Fusarium virguliforme*. SDS was identified in Richland County of ND a few years ago. However, the first report of SDS was confirmed in Cavalier County in 2020. Severe SDS can result in yield losses greater than 50 percent.

Symptoms:

Foliar

SDS fungus primarily attacks the roots and releases fungal toxins into the plant system that later reach the above ground parts of the plant. Symptoms on leaves usually appear during late vegetative to flowering and pod development stages of the crop. Leaf symptoms first appear as pale green to yellow spots in between the veins. As the disease progresses, the area between veins turn bright yellow (Fig. 2A&B) and eventually dead-brown with green veins (Fig. 2C). The leaves will detach from the petiole and fall leaving the petioles attached to the stem. In severe infestation, flowers and pods may abort or not fill.

Root

SDS causes root discoloration along with root and crown rot. Diseased plants pull out of the ground easily because of decayed roots. Also, when split lengthwise, the internal tissue will be gray to reddish brown. A blue mold may appear on the outer surface of the roots in advanced stages and during wet conditions.



Figure 1: Soybean field infested with SDS in Cavalier County.

Photo: A. Chirumamilla, NDSU



Figure 2: SDS foliar symptoms: 2A. Pale green to yellow spots in between veins; 2B. Bright yellow spots and green veins; 2C. Dead brown spots with green veins.
Photos: A. Chirumamilla, NDSU



Figure 3: Dr. Chapara checking for SDS symptoms on soybean roots.
Photo: A. Chirumamilla, NDSU

Similarities with Brown Stem Rot

The foliar symptoms of SDS can be confused with Brown Stem Rot (BSR) as they are very similar. However, the best way to differentiate is to split the stem of an infected plant and check the color of the pith. The pith stays white in SDS whereas it turns brown in a case of BSR.



Figure 4. Brown pith of the stem indicating brown stem rot in soybeans.

Photo: A. Chirumamilla, NDSU

Association with Soybean Cyst Nematode:

There is a high degree of association between the presence of Soybean Cyst Nematode (SCN) in a field and SDS development. If the field is confirmed with SDS it is always beneficial to get tested for the presence of SCN.

Management:

1. The most important tactic is to plant SDS resistant soybean varieties.
2. Considering the association of SDS with SCN, varieties should also be resistant to SCN.
3. Practice crop rotation with non-host crops such as wheat and canola.
4. Plant into warm soils and reduce excessive soil moisture with drainage.

(Source: Sudden death syndrome on soybeans-University of Minnesota Extension; and Soybean Diseases- Soybean research and information network)

Management of Clubroot (*Plasmodiophora brassicae*) with Surfactants, Fungicides and Lime Venkat Chapara

Objective: To determine the effect of surfactant (ORO-79) alone, and in combination with fungicides and beet lime to manage clubroot on canola.

Methods: The following treatments (Table 1) were tested alone and along with a surfactant (ORO-79) in a randomized complete block design (RCBD) with four replications under field conditions. The field has natural soil population of *P. brassicae* of 5.5 million resting spores/g of soil. Treatments of ORO-79, an experimental, Ranman®, and Allegro® were applied in-furrow as soil drenches just before planting at the rate mentioned in Table 1. Whereas, beet lime was incorporated at a depth of 4-6 inches a week before planting. A susceptible canola cultivar to clubroot ‘DKL 30-42’ was planted at a depth of a half inch. Beet lime was acquired from American Crystal Sugar Company in Drayton, ND. The trial was planted the first week of June and was evaluated the first week of August (exactly 60 days after planting) at growth stage BBCH-65.

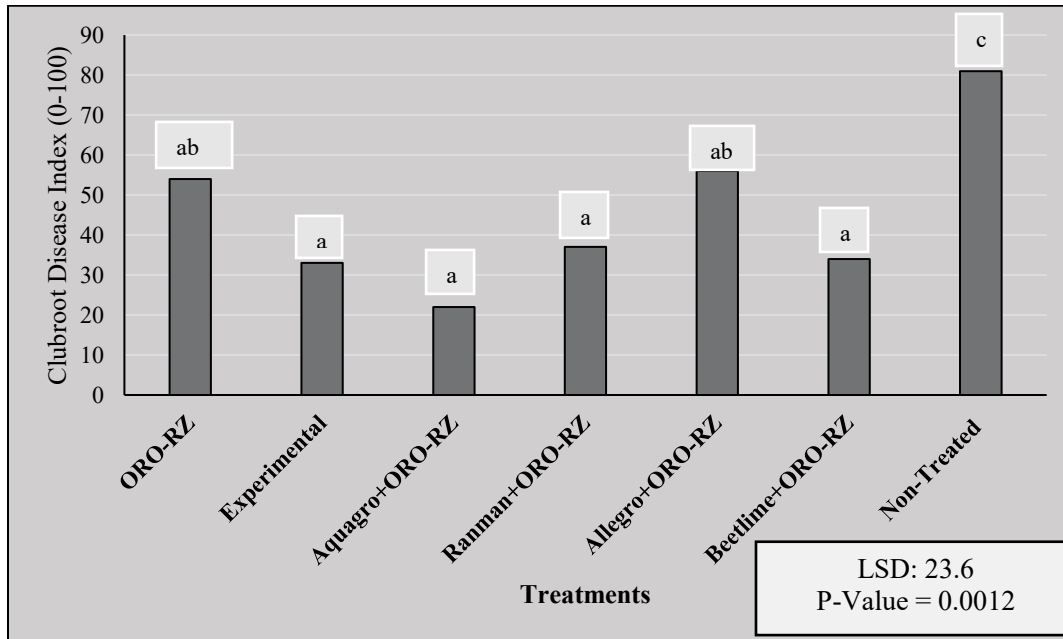
Rating scale: Clubroot rating scale: 0 = no galling, 1 = a few small galls (small galls on less than 1/3 of roots), 2 = moderate galling (small to medium-sized galls on 1/3 to 2/3 of roots), 3 = severe galling (medium to large-sized galls on more than 2/3 of roots). This rating scale was used for disease ratings of incidence and severity. A Clubroot Disease Index (CRDI) has been calculated using the incidence and severity data of clubroot samples obtained.

Soil sampling to determine pH: Soil samples were collected from all the plots before application of soil treatments and on the day of clubroot evaluations to know the effect of unit change in pH and their impact on clubroot control.

Table 1: List of treatments and the rates at which they were applied in soil.

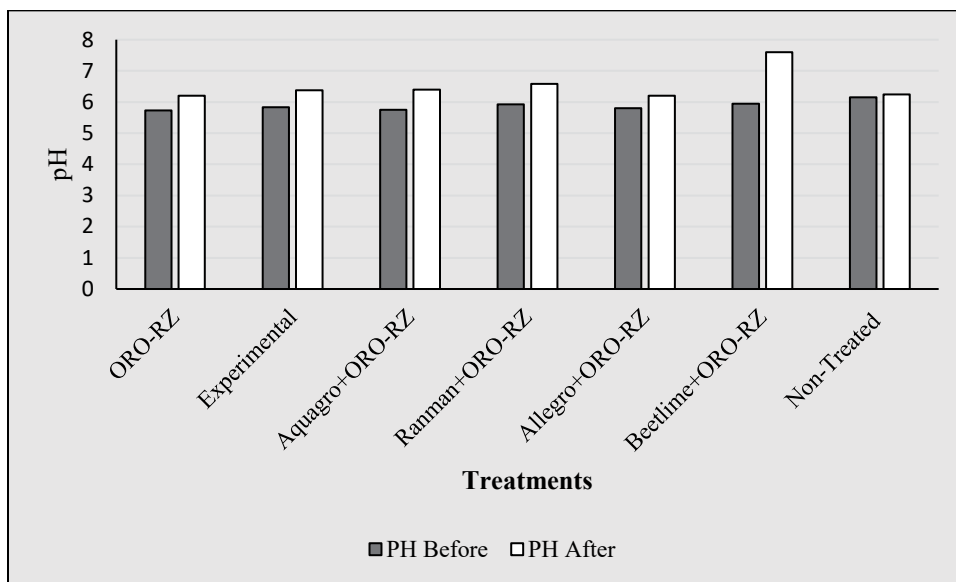
Treatments	Rate
ORO-RZ	32 oz/a
Experimental	10 oz/a
Aquagro + ORO-RZ	15.5g per 5ft row+ 32 oz/a
Ranman + ORO-RZ	25 + 32 oz/a
Allegro + ORO-RZ	11.6 ml/2litres + 32 oz/a
Beet lime + ORO-RZ	7.5 t/ha + 32 oz/a
Non-Treated	Check

Figure 1: Mean clubroot disease index (CRDI) observed on application of various in-furrow applied treatments.



*Bars followed by the same letter are not significantly different according to the LSD test ($p \leq 0.05$).

Figure 2: Observed change in soil pH before and after application of the treatments.



Results: The clubroot disease indexes (CRDI) of all the tested treatments were significantly different from the non-treated check (81%). A combination treatment of two surfactants (Aquagro + ORO-RZ) had lower CRDI (22%) followed by a new experimental biological alone (33%), Beet lime + ORO-RZ (34%) and Ranman + ORO-79 (37%) (Figure 1). These results indicate that the surfactants and biological products can be considered for patch management of clubroot on canola in solo or in combination.

Soil pH: The treatment of beet lime + ORO-RZ showed a significant increase of 1.6 units of pH compared to before application.

Efficacy of a Surfactant (ORO-79) in Various Rates with the Presence and Absence of Lime to Manage Clubroot on Canola

Venkat Chapara

Objective: To determine the efficacy of a surfactant (ORO-79) in various rates in the presence and the absence of lime to manage clubroot on canola.

Methods: The surfactant ORO-79 was tested in different application rates to manage clubroot under the influence of lime and without lime. The experiment was laid out under field conditions in a split-plot arrangement (where the main plots are lime and without lime; and the subplots are treatments). The trial was replicated four times. The field has natural soil population of *P. brassicae* of 5.5 million resting spores/g of soil. Different rates of the surfactant ORO-79, were compared with treatments of the non-treated check. A combination treatment of the fungicide Ranman® and ORO-79 was a new surfactant ORO-09 (Table 1). The treatment of lime was incorporated at a depth of 4-6 inches a week before planting, and the treatments of surfactant were applied right before planting in the form of soil drench. A susceptible canola cultivar to clubroot ‘Invigor L233P’ was planted at a depth of a half inch. Lime was acquired from the Langdon land fill station (a by-product of lime sludge from the Langdon water plant). The trial was planted in the first week of June and evaluated the first week of August (exactly 60 days after planting) at growth stage BBCH-65.

Rating scale: Clubroot rating scale: 0 = no galling, 1 = a few small galls (small galls on less than 1/3 of roots), 2 = moderate galling (small to medium-sized galls on 1/3 to 2/3 of roots), 3 = severe galling (medium to large-sized galls on more than 2/3 of roots) was used for disease rating of incidence and severity. A Clubroot Disease Index (CRDI) has been calculated using the incidence and severity data of clubroot obtained.

Table 1: List of treatments in main plots and sub-plots that were tested in the trial.

Main Plot	Sub-plot	Rate
Lime	ORO-09	2 pt/a
Lime	ORO-79	8 pt/a
Lime	ORO-79	4 pt/a
Lime	ORO-79	2 pt/a
Lime	Non-Treated	Check
Lime	Ranman + ORO-79	25 fl oz + 2 pt/a
Without Lime	ORO-09	2 pt/a
Without Lime	ORO-79	8 pt/a
Without Lime	ORO-79	4 pt/a
Without Lime	ORO-79	2 pt/a
Without Lime	Non-Treated	Check
Without Lime	Ranman + ORO-79	25 fl oz + 2 pt/a

Table 2: The effect of ORO-79 at various rates on the mean clubroot disease index (CRDI) ratings.

Treatments	Rate	CRDI
Ranman + ORO-79	20 fl oz+2 pt/a	20
Non-Treated	CHK	84
ORO-79	2 pt/a	34
ORO-79	4 pt/a	16
ORO-79	8 pt/a	23
ORO-09	4 pt/a	22
Mean		33
CV%		65
LSD (0.05)		22
P- Value (0.05)		0.00001*

* indicates significance at $P \leq 0.05$; “ns” is non-significant at $P \leq 0.05$

Results: Different rates of ORO-79, ORO-09 and Ranman + ORO-79 had similar effects in managing the clubroot under field conditions (Table 2) and the treatments were significant when compared with the non-treated check. The two-way interaction among main plots (lime and without lime) and sub plots (different treatments) did not have a significant effect at $p \leq 0.05$, indicating there was no added advantage on combination treatments of lime + surfactant to control clubroot.

Acknowledgments: Funding from the ORO Agri and Northern Canola Growers Association and thanks to all the product suppliers. Special thanks to Interns Jacob Kram (NDSU), Ben Girodat and Vivek Muddana.

Efficacy of Fungicides at Different Application Timings to Manage Fusarium Head Blight in Hard Red Spring Wheat

Venkat Chapara, Amanda Arens and Andrew Friskop

Objective:

To evaluate the efficacy of fungicides at different application timings to manage Fusarium head blight in Hard Red Spring Wheat (HRSW).

Methods:

Location: NDSU Langdon Research Extension Center

Experimental design: Randomized complete block, replicated four times.

Previous crop: Canola

Cultivars of HRSW tested: WB Mayville

Planting: 1.5 million pure live seeds/acre planted on May 20, 2020. A border plot was planted between treated plots to minimize interference from spray drift.

Plot size: Seven rows at six inch spacing, 5 ft. x 20 ft., mowed back to 5 ft. x 16 ft.

Herbicides applied: Axial XL (16.4 oz/A) + Huskie (13 oz/A) applied on June 17, 2020.

Inoculation: Plots were inoculated by spreading corn spawn inoculum at approximately boot stage (Feekes 9-10) at the rate of 300 g/plot.

Disease development: Supplemental moisture was provided by running overhead irrigation from booting to soft dough stage at the rate of one hour per day to create a conducive environment for FHB development.

Fungicide treatments: Fungicides were applied with a CO₂-pressurized backpack sprayer with a three nozzle boom (XR-8002) and the water volume used was 20 GPA. Fungicide (Miravis Ace) application was made at full head emergence on July 2nd. Miravis Ace, Prosaro and Caramba were applied at 10% flowering (anthesis) on July 6th and repeated 5 days after the first spray (July 11th). Refer to Table 1 for the treatments, rates and application timings.

Disease assessment: Data on FHB incidence was obtained by counting the number of heads showing FHB symptoms out of 50 heads at hard dough stage. FHB head severity was rated using 0-100% scale on arbitrary 50 heads, excluding two outer rows. FHB index (Index) was calculated using formula: $\text{Index} = (\text{SEV} * \text{INC}) / 100$.

Harvest: Plots were harvested on September 2nd with a small plot combine and the yield was determined at 13.5% moisture.

Data analysis: Statistical analysis was done using Agrobase Generation II software. Fisher's least significant difference (LSD) was used to compare means at $p (\alpha = 0.05)$. Means were presented in the table for simplicity of understanding.

Table 1: Efficacy of fungicides at various application timings to manage Fusarium Head Blight on Hard Red Spring Wheat.

Treatments and their application timings	Rate (Fl Oz/A)	Fusarium Head Blight			Yield	Test Weight
		Incidence (%)	Severity (%)	Index	bu/A	lbs/bu
Non-Treated Check	Check	73	20	15	53	55
Prosaro at 10% flowering	6.5	23	8	2.0	57	57
Caramba at 10% flowering	13.5	23	7	1.9	50	54
Experimental 1 at 10% flowering	7.3	10	3	0.3	56	56
MiravisAce at complete head emergence	13.7	24	7	2.3	62	58
MiravisAce at 10% flowering	13.7	16	4	0.7	72	60
MiravisAce 4-5 days after 10% flowering	13.7	12	4	0.5	66	58
MiravisAce at 10% flowering + Prosaro 4-5 days after 10% flowering	13.7+6.5	5	2	0.1	74	59
MiravisAce at 10% flowering + Tebuconazole 4-5 days after 10% flowering	13.7+4	12	4	0.5	70	58
MiravisAce at 10% flowering + Caramba 4-5 days after 10% flowering	13.7+13.5	6	3	0.2	66	58
Experimental 2 at 10% flowering	6.5	15	5	0.7	66	57
	Mean	20	6	2.2	63	2
	CV %	47	41	83	12	2
	LSD	13	4	2.7	11	2
	P- Value (0.05)	0.00001*	0.00001*	0.00001*	0.001*	0.00001*

* Indicates treatments are statistically significant.

Note: All treatments were applied with NIS @ 0.125 v/v.

Results: All the fungicide treatments at different application timings were statistically significant from that of the non-treated check among the variables tested except yield. Application of Miravis Ace at 10% flowering plus Prosaro 4-5 days after 10% flowering was the best treatment (Table 1).

Funded by: US Wheat and Barley Scab Initiative Project.

Evaluation of Seed Treatments to Manage Blackleg on Canola

Venkat Chapara and Amanda Arens

Objective: To evaluate seed treatments to manage blackleg on canola.

Materials and Methods:

A research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of seed treatments to manage blackleg on canola. The trial was planted on May 22, 2020 with treated seed of various treatments on the canola cultivar ‘Westar’ compared with non-treated seed. The design was randomized complete block with four replications. The trial followed state recommended practices for land preparation, fertilization, seeding rate and weed control. The plot size was 5 ft. wide x 16 ft. long. Data on blackleg infections were rated following the scale of 0-5. Infections obtained in the research plots were natural. Twenty five canola stubbles were rated within each plot and the incidence (number of plants that had blackleg infections out of twenty five cut stems) and severity on each was recorded after swathing (August 18) on a 0-5 scale, where 0 = no disease tissue visible in the cross section; 1 = $\leq 25\%$ of the cross section has disease tissue; 2 = 26 to 50% of the cross section has disease tissue; 3 = 51 to 75% of the cross section has disease tissue; 4 = $\geq 75\%$ of the cross section has disease tissue; 5 = 100% diseased tissue/plant dead. A blackleg mean disease severity index was calculated with weighted mean of incidence and number of plants in each severity rating. Data were subjected to analysis of variance using complete block, balanced orthogonal designs of Agrobases generation II software.

Table 1: Mean blackleg disease incidence, severity and their effect on yield and test weights on the application of different seed treatments on canola.

Treatments	Rate (fl oz/100 lb seed)	Blackleg		Yield (lbs/A)	Test Weight (lbs/bu)
		Incidence (%)	Mean Disease Severity (0-5)		
Control	Check	69	1.78	1087	50.2
Biological	0.62	74	2.24	1258	50.8
Biological	1.23	62	1.67	1499	50.9
Biological	2.46	36	0.66	1268	50.0
Saltro	1.23	42	0.87	1529	51.1
	Mean	57	1	1328	51
	CV %	28	36	19	1
	LSD	24	1	NS	NS
	P-Value (0.05)	0.017	0.0052	0.13	0.13

Results: Canola seed treated with the biological at the higher rate followed by Saltro® had the lowest blackleg incidence and mean disease severity (Table 1) and was statistically significant from the other treatments tested. There was no significant difference in yield or test weight in the treatments tested when compared with the non-treated check.

Clubroot on Canola: Survey & Quantification of Resting Spores of *Plasmodiophora brassicae* from Field Collected Soil Samples in North Dakota

Principle Investigator: Venkat Chapara

Collaborators: Dr. Travis J. Prochaska, Dr. Audrey Kalil, , Dr. Jingwei Guo, Dr. Zhaohui Liu, Dr. Luis del Rio, and Dr. Anitha Chirumamilla

Take Home Message: An ongoing clubroot survey for over five years in various counties of North Dakota indicates a threat to the canola crop if proper attention is not given towards longer crop rotations (**1 in 3 years**). In addition, growers should consider growing an available clubroot resistant canola variety in endemic areas and follow proper equipment sanitation. Cleaning equipment thoroughly after working in a clubroot infected field is highly recommended since the primary mechanism of spread between fields is the movement of infested soil on farm equipment.

Survey Procedure:

The survey involved three components 1. visual survey, 2. soil sampling and 3. molecular quantification of resting spores of the clubroot pathogen.

Components 1&2. Visual survey and soil sampling: Clubroot scouting was done visually by inspecting canola crop roots. The disease survey was conducted in over 40 counties in North Dakota. In each county, one field in every 5000 acres was targeted for scouting. Soil samples were collected from fields with an intent to know the pH of the soil and to determine the number of resting spores per gram of soil. In all, a minimum of 3-10 fields per county were targeted for scouting.

The survey was done in two phases.

1st phase: at flowering (10% of flowering onwards)

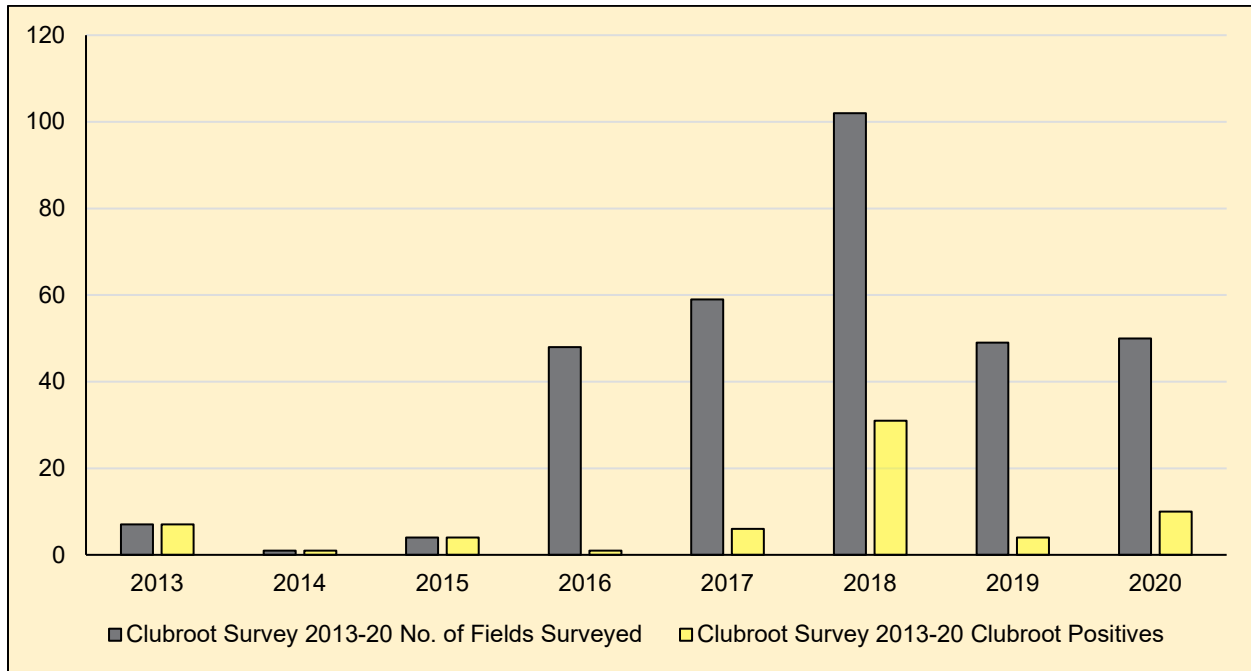
In the growing season, plants were sampled from distinct stunted patches or prematurely senescing plants in the field. Patches visible from the edge of the field were checked by digging and observing the roots for symptoms of clubroot and soil samples were collected from those areas.

2nd phase: after swathing

Scouting at swathing was based on the methodology followed in Canada by the Alberta Agricultural and Rural Development (AARD) for their annual clubroot disease survey. Reports of AARD indicated that the incidence of clubroot is increased in the field entrances. Hence, the survey was done from the main entrances/approaches in each field. The survey group walked a “W” pattern stopping at 5 spots and uprooting 10 consecutive stems from the ground at each spot. Each sampling point was separated by 100 meters or 328 feet. In all, roots of 50 stems were evaluated for the presence of clubroot and incidence was noted. Excess soil was removed. Roots were visually examined for the presence of galls. At sample sites where infection was observed or suspected, root specimens with galls, along with soil, were double bagged and labeled with the field location. Infected roots and soil samples from all the fields surveyed were collected and a representative sample was submitted to Dr. Zhaohui Liu’s laboratory for molecular quantification of resting spores per gram of soil and another half-pound of soil to the NDSU Soil Testing Laboratory for pH determination.

Results: Over 40 counties in North Dakota were surveyed in 2020 for visual symptoms of galls on canola roots. Clubroot galls on canola roots have only been found in Cavalier County, in 10 out of 50 canola fields surveyed (Figure 1).

Figure 1: Fields surveyed from 2013 to 2020 for prevalence of clubroot in Cavalier County, North Dakota.



Component 3. Molecular detection of soil samples to quantify *Plasmodiophora brassicae* (the clubroot pathogen) resting spores:

The objective of this procedure is to quantify resting spores of the clubroot pathogen in the soil and to inform growers prior to the occurrence of visible gall symptoms in canola.

Results from molecular assays on soil samples in 2019: The molecular assays indicated the clubroot spread occurred to the neighboring counties (Table 1). However, there were no visible symptoms observed when the roots were uprooted. To date, results received from 125 fields collected from 34 counties have shown that 18 counties have fields with clubroot resting spores (Figure 2 & Table 1). Quantified resting spores of *P. brassicae* from those samples ranged from 500 to 40 million per gram of soil (minimum detection limit of the assay being 10 resting spores/g of soil). Lack of visible galls in the surveyed fields but positive in the molecular soil quantification assay indicate either the resting spore population may not have reached required spores per gram of soil in acidic soils to show galls or the pH of soil is basic. In general, clubroot infections are expressed on canola plants where soil population is about 80,000 spores per gram of soil (Canadian Research). These results indicate that there is a need for continuous annual monitoring.

Notice: Growers who want to know about the presence of clubroot/resting spores in their field(s) are encouraged to contact Dr. Venkat Chapara at the Langdon REC (701-256-2582), Dr. Anitha Chirumamilla at the NDSU Cavalier County Extension Office (701-256-2560) or NDSU Extension (701-231-8363).

Figure 2: Number of fields with *P. brassicae* spores found in soil samples collected from various counties in North Dakota through molecular assays.

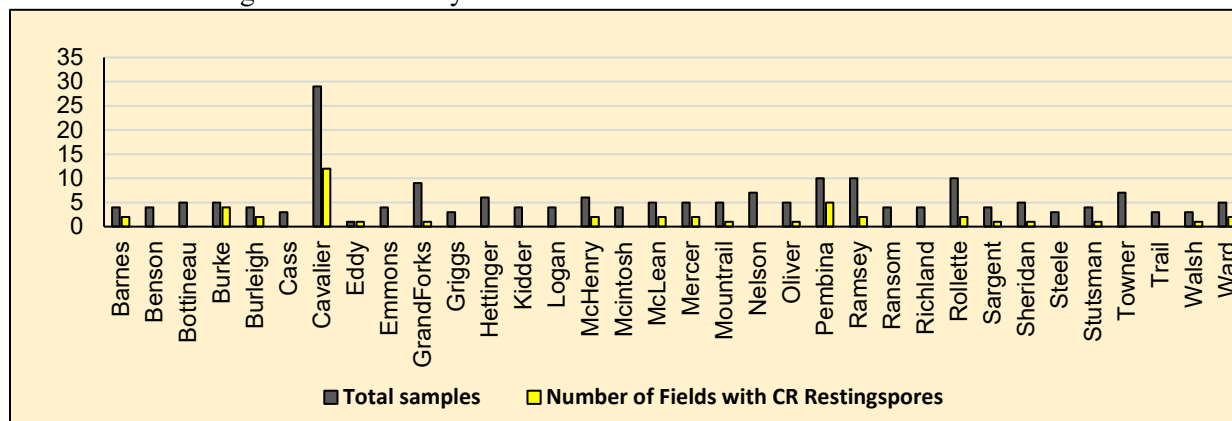


Table 1: Number of fields with *P. brassicae* spores found in soil samples collected from various counties in North Dakota.

Number	County Name	Number of Fields with	
		Total samples	CR Resting Spores
1	Barnes	4	2
2	Burke	5	4
3	Cavalier	29	12
4	Eddy	1	1
5	Grand Forks	9	1
6	McHenry	6	2
7	McLean	5	2
8	Mercer	5	2
9	Mountrail	5	1
10	Oliver	5	1
11	Pembina	10	5
12	Ramsey	10	2
13	Rollette	10	2
14	Sargent	4	1
15	Sheridan	5	1
16	Stutsman	4	1
17	Walsh	3	1
18	Ward	5	2

Evaluation of Various Fungicide Treatments at Different Application Times on Prominent Cultivars to Manage Fusarium Head Blight of Barley

Amanda Arens and Venkat Chapara

Objective: To evaluate the efficacy of fungicides in single and sequential applications to manage Fusarium head blight (FHB) in barley.

Methods:

Location: NDSU Langdon Research Extension Center

Experimental design: Randomized complete block with split plot arrangement, four replications.

Previous crop: Canola

Cultivars of barley tested: ND Genesis (moderately susceptible/susceptible, released by NDSU) and AAC Synergy (moderately resistant, Syngenta)

Planting: 1.25 million pure live seeds/acre planted on May 20, 2020. A border plot was planted between treated plots to minimize interference from spray drift.

Plot size: Seven rows at six inch spacing, 5 ft. x 20 ft., mowed back to 5 ft. x 16 ft.

Herbicides applied: Huskie Complete (1 pt/A) + Axial Bold (15 fl oz/A) on 6/8/2020

Inoculation: Plots were inoculated by spreading corn spawn inoculum around boot stage (Feekes 9-10) at the rate of 300 g/plot.

Disease development: Supplemental moisture was provided by running overhead irrigation from Feekes 9 to 11.2.5 at the rate of one hour per day to create a conducive environment for FHB development.

Fungicide treatments: Fungicides were applied with a CO₂-pressurized backpack sprayer with a three-nozzle boom (XR-8002) and the water volume used was 20 GPA. Fungicide (Miravis Ace) application was made at half head emergence on July 2nd. Miravis Ace, Prosaro and Caramba were applied at full head emergence stage on July 5th and repeated 5 days after the full head emergence (July 9th) as per the protocol requirements. Refer to Table 2 for the treatments, dosages and application timings.

Disease assessment: Data on FHB incidence was obtained by counting the number of heads showing FHB symptoms out of 50 heads. FHB head severity was rated using 0-100% scale on arbitrary 50 heads, excluding two outer rows. FHB index (Index) was calculated using the formula: $\text{Index} = (\text{SEV} * \text{INC}) / 100$.

Harvest: Plots were harvested on August 24th with a small plot combine and the yield was determined at 13.5% moisture.

Data analysis: Statistical analysis was done using Agrobase Generation II software. Fisher's least significant difference (LSD) was used to compare means at p ($\alpha = 0.05$). Means were presented in the table for simplicity of understanding.

Results: Statistically significant differences were obtained among the barley cultivars tested when the variables of DON, yield and test weight were compared. However, there were no significant differences obtained among the variables of FHB incidence, severity and index (Table 1). There was no interaction effect found between the main plot (varieties) and the subplot (fungicide) treatments. Among the fungicides tested at different application timings, the treatment of Miravis Ace at 5 days after full head emergence has shown better performance in

terms of FHB incidence, severity, index, and DON values. Likewise, yield is on par with the highest yielded treatment of the trial (Miravis Ace sprayed at Feekes 10.3 (half head emergence) stage) (Table 2).

Table 1: Mean values of the variables tested on the barley cultivars ND Genesis and AAC Synergy obtained on application of fungicide treatments.

Cultivars	Fusarium Head Blight				Yield (bu/A)	Test Weight (lbs/bu)
	Incidence (%)	Severity (%)	Index	DON (ppm)		
ND Genesis	58	19	13	2.0	73	45
AAC Synergy	66	24	17	3.3	79	46
Mean	45	22	15	2.7	76	45
CV (%)	61	40	60	3.3	6	1
LSD	NS	NS	NS	0.5	2	0
p-Value (0.05)	0.1199	0.547	0.2	0.00001*	0.00001*	0.00001*

* Indicates the variables are statistically significant between the cultivars tested.

NS: Indicates the variables are statistically non-significant between the cultivars tested

Table 2: Mean values of the variables tested on application of various fungicide treatments applied at different timings on two barley cultivars.

Treatments	Rate (fl oz/A)	Application (Feekes) Stage	Fusarium Head Blight				Yield (bu/A)	Test Weight (lbs/bu)
			Incidence (%)	Severity (%)	Index	DON		
Caramba	13.5	10.5.1	71	23	17	3.8	76	44
MiravisAce	13.7	10.3	62	27	13	2.7	82	46
MiravisAce	13.7	10.5.1	48	17	8	2.3	77	45
MiravisAce	13.7	5 Days after 10.5.1 spray	37	17	10	0.9	77	46
MiravisAce+Tebuconazole	13.5 + 4.0	10.5.1 + 5 Days after 10.5.1 spray	60	17	11	1.5	74	45
Prosaro	6.5	10.5.1	67	21	16	3.0	74	45
Non-Treated Check	Check	Check	90	36	32	4.3	73	44
		Mean	62	22	15	2.7	76	45
		CV (%)	33	40	60	32.0	6	1
		LSD	21	9	9	0.9	4	0
		p-Value	0.0005*	0.0008*	0.0001*	0.00001*	0.0075*	0.00001*

* Indicates treatments are statistically significant.

Note: All treatments were applied with NIS @ 0.125 v/v.

Funded By: US Wheat and Barley Scab Initiative Project.

DETERMINING THE ECONOMIC RESPONSE OF SODIC SOILS TO REMEDIATION BY GYPSUM, ELEMENTAL SULFUR AND VERSALIME IN NORTHEAST NORTH DAKOTA ON TILED FIELDS

Naeem Kalwar (Extension Soil Health Specialist)



Figure 1. The NDSU Langdon Research Extension Center Groundwater Management Research Project Lift Station.

This research report is an extension of an ongoing long-term research trial on a tiled saline-sodic site. The main objectives of the trial are:

- Does soil sodicity negatively affect tile drainage performance?
- Will tiling lower soil salinity under wet and dry weather conditions?
- Does the drained water from a tiled field increase salinity and sodicity levels of the surface water resources?

This abbreviated report only summarizes annual soil Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR), pH, bulk density and key drained water quality analysis results. If you would like to access the information about the trial background, objectives, location, site, description, design, methodology and complete set of data collected annually, please contact the NDSU Langdon Research Extension Center:

Mail: 9280 107th Avenue NE, Langdon, ND 58249

Phone: (701) 256-2582

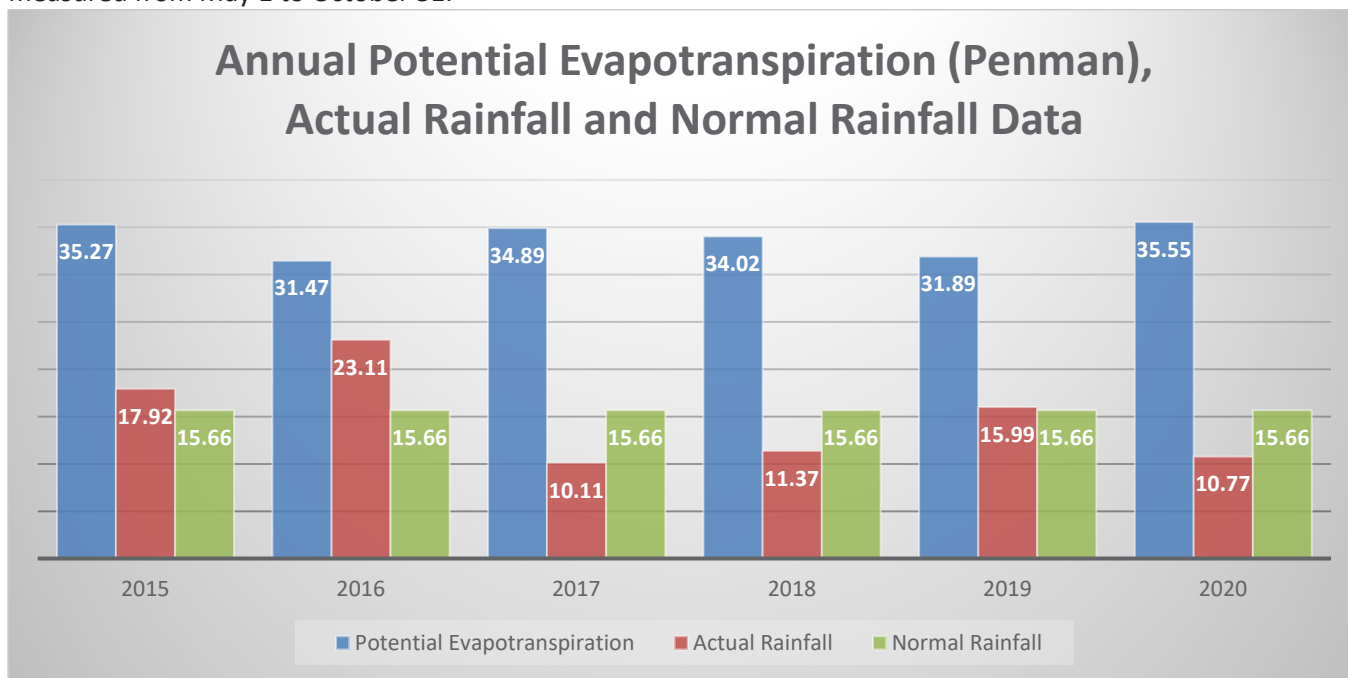
RESULTS AND DISCUSSION

The findings below are based on the statistical analysis of soil electrical conductivity (EC), sodium adsorption ratio (SAR), pH and bulk density. In addition, included are the results of conductivity (mmhos/cm), dissolved solids (mg/L), SAR and pH of the water quality analysis. This was done to measure the differences in these properties at the time of tiling compared to after applying the soil amendments (treatments). In addition, effects of annual growing-season rainfall, resulting average annual growing-season groundwater depths and potential evapotranspiration (Penman) were measured from May to October on a weekly basis and noted for any changes in these properties. Water quality analysis results are also presented to determine if water drained from the tiled field is adding more salts and sodicity to the surface water resources. The treatment means of EC, SAR and pH represent 2014, 2016, 2017, 2018, 2019 and 2020 results of three replications for the zero to four-foot soil depths. The treatment means of groundwater depths represent 2015 to 2020 results of three replications measured for zero to seven and a half-foot soil depths. Water quality analysis results represent 2015 to 2020 water samples that were collected from the tile drainage lift station as well as upstream and downstream of the lift station from the surface water drainage ditch in which tile drainage water has been draining. These water samples were collected one to three times a year depending upon the weather.

Annual Changes in Weather and Soil Groundwater Depths

Changes in soil chemical properties are also greatly influenced by the fluctuations in the weather such as annual evapotranspiration and rainfall (Figure 2), and resulting groundwater depths and capillary rise of soil water.

Figure 2. Annual growing-season potential evapotranspiration (Penman), actual rainfall and normal rainfall in inches measured from May 1 to October 31.

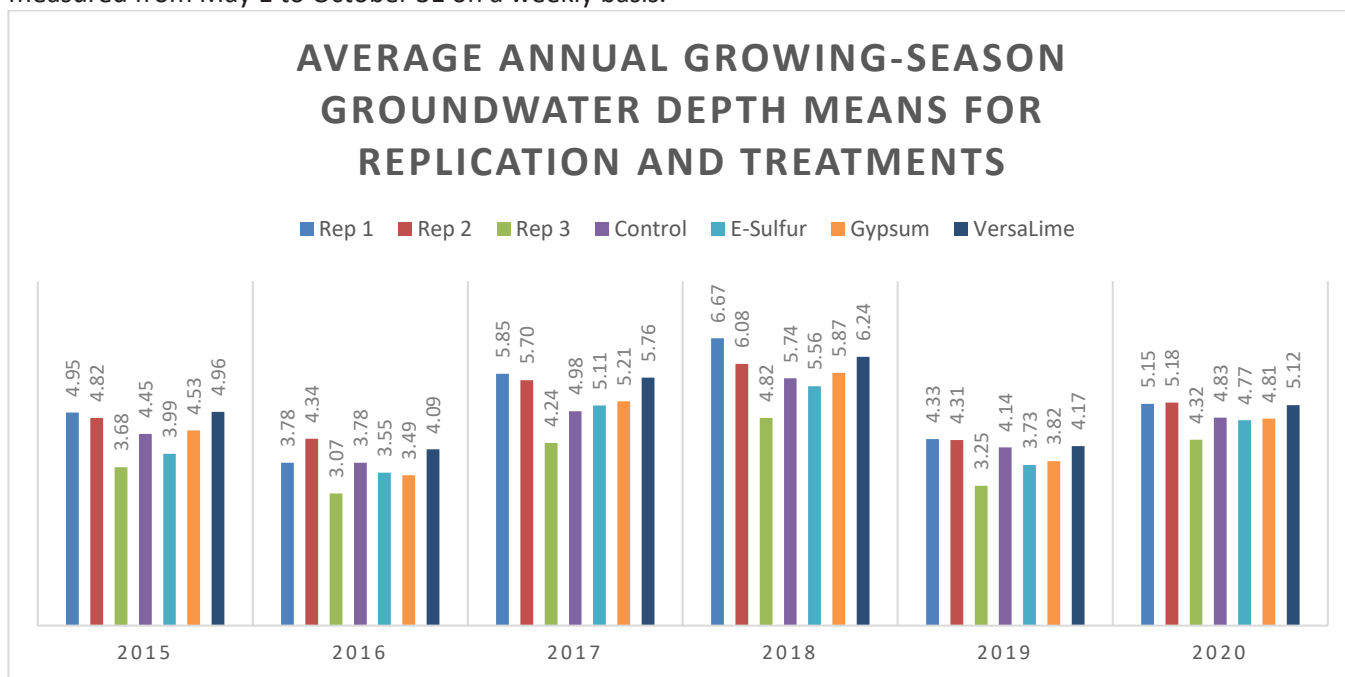


A bigger gap between evapotranspiration and rainfall means increased capillary rise of soil water, less leaching of soluble salts and slower dissolution of soil amendments. A narrower gap between these two could result in shallower groundwater depths, however, under good soil water infiltration and improved drainage, not only excess salts can be moved out of the fields but soil amendments can also produce favorable results. In addition, a narrower gap between evapotranspiration and rainfall will result in reduced capillary rise of soil water (wicking up). In 2016

on the tiled site, the gap between evapotranspiration and rainfall was narrow and the infiltration was still good as higher levels of soluble salts were neutralizing the dispersion caused by sodicity. This resulted in the highest decrease in soil salt levels since the site has been tiled in 2014. In 2017, there was a significant increase in soil salt levels compared to 2016, which could be due to an increase in the capillary rise of soil water due to the greater differences between annual evapotranspiration and rainfall. That trend continued in 2018, early part of 2019 and 2020 due to the drier weather.

Figure 3 below has the average annual growing-season groundwater depth means for replications and treatments for 2015 to 2020. These means of groundwater depths represent actual annual measurements of groundwater depths measured from May 1 to October 31 on a weekly basis.

Figure 3. Annual means of average growing-season groundwater depths for replications and treatments in feet measured from May 1 to October 31 on a weekly basis.



Note: In 2015, groundwater depths were only measured from mid-June to the end of October.

The 2016 groundwater depths were shallower than the depths in 2015, 2017, 2018, 2019 and 2020, whereas, the 2018 groundwater depths were the deepest versus the other years. Replication 3 had significantly shallower average annual growing-season groundwater depths compared to replications 1 and 2 during all years.

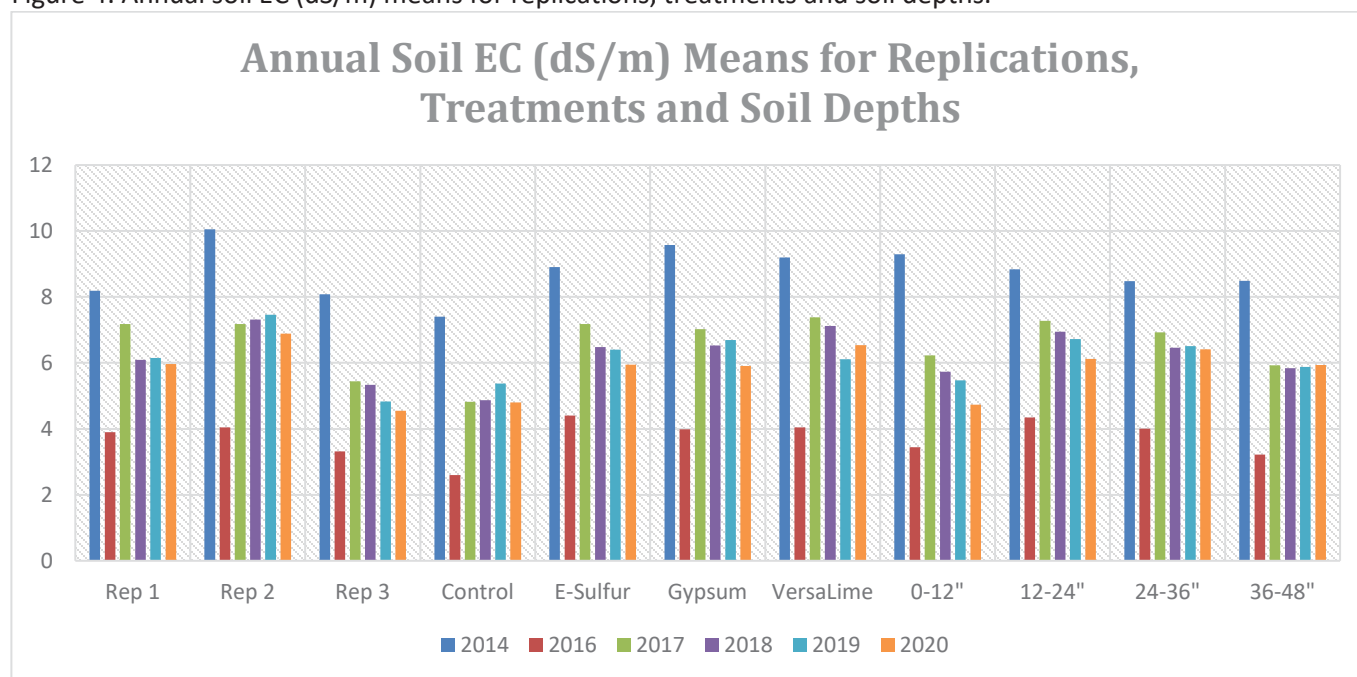
These fluctuations in groundwater depths are also reflective of a very wet 2016 versus drier weather in 2017 and 2018. In 2019, weather was dry until July 30th. After which, it started getting wet. The NDSU Langdon Research Extension Center, North Dakota Agricultural Weather Network (NDAWN) Station recorded 5.88 inches of rainfall from May 1st to July 30th in 2019 versus a normal of 9.71 inches. The total potential evapotranspiration (Penman) for the same period was 21.44 inches. The same station recorded 9.74 inches of rain versus a normal of 4.76 inches from July 31st to October 5th, 2019. The total potential evapotranspiration (Penman) for the same period was 9.04 inches. On July 31st, 0.77 inches was recorded and in August of 2019, 2.48 inches of rain were recorded versus a normal of 2.57 inches. September 2019 was the wettest month of the year and 5.87 inches of rain were recorded versus a normal of 1.81 inches. Overall, most of the early growing-season was dry, whereas, fall was very wet which also created harvest issues. The 2020 total potential evapotranspiration (Penman) and actual rainfall numbers were similar to the 2017 numbers.

Differences in Soil Electrical Conductivity (Salinity) Levels

Soil EC levels have been directly related to the annual growing-season rainfall and resulting moisture levels in the topsoil. A narrower gap between annual total potential evapotranspiration and rain means more leaching of salts and less capillary rise of soil water, whereas, a wider gap indicates less leaching and increased capillary rise. This is evident from the significant decrease in 2016 EC levels despite shallow average annual growing-season groundwater depths due to excess rainfall and improved drainage under tiling. Electrical conductivity spiked in 2017 and that trend continued in 2018, 2019 (until July 30, 2019) and 2020 despite average annual growing-season groundwater depths being deeper than the depth of the tiles (four-feet) and land being tiled. That was a result of increased capillary rise of soil water due to low rainfall and higher evapotranspiration. This defies the common belief that just lowering the groundwater depths will cause excess salts to leach out. Lowering soil EC levels will need an optimum combination of low enough groundwater depths combined with sufficient rain and good soil water infiltration to push the salts into deeper depths. Importance of good soil water infiltration is also evident from the fact that the highest EC levels were observed in 12-24 and 24-36 inch soil depths. This could be an indication of decent infiltration through the first foot, however, much slower water movement through the second and third feet of soil resulting in higher levels of salts. Sufficient rain will also result in improved moisture levels in the topsoil resulting in decreased capillary rise. Based on soil test EC levels, establishing a salt-tolerant annual crop (barley, oat) or perennial grass mix is also very important as that will reduce evaporation and consequently capillary rise.

Electrical conductivity in 2014 were the highest followed by 2017, 2018, 2019, 2020 and 2016. Replication 2 had the highest EC levels followed by replications 1 and 3. VersaLime treatments had the highest levels followed by gypsum, E-sulfur and control treatments. The highest EC levels were found in the 12-24 inch soil depths followed by 24-36 inch, 36-48 inch and 0-12 inch depths. Details of soil EC (dS/m) levels are shown in Figure 4.

Figure 4. Annual soil EC (dS/m) means for replications, treatments and soil depths.



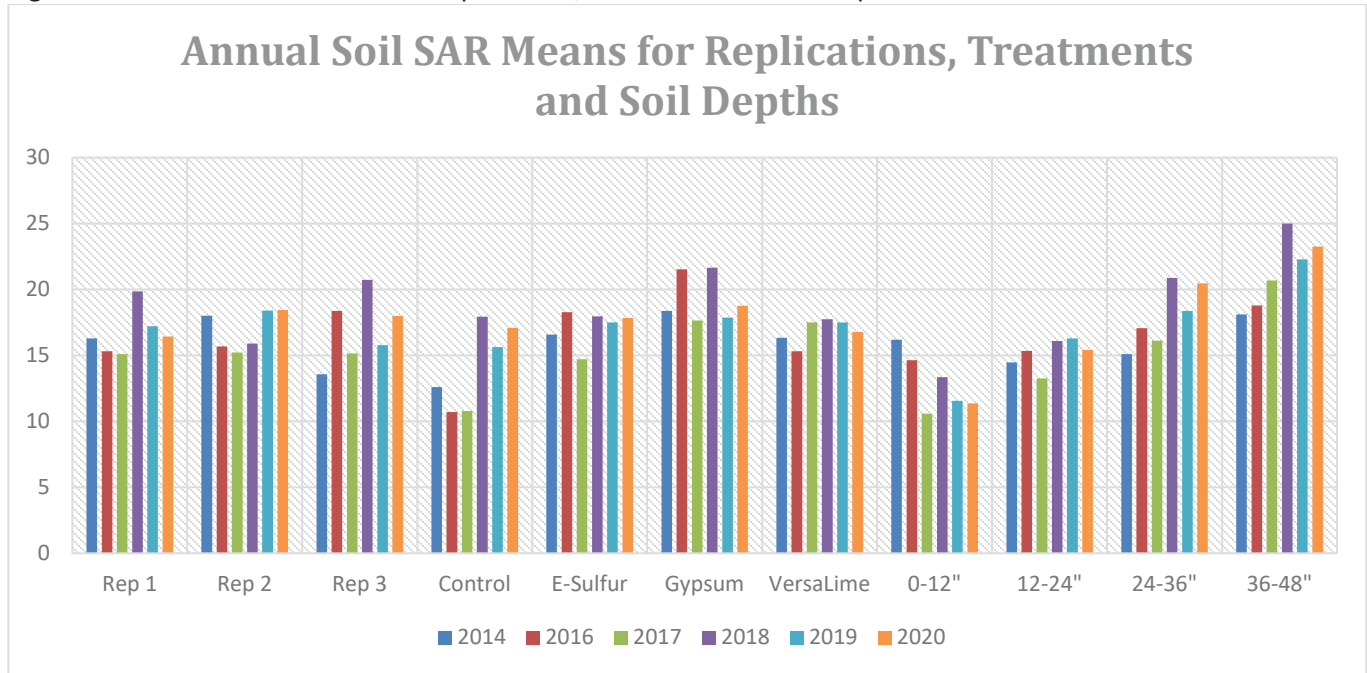
Differences in Soil Sodium Adsorption Ratio SAR (Sodicity) Levels

Soil SAR levels have been inconsistent irrespective of soil amendment applications (even after five-years), weather conditions, resulting average annual growing-season groundwater depths and tiling. It could be due to the drier weather in 2017, 2018, the early part of 2019 and 2020 resulting in insufficient soil water to dissolve the amendments and create the desired chemical reaction for sodicity remediation. This could also be a good insight that lowering SAR levels is more complex than lowering EC, which will take a longer time and equal or higher than

normal annual rainfall. In addition, soil SAR levels increased with soil depth showing 0-12 inch depths having the lowest SAR levels and 36-48 inch depths having the highest SAR levels.

Sodium adsorption ratio remained the highest in 2018 followed by 2020, 2019, 2016, 2014 and 2017. Replication 2 had the highest SAR levels followed by replications 3 and 1. Gypsum treatments had the highest levels followed by E-sulfur, VersaLime and control treatments. The 36-48 inch soil depths had the highest SAR levels followed by 24-36 inch, 12-24 inch and 0-12 inch depths. Details of soil SAR levels are shown in Figure 5.

Figure 5. Annual soil SAR means for replications, treatments and soil depths.

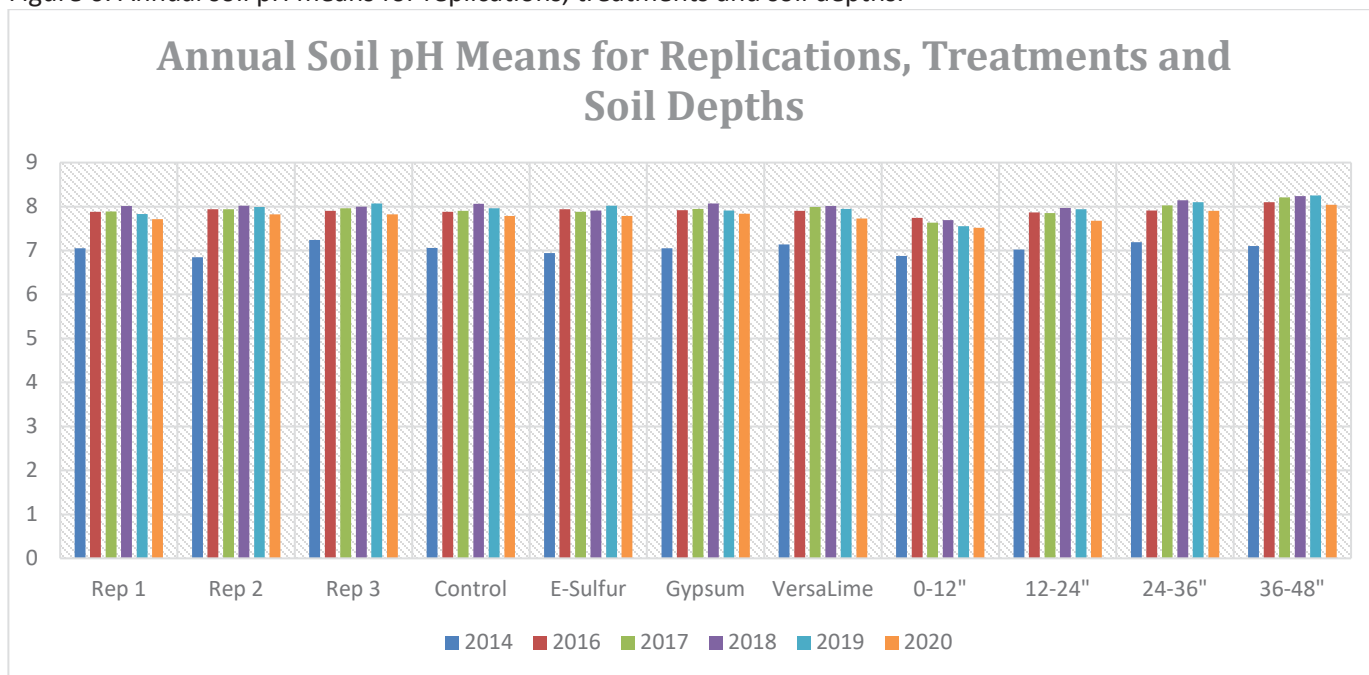


Differences in Soil pH Levels

Soil pH levels were consistent with the annual growing-season rainfall and resulting soil moisture levels and have had no impact so far related to the application of soil amendments. Like SAR, soil pH significantly increased with soil depth and the 0-12 inch depth having the lowest pH levels and the 36-48 inch depths having the highest pH levels. An increase in pH with soil depth was due to the increase in soil moisture levels.

Soil pH levels remained the highest in 2018 followed by 2019, 2017, 2016, 2020 and 2014 while replication 3 had the highest pH levels followed by replications 2 and 1. That is interesting as generally replication 3 has the shallowest average annual growing-season groundwater depths followed by replications 2 and 1 every year. The VersaLime treatments had the highest levels followed by gypsum, control and E-sulfur treatments. The 36-48 inch soil depths had the highest pH levels followed by 24-36 inch, 12-24 inch and 0-12 inch depths. Details of soil pH levels are shown in Figure 6.

Figure 6. Annual soil pH means for replications, treatments and soil depths.

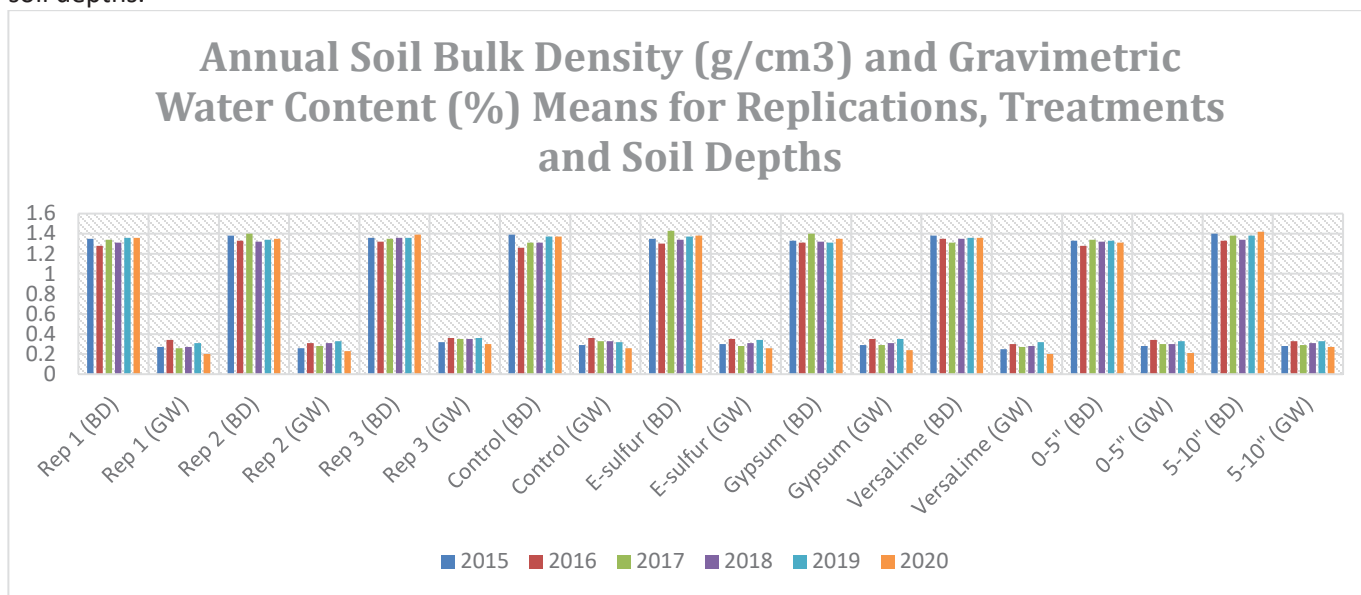


Differences in Soil Bulk Density Levels

Soil bulk density increased with soil depths. Despite not being a clear trend, bulk density increased as the gravimetric soil water content decreased.

Bulk density levels in 2020 were the highest followed by 2015, 2017, 2019, 2018 and 2016 at 24, 28, 29, 33, 31 and 34 percent gravimetric water levels respectively. Replication 3 had the highest bulk density levels followed by replications 2 and 1 at 34, 28 and 27 percent gravimetric water levels. E-sulfur treatments had the highest levels followed by VersaLime, control and gypsum treatments at 30, 27, 32 and 30 percent gravimetric water levels. The 0-12 inch soil depths had lower bulk density levels compared to 5-10 inch depths at 29 and 30 percent gravimetric water levels. Soil bulk density (g/cm^3) and corresponding gravimetric water content (%) levels are shown in Figure 7.

Figure 7. Annual means of soil bulk density (g/cm^3) and gravimetric water (%) levels for replications, treatments and soil depths.



Is Drained Water from the Tiled Saline and Sodic Field Adding More Salts and Sodicity to the Surface Water Resources?

Based on the cumulative means of all sampling times, conductivity, total dissolved solids and SAR levels of the lift station samples were higher than the upstream and downstream samples (Figures 8 and 9). The pH means of upstream, lift station and downstream samples were roughly equal. These trends point out that over time depending upon the site specific soil chemistry, tile drainage water can add salts and sodicity to the surface water resources. Details of conductivity, dissolved solids, SAR and pH of each sampling activity are outlined in Table 1.

Table 1. Results of conductivity ($\mu\text{mhos/cm}$), dissolved solids (mg/L), Sodium Adsorption Ratio (SAR) and pH for each water sampling activity.

Date	Site	Conductivity ($\mu\text{mhos/cm}$)	Total Dissolved Solids (mg/L)	Sodium Adsorption Ratio (SAR)	pH
November 9, 2015	Upstream	5650	4510	13.10	8.27
	Lift Station	10200	8840	17.40	7.91
	Downstream	6800	5700	16.30	8.37
May 11, 2016	Upstream	7220	6060	16.60	8.92
	Lift Station	7200	7170	14.90	7.96
	Downstream	7560	6390	17.60	9.23
July 11, 2016	Upstream	999	647	3.54	7.60
	Lift Station	8140	6820	16.20	8.32
	Downstream	966	627	3.07	7.56
September 8, 2016	Upstream	3440	2570	8.55	8.31
	Lift Station	7220	5960	15.60	8.10
	Downstream	3200	2340	6.87	7.92
May 10, 2017	Upstream	6920	5840	14.20	8.27
	Lift Station	5980	4950	13.50	8.08
	Downstream	6070	5200	14.00	8.28
August 17, 2017	Upstream	3360	2590	8.36	7.60
	Lift Station	6590	6010	22.60	7.99
	Downstream	2100	1430	6.52	7.67
June 12, 2018	Upstream	5130	3910	13.80	7.70
	Lift Station	4470	3420	11.00	8.00
	Downstream	4840	3680	13.50	7.92
August 26, 2019	Upstream	3710	2860	10.70	7.92
	Lift Station	5430	4290	14.70	8.03
	Downstream	5070	4080	14.60	8.11
September 30, 2019	Upstream	754	488	3.11	7.77
	Lift Station	6460	5620	15.20	7.78
	Downstream	1350	891	4.55	7.71
July 6, 2020	Upstream	3510	2630	7.93	7.76
	Lift Station	6760	5560	15.4	7.95
	Downstream	4240	3380	11.2	7.76

Figure 8. Cumulative means of conductivity ($\mu\text{mhos/cm}$) and dissolved solids (mg/L) for all sampling activities.

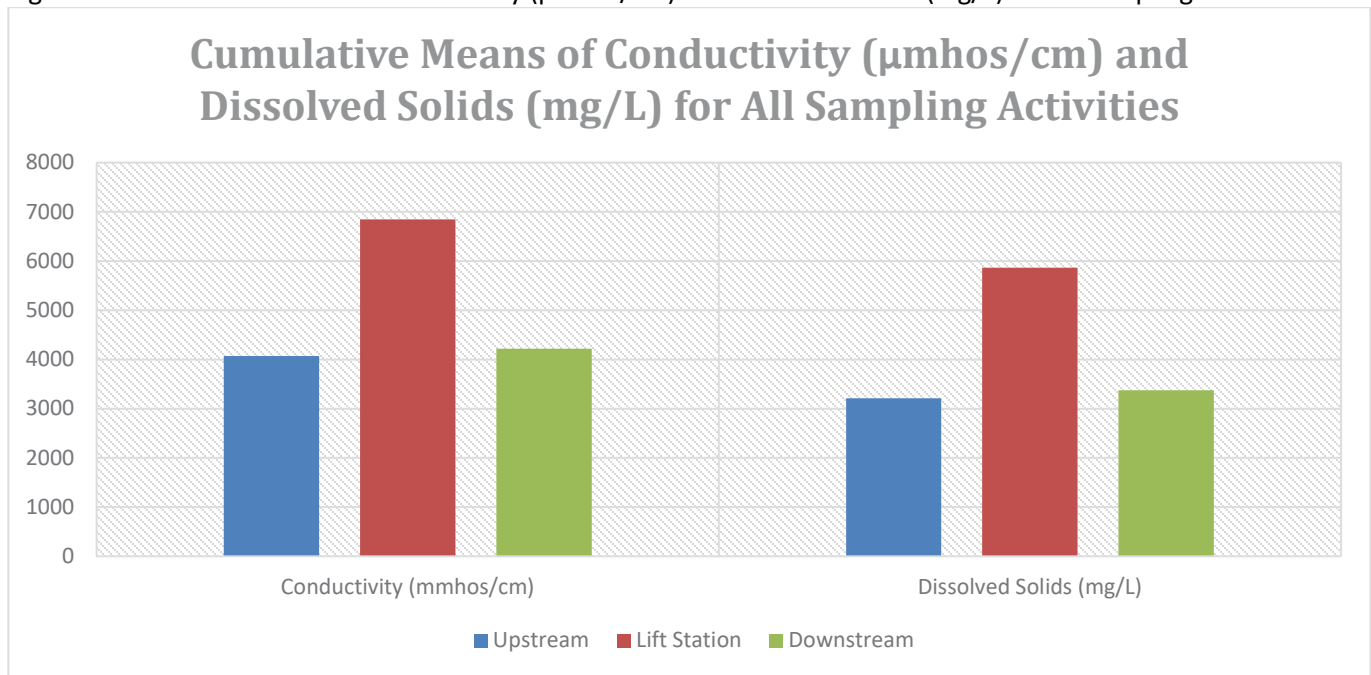
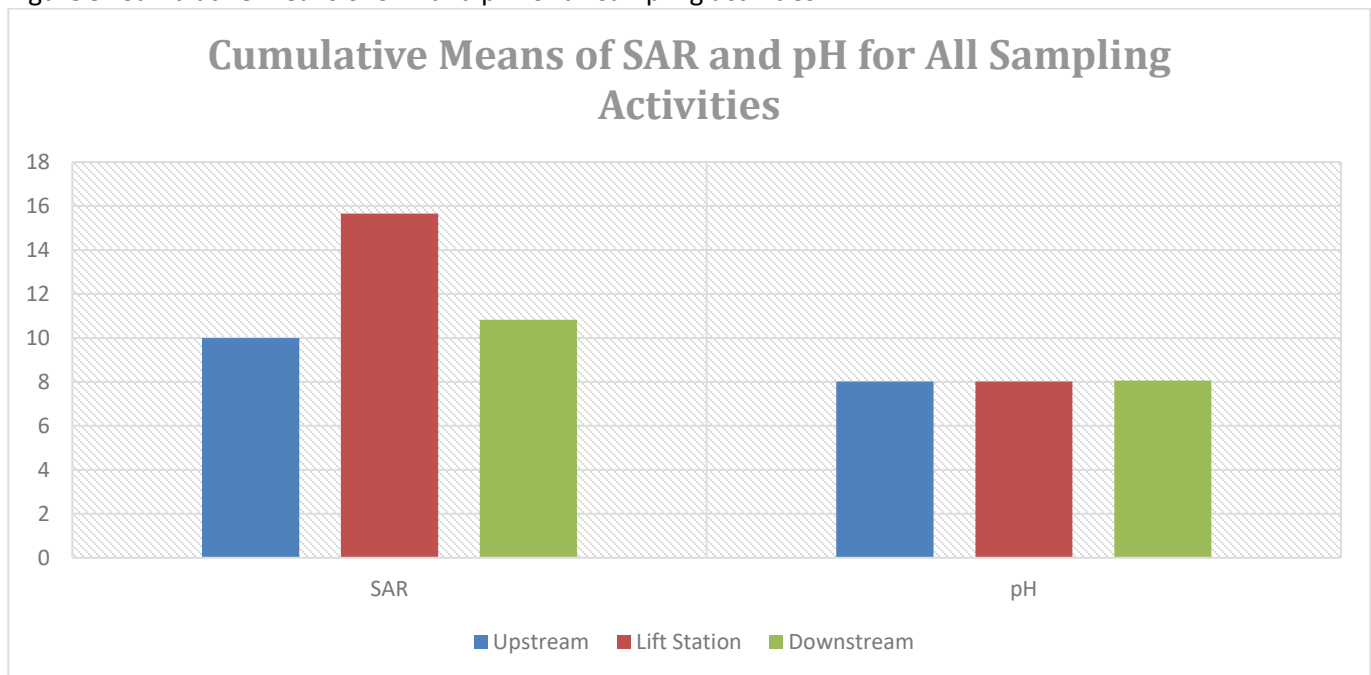


Figure 9. Cumulative means of SAR and pH for all sampling activities.



SUMMARY

Research data and observations are not conclusive at this point. However, producers and landowners having unproductive areas with potential soil dispersion issues (due to sodicity or excessive swelling of the soils due to the higher magnesium (Mg^{2+}) versus calcium (Ca^{2+}) levels) and may be thinking about tiling entire fields as a single-step strategy to reclaim potential saline-sodic areas. They may want to consider the following points before making a final decision:

Under Wet Weather

- Depending upon soil texture, tiling may drain excess water timely **under good soil water infiltration**.
- If the potential fields have unproductive or marginal areas, **they may want to sample these areas three to four-feet deep and analyze the samples for EC (salinity), SAR (sodicity) and pH by using the saturated paste extract method**. That will be a very inexpensive activity compared to tiling and will help them make informed decisions.
- Based on the soil SAR results, if sodicity is established **they may want to consider applying the soil amendments before tiling as amendments will convert sodicity into a salinity issue**. Once sodicity levels are lowered, soil water infiltration will also improve and tiles will help drain the excess water along with leaching the excess salts.
- Tiling sodic or saline-sodic fields alone **will not remediate sodicity and will require application of amendments at some point in time**.
- Note: calculating the rates of soil amendments will also require analyzing the 0-12 inch depth samples for **Cation Exchange Capacity (CEC) by using sodium saturation and ammonium extraction method**.
- Based on soil EC levels, **it will be beneficial to plant a salt-tolerant annual crop or a perennial salt-tolerant grass mix on the saline or saline-sodic areas**. That will use excess soil water, reduce evaporation, and minimize capillary rise of soil water as well as upward movement of excess water soluble salts.

Under Drier Weather

- **Tiling entire fields may not be necessary as average annual growing-season groundwater depths may lower naturally**.
- Tiling alone **may not lower salinity as moving the excess water soluble salts into the deeper soil depths will require sufficient rain resulting in free or gravitational water**.
- **Salinity levels can actually increase despite tiling due to the increased evaporation and resulting capillary rise of soil water**.
- If the potential fields have unproductive or marginal areas, **they may still be sampled three to four-feet deep and analyzed for EC (salinity), SAR (sodicity) and pH levels by using the saturated paste extract method**. This will be a very inexpensive activity compared to tiling.
- Based on the soil SAR results, if sodicity is established **they may still want to consider applying the soil amendments before tiling as amendments will convert sodicity into a salinity issue**. Once sodicity levels are lowered, soil water infiltration will also improve, which will help leach salts during spring-melt or decent rain events.
- Tiling sodic or saline-sodic fields alone **will not remediate sodicity and will require the application of amendments at some point in time**.
- Note: calculating the rates of soil amendments will require analyzing the 0-12 inch depth samples for **Cation Exchange Capacity (CEC) by using sodium saturation and the ammonium extraction method**.
- Despite applying amendments, conversion of sodicity into salinity **will take longer, possibly several years**.
- Based on soil EC levels, **it will be beneficial to plant a salt-tolerant annual crop or a perennial salt-tolerant grass mix on the saline or saline-sodic areas**, which will reduce evaporation, minimize capillary rise of soil water and minimize upward movement of excess soluble salts.

CONCLUSION

Since most soils in North Dakota are clayey, the general belief is that these soils will infiltrate water slower and we cannot do much about it. That is true if we only compare the texture of clay soils with silty or sandy soils. However, a clayey soil with high to very high dispersion or swelling will infiltrate water much slower than the same clay type not having these issues. Reducing soil dispersion and/or swelling combined with no or minimum-till practices and increasing organic matter will improve soil particle aggregation, structure, pore space and water infiltration.

SALT AND SODICITY TOLERANCE OF BARLEY AND OATS

Barley and oats are one of the most salt and sodicity tolerant annual crops producers can profitably grow in North Dakota. However, at certain salinity and sodicity levels, even barley and oats can result in significant losses. Especially important are the levels of salinity and sodicity in the top six inches of the soil. A trial was initiated to determine the threshold of soil salinity (Electrical Conductivity or EC) and sodicity (Sodium Adsorption Ratio or SAR) for barley and oats. Four barley and oat varieties were planted at the Langdon REC at three different salinity and sodicity levels in 2020.

Soil Analysis Results

Two-foot deep composite soil samples separated into 0-6 and 6-24 inch depths were taken in May 2020 from each level of salinity and sodicity (replications 1, 2 and 3) by taking three cores for each sample. Soil EC, SAR and pH were analyzed by using the saturated paste extract method, whereas, standard methods were used to analyze NO₃-N, P and K (Table 1). Table 1. Soil EC, SAR, pH, NO₃-N, P and K results of the three replications for the 0-6 and 6-24 inch depths.

Site	Sample ID	Depth (inches)	EC (dS/m)	SAR	pH	NO ₃ -N (lbs./acre)	P (ppm)	K (ppm)
Rep 1	Low to moderate salinity-sodicity	0-6	3.99	7.12	7.18	5	20	299
		6-24	7.32	15.05	7.71	6	5	137
Rep 2	Moderate to high salinity-sodicity	0-6	7.80	18.13	7.61	6	29	247
		6-24	10.39	20.92	7.95	6	2	148
Rep 3	Very high salinity-sodicity	0-6	10.50	27.30	7.59	5	51	270
		6-24	9.86	32.87	7.81	6	4	169

Trial Design, Plot Sizes and Planting Data

Trial design was randomized split block. Plot sizes were 4.7 X 22 feet. Details are in Table 2.

Table 2. Barley and oat varieties, seeding rates and depths and fertilizer rates per acre.

Crop	Variety	Planting Date	Seeding Rates (live seeds/acre)	Seeding Depth (inches)	Fertilizer Application (lbs./acre)
Barley	AAC Synergy (2-row)	June 1, 2020	1.25 million live seeds per acre	1 – 1.5	Based on soil NO ₃ -N, P and K analysis a uniform rate of 120 lbs. of N was applied as Urea to all three replications.
	ND Genesis (2-row)				
	Pinnacle (2-row)				
	Tradition (6-row)				
Oats	CS Camden	June 1, 2020	1.00 million live seeds per acre	1 – 1.5	Based on soil NO ₃ -N, P and K analysis a uniform rate of 120 lbs. of N was applied as Urea to all three replications.
	ND Heart				
	Rockford				
	Souris				

Results and Discussion

There were significant differences between the three replications starting from seedbed preparation, germination, plant growth and vigor, maturity, yield and quality. See pictures to compare growth and maturity of the three replications.



Barley and oat varieties growing on replication 1 (low to moderate salinity-sodicity) on July 28 and September 15, 2020.

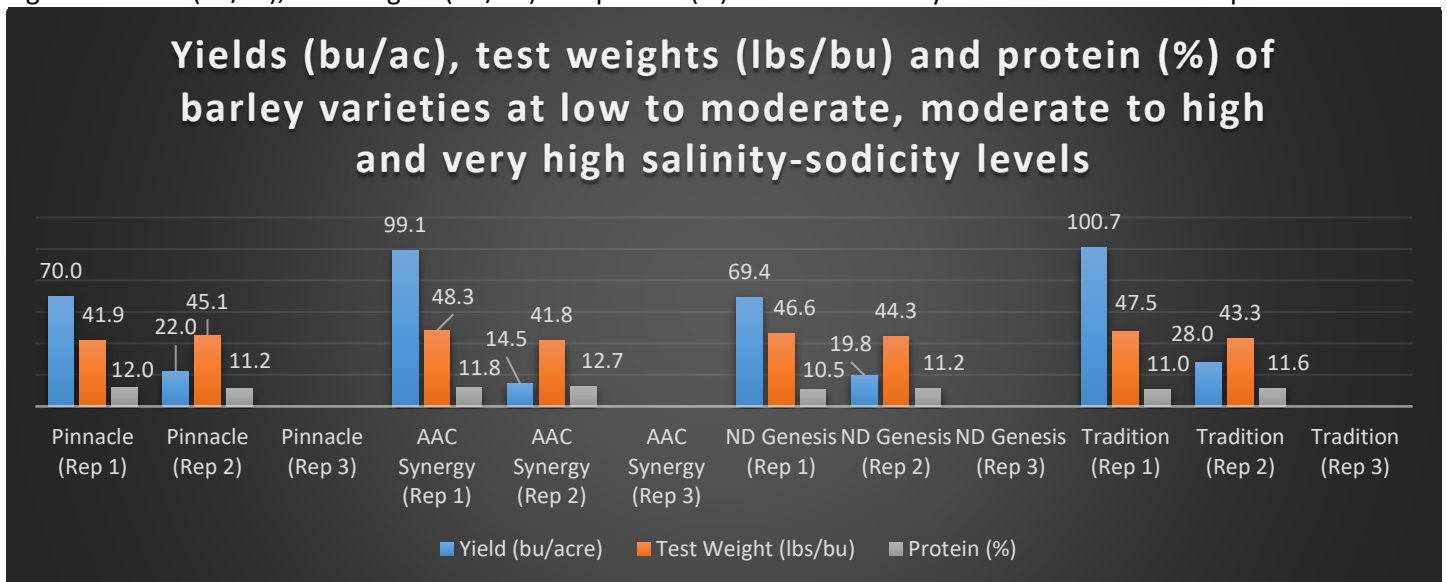


Barley and oat varieties growing on replication 2 (moderate to high salinity-sodicity) on July 28 and September 15, 2020.



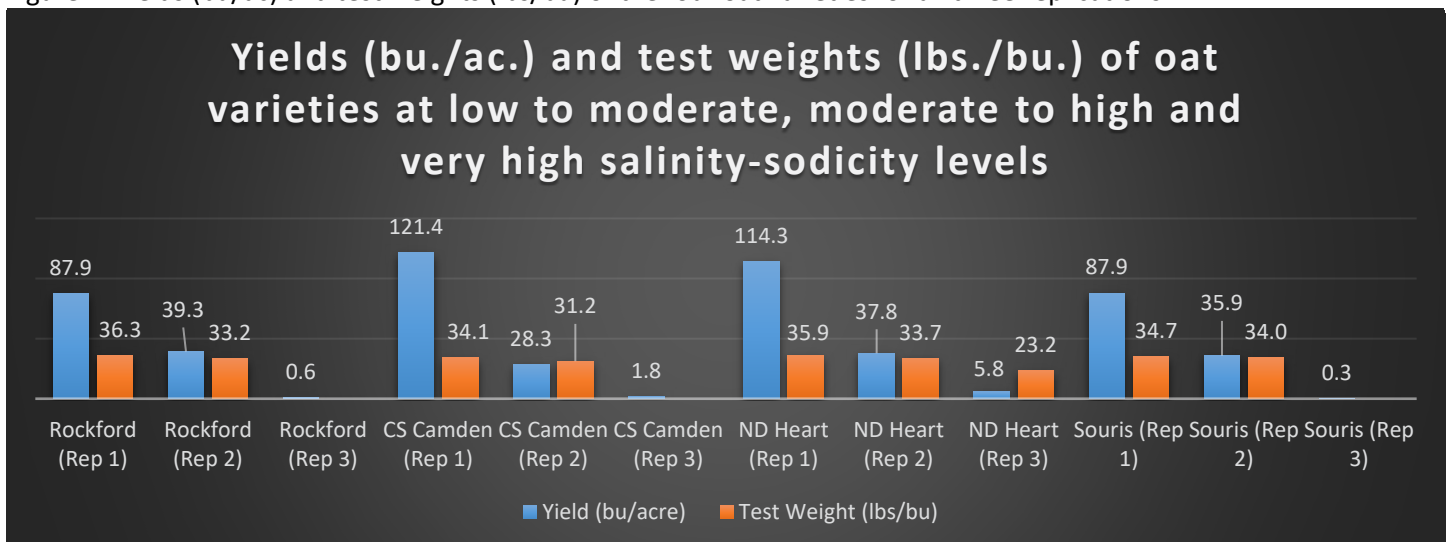
Barley and oat varieties growing on replication 3 (very high salinity-sodicity) on July 28 and September 15, 2020. Average barley yield of replication 1 was 84.8 bu/acre versus 21.1 bu/acre of replication 2. That was a 75 percent reduction in yield (Figure 1). Replication 1 also had five percent higher average test weight compared to replication 2. However, average protein of replication 2 was slightly higher than replication 1. Replication 3 resulted in 100 percent loss. Tradition (six-row) barley had the highest yields in replications 1 and 2 versus the other three two-row varieties.

Figure 1. Yields (bu/ac), test weights (lbs/bu) and protein (%) of the four barley varieties for all three replications.



Average yield of oats in replication 1 was 102.8 bu/acre versus 35.3 bu/acre of replication 2 and 2.1 bu/acre of replication 3. That was 65 and 98 percent reduction in yields (Figure 2). Replication 1 had 6.3 and 83.5 percent higher average test weight than replications 2 and 3. One key observation was that oats had some growth in replication 3, whereas, barley had zero growth pointing to a slightly higher salt-sodicity tolerance of oats compared to barley.

Figure 2. Yields (bu/ac) and test weights (lbs/bu) of the four oat varieties for all three replications.



Summary: At an EC of 3.99 dS/m and SAR of 7.12 in the 0-6 inch soil depth, both barley and oats produced higher yields and quality. Increased EC and SAR levels in the topsoil may result in significant economic losses.

Langdon REC Foundation Seed Stocks Program

The Langdon REC supports a Foundation Seed Stocks (FSS) Program to help increase and distribute the newest NDSU varieties of HRSW, durum, barley, soybeans and flax. We also periodically increase seed for the University of Minnesota and South Dakota Ag Experiment Station. Each year approximately 500 acres are planted for the FSS program. The harvested acreage is available for sale to producers and seedsmen in the region. The varieties of crops that are available for the 2021 growing season are listed below:

HRSW – Faller, Prosper, Linkert, Bolles, ND VitPro, MN-Washburn, MN-Torgy, ND Frohberg, Glenn

Barley – ND Genesis, Lacey

Flax – ND Hammond

Soybeans – ND17009GT

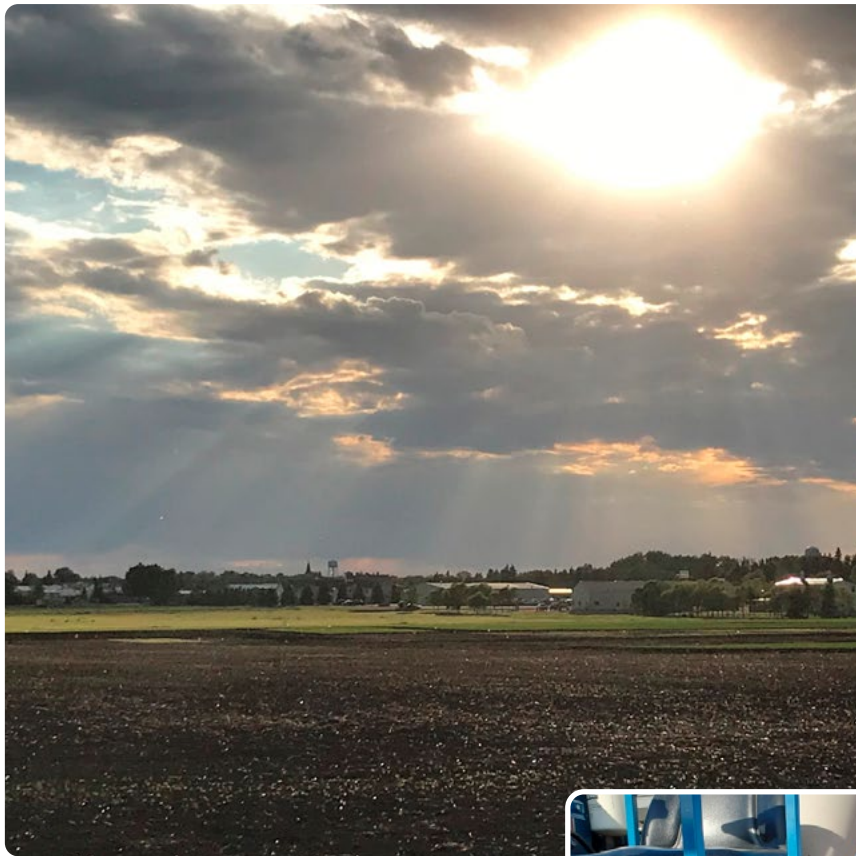
Growers who have grown seed for certification in one of the last four years who request seed prior to December 1st will be guaranteed an allocation. Any seed inventories available after December 1st will be sold on a first come, first serve basis. Seed availability and prices may be obtained by calling the Langdon Research Extension Center at 701-256-2582.



Visit our website at www.ag.ndsu.edu/langdonrec/

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