

Langdon Research Extension Center

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NDSU NORTH DAKOTA
STATE UNIVERSITY



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NDSU NORTH DAKOTA AGRICULTURAL
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*Variety trials of HRWW, Oat, and Sunflower were not harvested in 2021. Please refer to last year's report and 2021 NDSU Extension Bulletins for variety trial information across the state.

The 2021 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/ (old NDSU variety trial website) and <https://vt.ag.ndsu.edu/> (new NDSU variety trial website).

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 characteristics.

The NDSU Langdon Research Extension Center, in addition to its on-station research program, conducted variety research trials at several locations in 2021. 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.

2021 Weather Summary

Fall recharge at Langdon from September through October 2020 was 1.21 inches, 3.33 inches below normal. Precipitation from November 2020 through March 2021 was 2.72 inches, 0.76 inches below normal. Snowfall for 2020-2021 was 24.9 inches, 5.4 inches below normal. December-February temperatures averaged 9.9°F, 4.5°F above normal. The 2021 growing season in NE ND started with much below normal subsoil moisture in the region, a result of below average precipitation from August-October of 2020. The 2021 growing season precipitation averaged 50 percent of normal across NE North Dakota from April-July. August rainfall was much improved but spotty ranging from 1 inch below normal to 3.50 inches above normal. Disease levels were low this year with the drier conditions. Crop yields varied greatly across the region depending on previous crop, subsoil moisture and local rainfall.

2021 Crop Management - Langdon					
Field Trial	Previous Crop	Seeding Rate Unit/Acre	Planting Date	Harvest Date	Row Spacing
Barley	soybean	1.0 million pls	May 4	Aug. 13	6
Buckwheat	wheat	50 lbs pls	May 24	Sept. 17	6
Canola - LL, CL	wheat	610,000 pls	May 25	Sept. 1	6
Canola – RR	wheat	610,000 pls	May 24	Aug. 31	6
Corn	soybean	28,000 thinned	May 11	Oct. 18	30
Durum	soybean	1.50 million pls	May 6	Sept. 7	6
Dry Bean	wheat	70,000-90,000 pls	May 25	Sept. 15	30
Faba Bean	wheat	192,000 pls	May 12	Sept. 15	6
Field Pea	wheat	325,000 pls	May 12	Aug. 17	6
Flax	wheat	2.8 million pls	May 11	Sept. 8	6
HRSW	soybean	1.50 million pls	May 5	Sept. 7	6
HRWW	fallow	1.0 million pls	Sept. 15, 2020	*	6
Hemp	soybean	696,000 pls	May 26	Sept. 13	12
Oats	soybean	1.0 million pls	May 4	*	6
Rye	fallow	1.0 million pls	Sept. 15, 2020	Aug. 19	6
Soybean – Conv.	wheat	200,000 pls	May 13	Sept. 27	6
Soybean – RR	wheat	200,000 pls	May 13	Sept. 27	6
Sunflower - Confection	wheat	17,000 thinned	May 19	*	30
Sunflower - Oil	wheat	20,000 thinned	May 19	*	30

pls=pure live seed emergence

* Trial was not harvested

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 - McVille

2021 Crop Management – Off-Station					
Location (County/Field Trial)	Previous Crop	Seeding Rate Unit/Acre	Planting Date	Harvest Date	Row Spacing
Cavalier (Pembina)					
HRSW	soybean	1.50 million pls	April 29	Aug. 30	6
Soybean	soybean	200,000 pls	May 14	Sept. 28	6
Park River (Walsh)					
HRSW	fallow	1.50 million pls	April 29	Aug. 11	6
Soybean	wheat	200,000 pls	May 17	Sept. 29	6
Pekin (Nelson)					
HRSW	soybean	1.50 million pls	May 7	Sept. 9	6
Soybean	wheat	200,000 pls	May 28	Oct. 5	6
Cando (Towner)					
HRSW	dry bean	1.50 million pls	April 28	Aug. 31	6
Location	Soil Type				
Cavalier	Fargo silty clay				
Park River	HRSW- Glyndon silt loam, Soybean – Overly silty loam				
Pekin	Lankin loam				
Cando	Great Bend-Overly silty loam				

pls = pure live seeds



**Record of Climatological Observation
Langdon, ND**

	Precipitation		Dep. from	Temperature		Dep. from	
	Normal*	2021	Normal	Normal*	2021	Normal	
April	1.22	0.36	-0.86	April	38.0	36.9	-1.1
May	2.26	1.46	-0.80	May	51.6	50.1	-1.5
June	3.24	2.27	-0.97	June	61.0	66.5	+5.5
July	2.93	2.64	-0.29	July	66.3	70.3	+4.0
August	2.60	5.49	2.89	August	64.5	64.9	+0.4
September	2.08	1.23	-0.85	September	54.5	60.0	+5.5
Total	14.33	13.45	-0.88	Total	56.0	58.1	+2.1

*119 year average

Monthly Growing Degree Days and Normals-Langdon

	Wheat Growing Degree Days			Corn Growing Degree Days			Sunflower Growing Degree Days		
	2021	Normal	Deviation	2021	Normal	Deviation	2021	Normal	Deviation
April	289	274	+15	--	--	--	--	--	--
May	562	613	-51	221	219	+2	324	314	+10
June	963	875	+88	498	356	+142	685	519	+166
July	1091	1018	+73	601	499	+102	794	685	+109
August	936	962	-26	447	457	-10	622	642	-20
September	819	671	+148	356	255	+101	499	358	+141
Total	4660	4413	+247	2123	1786	+337	2924	2518	+406

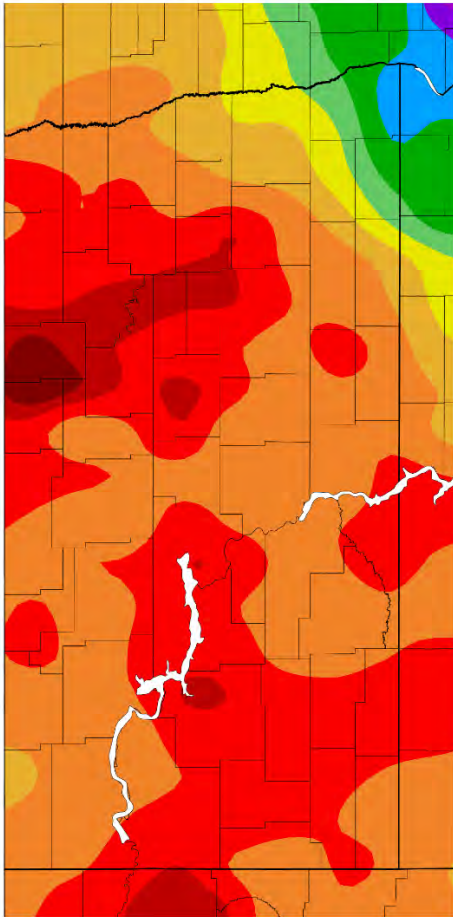
Frost Dates-Langdon and Selected Cities

	Last		First		Frost Free Days	
	Spring Frost		Fall Frost		Frost Free Days	
	32°F	28°F	32°F	28°F	32°F	28°F
Langdon						
Normal	20-May	9-May	19-Sep	29-Sep	122	143
2021	28-May	10-May	16-Oct	20-Oct	141	163
Cavalier						
Normal	16-May	5-May	24-Sep	5-Oct	131	153
2021	28-May	11-May	20-Oct	21-Oct	145	163
Park River						
Normal	8-May	30-Apr	30-Sep	10-Oct	145	163
2021	11-May	10-May	17-Oct	21-Oct	159	164
Pekin						
Normal	18-May	3-May	22-Sep	30-Sep	127	150
2021	28-May	11-May	20-Oct	20-Oct	145	162

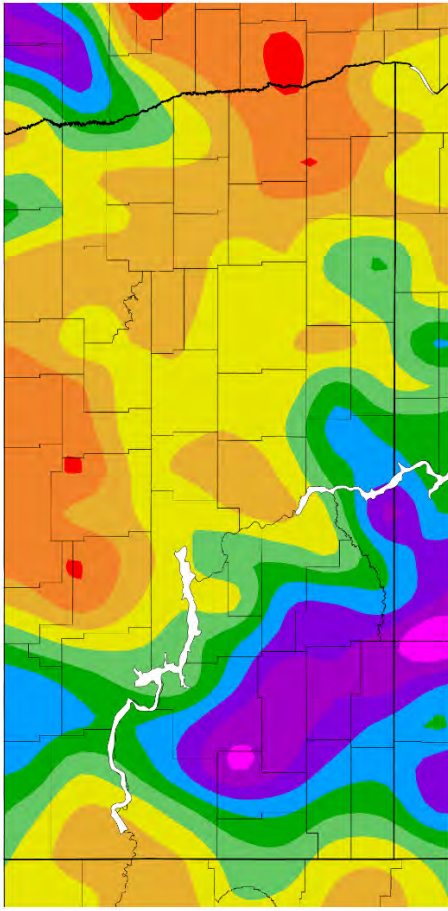
Normals are from the NWS. The 2021 frost dates are from the nearest reporting NDAWN station.

North Dakota 2021 Precipitation (inches) Maps

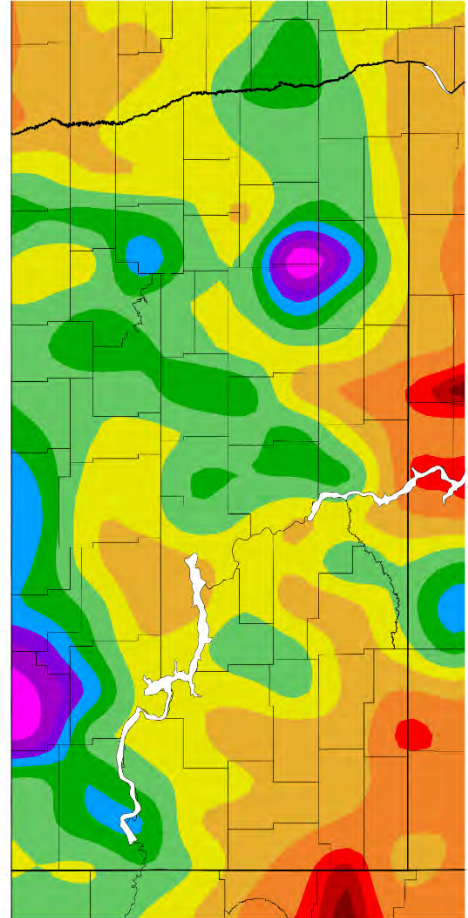
4/1/21 – 4/30/21



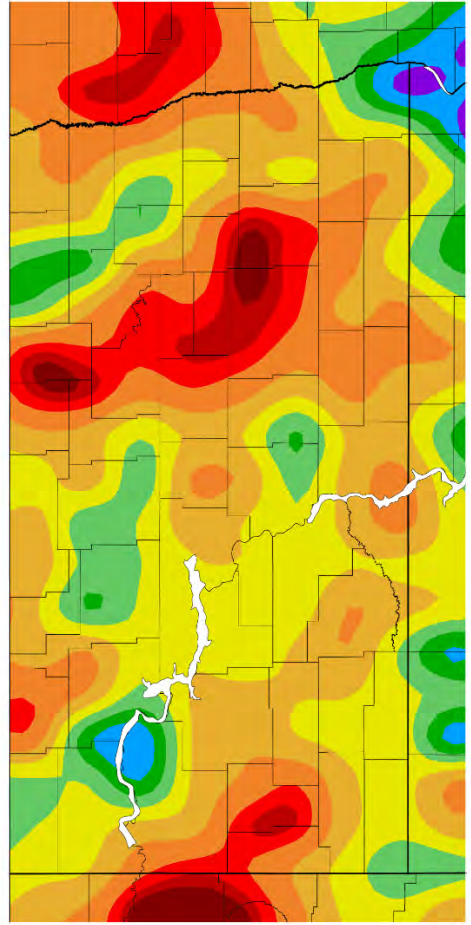
5/1/21 – 5/31/21



6/1/21 – 6/30/21

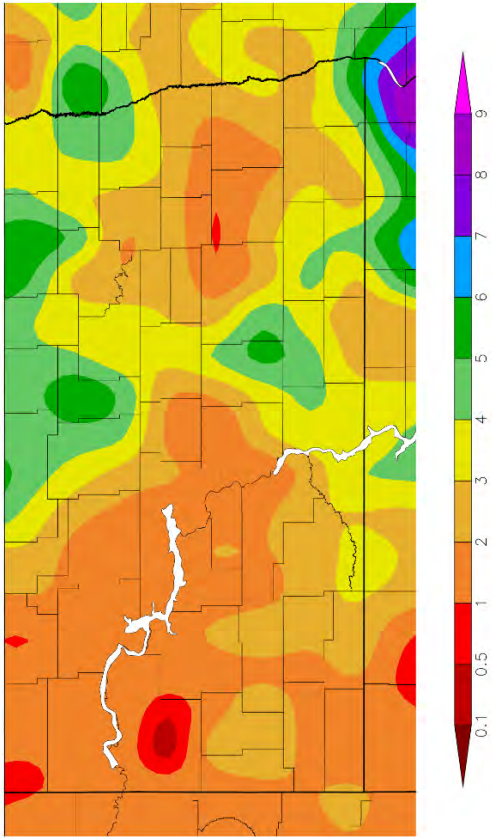


7/1/21 – 7/31/21

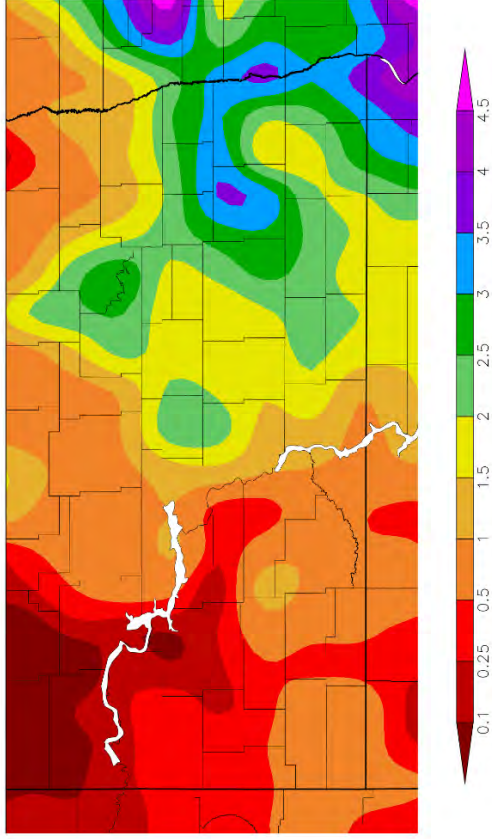


North Dakota 2021 Precipitation (inches) Maps Continued

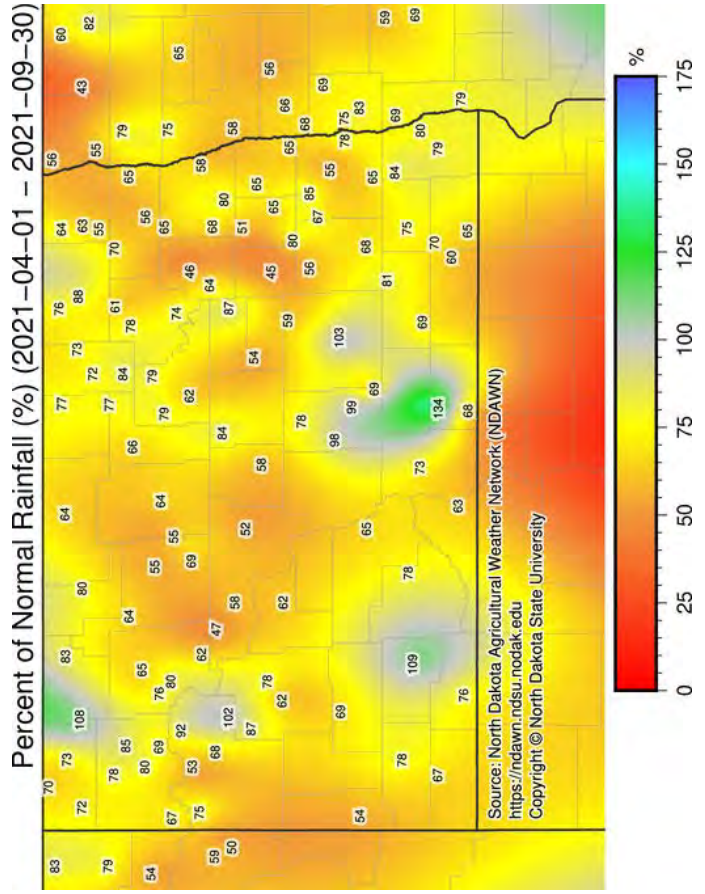
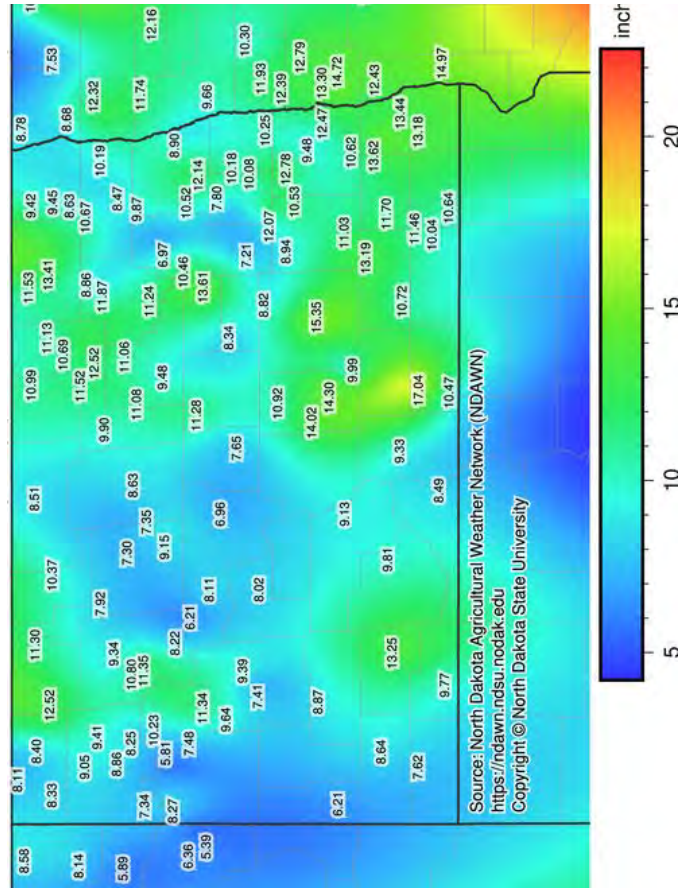
8/1/21 – 8/31/21



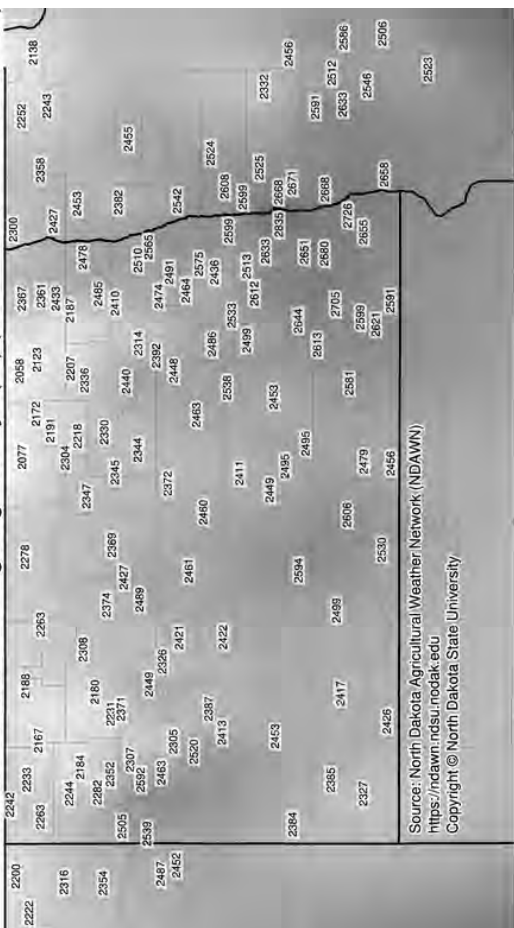
9/1/21 – 9/30/21



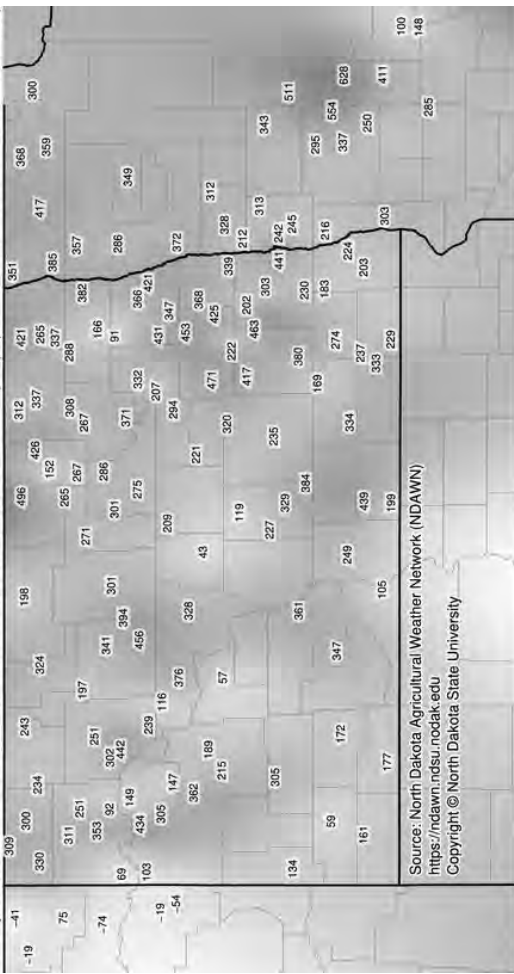
Growing Season 4/1/21 – 9/30/21



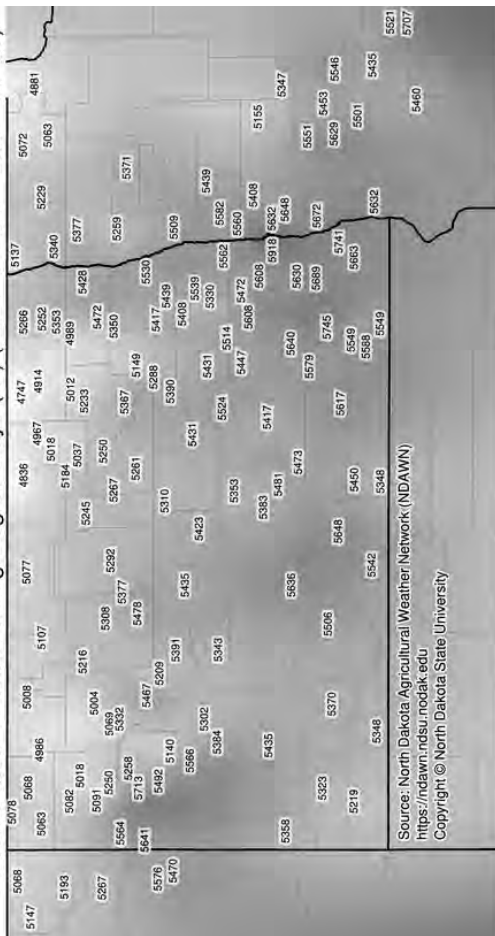
Corn Accumulated Growing Degree Days (°F) (2021-05-01 – 2021-09-30)



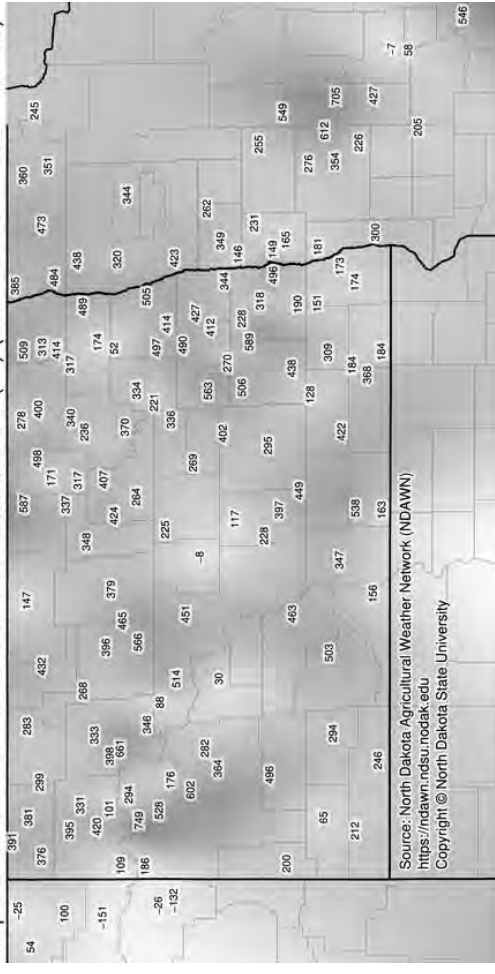
Departure from Normal Corn Accumulated GDD (°F) (2021-05-01 – 2021-09-30)



Accumulated Wheat Growing Degree Days (°F) (2021-04-01 – 2021-09-30)



Departure from Normal Wheat Accumulated GDD (°F) (2021-04-01 – 2021-09-30)



Durum Summary, Langdon 2017-2021																											
Variety	Yield (bu/a)					Test Weight (lbs/bu)					Lodging (0-9)					Height (in)					Days to Head						
	17	18	19	20	21	17	18	19	20	21	15	16	17	20	4yr	18	19	20	21	4yr	18	19	20	21	4yr		
AC Commander	70	75	65	59	42	62	57.8	61.0	58.8	54.7	58.7	58.2	1.0	3.8	1.8	0.4	1.8	28	30	30	25	28	53	57	49	58	54
Alkabo	71	81	67	80	49	69	61.0	61.4	60.2	59.8	59.5	60.4	0.5	5.8	1.3	0.1	1.9	35	34	37	29	34	56	57	49	62	56
Ben	66	76	68	75	46	66	60.3	62.3	60.7	59.5	59.8	60.5	2.3	6.2	4.0	3.5	4.0	36	35	37	33	35	52	57	49	60	55
Grenora	69	87	70	84	49	72	59.7	62.1	59.1	58.4	59.1	59.7	0.8	6.7	5.8	4.3	4.4	33	32	35	29	32	52	56	48	61	54
Lebsock	78	77	70	75	45	69	61.3	63.0	61.1	60.4	60.0	61.2	3.8	5.7	3.8	2.0	3.8	33	33	35	29	33	52	56	48	61	54
Maier	77	80	69	62	40	65	60.5	61.5	60.9	56.0	59.4	59.7	0.5	5.0	4.8	2.6	3.2	33	34	38	27	33	52	57	49	61	55
Mountrail	81	87	68	70	49	71	60.0	62.3	58.5	57.4	59.3	59.5	2.0	7.2	5.0	3.8	4.5	34	34	36	29	33	52	58	49	61	55
Pierce	76	91	70	76	45	71	61.5	62.7	60.9	59.1	59.7	60.8	3.0	6.6	5.3	3.7	4.7	35	33	36	29	33	52	57	49	61	55
Strongfield	63	77	64	62	46	62	58.9	61.5	60.1	56.2	58.8	59.1	3.8	6.4	4.5	5.5	5.1	33	34	35	30	33	52	58	50	62	56
Tioga	70	89	69	77	48	71	60.3	62.2	60.5	58.4	59.3	60.1	0.3	6.4	6.0	4.0	4.2	37	36	39	33	36	54	57	50	61	56
Carpio	79	93	70	77	50	74	61.7	62.6	61.1	59.5	59.8	60.9	1.0	7.6	6.5	2.7	4.5	36	34	38	31	35	54	59	52	63	57
Alzada	47	55	59	48	39	50	55.3	59.9	58.7	54.1	57.3	57.1	0.0	3.0	0.3	0.4	0.9	28	29	31	26	29	52	56	48	59	54
Joppa	75	90	75	76	44	72	60.5	62.3	60.9	58.3	60.2	60.4	0.5	6.9	6.8	3.5	4.4	35	34	39	32	35	52	58	49	63	56
Divide	78	89	68	78	51	73	60.7	61.6	59.9	58.6	59.7	60.1	1.8	6.9	6.3	2.9	4.5	37	34	38	32	35	54	58	51	62	56
CDC Verona	72	80	67	61	52	66	60.8	61.7	60.2	54.9	59.4	59.4	0.8	5.7	6.0	4.8	4.3	34	34	35	30	33	53	58	50	62	56
Rugby	61	76	63	63	41	61	60.2	61.8	60.3	57.1	59.8	59.8	4.0	7.0	8.0	7.0	6.5	38	36	38	31	36	53	57	49	61	55
VT Peak	85	82	72	80	49	73	62.4	62.4	61.7	59.6	60.8	61.4	0.5	4.3	4.3	0.8	2.5	34	35	38	31	35	52	57	50	61	55
ND Grano	78	84	70	75	50	71	61.0	62.1	60.7	58.2	61.0	60.6	0.8	6.4	5.0	1.9	3.5	34	35	39	29	34	54	59	50	64	57
ND Riveland	88	89	71	79	45	74	61.5	62.0	60.3	58.7	59.5	60.4	1.8	5.9	3.3	3.1	3.5	36	35	40	32	36	53	58	50	63	56
ND Stanley	79	86	66	82	50	73	61.5	62.7	60.7	60.0	60.4	61.1	--	--	4.0	2.6	--	33	33	38	30	33	53	58	50	63	56
TCG Webster	--	69	71	55	40	--	--	62.0	59.8	57.7	59.6	--	--	--	--	0.2	--	27	28	31	24	28	50	54	47	59	53
Trial Mean	74	84	70	74	48		60.7	62.2	60.5	58.3	59.8		1.7	6.1	5.9	3.3		35	34	37	30		53	58	50	62	
C.V. %	7.0	8.4	5.6	8.6	7.1		1.1	0.8	0.8	1.8	0.5		114	14.9	31.8	52.6		5.1	3.5	4.2	1.9		2.9	1.0	1.3	1.9	
LSD 5%	7.2	9.8	5.5	8.8	3.1		0.9	0.7	0.7	1.5	0.2		NS	1.3	2.6	2.4		2.5	1.7	2.2	1.0		2.2	0.8	0.9	1.0	
LSD 10%	6.0	8.2	4.6	7.4	2.6		0.8	0.6	0.6	1.3	0.2		2.2	1.1	2.2	2.0		2.1	1.4	1.8	0.9		1.8	0.7	0.7	0.9	

Average Data by Crop and Year Across Sites

HRSW	Yield (bu/a)												Test Weight (lbs/bu)												Protein (%)												Height (in)												Days to Head												Lodging											
	5			4			5			5			13			17			18			19			20			21			3yr			4			5			5			13			16			17			19			20			3yr														
	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	18	19	20	21	3yr	18	19	20	21	3yr	18	19	20	21	3yr	16	17	19	20	3yr																											
Faller	84	86	85	69	62	72	60.7	61.8	59.5	58.6	59.3	59.1	12.9	13.6	13.9	14.4	14.5	14.3	33	33	32	27	31	31	51	55	49	58	54	54	2.7	1.3	2.2	2.0	1.8																																					
SY Ingmar	71	74	78	65	53	65	60.0	62.3	60.2	60.0	60.5	60.2	14.5	14.8	14.4	15.4	15.6	15.1	29	29	29	29	24	27	51	52	47	56	52	52	1.4	0.1	0.1	0.0	0.1																																					
SY Valda	81	86	80	71	59	70	60.1	61.6	59.5	59.6	59.7	59.6	13.5	13.6	13.5	14.3	14.7	14.2	29	29	29	29	25	28	51	53	47	57	53	53	1.8	0.6	1.6	0.5	1.1																																					
LCS Rebel	79	78	79	67	58	68	62.0	62.6	60.7	60.9	60.4	60.7	13.8	14.1	14.6	15.3	15.7	15.2	33	33	32	26	30	30	49	52	45	54	50	50	--	1.3	2.2	5.4	1.8																																					
LCS Trigger	--	88	89	75	65	76	--	62.0	59.8	59.9	59.2	59.6	--	11.8	12.1	12.3	13.0	12.5	34	34	33	26	31	31	55	58	53	61	58	58	--	--	1.4	3.7	--																																					
MS Barracuda	--	79	81	61	50	64	--	61.9	59.6	58.6	59.5	59.2	--	14.4	14.4	15.6	15.7	15.2	29	29	28	23	27	27	48	51	45	53	50	50	--	--	0.6	0.1	--																																					
TCG-Spiffire	--	79	79	69	56	68	--	61.3	58.9	58.7	58.9	58.8	--	13.9	13.8	14.1	15.3	14.4	30	31	30	27	29	29	53	56	50	58	55	55	--	--	0.0	0.3	--																																					
DG Ambush	--	--	75	64	58	65	--	--	60.0	59.9	60.8	60.2	--	--	15.0	15.6	15.5	15.4	--	31	30	25	29	29	--	53	47	56	52	52	--	--	0.5	0.2	--																																					
DG Ballistic	--	--	88	66	66	73	--	--	59.3	57.6	58.9	58.6	--	--	13.9	14.9	14.7	14.5	--	33	32	27	31	31	--	54	48	58	53	53	--	--	1.4	1.9	--																																					
DG Commander	--	--	81	66	54	67	--	--	59.9	59.3	60.2	59.8	--	--	14.0	14.6	15.0	14.5	--	31	30	25	28	28	--	52	46	55	51	51	--	--	0.2	0.0	--																																					
LCS Cannon	--	--	80	66	54	67	--	--	60.0	60.1	61.0	60.4	--	--	14.0	14.6	14.9	14.5	--	31	29	23	28	28	--	50	44	53	49	49	--	--	0.6	0.0	--																																					
MN-Washburn	--	--	73	63	56	64	--	--	59.6	59.2	59.5	59.4	--	--	14.5	14.7	15.2	14.8	--	30	29	25	28	28	--	55	49	57	54	54	--	--	0.1	0.0	--																																					
SY McCloud	--	--	77	63	56	65	--	--	60.8	60.4	61.1	60.8	--	--	14.8	15.5	16.0	15.4	--	30	31	24	28	28	--	52	48	56	52	52	--	--	0.3	0.0	--																																					
SY611CL2	--	--	79	66	58	68	--	--	60.7	59.8	60.4	60.3	--	--	14.0	15.1	15.5	14.9	--	28	28	23	26	26	--	52	47	55	52	52	--	--	0.2	0.2	--																																					
TCG-Heartland	--	--	73	59	55	62	--	--	60.6	59.5	60.9	60.3	--	--	15.0	15.7	16.1	15.6	--	29	28	24	27	27	--	52	46	55	51	51	--	--	0.0	0.0	--																																					
AP Murdock	--	--	80	73	52	68	--	--	58.8	59.7	59.6	59.4	--	--	14.0	14.3	14.9	14.4	--	30	29	25	28	28	--	53	48	56	52	52	--	--	1.1	0.6	--																																					
LCS Buster	--	--	--	72	61	--	--	--	--	57.6	57.7	--	--	--	--	12.5	13.0	--	--	--	33	26	--	--	--	--	53	59	--	--	--	--	--	2.7	--																																					
MN-Torgy	--	--	--	68	59	--	--	--	--	59.4	60.0	--	--	--	--	15.5	15.4	--	--	--	31	26	--	--	--	--	50	58	--	--	--	--	--	2.4	--																																					
ND Froberg	--	--	--	64	54	--	--	--	--	60.3	60.4	--	--	--	--	15.1	15.6	--	--	--	32	26	--	--	--	--	46	56	--	--	--	--	--	1.2	--																																					
TCG-Wildcat	--	--	--	66	60	--	--	--	--	60.2	60.5	--	--	--	--	15.4	15.5	--	--	--	30	24	--	--	--	--	47	56	--	--	--	--	--	0.2	--																																					
AP Smith	--	--	--	65	59	--	--	--	--	59.0	59.9	--	--	--	--	14.9	15.2	--	--	--	28	23	--	--	--	--	47	57	--	--	--	--	--	--	--																																					
CP3530	81	83	78	--	62	--	60.4	61.5	59.3	--	59.0	--	13.9	14.1	14.9	--	14.8	--	34	35	--	26	--	--	53	55	--	60	--	--	2.4	0.1	1.9	--	--																																					
Driver	--	--	--	--	58	--	--	--	--	--	60.3	--	--	--	--	--	14.8	--	--	--	--	27	--	--	--	--	--	58	--	--	--	--	--	--	--																																					
APGunsmokeCL2	--	--	--	--	58	--	--	--	--	--	59.3	--	--	--	--	--	15.5	--	--	--	--	25	--	--	--	--	--	56	--	--	--	--	--	--	--																																					
CP3119A	--	--	--	--	63	--	--	--	--	--	56.7	--	--	--	--	--	13.4	--	--	--	--	28	--	--	--	--	--	61	--	--	--	--	--	--	--																																					
CP3188	--	--	--	--	53	--	--	--	--	--	57.8	--	--	--	--	--	13.4	--	--	--	--	25	--	--	--	--	--	57	--	--	--	--	--	--	--																																					
MS Cobra	--	--	--	--	58	--	--	--	--	--	59.7	--	--	--	--	--	15.5	--	--	--	--	24	--	--	--	--	--	55	--	--	--	--	--	--	--																																					
Linkert	67	68	69	60	--	--	60.1	61.4	59.4	59.6	--	--	14.8	14.9	15.3	15.5	--	--	28	29	28	--	--	52	54	48	--	--	--	0.2	0.1	0.0	0.1	0.1																																						
Bolles	73	70	73	55	--	--	60.2	61.1	59.2	57.3	--	--	15.4	15.5	15.9	16.7	--	--	32	31	32	--	--	53	55	50	--	--	--	1.8	0.0	0.9	0.6	0.5																																						
Shelly	82	80	79	62	--	--	61.5	62.1	59.5	57.7	--	--	13.5	13.6	14.0	15.2	--	--	30	30	29	--	--	52	55	48	--	--	--	1.3	0.1	0.9	0.1	0.5																																						
ND VitPro	69	71	75	63	--	--	62.1	63.0	61.7	61.1	--	--	14.6	14.7	15.2	15.5	--	--	32	32	31	--	--	50	52	47	--	--	--	1.4	0.3	1.1	0.7	0.7																																						
Lang-MIN	74	74	74	67	--	--	62.4	61.9	60.6	59.8	--	--	14.9	14.8	15.4	15.0	--	--	34	34	33	--	--	53	55	50	--	--	--	--	0.1	3.0	2.5	1.6																																						
CP3055	--	--	--	64	--	--	--	--	--	54.9	--	--	--	--	--	13.5	--	--	--	--	32	--	--	--	--	53	--	--	--	--	--	--	1.3	--																																						
CP3915	--	--	--	67	--	--	--	--	--	60.2	--	--	--	--	--	14.6	--	--	--	--	30	--	--	--	--	46	--	--	--	--	--	--	0.0	--																																						
DG Velocity	--	--	--	61	--	--	--	--	--	60.1	--	--	--	--	--	16.1	--	--	--	--	29	--	--	--	--	47	--	--	--	--	--	--	0.0	--																																						
MS Ranchero	--	--	--	62	--	--	--	--	--	56.5	--	--	--	--	--	14.7	--	--	--	--	33	--	--	--	--	52	--	--	--	--	--	--	5.8	--																																						
CP3888	--	77	75	--	--	--	--	60.9	58.5	--	--	--	--	13.9	14.4	--	--	--	30	30	--	--	--	51	53	--	--	--	--	--	--	0.3	--	--																																						
WB9590	73	80	--	--	--	--	59.6	62.0	--	--	--	--	14.2	14.4	--	--	--	--	27	--	--	--	--	50	--	--	--	--	--	--	0.1	--	--	--																																						
WB9479	76	74	--	--	--	--	60.4	62.4	--	--	--	--	14.6	15.3	--	--	--	--	28	--	--	--	--	51	--	--	--	--	--	--	0.0	--	--	--																																						

¹ Average of three locations. Langdon was excluded due to low yields caused by drought conditions. In addition, shattering occurred at both Langdon and Nelson County due to uneven emergence resulting in uneven maturity, delayed harvest, and high winds prior to harvest.

HRSW Summary, Langdon 2017-2021

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)					
	17	18	19	20	21	2yr ¹	17	18	19	20	21	3yr	17	18	19	20	21	3yr
Faller	82	98	84	81	28	82	61.5	62.3	60.4	59.7	58.6	59.6	11.7	12.7	13.7	14.1	15.3	14.4
Glenn	71	76	75	74	27	74	63.8	62.9	63.2	62.5	61.3	62.3	14.3	14.4	15.0	15.2	17.1	15.8
SY Soren	76	80	78	71	18	74	61.3	61.5	61.5	59.5	60.5	60.5	13.6	13.4	14.4	15.1	18.0	15.8
Bolles	74	82	73	68	15	70	61.2	61.3	60.3	58.8	59.4	59.5	15.0	14.9	15.3	16.6	18.5	16.8
SY Ingmar	74	91	81	77	21	79	61.1	62.9	61.5	60.6	60.9	61.0	14.1	14.2	14.2	15.2	17.1	15.5
SY Valda	85	100	80	79	28	80	60.3	62.3	60.6	59.9	60.4	60.3	12.8	13.1	13.0	14.2	16.4	14.5
CP3530	79	99	78	83	32	81	61.3	62.2	60.1	60.1	59.8	60.0	12.7	13.0	14.2	15.3	16.5	15.3
TCG-Spitfire	76	92	79	80	25	79	59.8	61.7	60.2	60.1	59.2	59.8	13.2	12.9	13.6	14.0	16.5	14.7
ND VitPro	72	78	73	76	21	75	62.7	63.2	63.0	62.2	60.7	62.0	14.2	14.1	14.8	15.1	17.4	15.8
Lang-MN	78	79	77	73	26	75	63.3	61.9	61.4	59.8	60.3	60.5	14.7	14.3	15.0	15.6	16.5	15.7
LCS Rebel	84	93	81	76	22	78	62.4	63.1	61.7	61.5	59.6	60.9	13.2	13.6	14.4	15.4	17.4	15.7
LCS Trigger	98	110	87	81	23	84	62.3	62.6	60.5	60.2	59.5	60.1	11.0	11.1	11.9	12.6	14.3	12.9
DG Ambush	72	88	76	68	17	72	61.5	63.2	61.5	59.6	60.1	60.4	13.8	14.2	14.9	15.6	17.3	15.9
SY McCloud	--	83	78	76	23	77	--	62.9	61.8	61.2	61.1	61.4	--	13.7	14.7	15.1	18.0	15.9
SY611CL2	--	84	83	78	23	81	--	61.6	62.3	60.4	60.7	61.1	--	13.3	13.6	14.9	17.5	15.3
MS Barracuda	--	93	83	66	15	75	--	62.9	61.3	57.9	58.4	59.2	--	14.2	14.3	14.8	17.4	15.5
LCS Cannon	--	90	81	73	23	77	--	63.5	61.8	59.8	60.8	60.8	--	13.7	13.8	14.8	16.5	15.0
MN-Washburn	--	85	76	78	22	77	--	61.2	60.7	60.0	59.6	60.1	--	13.4	14.3	14.4	16.8	15.2
CP3915	--	--	78	80	29	79	--	--	61.7	61.1	60.5	61.1	--	--	14.3	14.9	16.6	15.3
DG Ballistic	--	--	90	73	24	82	--	--	60.7	56.7	58.8	58.7	--	--	13.5	15.1	16.0	14.9
DG Commander	--	--	80	74	17	77	--	--	61.2	59.2	59.7	60.0	--	--	13.7	14.7	16.5	15.0
TCG-Heartland	--	--	75	67	23	71	--	--	61.9	59.8	60.9	60.9	--	--	14.7	15.7	17.7	16.0
SY Longmire	--	--	79	78	26	78	--	--	61.5	59.4	60.9	60.6	--	--	14.0	15.2	17.4	15.5
AP Murdock	--	--	82	87	21	84	--	--	60.5	59.7	59.6	59.9	--	--	14.1	14.0	16.8	15.0
MN-Torgy	--	--	84	70	28	77	--	--	61.2	59.1	60.2	60.2	--	--	14.6	15.5	16.8	15.6
AP GunsmokeCL2	--	--	--	77	24	--	--	--	--	58.0	59.4	--	--	--	--	15.5	17.4	--
AP Smith	--	--	--	76	24	--	--	--	--	59.6	60.9	--	--	--	--	14.9	16.6	--
Allegiant 822	--	--	--	72	28	--	--	--	--	61.4	61.2	--	--	--	--	14.4	17.1	--
Allegiant 8432	--	--	--	74	22	--	--	--	--	58.8	60.6	--	--	--	--	15.2	17.2	--
Dagmar	--	--	--	66	24	--	--	--	--	58.9	58.7	--	--	--	--	16.2	16.5	--
Driver	--	--	--	73	29	--	--	--	--	60.0	60.6	--	--	--	--	14.5	15.9	--
Lanning	--	--	--	57	28	--	--	--	--	55.1	58.6	--	--	--	--	16.6	17.4	--
LCS Buster	--	--	--	73	22	--	--	--	--	57.0	57.8	--	--	--	--	12.8	13.9	--
MS Rancho	--	--	--	62	33	--	--	--	--	54.6	58.9	--	--	--	--	15.4	15.1	--
ND Frohberg	--	--	--	73	14	--	--	--	--	61.0	59.9	--	--	--	--	14.7	17.2	--
TCG-Wildcat	--	--	--	74	23	--	--	--	--	60.5	60.4	--	--	--	--	15.2	17.0	--
WB9590	--	--	--	--	22	--	--	--	--	--	59.3	--	--	--	--	--	17.8	--
CP3099A	--	--	--	--	31	--	--	--	--	--	59.2	--	--	--	--	--	13.9	--
CP3119A	--	--	--	--	31	--	--	--	--	--	57.5	--	--	--	--	--	14.0	--
CP3188	--	--	--	--	27	--	--	--	--	--	58.2	--	--	--	--	--	14.2	--
CAG-Justify	--	--	--	--	23	--	--	--	--	--	57.9	--	--	--	--	--	15.2	--
CAG-Reckless	--	--	--	--	24	--	--	--	--	--	59.9	--	--	--	--	--	16.7	--
PFS-Buns	--	--	--	--	33	--	--	--	--	--	57.4	--	--	--	--	--	15.0	--
AL8175	--	--	--	--	21	--	--	--	--	--	60.0	--	--	--	--	--	17.0	--
Brandon	--	--	--	--	30	--	--	--	--	--	60.0	--	--	--	--	--	17.0	--
WB9479	--	--	--	--	18	--	--	--	--	--	59.9	--	--	--	--	--	18.6	--
MS Cobra	--	--	--	--	20	--	--	--	--	--	59.9	--	--	--	--	--	16.9	--
Barlow	74	85	76	68	--	--	61.5	62.6	62.3	59.3	--	--	13.8	14.2	14.4	15.6	--	--
Elgin-ND	81	89	81	66	--	--	61.1	61.7	60.7	59.1	--	--	13.5	13.6	13.9	14.7	--	--
Linkert	64	75	69	69	--	--	60.8	61.0	60.5	59.8	--	--	14.7	14.3	15.1	15.8	--	--
MS Chevelle	86	94	85	75	--	--	61.3	62.3	61.0	58.1	--	--	12.2	12.6	12.6	14.3	--	--
Boost	79	88	75	71	--	--	60.7	61.9	60.1	59.7	--	--	13.3	13.7	14.2	14.8	--	--
Shelly	81	88	82	58	--	--	61.9	62.2	61.1	55.5	--	--	13.0	13.1	13.5	16.1	--	--
CP3910	--	--	76	70	--	--	--	--	60.9	58.6	--	--	--	--	13.7	15.1	--	--
SY Rockford	--	--	81	55	--	--	--	--	59.3	54.9	--	--	--	--	13.9	15.8	--	--
Allegiant 834	--	--	--	42	--	--	--	--	--	53.0	--	--	--	--	--	16.3	--	--
CP3055	--	--	--	61	--	--	--	--	--	53.1	--	--	--	--	--	14.2	--	--
CP3903	--	--	--	77	--	--	--	--	--	62.1	--	--	--	--	--	14.9	--	--
DG Velocity	--	--	--	70	--	--	--	--	--	60.3	--	--	--	--	--	16.1	--	--
Trial Mean	76	87	79	71	24		61.3	62.2	61.2	59.1	59.7		13.4	13.7	14.2	15.1	16.6	
C.V. %	5.9	4.1	4.7	8.1	9.3		0.9	0.7	0.8	1.8	0.5		2.9	2.8	2.4	3.0	1.1	
LSD 5%	6.3	4.9	5.2	8.1	2.0		0.8	0.6	0.7	1.5	0.3		0.5	0.5	0.5	0.6	0.2	
LSD 10%	5.3	4.1	4.4	6.8	1.7		0.7	0.5	0.6	1.2	0.2		0.5	0.4	0.4	0.5	0.1	

¹ Average of 2019-20, 2021 was excluded due to low yields caused by drought conditions. In addition, shattering occurred due to uneven emergence resulting in uneven maturity, delayed harvest, and high winds prior to harvest.

HRSW Summary, Langdon 2017-2021																
Variety	Days to Head						Height (in)						Shatter (0-9) ¹		Lodging (0-9)	
	17	18	19	20	21	3yr	17	18	19	20	21	3yr	2021	2020		
Faller	59	50	57	48	63	56	39	33	31	34	24	30	1.3	2.0		
Glenn	55	46	55	45	59	53	42	35	33	35	21	30	1.6	1.3		
SY Soren	58	48	55	46	60	54	34	28	27	30	18	25	0.3	0.0		
Bolles	61	50	58	50	62	57	37	33	30	33	23	29	4.1	0.6		
SY Ingmar	59	49	56	47	59	54	34	29	28	31	20	26	0.9	0.0		
SY Valda	58	49	56	47	62	55	35	30	27	32	21	27	1.5	0.5		
CP3530	60	50	57	48	63	56	39	34	33	36	22	30	0.9	1.2		
TCG-Spitfire	60	51	59	50	62	57	34	31	30	33	22	28	1.3	0.3		
ND VitPro	57	48	55	46	59	53	37	33	31	34	21	29	0.5	0.7		
Lang-MN	60	51	58	50	63	57	41	35	33	35	22	30	0.9	2.5		
LCS Rebel	57	46	55	45	58	53	41	34	31	35	22	29	0.9	5.4		
LCS Trigger	62	53	61	53	64	59	39	35	32	35	20	29	0.0	3.7		
DG Ambush	56	47	54	46	61	54	36	31	30	32	21	28	2.2	0.2		
SY McCloud	--	49	55	47	60	54	--	29	29	33	20	27	0.2	0.0		
SY611CL2	--	49	55	47	61	54	--	29	28	30	18	25	0.0	0.2		
MS Barracuda	--	45	54	44	58	52	--	29	28	29	19	25	1.2	0.1		
LCS Cannon	--	44	53	43	58	51	--	30	29	30	20	26	1.4	0.0		
MN-Washburn	--	51	57	49	62	56	--	32	29	31	21	27	0.6	0.0		
CP3915	--	--	55	46	61	54	--	--	29	32	21	27	0.1	0.0		
DG Ballistic	--	--	56	47	63	55	--	--	31	34	24	30	2.7	1.9		
DG Commander	--	--	55	46	59	53	--	--	30	31	21	27	2.1	0.0		
TCG-Heartland	--	--	54	46	60	53	--	--	28	31	20	26	1.3	0.0		
SY Longmire	--	--	56	46	60	54	--	--	29	31	21	27	1.2	0.0		
AP Murdock	--	--	56	47	61	55	--	--	28	31	21	27	2.1	0.6		
MN-Torgy	--	--	56	49	64	56	--	--	30	34	21	28	0.9	2.4		
AP GunsmokeCL2	--	--	--	46	61	--	--	--	--	33	19	--	2.0	2.0		
AP Smith	--	--	--	48	60	--	--	--	--	30	18	--	1.7	0.0		
Allegiant 822	--	--	--	46	61	--	--	--	--	31	19	--	0.4	0.5		
Allegiant 8432	--	--	--	45	59	--	--	--	--	32	21	--	3.7	0.0		
Dagmar	--	--	--	46	59	--	--	--	--	32	21	--	1.5	3.7		
Driver	--	--	--	48	62	--	--	--	--	34	22	--	1.3	0.6		
Lanning	--	--	--	49	62	--	--	--	--	32	21	--	0.4	0.2		
LCS Buster	--	--	--	53	63	--	--	--	--	35	22	--	3.4	2.7		
MS Ranchero	--	--	--	51	63	--	--	--	--	34	21	--	0.3	5.8		
ND Frohberg	--	--	--	47	60	--	--	--	--	35	21	--	4.8	1.2		
TCG-Wildcat	--	--	--	47	59	--	--	--	--	32	18	--	2.0	0.2		
WB9590	--	--	--	--	60	--	--	--	--	--	19	--	1.6	--		
CP3099A	--	--	--	--	63	--	--	--	--	--	22	--	0.3	--		
CP3119A	--	--	--	--	63	--	--	--	--	--	23	--	1.1	--		
CP3188	--	--	--	--	61	--	--	--	--	--	20	--	1.2	--		
CAG-Justify	--	--	--	--	62	--	--	--	--	--	22	--	2.4	--		
CAG-Reckless	--	--	--	--	61	--	--	--	--	--	20	--	3.6	--		
PFS-Buns	--	--	--	--	66	--	--	--	--	--	21	--	1.6	--		
AL8175	--	--	--	--	60	--	--	--	--	--	22	--	0.6	--		
Brandon	--	--	--	--	61	--	--	--	--	--	22	--	0.6	--		
WB9479	--	--	--	--	60	--	--	--	--	--	18	--	1.7	--		
MS Cobra	--	--	--	--	60	--	--	--	--	--	20	--	1.5	--		
Barlow	56	46	55	45	--	--	41	34	32	34	--	--	--	3.8		
Elgin-ND	58	48	55	45	--	--	43	36	33	36	--	--	--	2.8		
Linkert	58	50	56	47	--	--	31	29	27	29	--	--	--	0.1		
MS Chevelle	57	46	55	45	--	--	37	31	31	31	--	--	--	0.8		
Boost	60	51	59	48	--	--	38	33	31	35	--	--	--	2.7		
Shelly	59	51	58	48	--	--	36	30	28	31	--	--	--	0.1		
CP3910	--	--	54	45	--	--	--	--	27	32	--	--	--	0.1		
SY Rockford	--	--	58	49	--	--	--	--	31	32	--	--	--	0.0		
Allegiant 834	--	--	--	48	--	--	--	--	--	28	--	--	--	0.0		
CP3055	--	--	--	53	--	--	--	--	--	35	--	--	--	1.3		
CP3903	--	--	--	46	--	--	--	--	--	34	--	--	--	0.0		
DG Velocity	--	--	--	47	--	--	--	--	--	31	--	--	--	0.0		
Trial Mean	58	49	56	47	61		37	31	30	33	21		1.4	1.1		
C.V. %	1.7	1.7	1.4	1.2	0.9		3.7	3.3	3.9	3.3	6.7		56.1	88		
LSD 5%	1.3	1.1	1.1	0.8	0.4		1.9	1.5	1.7	1.5	1.2		0.7	1.4		
LSD 10%	1.1	1.0	0.9	0.7	0.4		1.6	1.2	1.4	1.3	1.0		0.6	1.1		

¹Relative Rating 0-9

There was significant negative correlation between yield and shatter of $r = -0.47$

HRSW Summary, Nelson County 2017-2021

Variety	Yield (bu/a)					Test Weight (lbs/bu)					Protein (%)					Lodging(0-9)	Shatter (0-9) ²
	18	19	20	21	2yr ¹	18	19	20	21	3yr	18	19	20	21	3yr	19	2021
Faller	93	86	51	44	68	61.5	58.1	55.3	59.0	57.5	13.9	14.1	15.0	14.9	14.7	5.2	2.3
LCS Rebel	85	76	64	48	70	62.4	58.5	60.3	59.8	59.5	14.1	15.1	15.4	16.1	15.5	5.0	2.3
SY Ingmar	82	76	57	45	67	61.7	58.5	58.5	60.2	59.1	14.8	14.6	15.6	16.0	15.4	0.0	2.0
SY Valda	96	79	65	53	72	61.2	58.4	58.7	58.8	58.6	13.8	13.9	14.6	14.8	14.4	3.2	1.7
LCS Trigger	91	91	71	61	81	61.4	58.7	58.3	58.6	58.5	11.7	12.3	12.2	13.7	12.7	3.5	1.7
MS Barracuda	90	81	42	39	61	61.0	57.7	55.1	59.2	57.3	14.6	14.8	16.3	16.5	15.9	2.0	2.7
TCG-Spitfire	86	74	59	50	67	60.6	56.6	57.3	58.5	57.5	13.7	13.9	14.3	15.8	14.7	0.0	1.0
SY611CL2	84	76	54	57	65	61.1	58.6	57.4	59.7	58.6	14.3	14.3	15.9	15.6	15.3	0.5	0.7
DG Ambush	--	72	53	41	62	--	57.7	58.6	60.2	58.8	--	15.0	15.6	15.9	15.5	0.3	2.0
DG Ballistic	--	87	46	49	67	--	57.1	54.4	58.2	56.6	--	13.9	15.0	14.8	14.6	4.0	3.3
DG Commander	--	80	55	27	67	--	58.2	57.8	59.6	58.5	--	13.9	15.0	15.0	14.6	0.0	6.7
LCS Cannon	--	83	50	58	66	--	58.5	56.8	60.6	58.6	--	14.0	14.9	15.4	14.8	1.5	1.3
MN-Washburn	--	67	49	56	58	--	58.1	57.6	59.1	58.3	--	15.0	15.4	15.4	15.3	0.0	0.0
SY McCloud	--	74	53	51	63	--	58.7	59.4	60.7	59.6	--	14.9	15.5	16.3	15.6	0.0	2.3
TCG-Heartland	--	68	50	54	59	--	58.8	56.3	60.5	58.5	--	15.0	15.8	16.8	15.9	0.0	2.0
AP Murdock	--	83	69	37	76	--	57.3	58.6	59.4	58.4	--	13.8	14.5	15.3	14.5	2.5	4.0
LCS Buster	--	--	60	40	--	--	--	54.9	57.3	--	--	--	12.9	13.6	--	--	3.0
MN-Torgy	--	--	56	55	--	--	--	57.4	59.6	--	--	--	16.1	16.1	--	--	3.0
ND Frohberg	--	--	53	20	--	--	--	58.8	59.8	--	--	--	15.3	16.0	--	--	6.0
TCG-Wildcat	--	--	65	44	--	--	--	59.0	60.0	--	--	--	14.9	15.9	--	--	4.3
AP Smith	--	--	57	48	--	--	--	57.4	59.1	--	--	--	15.2	15.4	--	--	3.0
Driver	--	--	--	57	--	--	--	--	59.6	--	--	--	--	15.2	--	--	2.0
AP GunsmokeCL2	--	--	--	59	--	--	--	--	57.9	--	--	--	--	15.6	--	--	0.7
CP3119A	--	--	--	47	--	--	--	--	55.8	--	--	--	--	14.4	--	--	2.7
MS Cobra	--	--	--	41	--	--	--	--	59.1	--	--	--	--	15.7	--	--	4.3
CP3188	--	--	--	50	--	--	--	--	56.7	--	--	--	--	13.9	--	--	1.3
CP3530	93	79	--	54	--	61.0	57.6	--	58.9	--	13.6	15.2	--	15.4	--	4.0	1.0
Linkert	72	64	52	--	--	60.6	56.5	57.7	--	--	14.9	15.1	15.8	--	--	0.0	0.0
Bolles	74	73	49	--	--	60.7	57.4	56.5	--	--	15.5	15.6	16.9	--	--	3.3	--
Shelly	91	82	46	--	--	61.2	57.4	53.9	--	--	13.5	13.8	16.1	--	--	2.8	--
ND VitPro	80	71	52	--	--	62.9	60.2	59.3	--	--	14.9	15.4	15.7	--	--	2.2	--
Lang-MN	73	71	54	--	--	60.9	58.9	58.5	--	--	15.3	15.9	15.6	--	--	6.3	--
CP3055	--	--	42	--	--	--	--	49.5	--	--	--	--	14.9	--	--	--	--
CP3915	--	--	51	--	--	--	--	56.8	--	--	--	--	14.8	--	--	--	--
DG Velocity	--	--	51	--	--	--	--	58.0	--	--	--	--	16.5	--	--	--	--
MS Ranchero	--	--	43	--	--	--	--	53.2	--	--	--	--	15.2	--	--	--	--
CP3888	82	62	--	--	--	60.3	55.9	--	--	--	13.8	15.1	--	--	--	1.0	--
TCG-Climax	72	66	--	--	--	62.4	59.4	--	--	--	15.6	16.0	--	--	--	0.0	--
CP3939	--	69	--	--	--	--	57.6	--	--	--	--	15.5	--	--	--	1.0	--
TCS-Stalwart	--	51	--	--	--	--	53.6	--	--	--	--	15.8	--	--	--	0.5	--
LCS Breakaway	--	69	--	--	--	--	58.6	--	--	--	--	14.8	--	--	--	3.0	--
MS Chevelle	--	74	--	--	--	--	56.5	--	--	--	--	13.8	--	--	--	4.0	--
WB9590	95	--	--	--	--	61.5	--	--	--	--	14.0	--	--	--	--	--	--
WB9479	88	--	--	--	--	62.0	--	--	--	--	14.6	--	--	--	--	--	--
Trial Mean	84	74	54	48		61.9	61.3	57.8	59.1		14.2	14.7	15.2	15.4		2.0	2.4
C.V. %	5.8	4.9	7.8	10.1		0.5	0.8	1.1	0.4		4.4	2.0	2.8	1.3		45	35.5
LSD 5%	6.9	5.1	5.9	4.6		0.5	0.7	0.9	0.2		0.9	0.4	0.6	0.2		1.3	1.4
LSD 10%	5.7	4.3	5.0	3.9		0.4	0.6	0.7	0.2		0.7	0.4	0.5	0.2		1.1	1.2

¹ Average of 2019-20, 2021 excluded due to shattering.

² Relative Rating 0-9.

HRSW Summary, Pembina County 2016-2021

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)		
	16	17	19	20	21	3yr	16	17	19	20	21	3yr	16	17	19	20	21	3yr	17	19	2yr
Faller	61	96	88	75	50	71	60.1	62.5	61.0	59.2	57.9	59.4	13.8	13.0	14.2	13.1	12.5	13.3	0.6	0.5	0.6
SY Ingmar	55	78	75	69	44	62	59.9	61.3	61.8	59.6	58.9	60.1	14.9	14.1	14.5	14.3	13.9	14.2	0.0	0.0	0.0
SY Valda	59	86	78	71	48	66	59.2	60.6	60.9	59.5	57.8	59.4	13.9	13.3	13.7	13.6	12.8	13.4	1.3	0.0	0.7
LCS Rebel	--	83	78	71	47	65	--	62.1	62.0	60.9	59.3	60.7	--	13.8	14.8	14.5	13.4	14.2	1.6	0.5	1.1
DG Ambush	--	--	77	70	47	65	--	--	62.0	60.2	59.8	60.7	--	--	15.2	14.6	13.8	14.5	--	0.0	--
DG Ballistic	--	--	88	79	58	75	--	--	63.2	58.5	58.2	60.0	--	--	14.1	13.5	13.0	13.5	--	0.0	--
DG Commander	--	--	83	70	47	66	--	--	61.7	59.3	58.8	59.9	--	--	14.2	13.8	13.1	13.7	--	0.0	--
LCS Cannon	--	--	85	70	46	67	--	--	62.2	59.6	59.6	60.5	--	--	14.2	13.7	12.5	13.5	--	0.0	--
LCS Trigger	--	--	87	78	59	75	--	--	61.1	60.3	57.6	59.7	--	--	12.2	11.5	11.2	11.6	--	0.5	--
MN-Washburn	--	--	72	71	49	64	--	--	60.7	59.6	57.8	59.4	--	--	14.7	14.0	13.2	14.0	--	0.0	--
MS Barracuda	--	--	85	68	41	65	--	--	61.4	58.7	58.6	59.6	--	--	14.7	15.1	13.5	14.4	--	0.0	--
SY McCloud	--	--	75	70	52	65	--	--	62.5	60.0	59.6	60.7	--	--	15.2	14.6	13.8	14.5	--	0.0	--
SY611CL2	--	--	80	72	58	70	--	--	62.4	60.1	59.1	60.5	--	--	14.4	14.3	13.4	14.0	--	0.0	--
TCG-Heartland	--	--	77	58	47	61	--	--	62.2	59.0	59.5	60.2	--	--	15.4	15.0	14.3	14.9	--	0.0	--
TCG-Spitfire	--	--	79	69	48	65	--	--	60.5	58.4	58.0	59.0	--	--	13.9	13.4	13.7	13.7	--	0.0	--
AP Murdock	--	--	80	74	41	65	--	--	60.7	59.1	58.2	59.3	--	--	14.3	13.4	13.2	13.6	--	0.0	--
LCS Buster	--	--	--	79	51	--	--	--	--	57.9	55.8	--	--	--	--	11.4	11.5	--	--	--	--
MN-Torgy	--	--	--	77	49	--	--	--	--	59.8	58.3	--	--	--	--	14.3	12.9	--	--	--	--
ND Frohberg	--	--	--	65	46	--	--	--	--	60.1	59.2	--	--	--	--	13.7	13.6	--	--	--	--
TCG-Wildcat	--	--	--	73	51	--	--	--	--	59.9	59.2	--	--	--	--	14.0	13.5	--	--	--	--
AP Smith	--	--	--	72	52	--	--	--	--	59.0	58.0	--	--	--	--	13.8	13.4	--	--	--	--
CP3530	57	88	78	--	50	--	59.3	61.3	60.5	--	57.2	--	14.4	14.0	15.3	--	12.8	--	0.0	0.5	0.3
Driver	--	--	--	--	47	--	--	--	--	58.8	--	--	--	--	--	--	12.9	--	--	--	--
AP GunsmokeCL2	--	--	--	--	44	--	--	--	--	58.0	--	--	--	--	--	--	13.5	--	--	--	--
CP3119A	--	--	--	--	57	--	--	--	--	55.4	--	--	--	--	--	--	11.6	--	--	--	--
CP3188	--	--	--	--	44	--	--	--	--	56.4	--	--	--	--	--	--	12.0	--	--	--	--
MS Cobra	--	--	--	--	52	--	--	--	--	58.2	--	--	--	--	--	--	13.6	--	--	--	--
Bolles	48	76	73	62	--	--	57.9	61.4	61.2	58.7	--	--	15.9	15.3	17.0	15.6	--	--	0.0	0.0	0.0
Linkert	56	69	72	60	--	--	59.3	61.0	61.9	59.4	--	--	14.7	14.3	15.8	14.9	--	--	0.1	0.0	0.1
Shelly	51	88	80	71	--	--	58.8	62.7	61.5	58.5	--	--	13.8	13.2	14.6	13.5	--	--	0.1	0.0	0.1
ND VitPro	50	73	80	62	--	--	61.4	63.0	62.5	61.1	--	--	15.0	14.4	15.9	14.7	--	--	0.1	2.3	1.2
Lang-MN	--	80	78	67	--	--	--	63.0	61.7	59.6	--	--	--	14.6	15.5	14.7	--	--	0.2	1.3	0.8
CP3055	--	--	--	74	--	--	--	--	--	56.2	--	--	--	--	--	12.6	--	--	--	--	--
CP3915	--	--	--	75	--	--	--	--	--	60.8	--	--	--	--	--	14.1	--	--	--	--	--
DG Velocity	--	--	--	60	--	--	--	--	--	59.7	--	--	--	--	--	15.2	--	--	--	--	--
MS Rancho	--	--	--	67	--	--	--	--	--	57.6	--	--	--	--	--	14.2	--	--	--	--	--
LCS Breakaway	46	74	73	--	--	--	60.0	61.6	61.9	--	--	--	14.7	13.8	15.1	--	--	--	0.0	0.0	0.0
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	--
WB9590	--	79	--	--	--	--	--	60.6	--	--	--	--	--	13.8	--	--	--	--	0.0	--	--
WB9479	--	77	--	--	--	--	--	60.6	--	--	--	--	--	14.4	--	--	--	--	0.0	--	--
Trial Mean	53	80	79	70	49		59.0	61.4	61.6	59.3	58.2		14.3	13.7	14.9	14.0	13.1		0.4	0.2	
C.V. %	7.8	3.3	5.2	5.0	6.4		1.1	0.7	1.3	0.8	0.6		1.9	1.7	1.1	2.2	2.5		89.4	375	
LSD 5%	5.9	3.7	5.8	5.0	3.3		0.9	0.6	1.1	0.7	0.3		0.4	0.3	0.2	0.4	0.5		1.1	NS	
LSD 10%	4.9	3.1	4.8	4.2	2.8		0.7	0.5	0.9	0.5	0.2		0.3	0.3	0.2	0.4	0.4		0.9	0.9	

No trial data from 2018.

HRSW Summary, Towner County 2017-2021

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)		
	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	18	19	20	21	3yr	16	19	2yr
Faller	59	66	77	59	76	71	57.1	61.0	57.0	58.3	58.8	58.0	14.3	15.0	13.8	15.7	14.4	14.6	2.9	0.5	1.7
SY Ingmar	43	63	75	54	66	65	54.4	61.8	57.9	60.0	59.9	59.3	15.4	15.3	14.2	16.7	15.2	15.4	1.2	0.0	0.6
SY Valda	54	66	75	65	72	71	56.3	60.8	56.4	60.2	59.2	58.6	14.7	14.4	13.6	15.6	14.4	14.5	1.4	2.3	1.9
LCS Rebel	60	64	78	60	75	71	59.5	61.5	58.7	60.8	60.1	59.9	14.0	15.4	14.3	16.4	15.1	15.3	--	0.5	--
LCS Trigger	--	66	84	65	69	73	--	61.4	57.4	60.8	57.9	58.7	--	13.6	12.4	13.9	12.9	13.1	--	0.0	--
MS Barracuda	--	62	74	62	62	66	--	60.9	56.2	60.2	59.4	58.6	--	15.3	14.5	17.0	15.4	15.6	--	0.0	--
TCG-Spitfire	--	63	79	63	67	70	--	61.6	56.9	59.3	58.1	58.1	--	14.7	13.6	15.1	15.4	14.7	--	0.1	--
AP Murdock	--	--	74	57	68	67	--	--	55.7	59.8	58.8	58.1	--	--	14.1	16.4	14.6	15.0	--	0.0	--
DG Commander	--	--	75	59	65	66	--	--	57.2	59.5	60.2	59.0	--	--	14.2	15.4	14.8	14.8	--	0.0	--
DG Ambush	--	--	69	57	74	67	--	--	57.6	59.9	61.1	59.5	--	--	15.1	17.1	15.1	15.8	--	0.0	--
DG Ballistic	--	--	77	58	80	72	--	--	55.2	58.4	57.7	57.1	--	--	14.2	16.1	14.1	14.8	--	1.0	--
LCS Cannon	--	--	67	62	67	65	--	--	56.1	61.4	60.4	59.3	--	--	14.5	15.8	14.7	15.0	--	0.0	--
MN-Washburn	--	--	67	50	67	61	--	--	57.6	58.4	59.1	58.4	--	--	14.1	15.9	14.7	14.9	--	0.0	--
SY McCloud	--	--	75	54	66	65	--	--	59.0	59.6	60.9	59.8	--	--	14.4	16.3	16.1	15.6	--	0.0	--
SY611CL2	--	--	76	57	65	66	--	--	58.4	60.5	59.6	59.5	--	--	14.2	15.6	15.3	15.0	--	0.0	--
TCG-Heartland	--	--	68	56	73	66	--	--	58.2	60.8	60.7	59.9	--	--	14.9	16.9	15.9	15.9	--	0.0	--
LCS Buster	--	--	--	66	69	--	--	--	--	59.7	56.2	--	--	--	--	14.1	12.7	--	--	--	--
MN-Torgy	--	--	--	61	72	--	--	--	--	60.0	59.6	--	--	--	--	16.9	15.2	--	--	--	--
AP Smith	--	--	--	55	72	--	--	--	--	59.7	59.4	--	--	--	--	15.9	14.6	--	--	--	--
ND Frohberg	--	--	--	59	63	--	--	--	--	60.1	60.3	--	--	--	--	16.5	15.0	--	--	--	--
TCG-Wildcat	--	--	--	51	74	--	--	--	--	60.5	60.1	--	--	--	--	17.4	15.4	--	--	--	--
Driver	--	--	--	--	77	--	--	--	--	--	59.8	--	--	--	--	--	14.6	--	--	--	--
AP GunsmokeCL2	--	--	--	--	77	--	--	--	--	--	59.2	--	--	--	--	--	15.3	--	--	--	--
CP3119A	--	--	--	--	65	--	--	--	--	--	55.0	--	--	--	--	--	13.7	--	--	--	--
MS Cobra	--	--	--	--	70	--	--	--	--	--	59.4	--	--	--	--	--	15.0	--	--	--	--
CP3188	--	--	--	--	61	--	--	--	--	--	56.4	--	--	--	--	--	13.3	--	--	--	--
CP3530	51	62	71	--	78	--	55.5	60.4	57.7	--	57.9	--	15.0	15.6	14.5	--	14.3	--	2.5	0.3	1.4
Linkert	48	58	64	54	--	--	55.7	61.9	56.7	59.6	--	--	15.5	15.3	15.1	16.2	--	--	0.0	0.0	0.0
Bolles	50	60	66	37	--	--	55.6	60.7	56.3	54.0	--	--	16.3	16.9	15.7	17.9	--	--	2.5	0.0	1.3
Shelly	63	67	67	58	--	--	59.4	62.1	56.3	59.8	--	--	14.3	14.7	14.2	16.0	--	--	1.4	0.7	1.1
ND VitPro	49	58	73	58	--	--	59.0	62.1	60.4	60.8	--	--	15.0	15.6	15.0	16.7	--	--	2.2	0.0	1.1
Lang-MN	58	68	72	67	--	--	60.4	61.8	59.4	59.8	--	--	15.4	15.1	15.2	15.8	--	--	--	1.3	--
CP3055	--	--	--	68	--	--	--	--	--	58.1	--	--	--	--	--	13.9	--	--	--	--	--
CP3915	--	--	--	60	--	--	--	--	--	61.1	--	--	--	--	--	15.4	--	--	--	--	--
DG Velocity	--	--	--	58	--	--	--	--	--	60.6	--	--	--	--	--	16.8	--	--	--	--	--
MS Ranchero	--	--	--	62	--	--	--	--	--	57.7	--	--	--	--	--	15.5	--	--	--	--	--
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	49	--	72	--	--	--	56.8	--	58.5	--	--	--	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	--
WB9590	42	63	--	--	--	--	54.1	61.2	--	--	--	--	15.9	15.3	--	--	--	--	--	--	--
WB9479	57	60	--	--	--	--	55.9	61.6	--	--	--	--	15.7	16.0	--	--	--	--	--	--	--
Trial Mean	53	63	71	58	70		56.7	61.4	57.3	59.7	59.1		14.9	15.1	14.5	16.0	14.7		1.8	0.2	
C.V. %	10.3	6.2	5.4	8.3	7.0		2.3	0.7	1.0	0.8	0.5		2.0	1.9	2.4	2.4	1.1		59.7	282	
LSD 5%	11.3	5.5	5.4	6.8	4.2		2.8	0.6	0.8	0.7	0.3		0.6	0.4	0.5	0.5	0.1		1.5	1.0	
LSD 10%	9.4	4.6	4.5	5.7	3.6		2.3	0.5	0.7	0.6	0.2		0.5	0.3	0.4	0.5	0.1		1.3	0.8	

HRSW Summary, Walsh County 2017-2021

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)		
	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	19	2yr
Faller	89	85	91	80	60	77	60.3	62.5	61.0	60.3	62.2	61.2	12.5	12.8	13.6	14.0	15.2	14.3	1.1	2.5	1.8
SY Ingmar	80	61	82	67	50	66	61.6	62.6	61.2	61.5	62.5	61.7	14.6	14.8	14.3	15.2	15.7	15.1	0.1	0.2	0.2
SY Valda	90	81	86	73	57	72	61.7	62.1	61.0	59.8	62.4	61.1	13.5	12.9	13.5	13.5	15.1	14.0	0.0	0.8	0.4
LCS Rebel	84	71	84	66	52	67	62.5	63.3	62.5	61.0	63.1	62.2	13.7	13.2	14.3	14.8	16.5	15.2	1.7	2.7	2.2
LCS Trigger	--	83	95	80	68	81	--	62.4	61.3	60.0	62.5	61.3	--	10.9	11.7	11.1	12.9	11.9	--	1.5	--
MS Barracuda	--	70	80	69	47	66	--	62.7	61.3	60.9	61.8	61.3	--	13.6	13.9	14.6	15.8	14.8	--	0.5	--
SY McCloud	--	68	84	60	51	65	--	63.1	61.8	61.7	63.1	62.2	--	14.8	14.7	15.9	16.0	15.5	--	1.3	--
SY611CL2	--	71	82	71	50	68	--	62.6	61.9	60.8	62.7	61.8	--	13.5	13.6	14.7	15.8	14.7	--	0.1	--
TCG-Spitfire	--	74	82	74	54	70	--	61.4	60.4	58.2	60.8	59.8	--	14.1	13.8	13.8	15.2	14.3	--	0.0	--
DG Ambush	--	--	80	70	51	67	--	--	61.2	61.3	62.7	61.7	--	--	14.9	15.1	15.6	15.2	--	1.7	--
DG Ballistic	--	--	98	74	60	77	--	--	60.5	59.9	61.5	60.6	--	--	13.7	14.8	15.7	14.7	--	0.7	--
DG Commander	--	--	89	74	51	71	--	--	61.2	60.6	62.5	61.4	--	--	14.1	14.3	15.7	14.7	--	0.7	--
LCS Cannon	--	--	85	73	48	69	--	--	61.5	62.9	63.4	62.6	--	--	13.7	14.0	15.6	14.4	--	0.8	--
MN-Washburn	--	--	81	65	52	66	--	--	61.1	60.5	61.8	61.1	--	--	14.5	13.9	15.7	14.7	--	0.3	--
TCG-Heartland	--	--	77	63	46	62	--	--	62.1	61.4	62.9	62.1	--	--	14.9	15.3	15.9	15.4	--	0.0	--
AP Murdock	--	--	84	76	48	70	--	--	59.7	61.1	61.9	60.9	--	--	13.8	13.4	14.8	14.0	--	2.0	--
LCS Buster	--	--	--	82	62	--	--	--	--	58.4	61.2	--	--	--	--	11.5	13.5	--	--	--	--
MN-Torgy	--	--	--	77	54	--	--	--	--	60.5	62.1	--	--	--	--	14.5	15.8	--	--	--	--
ND Frohberg	--	--	--	70	53	--	--	--	--	61.4	62.8	--	--	--	--	15.2	16.1	--	--	--	--
TCG-Wildcat	--	--	--	69	55	--	--	--	--	60.9	62.6	--	--	--	--	15.6	15.6	--	--	--	--
AP Smith	--	--	--	67	54	--	--	--	--	59.2	61.9	--	--	--	--	14.7	15.8	--	--	--	--
CP3530	94	77	82	--	59	--	61.7	62.3	60.6	--	61.1	--	13.4	14.0	15.1	--	15.0	--	0.1	2.7	1.4
Driver	--	--	--	--	50	--	--	--	--	--	62.7	--	--	--	--	15.4	--	--	--	--	--
AP GunsmokeCL2	--	--	--	--	54	--	--	--	--	--	61.8	--	--	--	--	15.6	--	--	--	--	--
CP3119A	--	--	--	--	67	--	--	--	--	--	59.9	--	--	--	--	13.5	--	--	--	--	--
CP3188	--	--	--	--	56	---	--	--	--	--	61.4	---	--	--	--	--	13.7	---	--	--	--
MS Cobra	--	--	--	--	51	--	--	--	--	--	61.9	--	--	--	--	16.3	--	--	--	--	--
Linkert	82	67	75	66	--	--	61.3	62.2	61.2	61.7	--	--	14.7	14.9	15.2	14.8	--	--	0.0	0.0	0.0
Bolles	86	64	82	61	--	--	60.9	61.5	60.8	58.5	--	--	14.9	14.6	15.7	16.3	--	--	0.0	0.3	0.2
Shelly	87	73	85	75	--	--	61.1	62.9	61.1	60.8	--	--	13.4	13.1	13.8	14.1	--	--	0.1	0.2	0.2
ND VitPro	80	66	76	66	--	--	62.8	63.8	62.5	62.0	--	--	14.9	14.0	15.0	15.2	--	--	0.0	0.0	0.0
Lang-MN	82	74	74	72	--	--	62.9	62.8	61.5	61.3	--	--	15.0	14.4	15.2	14.9	--	--	0.0	3.2	1.6
CP3055	--	--	--	76	--	--	--	--	--	57.4	--	--	--	--	--	12.0	--	--	--	--	--
CP3915	--	--	--	69	--	--	--	--	--	61.3	--	--	--	--	--	13.9	--	--	--	--	--
DG Velocity	--	--	--	64	--	---	--	--	--	61.9	--	---	--	--	--	15.8	--	---	--	--	--
MS Ranchero	--	--	--	75	--	--	--	--	--	59.5	--	--	--	--	--	13.3	--	--	--	--	--
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	83	--	80	--	--	--	62.2	--	62.1	--	--	--	13.9	--	14.0	--	--	--	0.1	1.7	0.9
MS Chevelle	88	--	90	--	--	--	59.4	--	60.6	--	--	--	12.9	--	13.1	--	--	--	0.8	3.8	2.3
CP3939	--	--	79	--	--	--	--	--	61.0	--	--	--	--	--	14.9	--	--	--	--	0.2	--
TCG-Stalwart	--	--	79	--	--	--	--	--	59.5	--	--	--	--	--	15.4	--	--	--	--	2.5	--
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	--	--
Trial Mean	86	72	82	71	54		61.2	62.5	61.2	60.6	62.1		13.9	13.8	14.4	14.3	15.3		0.5	1.1	
C.V. %	4.8	8.5	4.2	6.9	4.0		0.9	0.7	0.6	1.2	0.5		2.6	5.4	2.6	3.1	1.9		190	87	
LSD 5%	5.8	8.6	4.8	6.9	1.8		0.8	0.6	0.5	1.0	0.2		0.5	1.1	0.5	0.6	0.2		1.2	1.4	
LSD 10%	4.8	7.2	4.0	5.7	1.5		0.7	0.5	0.4	0.8	0.2		0.4	0.9	0.4	0.5	0.2		1.0	1.2	

Buckwheat, Langdon 2021					
Variety	Days to Flower	Plant Height (in)	1000 KWT (g)	Test Weight (lbs/bu)	Yield
					2021 (lbs/a)
Springfield	44	36	33.3	46.1	1441
Horizon	44	37	32.3	46.5	1395
Koma	44	35	29.1	49.4	1187
Koto	43	38	33.6	48.3	1386
Manor	43	40	28.1	45.4	1200
Devyatka	37	30	27.3	45.8	1143
Green Testa	44	36	28.5	47.2	861
Trial Mean	43	36	30.3	46.9	1230
C.V. %	0.6	3.6	2.0	0.6	9.7
LSD 5%	0.3	1.4	0.6	0.3	125.9
LSD 10%	0.2	1.1	0.5	0.3	104.1

No lodging in trial.

Rye, Langdon 2021							
Variety	Spring Stand	Julian Days to Head	Plant Height (in)	Test Weight (lbs/bu)	Yield		
					2021 (bu/a)	2 yr avg. (bu/a)	3 yr avg. (bu/a)
Aroostok	78	152	46	53.0	59.9	49.4	50.7
Bono	80	157	35	54.7	97.0	74.4	79.5
Brasetto	68	157	36	52.9	90.9	79.6	80.6
ND Dylan	80	155	45	53.3	67.1	63.3	66.1
ND Gardner	83	151	45	53.8	66.7	57.9	57.2
Rymin	68	155	43	53.6	66.7	60.6	62.3
Spooner	73	154	44	53.0	58.5	51.6	54.8
Hazlet	78	154	43	54.7	75.6	65.3	67.4
Danko	60	156	40	54.0	68.2	48.0	--
Serfanio	68	156	35	54.0	94.8	--	--
Tayo	88	156	36	53.5	111.8	--	--
Trial Mean	70	156	40	53.7	77.1	--	--
C.V. %	12.4	0.9	3.5	0.9	9.5	--	--
LSD 5%	12.5	1.9	2.0	0.7	10.5	--	--
LSD 10%	10.4	1.6	1.7	0.6	8.8	--	--

No lodging in 2020-2021.

Fall stand emergence was variable and reduced because of very dry conditions. Spring stand is a visual rating based on fall stand and any winter kill that occurred.

Corn Grain, Langdon 2021

Brand	Hybrid	RM ¹	Hybrid Traits ¹	Insect Traits	Harvest Moisture (%)	Test Weight (lbs/bu)	Yield (bu/a)
Innvictis	A7837VT2PRIB	78	RR2	VT Double Pro	30.6	56.0	144.5
Innvictis	A7988VT2PRIB	79	RR2	VT Double Pro	27.8	56.0	173.6
Legacy	LC295-21 GTCBLL	79	GT/LL	CB	32.5	57.6	133.5
Legacy	LC304-21	80	Enlist	VT2P, HX1	46.0	53.4	133.6
Legacy	LC-1818	78	RR2	VT2P	27.1	56.0	167.9
Legacy	LC311-20	81	RR2	VT2P	35.4	54.0	149.7
Legacy	LC295-21 GT	80	GT		32.3	58.4	151.9
PFS	22C74	74	RR2		26.5	59.0	154.6
PFS	77P79	79	RR2	VT2P	30.3	55.4	149.8
PFS	70D80	80	RR2	VT2P	29.6	55.2	170.2
PFS	71V81	81	RR2	VT2P	32.1	54.1	163.4
Pioneer	P7417AM	74	RR2Y/LL	ACREMAX	25.0	55.7	152.4
Pioneer	P7861AM	78	RR2Y/LL	ACREMAX	23.2	56.6	161.5
Pioneer	P7844AM	78	RR2Y/LL	ACREMAX	27.4	55.8	167.7
Proseed	1974	74	RR2	VT2P	25.7	58.9	144.2
Proseed	2078	78	GT	CB	34.5	52.2	138.5
REA	1R710	71	RR2		22.5	58.9	163.8
REA	1B750	75	RR2	VT2 Pro	26.4	57.7	147.4
REA	1B771	77	RR2	VT2 Pro	25.9	55.2	174.4
Stine	9140-G	81	GT		37.1	52.5	154.3
Stine	EXP80-20	80	GT	Double Stack	37.2	54.4	145.5
Thunder	T4072 RR	72	RR2		29.5	56.7	134.0
Thunder	T6074 VT2P	74	RR2	VT2P	30.8	58.5	139.3
Thunder	T6278 VT2P	78	RR2	VT2P	26.4	56.0	160.4
Thunder	T6181 VT2P	81	RR2	VT2P	34.9	54.2	152.6
Trial Mean					30.3	55.9	153.1
C.V. %					7.4	0.8	4.9
LSD 5%					2.8	0.6	9.6
LSD 10%					2.3	0.5	8.0

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

Yield and test weight reported at 15.5% moisture.

GDD from May 11 to October 18 were 2196. Normal is 1774.

GDD to reach RM for 75 day corn is 1797, 80 day corn is 1917.

Barley Summary, Langdon 2017-2021																							
Variety	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)				Plump (%)						
	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	19	20	3yr	17	18	19	20	21	3yr	
Tradition*	122	131	121	119	79	106	48.8	49.8	48.3	46.4	47.2	47.3	2.3	0.0	0.2	0.8	94	96	92	90	93	92	
Pinnacle	133	130	127	106	84	106	50.8	52.0	50.6	45.3	50.2	48.7	0.0	0.0	0.1	0.0	98	99	99	85	99	94	
ND Genesis	129	139	123	131	91	115	49.1	50.4	48.7	46.7	48.8	48.1	0.0	0.3	0.5	0.3	96	97	97	92	98	96	
AAC Synergy	131	147	123	132	92	116	49.5	51.2	50.1	46.2	48.2	48.2	3.5	1.3	2.7	2.5	94	97	97	86	94	92	
Explorer	131	125	123	99	80	101	47.7	51.0	49.1	43.6	48.2	47.0	0.0	0.0	0.1	0.0	91	96	96	76	96	89	
Conlon	--	111	110	109	57	92	--	51.7	51.0	48.4	49.9	49.8	--	1.8	0.3	--	--	98	98	90	98	95	
AAC Connect	--	--	120	127	90	112	--	--	49.7	45.5	47.1	47.4	--	0.5	2.0	--	--	--	97	77	90	88	
ABI Cardinal	--	--	120	109	83	104	--	--	49.3	46.5	46.9	47.6	--	1.0	1.7	--	--	--	96	87	93	92	
CDC Bow	--	--	--	130	82	--	--	--	--	48.6	47.8	--	--	--	0.3	--	--	--	--	--	92	96	--
Brewski	--	--	--	120	91	--	--	--	--	45.4	48.3	--	--	--	1.1	--	--	--	--	--	82	98	--
CDC Fraser	--	--	--	--	82	--	--	--	--	--	46.3	--	--	--	--	--	--	--	--	--	--	95	--
BC Leandra	--	--	--	--	73	--	--	--	--	--	46.0	--	--	--	--	--	--	--	--	--	--	92	--
BC Ellinor	--	--	--	--	92	--	--	--	--	--	48.1	--	--	--	--	--	--	--	--	--	--	99	--
BC Lexy	--	--	--	--	90	--	--	--	--	--	47.1	--	--	--	--	--	--	--	--	--	--	97	--
ABI Balster	117	142	124	--	--	--	46.4	50.5	49.5	--	--	--	3.3	0.0	--	--	85	93	94	--	--	--	--
Lacey*	135	133	124	--	--	--	49.4	50.4	48.9	--	--	--	0.3	0.0	--	--	94	98	95	--	--	--	--
Stellar-ND*	131	135	--	--	--	--	48.8	48.8	--	--	--	--	0.0	--	--	--	97	98	--	--	--	--	--
Celebration*	128	128	--	--	--	--	47.7	49.5	--	--	--	--	4.5	--	--	--	91	98	--	--	--	--	--
Quest*	115	126	--	--	--	--	47.2	49.6	--	--	--	--	5.5	--	--	--	82	94	--	--	--	--	--
Innovation*	121	118	--	--	--	--	48.6	49.9	--	--	--	--	2.5	--	--	--	93	98	--	--	--	--	--
Sirish	126	126	--	--	--	--	48.7	48.9	--	--	--	--	0.3	--	--	--	95	97	--	--	--	--	--
ABI Growler	118	133	--	--	--	--	45.7	50.6	--	--	--	--	3.8	--	--	--	82	97	--	--	--	--	--
LCS Genie	116	128	--	--	--	--	47.9	51.0	--	--	--	--	0.3	--	--	--	93	95	--	--	--	--	--
CDC Meredith	114	--	--	--	--	--	46.9	--	--	--	--	--	4.3	--	--	--	89	--	--	--	--	--	--
LCS Odyssey	129	--	--	--	--	--	47.3	--	--	--	--	--	0.8	--	--	--	95	--	--	--	--	--	--
Trial Mean	124	130	123	124	85		48.4	50.1	49.4	46.3	47.7		1.7	0.5	0.5		93	96	97	89	96		
C.V. %	6.3	6.0	3.4	4.2	9.9		1.7	2.3	0.7	0.9	1.5		122	149	126		3.4	1.5	1.3	2.4	2.8		
LSD 5%	11.1	11.0	5.9	7.5	9.9		1.2	1.6	0.5	0.6	0.8		2.8	1.0	0.9		4.4	2.0	1.8	3.0	3.0		
LSD 10%	9.3	9.2	4.9	6.2	7.7		1.0	1.4	0.4	0.5	0.6		2.4	0.9	0.7		3.7	1.7	1.5	2.5	2.0		

*6-row

Barley Summary, Langdon 2017-2021																		
Variety	Height (in)						Protein (%)						Days to Head					
	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	18	19	20	21	3yr
Tradition*	38	27	28	28	24	27	12.9	14.3	12.8	12.9	13.5	13.1	56	50	55	47	57	53
Pinnacle	39	27	29	27	23	26	12.0	12.8	12.1	11.5	13.7	12.4	57	51	56	49	61	55
ND Genesis	38	29	29	28	26	28	11.3	11.9	11.3	10.6	12.5	11.5	57	51	57	50	61	56
AAC Synergy	37	29	28	27	26	27	11.9	13.1	12.4	12.1	13.6	12.7	58	52	59	51	62	57
Explorer	32	24	24	24	22	23	11.5	13.4	12.4	12.4	13.9	12.9	58	50	57	50	61	56
Conlon	--	27	25	28	25	26	--	13.8	13.0	11.9	14.1	13.0	--	47	54	47	58	53
AAC Connect	--	--	27	26	24	26	--	--	13.1	12.5	14.5	13.4	--	--	58	50	62	57
ABI Cardinal	--	--	26	25	22	24	--	--	12.0	12.8	14.2	13.0	--	--	58	51	61	57
CDC Bow	--	--	--	28	23	--	--	--	--	12.5	14.2	--	--	--	--	52	63	--
Brewski	--	--	--	26	24	--	--	--	--	11.6	13.0	--	--	--	--	50	61	--
CDC Fraser	--	--	--	--	25	--	--	--	--	--	13.7	--	--	--	--	--	62	--
BC Leandra	--	--	--	--	20	--	--	--	--	--	14.5	--	--	--	--	--	62	--
BC Ellinor	--	--	--	--	22	--	--	--	--	--	13.0	--	--	--	--	--	62	--
BC Lexy	--	--	--	--	22	--	--	--	--	--	13.1	--	--	--	--	--	62	--
ABI Balster	35	28	25	--	--	--	12.4	13.4	12.2	--	--	--	59	51	59	--	--	--
Lacey*	41	28	29	--	--	--	12.7	14.3	12.7	--	--	--	55	50	55	--	--	--
Stellar-ND*	40	25	--	--	--	--	12.5	13.2	--	--	--	--	56	50	--	--	--	--
Celebration*	39	28	--	--	--	--	13.7	15.2	--	--	--	--	56	50	--	--	--	--
Quest*	39	27	--	--	--	--	13.5	14.1	--	--	--	--	57	50	--	--	--	--
Innovation*	40	25	--	--	--	--	13.5	14.7	--	--	--	--	56	51	--	--	--	--
Sirish	33	26	--	--	--	--	11.9	13.4	--	--	--	--	60	53	--	--	--	--
ABI Growler	36	26	--	--	--	--	13.1	13.4	--	--	--	--	59	54	--	--	--	--
LCS Genie	32	25	--	--	--	--	11.0	12.9	--	--	--	--	61	54	--	--	--	--
CDC Meredith	36	--	--	--	--	--	12.3	--	--	--	--	--	60	--	--	--	--	--
LCS Odyssey	33	--	--	--	--	--	10.7	--	--	--	--	--	61	--	--	--	--	--
Trial Mean	37	26	27	27	23		12.3	13.4	12.1	11.5	13.2		57	51	56	49	61	
C.V. %	5.8	6.3	5.5	4.1	7.3		4.6	3.4	3.5	3.6	3.7		1.4	2.1	1.5	1.4	2.2	
LSD 5%	3.0	2.3	2.1	1.6	2.0		0.8	0.6	0.6	0.6	0.6		1.1	1.5	1.2	0.9	2.0	
LSD 10%	2.5	2.0	1.8	1.3	2.0		0.7	0.5	0.5	0.5	0.4		0.9	1.3	1.0	0.4	1.0	

*6-row

Flax Summary, Langdon 2017-2021

Variety	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)						Height (in)						Days to Flower								
	17	18	19	20	21	3yr	17	18	19	20	21	3yr	16	17	17	18	19	20	21	3yr	17	18	19	20	21	3yr	17	18	19	20	21	3yr	
Carter*	48	38	42	43	21	36	53.0	53.0	53.2	53.1	53.1	53.1	0.5	0.0	0.3	27	24	25	25	21	24	57	49	53	47	52	51						
CDC Glas	54	43	42	50	21	37	51.1	51.8	50.6	52.0	51.2	51.3	0.2	0.1	0.2	25	27	22	25	19	22	58	49	53	51	54	53						
Omega*	46	39	39	40	21	33	52.5	53.4	53.4	53.2	53.2	53.3	1.0	0.4	0.7	26	22	23	20	19	21	57	48	54	45	54	51						
Webster	52	44	42	46	23	37	52.0	52.9	52.5	53.7	52.6	52.9	0.8	0.6	0.7	28	27	24	26	21	24	57	50	52	50	52	51						
York	50	42	43	48	20	37	52.2	52.5	51.7	53.4	52.3	52.5	0.3	0.0	0.2	27	25	28	25	20	24	56	48	52	47	53	51						
Gold ND*	52	43	41	48	21	36	52.2	53.1	52.7	53.4	53.0	53.0	0.7	0.1	0.4	28	27	25	23	20	23	57	52	53	49	55	52						
CDC Neela	46	38	43	43	22	36	52.4	52.4	51.4	53.0	52.1	52.2	1.6	0.0	0.8	26	23	23	24	20	22	57	49	51	50	53	51						
ND Hammond	49	39	38	40	21	33	51.1	52.5	51.5	52.9	52.3	52.2	--	0.0	--	26	25	24	23	21	23	56	48	52	46	52	50						
CDC Plava	46	--	40	39	21	33	50.7	--	51.6	52.1	52.1	51.9	4.0	0.0	2.0	24	--	22	26	19	22	56	--	52	46	53	50						
CDC Buryu	--	--	42	40	21	34	--	--	52.9	53.1	52.4	52.8	--	--	--	--	--	24	26	19	23	--	--	52	48	52	51						
AAC Bright	--	--	38	51	21	37	--	--	48.9	51.1	51.0	50.3	--	--	--	--	--	23	25	20	23	--	--	52	49	54	52						
CDC Dorado	--	--	--	38	18	--	--	--	--	52.8	51.8	--	--	--	--	--	--	23	19	--	--	--	--	--	43	51	--						
AAC Marvelous	--	--	--	--	22	--	--	--	--	--	52.5	--	--	--	--	--	--	--	20	--	--	--	--	--	--	53	--						
CDC Rowland	--	--	--	--	21	--	--	--	--	--	52.5	--	--	--	--	--	--	--	17	--	--	--	--	--	--	55	--						
Prairie Thunder	53	43	43	44	--	--	52.2	52.4	52.1	53.2	--	--	0.4	0.1	0.3	29	27	26	28	--	--	57	53	54	50	--	--						
Bison	49	40	40	41	--	--	52.3	52.7	52.7	53.3	--	--	0.3	0.1	0.2	28	25	27	26	--	--	57	49	52	46	--	--						
CDC Melyn	--	--	35	--	--	--	--	--	47.4	--	--	--	--	--	--	--	--	23	--	--	--	--	--	54	--	--							
CDC Bethune	49	42	--	--	--	--	52.9	52.7	--	--	--	--	0.5	0.0	0.3	28	26	--	--	--	57	48	--	--	--	--							
CDC Sanctuary	54	44	--	--	--	--	49.7	52.4	--	--	--	--	1.7	1.2	1.5	26	23	--	--	--	58	48	--	--	--	--							
CDC Sorrel	49	41	--	--	--	--	51.9	52.7	--	--	--	--	2.0	1.1	1.6	29	25	--	--	--	58	49	--	--	--	--							
Nekoma	52	42	--	--	--	--	52.9	52.7	--	--	--	--	0.6	0.2	0.4	28	23	--	--	--	57	50	--	--	--	--							
Pembina	52	43	--	--	--	--	53.0	53.0	--	--	--	--	0.3	0.2	0.3	27	24	--	--	--	57	49	--	--	--	--							
Prairie Blue	51	39	--	--	--	--	52.0	52.4	--	--	--	--	0.4	0.0	0.2	26	25	--	--	--	57	49	--	--	--	--							
Prairie Sapphire	54	46	--	--	--	--	51.3	51.9	--	--	--	--	2.1	0.0	1.1	28	24	--	--	--	57	50	--	--	--	--							
Rahab 94	51	43	--	--	--	--	49.7	52.3	--	--	--	--	0.4	0.0	0.2	27	25	--	--	--	56	50	--	--	--	--							
Trial Mean	51	42	41	45	21		52.0	52.6	52.2	53.1	52.6		0.8	0.2		27	25	25	25	20		57	50	53	48	53							
C.V. %	6.6	7.9	5.8	5.2	5.0		1.8	0.5	0.8	0.5	0.3		124	340		5.0	6.2	5.0	6.9	4.0		0.8	2.2	1.3	1.8	0.7							
LSD 5%	4.7	NS	3.9	3.9	1.4		1.3	0.4	0.6	0.4	0.2		1.5	1.1		1.9	2.5	2.0	2.8	1.1		0.7	1.8	1.1	1.4	0.6							
LSD 10%	3.9	NS	3.2	3.3	1.2		1.1	0.3	0.5	0.4	0.2		1.2	0.9		1.6	2.1	1.7	2.4	0.9		0.6	1.5	0.9	1.2	0.5							

*Yellow seeded.

Canola - Liberty Link and Clearfield Varieties, Langdon 2020-2021

Company/Brand	Variety	Type ¹	Blackleg Rating ²		Status ³	Clubroot Resistant ⁵	Days to First Flower		Days to End Flower		Days to Mature		% Cover ⁴					
			20	21			20	21	20	21	20	21	20	21				
BASF	InVigor L233P	H,LL,TR	R		CA	No	39	41	40	57	59	58	87	79	83	88	75	82
BASF	InVigor L345PC	H,LL,TR	R		CA	Yes	41	44	43	64	60	62	92	82	87	88	83	86
BASF	InVigor L234PC	H,LL,TR	R		CA	Yes	39	41	40	57	59	58	86	80	83	89	78	84
BASF	InVigor L255PC	H,LL,TR	R		CA	Yes	42	46	44	64	61	63	91	84	88	79	73	76
Dyna-Gro	DG 200CL	H,CL,TR	R		CA	No	44	47	46	67	62	65	93	87	90	75	83	79
BASF	InVigor L340PC	H,LL,TR	R		CA	Yes	41	44	43	64	60	62	92	82	87	85	74	80
BASF	InVigor LR344PC	H,TFLL,TR	R		CA	Yes	40	42	41	61	59	60	91	83	87	91	79	85
Dekalb	DKTFLL2ISC	H,TFLL,TR	R		CA	No	39	41	40	59	60	60	89	80	85	69	70	70
Dekalb	DKLL82SC	H,LL,TR	R		CA	No	38	41	40	58	60	59	89	82	86	80	75	78
Meridian Seeds	CS2700 CL	H,CL,TR	R		CA	Yes	44	48	46	68	63	66	93	87	90	68	69	69
BASF	EXP #2	H, LL, TR	R		EXP	Yes	--	44	--	--	60	--	--	83	--	--	80	--
BASF	L343PC	H, LL, TR	R		CA	Yes	--	44	--	--	60	--	--	83	--	--	75	--
Croplan	CP7130LL	H,LL,TR	R		EXP	No	--	43	--	--	60	--	--	82	--	--	78	--
Croplan	CP7144LL	H,LL,TR	R		EXP	No	--	43	--	--	61	--	--	83	--	--	75	--
Dekalb	H19W94354	H,LL,TR	R		EXP	No	--	42	--	--	61	--	--	82	--	--	70	--
Meridian Seeds	CS4000 LL	H,LL,TR	R		CA	Yes	--	43	--	--	61	--	--	84	--	--	67	--
Pioneer	P505MSL	H,LL,TR	R		CA	Yes	--	43	--	--	60	--	--	83	--	--	74	--
Pioneer	P506ML	H,LL,TR	R		CA	Yes	--	42	--	--	60	--	--	82	--	--	72	--
Trial Mean							41	43		63	60		90	83		78	75	
C.V. %							2.6	1.7		2.2	0.7		1.0	0.9		10.7	7.2	
LSD 5%							1.5	0.6		1.9	0.4		1.2	0.7		11.7	5.3	
LSD 10%							1.3	0.5		1.6	0.3		1.0	0.6		9.8	4.5	

¹H-Hybrid, LL-Liberty Link, CL-Clearfield, TR-Traditional Oil Type, TFLL-Roundup Ready Truflex-Liberty Link stacked.

²Blackleg Rating: 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.

⁵Has clubroot resistance gene.

Canola - Liberty Link and Clearfield Varieties, Langdon 2019-2021

Company/Brand	Variety	Lodging												Yield ¹ (lbs/a)					
		Height (in)						Oil ¹ (%)						Yield ¹ (lbs/a)					
		20	21	2yr	19	20	2yr	20	21	2yr	20	21	2yr	2019	2020	2021	2yr	3yr	
BASF	InVigor L233P	43	36	40	5.5	5.8	5.7	42.0	42.1	42.1	42.1	42.1	42.1	3528	3565	1436	2501	2843	
BASF	InVigor L345PC	51	40	46	4.0	6.3	5.2	40.6	42.3	41.5	41.5	41.5	41.5	3947	3135	1512	2324	2865	
BASF	InVigor L234PC	48	37	43	6.5	6.0	6.3	41.6	42.4	42.0	42.0	42.0	42.0	3394	3195	1371	2283	2653	
BASF	InVigor L255PC	47	38	43	2.0	4.8	3.4	43.5	43.3	43.4	43.4	43.4	43.4	3937	2961	1200	2081	2699	
Dyna-Gro	DG 200CL	47	42	45	4.3	6.8	5.6	41.0	40.8	40.9	40.9	40.9	40.9	3216	2644	1518	2081	2459	
BASF	InVigor L340PC	46	36	41	--	5.3	--	40.9	41.3	41.1	41.1	41.1	41.1	--	3414	1351	2383	--	
BASF	InVigor LR344PC	50	36	43	--	6.5	--	41.4	42.8	42.1	42.1	42.1	42.1	--	3020	1485	2253	--	
Dekalb	DKTFL21SC	45	35	40	--	4.8	--	42.2	43.2	42.7	42.7	42.7	42.7	--	3327	978	2153	--	
Dekalb	DKLL82SC	42	36	39	--	4.5	--	42.2	43.2	42.7	42.7	42.7	42.7	--	3169	812	1991	--	
Meridian Seeds	CS2700 CL	49	44	47	--	4.0	--	42.6	42.5	42.6	42.6	42.6	42.6	--	2722	1696	2209	--	
BASF	EXP #2	--	36	--	--	--	--	--	42.7	--	--	--	--	--	--	1587	--	--	
BASF	L343PC	--	37	--	--	--	--	--	43.4	--	--	--	--	--	--	1641	--	--	
Croplan	CP7130LL	--	37	--	--	--	--	--	43.5	--	--	--	--	--	--	1238	--	--	
Croplan	CP7144LL	--	39	--	--	--	--	--	43.2	--	--	--	--	--	--	1421	--	--	
Dekalb	H19W94354	--	37	--	--	--	--	--	43.7	--	--	--	--	--	--	964	--	--	
Meridian Seeds	CS4000 LL	--	36	--	--	--	--	--	42.4	--	--	--	--	--	--	1076	--	--	
Pioneer	P505MSL	--	36	--	--	--	--	--	42.1	--	--	--	--	--	--	1216	--	--	
Pioneer	P506ML	--	37	--	--	--	--	--	44.1	--	--	--	--	--	--	1037	--	--	
Trial Mean		47	38		3.1	5.2		41.7	42.7					3432	2881				
C.V. %		6.6	4.4		56.4	18.4		1.4	1.0					8.2	8.2				
LSD 5%		4.3	1.4		2.5	1.3		0.8	0.4					396	331				
LSD 10%		3.6	1.2		2.1	1.1		0.7	0.3					331	277				

¹8.5% moisture

Canola - Roundup Ready, Langdon 2019-2021

Company	Variety	Lodging (0-9)						Height (in)			Oil ¹ (%)			Yield ¹ (lbs/a)					
		19		20		2yr		20	21	2yr	19	20	21	2yr	19	20	21	2yr	3yr
		20	21	2yr	20	21	2yr	20	21	2yr	20	21	2yr	20	21	2yr	20	21	2yr
CROPLAN	GP9978TF	44	34	39	1.2	5.9	3.6	41.6	41.9	41.8	4060	3543	1313	2428	2972				
Meridian Seeds	CS2600 CR-T	46	34	40	4.1	6.5	5.3	42.2	43.9	43.1	4003	3325	1367	2346	2898				
Pioneer	45CM39	46	35	41	0.4	5.4	2.9	43.2	46.3	44.8	4274	3159	1880	2520	3104				
Star	StarFlex	44	36	40	1.9	5.6	3.8	42.7	43.4	43.1	3874	3076	1519	2298	2823				
BrettYoung	BY 6204TF	44	38	41	--	5.0	--	43.0	42.6	42.8	--	2870	1646	2258	--				
Dekalb	DKTF96SC	47	37	42	--	5.6	--	43.0	42.0	42.5	--	2830	1531	2181	--				
Dyna-Gro	DG 760TM	45	37	41	--	5.0	--	42.3	42.3	42.3	--	3307	1412	2360	--				
Dyna-Gro	DG 761TM	50	35	43	--	5.1	--	43.0	43.6	43.3	--	3013	1322	2168	--				
Integra	7361RC	45	35	40	--	6.6	--	41.2	42.8	42.0	--	3249	1676	2463	--				
Nuseed	NC401 TF	48	34	41	--	5.6	--	42.7	43.5	43.1	--	3552	1668	2610	--				
BrettYoung	BY 6207TF	--	41	--	--	--	--	--	43.8	--	--	--	1826	--	--				
BrettYoung	BY 6211TF	--	34	--	--	--	--	--	41.0	--	--	--	1262	--	--				
Dekalb	DKTF99SC	--	35	--	--	--	--	--	42.9	--	--	--	1793	--	--				
Dekalb	DKTFLL21SC	--	34	--	--	--	--	--	43.0	--	--	--	1438	--	--				
Meridian Seeds	CS3000 TF	--	32	--	--	--	--	--	43.4	--	--	--	1484	--	--				
Nuseed	NC155 TF	--	32	--	--	--	--	--	40.9	--	--	--	1244	--	--				
Nuseed	NC471 TF	--	35	--	--	--	--	--	42.4	--	--	--	1438	--	--				
Nuseed	NC527CR TF	--	34	--	--	--	--	--	43.3	--	--	--	1700	--	--				
Proseed	EXP2021TF	--	36	--	--	--	--	--	42.5	--	--	--	1693	--	--				
Trial Mean		46	35		1.5	5.5		42.3	42.9		3931	3209	1537						
C.V. %		7.2	4.2		64.3	13.7		2.4	0.7		5.1	8.4	8.0						
LSD 5%		4.7	1.4		1.3	1.1		1.5	0.3		284	384	123						
LSD 10%		3.9	1.1		1.1	0.9		1.2	0.2		238	320	103						

¹ 8.5% Moisture

Canola - Roundup Ready, Langdon 2020-2021

Company	Variety	Type ¹	Blackleg Rating ²		Status ³	Clubroot Resistant ⁵		Days to First Flower		Days to End Flower		Days to Mature		% Cover ⁴			
			Rating	Resistant		20	21	20	21	20	21	20	21	20	21		
			2yr	2yr		2yr	2yr	2yr	2yr	2yr	2yr						
CROPLAN	CP9978TF	TF	R	No	CA	No	39	40	40	60	58	90	82	86	85	80	83
Meridian Seeds	CS2600 CR-T	TF	R	Yes	CA	Yes	39	39	39	59	58	88	80	84	83	76	80
Pioneer	45CM39	RR	R	Yes	CA	Yes	39	41	40	58	57	90	81	86	92	90	91
Star	StarFlex	TF	R	No	CA	No	39	41	40	62	59	92	82	87	96	88	92
BrettYoung	BY 6204TF	TF	R	Yes	CA	Yes	42	43	43	68	59	93	83	88	83	93	88
Dekalb	DKTF96SC	TF	R	No	CA	No	41	44	43	66	61	91	84	88	96	87	92
Dyna-Gro	DG 760TM	TF	R	No	CA	No	38	41	40	58	59	86	83	85	96	81	89
Dyna-Gro	DG 761TM	TF	R	No	CA	No	40	42	41	63	59	92	82	87	92	82	87
Integra	7361RC	TF	R	Yes	CA	Yes	39	41	40	60	58	90	82	86	93	85	89
Nuseed	NC401 TF	TF	R	No	CA	No	40	40	40	64	60	92	82	87	88	93	91
BrettYoung	BY 6207TF	TF	R	Yes	CA	Yes	--	44	--	--	62	--	86	--	--	83	--
BrettYoung	BY 6211TF	TF	R	No	CA	No	--	41	--	--	59	--	82	--	--	85	--
Dekalb	DKTF99SC	TF	R	No	EXP	No	--	41	--	--	58	--	82	--	--	90	--
Dekalb	DKTFLL21SC	TFL	R	No	CA	No	--	39	--	--	58	--	79	--	--	91	--
Meridian Seeds	CS3000 TF	TF	R	Yes	CA	Yes	--	38	--	--	57	--	81	--	--	81	--
Nuseed	NC155 TF	TF	R	No	EXP	No	--	40	--	--	59	--	82	--	--	84	--
Nuseed	NC471 TF	TF	R	No	EXP	No	--	42	--	--	59	--	84	--	--	89	--
Nuseed	NC527CR TF	TF	R	Yes	EXP	Yes	--	41	--	--	58	--	84	--	--	93	--
Proseed	EXP2021TF	RR	R	N/A	EXP	N/A	--	39	--	--	57	--	80	--	--	87	--
Trial Mean							40	41		63	59	90	82		87	86	
C.V. %							1.5	1.4		2.6	0.8	1.2	0.8		8.2	4.1	
LSD 5%							0.9	0.5		2.3	0.4	1.5	0.6		10.3	3.4	
LSD 10%							0.8	0.4		1.9	0.4	1.3	0.5		8.5	2.8	

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

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.

⁵ Has clubroot resistance gene.

Dry Bean Summary, Langdon 2019-2021

Variety	Type	Days to Maturity	100 Seed Weight (g)	Yield					
				2019	2020	2021	2 yr Avg.	3 yr Avg.	4 yr Avg.
				(lbs/a)					
ND Palomino	Pinto	105	36.5	2239	3020	1585	2302	2281	2427
Windbreaker	Pinto	101	38.4	2291	3876	1587	2732	2585	2577
Monterrey	Pinto	103	35.4	2442	3807	2105	2956	2785	2605
Lariat	Pinto	105	38.3	2516	3455	1714	2585	2562	2637
LaPaz	Pinto	105	37.3	2564	3693	1827	2760	2695	2706
Stampede	Pinto	104	33.7	2415	3899	2028	2963	2781	2886
ND Falcon	Pinto	105	35.2	2280	3114	1695	2405	2363	--
Torreon	Pinto	103	37.2	2553	3804	2165	2984	2841	--
Vibrant	Pinto	106	34.7	2693	4033	2114	3074	2947	--
Cowboy	Pinto	100	36.1	--	--	1638	--	--	--
DR Wood	Pinto	107	37.6	--	--	2127	--	--	--
Croissant	Pinto	106	35.5	--	--	1710	--	--	--
Centennial	Pinto	107	38.3	--	--	1567	--	--	--
T9905	Navy	107	19.5	2065	3781	1835	2808	2560	2615
HMS Medalist	Navy	106	16.5	2346	3891	2197	3044	2811	2750
Blizzard	Navy	103	18.9	2327	3321	1962	2642	2537	--
Eclipse	Black	102	19.9	2181	3634	2049	2841	2621	2636
Black Tails	Black	106	19.0	2112	3759	2063	2911	2645	--
ND Twilight	Black	101	19.7	--	3205	1522	2363	--	--
Zorro	Black	103	19.8	2376	--	1899	--	--	--
Merlot	Small Red	104	37.0	2205	3089	2036	2562	2443	2403
Viper	Small Red	105	28.7	2854	3329	2587	2958	2923	--
Rosetta	Pink	107	33.6	2389	--	2044	--	--	--
ND Pegasus	Great Northern	106	38.5	2811	--	2320	--	--	--
Trial Mean		104	30.7	2385	3470	1915			
C.V. %		0.9	3.4	10.8	7.8	9.5			
LSD 5%		1.2	1.3	427	446	235			
LSD 10%		1.0	1.1	355	371	197			

Days to mature (R9) at least 80% of pods showing yellow and mostly ripe.



Field Pea, Langdon 2019-2021

Variety	Days to 1st Flower	Canopy		1000 Seeds/ Pound	Test Weight	Protein ²	Yield						
		Ht. at Harvest	Harvest Ease ¹				2019	2020	2021	2 yr Avg.	3 yr Avg.		
	(days)	(in)	(0-9)	(g)	(lbs/bu)	(%)	bu/a						
Yellow Cotyledon Type													
DS Admiral	52	81	16	0	249	1826	63.2	27.6	61.2	73.0	39.6	56.3	57.9
Agassiz	53	82	21	0	244	1869	64.2	26.1	64.3	76.3	44.2	60.3	61.6
CDC Amarillo	55	84	24	0	243	1868	64.2	26.8	68.1	70.4	53.1	61.8	63.9
Durwood	53	82	23	0	245	1853	64.7	26.8	60.6	75.6	45.7	60.7	60.6
Salamanca	53	83	22	0	262	1739	63.9	28.9	61.2	74.5	46.4	60.5	60.7
AAC Chrome	55	84	20	0	257	1769	65.1	25.3	76.8	76.7	61.8	69.3	71.8
Hyline	54	82	22	0	255	1786	64.8	25.4	68.7	62.1	53.1	57.6	61.3
DL Apollo	53	82	21	0	242	1881	64.6	27.6	64.0	59.6	41.5	50.6	55.0
LG Sunrise	50	82	20	0	261	1750	64.6	25.8	63.7	72.4	40.1	56.3	58.7
AAC Carver	52	81	23	0	276	1639	64.6	25.3	74.0	68.2	55.7	62.0	66.0
CDC Inca	54	83	24	0	249	1822	64.6	26.5	70.6	74.4	50.4	62.4	65.1
CDC Spectrum	54	83	18	0	253	1797	64.0	27.0	69.6	55.9	45.4	50.7	57.0
AAC Profit	54	82	20	0	253	1791	64.8	27.4	69.5	74.5	49.5	62.0	64.5
AAC Asher	55	84	17	0	288	1571	64.0	26.2	77.1	64.2	42.9	53.6	61.4
Orchestra	54	83	18	0	281	1619	64.7	29.1	--	72.4	41.8	57.1	--
ND Dawn	53	81	18	0	246	1846	63.5	25.7	--	59.7	38.4	49.1	--
Cronos	50	82	18	0	286	1587	63.5	29.5	--	58.2	31.8	45.0	--
EP_6360	50	80	18	0	255	1781	62.2	29.0	--	--	43.7	--	--
EP_6381	53	82	20	0	224	2025	64.0	28.0	--	--	40.5	--	--
EP_6816	54	82	23	0	221	2056	64.5	26.8	--	--	39.7	--	--
EP_8272	51	82	21	0	253	1792	63.9	28.9	--	--	33.2	--	--
EP_8506	54	84	20	0	226	2017	64.2	27.8	--	--	36.7	--	--
EP_8971	54	85	20	0	281	1616	64.1	30.6	--	--	46.2	--	--
EPX_6186	54	83	21	0	247	1838	64.9	27.4	--	--	45.5	--	--
AAC Julius	54	82	23	0	232	1957	64.8	27.2	--	--	53.3	--	--
Spider	53	83	21	0	252	1805	64.8	27.4	--	--	50.5	--	--
LG Stunner	50	82	22	0	220	2071	64.4	29.0	--	--	45.2	--	--
MS-20YP4	55	85	23	0	240	1897	64.6	27.4	--	--	50.3	--	--
DL GrowPro	53	83	26	0	295	1539	64.1	28.5	--	--	52.9	--	--
PSTSP39	53	83	19	1	272	1684	65.2	27.3	--	--	49.6	--	--
PSTSP43	54	86	17	0	289	1578	64.6	28.8	--	--	43.5	--	--
Green Cotyledon Type													
CDC Striker	52	81	16	2	211	2141	64.4	26.0	66.1	59.6	44.6	52.1	56.8
Arcadia	53	80	16	2	217	2095	64.6	26.0	65.4	64.6	39.5	52.1	56.5
Aragorn	49	77	15	1	209	2169	62.4	27.1	--	53.2	34.7	44.0	--
Greenwood	51	80	18	0	216	2111	64.7	25.0	--	48.7	45.5	47.1	--
Shamrock	54	83	23	0	244	1859	65.1	26.0	--	58.9	48.0	53.5	--
Empire	54	84	26	0	217	2087	65.1	26.1	--	73.3	46.5	59.9	--
PSTSP38	53	84	20	0	287	1580	64.5	27.0	--	--	50.8	--	--
Maple Cotyledon Type													
PSTSP45	55	84	22	0	266	1710	65.5	27.3	--	--	44.8	--	--
Trial Mean	53	83	20	0	250	1829	64.4	27.2	66.1	64.0	45.9		
C.V. %	1.7	1.1	12.7	322	3.2	3.0	0.7	1.8	5.8	8.7	13.3		
LSD 5%	1.4	1.4	4.2	0.7	13.1	90.5	0.7	0.8	5.4	9.1	10.0		
LSD 10%	1.2	1.2	3.5	0.6	11.0	75.6	0.6	0.7	4.5	7.6	8.3		

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

² 0% moisture basis

Faba Bean, Langdon 2021

Company	Variety	Days to 1st Flower (DAP) ¹	Days to Mature (DAP) ¹	Plant Height (in)	1000 KWT (g)	Protein ² (%)	Test Weight (lbs/bu)	Seed Yield ²		
								2021 (bu/a)	2-yr Avg. (bu/a)	3-yr Avg. (bu/a)
Valesco Genetics	Boxer	49	103	28	508	24.6	63.4	42.2	63.9	59.7
Premier Genetics	Tiffany	49	98	26	476	24.2	61.5	42.2	63.9	60.9
Premier Genetics	Fabelle	49	99	26	497	25.0	63.5	40.1	57.4	56.1
Valesco Genetics	Victus	48	100	24	521	24.4	63.1	37.3	66.0	--
PUSA	2001	48	97	24	494	23.5	59.8	39.3	52.3	--
Premier Genetics	Bolivia	49	101	25	447	24.3	64.4	41.5	--	--
Premier Genetics	Allison	47	98	26	468	22.8	62.5	42.4	--	--
Premier Genetics	Escada	49	100	27	536	23.2	62.0	50.1	--	--
Trial Mean										
C.V. %										
LSD 5%										
LSD 10%										

¹ DAP - Days after planting

² Yield and protein at 16% moisture.

Targeted plant stand was 4.5 plants/ft².



Soybean - RR2X, RR2XF, Enlist, and GT, Langdon 2021 (page 1 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity date ³	Plant Height (in)	Protein (%)	Oil (%)	Yield		
								2021	2 yr Avg.	2-site Avg. ⁴
BioGene	BG8000	RR2X	00.9	9/10	37	32.3	16.5	59.6	59.0	54.5
BioGene	BG8006	RR2X	00.6	9/8	34	32.3	16.3	61.4	--	51.8
BioGene	BG9021E3	Enlist	0.2	9/18	34	32.8	15.4	62.4	--	53.6
Dahlman	1102E3N	Enlist	0.2	9/21	27	32.2	16.0	66.3	64.4	56.9
Dahlman	1201E3N	Enlist	0.1	9/18	33	32.1	15.8	64.5	--	54.6
Dairyland	DSR-0119E	Enlist	0.1	9/18	34	30.9	16.5	68.3	--	--
Dyna-Gro	S009XF52	RR2XF	00.9	9/6	31	31.3	16.9	55.9	--	46.5
Dyna-Gro	S009XT68	RR2X	00.9	9/12	36	33.4	15.0	63.2	63.3	57.2
Dyna-Gro	S02EN71	Enlist	0.2	9/20	26	32.2	15.9	67.7	--	58.4
Golden H.	GH00833E3	Enlist	00.8	9/13	37	32.7	16.3	65.9	61.5	54.1
Golden H.	GH00982XF	RR2XF	00.9	9/12	31	32.6	16.0	63.1	--	53.6
Golden H.	GH0272XF	RR2XF	0.2	9/11	33	31.5	16.3	59.1	--	55.4
Innivitis	A00918X	RR2X	00.9	9/11	35	32.3	15.9	60.7	--	51.5
Innivitis	A00979X	RR2X	00.9	9/13	29	34.1	15.8	66.6	--	56.0
Integra	40089N	Enlist	00.8	9/13	35	32.6	15.9	64.8	60.3	54.0
Integra	50081N	RR2X	00.8	9/8	30	34.4	15.5	52.8	55.1	44.3
Legacy	LS-00639N RR2X	RR2X	00.6	9/6	32	32.3	16.2	59.5	60.0	48.5
Legacy	LS0094-21 XF	RR2XF	00.9	9/8	31	31.3	16.4	52.5	--	45.7
Legacy	LS-00930 RR2X	RR2X	00.9	9/13	30	33.9	16.0	63.4	58.9	56.8
Legacy	LS012-20E	Enlist	0.1	9/15	29	32.3	15.9	61.1	63.4	53.8
Legacy	LS012-21E	Enlist	0.1	9/20	34	32.8	16.1	66.8	--	58.7
Legacy	LS-0239N RR2X	RR2X	0.2	9/15	35	31.5	15.8	66.7	65.6	60.5
LG Seeds	LGS00663RX	RR2X	00.6	9/9	33	33.3	15.7	61.7	62.4	51.9
LG Seeds	LGS00838XF	RR2XF	00.8	9/12	32	33.0	15.8	57.8	--	49.2
LG Seeds	LGS0111RX	RR2X	0.1	9/14	37	33.7	16.1	67.3	65.1	58.3
NDSU	21ND008GT20	GT	00.8	9/7	33	33.6	16.0	59.4	--	50.3
NDSU	ND17009GT	GT	00.9	9/11	36	34.7	16.5	56.1	55.7	48.8
P3 Genetics	2002E	Enlist	0.2	9/18	28	32.5	15.5	61.0	--	53.1
P3 Genetics	2201E	Enlist	0.1	9/21	35	32.8	16.2	60.6	--	56.0
Peterson	19EN008	Enlist	00.8	9/12	37	32.8	16.0	67.9	62.8	56.8
Peterson	21X007	RR2X	00.7	9/6	33	30.7	16.1	68.7	64.0	55.2
Peterson	22XF009	RR2XF	00.9	9/7	32	31.5	16.6	54.6	--	48.0
Pioneer	P005A83X	RR2X	00.5	9/7	32	32.6	16.6	56.9	--	--
Pioneer	P006A37X	RR2X	00.6	9/5	30	32.4	16.8	62.6	--	--
Pioneer	P009T18E	Enlist	00.9	9/11	34	32.4	16.1	62.8	--	53.0

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant.

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).

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2X, RR2XF, Enlist, and GT, Langdon 2021 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity	Plant Height	Protein (%)	Oil (%)	Yield		
								2021	2 yr Avg.	2-site Avg. ⁴
				date ³	(in)	(%)	(%)	-----bu/a-----		
Pioneer	P00A49X	RR2X	0.0	9/11	36	31.7	16.7	62.6	60.3	54.3
Pioneer	P01A84X	RR2X	0.1	9/17	32	31.3	16.8	61.0	57.1	49.5
Pioneer	P01T92E	Enlist	0.1	9/17	33	31.9	16.3	61.1	--	--
Proseed	EL80-093N	Enlist	00.9	9/12	35	33.0	15.8	62.5	56.7	--
Proseed	XT20-07	RR2X	00.7	9/6	32	29.9	16.6	60.9	59.4	--
Proseed	XT80-20N	RR2X	0.2	9/13	35	32.0	15.6	65.5	--	--
REA	R0112XF	RR2XF	0.1	9/15	40	34.2	15.3	68.4	--	58.0
REA	RX00912	RR2X	00.9	9/11	35	31.2	16.6	59.4	--	51.7
Stine	002EE06	Enlist	00.6	9/2	32	33.6	16.0	47.5	--	37.0
Stine	01EA63	Enlist	0.0	9/14	31	33.2	15.5	67.7	64.3	55.2
Stine	01EE03	Enlist	0.1	9/20	35	33.1	16.2	64.2	--	57.4
Stine	03EB02	Enlist	0.2	9/16	28	32.0	15.6	62.7	--	54.6
Syng NK	NK009-T1XF	RR2XF	00.9	9/11	32	32.8	16.1	63.3	--	54.8
Syng NK	S006-R7X	RR2X	00.6	9/3	29	32.2	16.6	61.0	62.4	52.1
Syng NK	S008-E3	Enlist	008	9/11	34	33.1	15.8	64.4	61.3	57.1
Thunder	SB8001	RR2X	0.1	9/12	27	33.4	16.3	61.8	57.9	55.0
Thunder	SB81006	RR2X	00.6	9/6	31	30.3	16.6	56.8	57.8	48.7
Thunder	SB87009	RR2X	00.9	9/11	35	33.2	15.2	62.1	61.9	54.2
Thunder	SB88007N	RR2X	00.7	9/8	34	32.5	16.6	60.3	58.3	51.4
Thunder	TE71008N	Enlist	00.8	9/11	36	32.5	16.2	61.8	60.5	55.0
Thunder	TX82008N	RR2XF	00.8	9/12	34	32.7	15.9	63.1	--	54.5
Trial Mean				9/12	33	32.7	16.1	61.5		
C.V. %				1.6	7.9	1.5	1.6	8.2		
LSD 5%				2.6	3.7	1.0	0.5	7.1		
LSD 10%				2.2	3.1	0.8	0.4	5.9		

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant.

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).

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2X, RR2XF, Enlist, and GT, Nelson County 2021 (page 1 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity date ³	Plant Height (in)	Protein (%)	Oil (%)	Yield		
								2021	2 yr Avg.	2-site Avg. ⁴
								----- bu/a -----		
Dahlman	6004XN	RR2X	0.4	9/15	25	33.6	17.0	57.6	58.8	45.2
Dahlman	7203XF	RR2XF	0.3	9/9	28	35.4	16.3	54.8	--	42.7
Dyna-Gro	S02EN71	Enlist	0.2	9/15	20	33.5	16.5	49.5	54.1	37.0
Dyna-Gro	S04XF32	RR2XF	0.4	9/16	31	33.7	16.3	53.8	--	44.3
Dyna-Gro	S04XT91	RR2X	0.4	9/12	24	32.7	17.4	55.0	59.2	44.2
Golden H.	GH0272XF	RR2XF	0.2	9/9	24	34.4	16.7	44.2	--	37.2
Golden H.	GH0325E3	Enlist	0.3	9/11	21	32.7	16.5	45.3	51.9	38.3
Golden H.	GH0452E3	Enlist	0.4	9/13	25	35.2	16.3	54.0	--	40.1
Inn victis	A0338X	RR2X	0.3	9/14	26	32.7	16.1	54.7	--	43.5
Inn victis	B0330E	Enlist	0.3	9/14	18	34.3	16.4	49.3	--	37.7
Integra	40201N	Enlist	0.2	9/16	17	33.3	16.8	53.8	55.4	41.3
Integra	40300N	Enlist	0.3	9/10	23	32.4	16.9	52.7	--	40.3
Integra	50309N	RR2X	0.3	9/13	26	32.5	16.2	57.0	56.9	43.6
Legacy	LS-00930 RR2X	RR2X	00.9	9/6	21	34.4	17.1	47.4	--	35.0
Legacy	LS012-21E	Enlist	0.1	9/15	23	33.4	17.1	55.0	--	46.1
Legacy	LS-0239N RR2X	RR2X	0.2	9/14	25	33.7	16.0	55.6	55.9	39.4
Legacy	LS-0320E	Enlist	0.4	9/10	20	32.4	16.9	46.7	52.3	38.2
Legacy	LS042-21E	Enlist	0.4	9/12	23	31.6	17.0	53.0	--	40.9
Legacy	LS-0429	Enlist	0.4	9/14	26	34.6	17.0	49.7	52.9	38.2
LG Seeds	LGS00663RX	RR2X	00.6	9/5	23	34.2	16.5	43.7	50.6	34.1
LG Seeds	LGS00838XF	RR2XF	00.8	9/6	26	33.4	16.9	45.7	--	34.5
LG Seeds	LGS0111RX	RR2X	0.1	9/9	29	34.7	16.5	55.5	56.2	41.8
LG Seeds	LGS0355RX	RR2X	0.3	9/12	23	33.6	16.0	54.0	55.4	41.8
LG Seeds	LGS0400RX	RR2X	0.4	9/12	28	32.7	16.9	61.6	62.3	47.5
NDSU	21ND008GT20	GT	00.8	9/4	20	33.0	17.3	38.6	--	28.5
NDSU	ND17009GT	GT	00.9	9/7	22	35.5	17.4	45.2	48.8	34.4
Peterson	22XF03	RR2XF	0.3	9/12	29	34.9	16.5	52.7	--	40.9
REA	R0112XF	RR2XF	0.1	9/8	31	33.7	16.8	53.1	--	40.8
REA	RX00912	RR2X	00.9	9/4	23	33.9	16.6	39.4	--	32.1
REA	RX0411	RR2X	0.4	9/12	31	33.5	16.4	53.2	56.1	43.0

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant

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).

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 - RR2X, RR2XF, Enlist, and GT, Nelson County 2021 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity date ³	Plant Height (in)	Protein (%)	Oil (%)	Yield		
								2021	2-yr Avg.	2-site Avg. ⁴
Stine	002EE06	Enlist	00.6	9/3	16	33.0	16.5	29.4	--	18.2
Stine	01EA63	Enlist	0.0	9/7	21	33.2	16.7	46.0	51.4	35.5
Stine	01EE03	Enlist	0.1	9/12	24	33.6	16.9	53.0	--	40.6
Stine	03EB02	Enlist	0.2	9/9	23	32.3	16.6	53.6	--	40.4
Syng NK	NK009-T1XF	RR2XF	00.9	9/6	25	33.0	16.9	51.3	--	38.2
Syng NK	S01-C4X	RR2X	0.1	9/6	27	32.9	16.7	50.0	54.3	38.5
Syng NK	S04-Q7X	RR2X	0.4	9/13	23	35.1	15.7	55.4	57.9	43.5
Thunder	SB8001	RR2X	0.1	9/8	20	34.2	17.0	49.2	53.8	36.9
Thunder	SB8104N	RR2X	0.4	9/12	23	33.2	16.7	55.7	59.6	43.0
Thunder	SB87009	RR2X	00.9	9/8	23	35.0	15.7	48.2	--	36.7
Thunder	SB8903N	RR2X	0.3	9/13	27	32.7	16.2	57.5	57.3	44.5
Thunder	TX82008N	RR2XF	00.8	9/8	22	34.6	16.8	46.6	--	35.1
Trial Mean				9/10	24	33.6	16.6	50.7		
C.V. %				1.1	7.9	1.8	1.9	6.2		
LSD 5%				1.2	1.7	1.2	0.6	2.7		
LSD 10%				1.0	1.4	1.0	0.5	2.3		

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant

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).

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 - RR2X, RR2XF, Enlist, and GT, Pembina County 2021 (page 1 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity date ³	Plant Height (in)	Protein (%)	Oil (%)	Yield		
								2021	2 yr Avg.	2-site Avg. ⁴
BioGene	BG8000	RR2X	00.9	9/6	26	32.0	17.3	49.5	52.7	54.5
BioGene	BG8006	RR2X	00.6	8/30	23	32.3	17.4	42.3	--	51.8
BioGene	BG9021E3	Enlist	0.2	9/13	23	32.3	16.1	44.8	--	53.6
Dahlman	1102E3N	Enlist	0.2	9/11	25	32.3	16.5	47.6	55.3	56.9
Dahlman	1201E3N	Enlist	0.1	9/12	23	32.6	16.3	44.7	--	54.6
Dyna-Gro	S009XF52	RR2XF	00.9	8/31	24	31.8	17.6	37.1	--	46.5
Dyna-Gro	S009XT68	RR2X	00.9	9/4	24	32.8	16.3	51.1	58.2	57.2
Dyna-Gro	S02EN71	Enlist	0.2	9/12	25	32.1	17.0	49.2	--	58.4
Golden H.	GH00833E3	Enlist	00.8	9/7	23	31.1	17.0	42.4	50.6	54.1
Golden H.	GH00982XF	RR2XF	00.9	9/5	23	32.8	16.7	44.1	--	53.6
Golden H.	GH0272XF	RR2XF	0.2	9/10	24	31.5	17.2	51.7	--	55.4
Innvictis	A00918X	RR2X	00.9	9/4	24	33.6	16.5	42.3	--	51.5
Innvictis	A00979X	RR2X	00.9	9/11	23	32.9	16.9	45.4	--	56.0
Integra	40089N	Enlist	00.8	9/6	24	32.0	17.2	43.1	52.7	54.0
Integra	50081N	RR2X	00.8	8/31	24	34.4	16.3	35.8	47.2	44.3
Legacy	LS-00639N RR2X	RR2X	00.6	8/31	24	31.6	17.2	37.6	47.9	48.5
Legacy	LS0094-21 XF	RR2XF	00.9	8/30	23	31.4	17.8	38.9	--	45.7
Legacy	LS-00930 RR2X	RR2X	00.9	9/10	21	32.5	16.8	50.3	55.0	56.8
Legacy	LS012-20E	Enlist	0.1	9/11	22	32.4	16.4	46.5	54.6	53.8
Legacy	LS012-21E	Enlist	0.1	9/14	22	32.3	17.1	50.7	--	58.7
Legacy	LS-0239N RR2X	RR2X	0.2	9/11	26	31.7	16.5	54.4	58.8	60.5
LG Seeds	LGS00663RX	RR2X	00.6	8/31	23	32.1	16.9	42.0	51.2	51.9
LG Seeds	LGS00838XF	RR2XF	00.8	9/5	24	32.3	17.1	40.5	--	49.2
LG Seeds	LGS0111RX	RR2X	0.1	9/11	26	32.7	16.5	49.3	53.6	58.3
NDSU	21ND008GT20	GT	00.8	9/3	24	32.5	17.1	41.1	--	50.3
NDSU	ND17009GT	GT	00.9	9/9	24	34.2	16.8	41.4	48.2	48.8
P3 Genetics	2002E	Enlist	0.2	9/13	20	32.9	16.3	45.2	--	53.1
P3 Genetics	2201E	Enlist	0.1	9/15	22	32.6	16.9	51.5	--	56.0
Peterson	19EN008	Enlist	00.8	9/7	24	31.0	17.4	45.7	52.9	56.8
Peterson	21X007	RR2X	00.7	8/30	26	30.5	17.4	41.7	50.6	55.2

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant.

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).

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2X, RR2XF, Enlist, and GT, Pembina County 2021 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Plant Maturity date ³	Plant Height (in)	Protein (%)	Oil (%)	Yield		
								2021	2 yr Avg.	2-site Avg. ⁴
Peterson	22XF009	RR2XF	00.9	9/1	26	32.0	17.0	41.4	--	48.0
Pioneer	P009T18E	Enlist	00.9	9/7	23	31.6	17.6	43.3	--	53.0
Pioneer	P00A49X	RR2X	0.0	9/7	26	32.8	16.9	46.1	51.7	54.3
Pioneer	P01T92E	Enlist	0.1	9/11	21	31.0	17.9	37.9	--	49.5
Pioneer	P03A17X	RR2X	0.2	9/12	24	31.2	17.7	48.9	53.1	--
Pioneer	P03A26X	RR2X	0.3	9/15	27	31.1	17.2	54.3	53.1	--
Pioneer	P03T87E	Enlist	0.3	9/14	20	31.2	16.6	43.3	--	--
REA	R0112XF	RR2XF	0.1	9/11	28	32.7	17.0	47.6	--	58.0
REA	RX00912	RR2X	00.9	9/5	22	32.2	16.9	43.9	--	51.7
Stine	002EE06	Enlist	00.6	8/25	20	32.5	17.1	26.5	--	37.0
Stine	01EA63	Enlist	0.0	9/11	21	32.4	16.4	42.8	--	55.2
Stine	01EE03	Enlist	0.1	9/13	22	32.7	16.9	50.7	--	57.4
Stine	03EB02	Enlist	0.2	9/11	23	31.7	16.7	46.4	--	54.6
Syng NK	NK009-T1XF	RR2XF	00.9	9/5	23	31.9	17.3	46.3	--	54.8
Syng NK	S006-R7X	RR2X	00.6	8/29	22	31.8	17.9	43.1	--	52.1
Syng NK	S008-E3	Enlist	008	9/8	25	31.9	17.0	49.9	57.5	57.1
Thunder	SB8001	RR2X	0.1	9/11	22	34.3	16.6	48.2	54.8	55.0
Thunder	SB81006	RR2X	00.6	8/30	24	30.5	17.5	40.7	51.7	48.7
Thunder	SB87009	RR2X	00.9	9/5	24	33.2	16.0	46.2	51.8	54.2
Thunder	SB88007N	RR2X	00.7	9/1	24	31.8	17.3	42.5	47.8	51.4
Thunder	TE71008N	Enlist	00.8	9/8	24	31.3	17.0	48.2	55.2	55.0
Thunder	TX82008N	RR2XF	00.8	9/5	22	32.0	17.3	45.9	--	54.5
Trial Mean				9/7	23	32.2	17.0	44.8		
C.V. %				1.3	6.7	2.0	2.0	7.4		
LSD 5%				1.3	1.3	1.3	0.7	2.8		
LSD 10%				1.1	1.1	1.1	0.6	2.4		

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant.

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).

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2X, RR2XF, Enlist, and GT, Walsh County 2021 (page 1 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Maturity date ³	Plant Height (in)	Protein (%)	Oil (%)	Yield		
								2021	2 yr Avg.	2-site Avg. ⁴
								----- bu/a -----		
BioGene	BG8000	RR2X	00.9	9/3	17	30.2	19.1	27.1	46.7	--
BioGene	BG8006	RR2X	00.6	8/31	18	31.1	18.3	23.5	--	--
BioGene	BG9021E3	Enlist	0.2	9/9	17	31.7	17.4	26.0	--	--
Dahlman	6004XN	RR2X	0.4	9/15	19	32.8	17.4	32.8	52.9	45.2
Dahlman	7203XF	RR2XF	0.3	9/7	22	32.5	17.7	30.6	--	42.7
Dyna-Gro	S02EN71	Enlist	0.2	9/14	16	33.0	17.3	24.5	51.2	37.0
Dyna-Gro	S04XF32	RR2XF	0.4	9/13	22	32.4	17.5	34.7	--	44.3
Dyna-Gro	S04XT91	RR2X	0.4	9/14	18	31.9	17.7	33.4	53.2	44.2
Golden H.	GH0272XF	RR2XF	0.2	9/9	19	32.2	18.2	30.1	--	37.2
Golden H.	GH0325E3	Enlist	0.3	9/9	19	31.1	17.9	31.2	53.5	38.3
Golden H.	GH0452E3	Enlist	0.4	9/13	19	34.3	17.3	26.3	--	40.1
Innvictis	A0338X	RR2X	0.3	9/8	18	32.0	16.9	32.2	--	43.5
Innvictis	B0330E	Enlist	0.3	9/14	18	32.6	17.9	26.1	--	37.7
Integra	40201N	Enlist	0.2	9/14	18	32.5	17.8	28.8	51.2	41.3
Integra	40300N	Enlist	0.3	9/9	19	32.1	17.4	27.9	--	40.3
Integra	50309N	RR2X	0.3	9/9	18	32.9	16.4	30.2	49.9	43.6
Legacy	LS-00930 RR2X	RR2X	00.9	9/7	16	33.4	17.7	22.5	--	35.0
Legacy	LS012-21E	Enlist	0.1	9/9	20	32.8	17.4	37.2	--	46.1
Legacy	LS-0239N RR2X	RR2X	0.2	9/10	18	30.6	17.6	23.3	48.4	39.4
Legacy	LS-0320E	Enlist	0.4	9/14	20	32.3	17.4	29.7	52.2	38.2
Legacy	LS042-21E	Enlist	0.4	9/13	19	33.0	17.3	28.8	--	40.9
Legacy	LS-0429	Enlist	0.4	9/15	20	34.1	17.4	26.6	--	38.2
LG Seeds	LGS00663RX	RR2X	00.6	9/1	17	31.5	17.9	24.4	47.8	34.1
LG Seeds	LGS00838XF	RR2XF	00.8	9/6	20	33.3	17.5	23.3	--	34.5
LG Seeds	LGS0111RX	RR2X	0.1	9/9	22	33.4	17.7	28.0	49.2	41.8
LG Seeds	LGS0355RX	RR2X	0.3	9/10	18	31.5	17.7	29.7	46.5	41.8
LG Seeds	LGS0400RX	RR2X	0.4	9/13	21	30.9	17.7	33.3	55.1	47.5
NDSU	21ND008GT20	GT	00.8	8/31	17	32.1	17.8	18.5	--	28.5
NDSU	ND17009GT	GT	00.9	9/5	18	33.2	18.2	23.6	44.5	34.4
Peterson	22XF03	RR2XF	0.3	9/7	21	32.0	18.1	29.1	--	40.9

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant.

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).

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

Yield reported at 13% moisture.

Soybean - RR2X, RR2XF, Enlist, and GT, Walsh County 2021 (page 2 of 2)

Brand	Variety	Herb. Trait ¹	Maturity Group ²	Maturity	Plant Height	Protein	Oil	2021	2 yr Avg.	2-site Avg. ⁴
				date ³	(in)	(%)	(%)	----- bu/a -----		
Pioneer	P00A49X	RR2X	0.0	9/5	20	32.3	18.4	27.5	--	--
Pioneer	P01A84X	RR2X	0.1	9/10	19	32.5	17.8	27.2	48.5	--
Pioneer	P01T92E	Enlist	0.1	9/7	17	31.0	18.6	22.6	--	--
Pioneer	P03A17X	RR2X	0.2	9/10	19	31.4	18.5	29.7	48.4	--
Pioneer	P03A26X	RR2X	0.3	9/11	21	32.3	17.4	28.5	49.0	--
Pioneer	P03T87E	Enlist	0.3	9/16	18	34.0	17.1	28.1	--	--
Proseed	EL90-33N	Enlist	0.3	9/8	18	31.6	17.3	27.8	--	--
Proseed	XT20-07	RR2X	00.7	8/31	18	30.3	18.6	20.6	46.1	--
Proseed	XT20-40	RR2X	0.4	9/14	18	33.0	17.2	29.3	--	--
Proseed	XT80-20N	RR2X	0.2	9/9	18	32.4	16.8	29.7	--	--
REA	R0112XF	RR2XF	0.1	9/7	23	31.4	18.5	28.4	--	40.8
REA	RX00912	RR2X	00.9	9/3	18	30.3	18.5	24.7	--	32.1
REA	RX0411	RR2X	0.4	9/13	22	30.7	18.0	32.8	54.7	43.0
Stine	002EE06	Enlist	00.6	8/28	16	32.8	17.6	7.0	--	18.2
Stine	01EA63	Enlist	0.0	9/10	18	32.9	17.1	25.0	--	35.5
Stine	01EE03	Enlist	0.1	9/12	20	32.4	17.9	28.2	--	40.6
Stine	03EB02	Enlist	0.2	9/10	17	30.9	17.6	27.2	--	40.4
Syng NK	NK009-T1XF	RR2XF	00.9	9/6	19	32.4	18.4	25.0	--	38.2
Syng NK	NK04-G8E3	Enlist	0.4	9/14	18	35.0	17.1	24.7	--	--
Syng NK	S008-E3	Enlist	008	9/3	20	31.6	18.0	25.6	--	--
Syng NK	S01-C4X	RR2X	0.1	9/8	19	32.7	17.3	27.0	49.5	38.5
Syng NK	S04-Q7X	RR2X	0.4	9/15	19	34.9	16.9	31.6	--	43.5
Thunder	SB8001	RR2X	0.1	9/8	17	33.4	17.6	24.6	52.4	36.9
Thunder	SB8104N	RR2X	0.4	9/14	18	31.5	17.1	30.2	53.3	43.0
Thunder	SB87009	RR2X	00.9	9/4	19	32.7	17.2	25.1	--	36.7
Thunder	SB8903N	RR2X	0.3	9/8	19	31.1	17.2	31.5	48.7	44.5
Thunder	TX82008N	RR2XF	00.8	9/6	19	32.4	18.2	23.6	--	35.1
Trial Mean				9/9	19	32.3	17.6	27.3		
C.V. %				1.1	7.6	--	--	9.5		
LSD 5%				1.1	1.2	--	--	2.2		
LSD 10%				0.9	1.0	--	--	1.9		

¹Herbicide Trait - RR2X, RR2XF=Xtend + Flex (Liberty Link), Enlist=Enlist E3, GT=Glyphosate Tolerant.

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).

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

Yield reported at 13% moisture.

Soybean - Conventional, Langdon 2021

Brand	Variety	Maturity Group ¹	Maturity date ²	Plant Height (in)	Protein (%)	Oil (%)	Yield	
							2021	2-yr Avg. ³
Conventional:								
Legacy	LS0090-20	00.9	9/7	25	35.7	16.2	49.9	51.0
Legacy	LS020-20	0.2	9/10	34	32.8	15.9	50.2	51.5
Legacy	LS004-21	00.4	9/5	32	32.4	17.6	43.5	30.6
Legacy	LS005-21	00.5	9/3	27	39.8	14.8	43.6	31.5
Legacy	LS006-21	00.6	9/5	29	34.0	16.2	51.3	36.6
Prograin	Liska	00.3	9/7	26	35.9	15.6	51.3	--
Prograin	Maya	00.7	9/7	26	36.2	14.7	48.8	47.9
Prograin	Hana	0.1	9/11	27	35.9	15.9	53.7	51.5
Richland	MK0249	0.2	9/13	24	32.2	15.8	49.3	45.4
Richland	EXP009*	0.2	9/13	27	31.3	16.0	47.0	--
Sevita	Astor	0.3	9/11	29	34.4	16.7	53.8	50.3
NDSU	ND Rolette	00.9	9/10	27	32.0	16.8	58.4	54.0
NDSU	ND Benson	0.4	9/18	30	33.0	16.3	52.6	49.6
Roundup Ready Check Varieties:								
	RR2X Check #1	00.5	9/4	25	31.4	16.4	53.1	50.7
	RR2Y Check #2	00.9	9/10	28	32.7	16.2	60.2	59.2
	RR2Y Check #3	00.8	9/8	26	31.7	15.8	53.8	54.2
Trial Mean								
C.V. %								
LSD 5%								
LSD 10%								

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).

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

*All varieties are commercially available except Richland EXP009 is an experimental.

Yield, oil and protein reported at 13% moisture.

Soybean - Conventional, Walsh County 2021

Brand	Variety	Maturity		Plant		Oil (%)	Protein (%)	Shatter ⁴ (0-9)	2021 Yield	2-yr Avg. Yield ³ (bu/a)
		Group ¹	date ²	Height (in)	Maturity					
Conventional:										
Legacy	LS0090-20	00.9	8/31	16	8/31	17.6	34.8	0	22.7	39.1
Legacy	LS020-20	0.2	9/2	20	9/2	18.0	32.8	1	24.6	42.0
Legacy	LS004-21	00.4	8/29	22	8/29	18.9	33.3	3	17.8	--
Legacy	LS005-21	00.5	8/30	16	8/30	15.7	39.7	4	19.3	--
Legacy	LS006-21	00.6	8/29	17	8/29	18.3	33.3	1	21.9	--
Legacy	LS040-21	0.4	9/5	21	9/5	17.0	34.7	0	29.0	--
NDSU	ND Rolette	00.9	9/6	16	9/6	18.7	32.1	0	26.5	48.0
NDSU	ND Benson	0.4	9/14	18	9/14	17.4	34.7	0	35.8	48.5
Richland	MK0249	0.2	9/8	17	9/8	17.4	32.1	0	28.3	41.7
Richland	EXP009*	0.2	9/8	18	9/8	16.7	32.9	0	24.4	--
Sevita	Astor	0.3	9/8	17	9/8	18.0	35.2	1	26.4	44.1
Roundup Ready Check Varieties:										
	RR2X Check #1	00.5	8/31	18	8/31	18.2	31.8	0	29.1	47.1
	RR2Y Check #2	00.9	9/6	20	9/6	17.7	32.1	0	34.4	55.6
	RR2Y Check #3	00.8	8/31	17	8/31	18.0	31.4	1	27.1	46.8
Trial Mean			9/4	18	9/4	18.0	33.2	1	27.0	
C.V. %			0.7	6.8	0.7	1.8	2.2	45.5	6.4	
LSD 5%			0.7	1.1	0.7	0.7	1.5	0.2	1.7	
LSD 10%			0.6	0.9	0.6	0.6	1.3	0.2	1.4	

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).

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

⁴Relative Rating 0-9, just prior to harvest.

*All varieties are commercially available except Richland EXP009 is an experimental.

Yield, oil and protein reported at 13% moisture.

Hemp, Langdon 2021

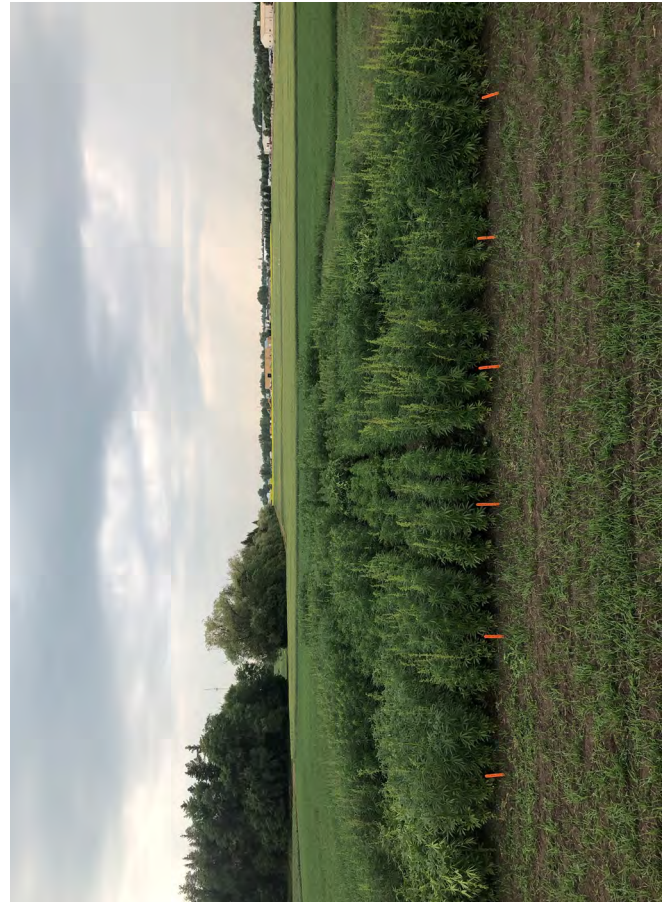
Company ¹	Variety	Plant Stand (ft ²)	PLSE ² (%)	Seedling Mortality (%)	Plant Height (in)	Test Weight (lbs/bu)	1000 KWT (g)	Oil ³ (%)	Grain Yield			
									2019	2020	2021	5 yr. Avg.
HGI	CFX-2	9.8	62	39	43	42.0	42.0	35.2	1361	1440	1312	1418
HGI	CRS-1	9.0	57	44	56	42.1	42.1	34.9	1400	1535	1319	1456
HGI	Katani	11.4	71	29	40	42.4	42.4	34.6	1151	1419	1266	1364
PIHG	Canda	9.4	59	41	58	41.4	41.4	33.0	1361	1461	1280	1382
PIHG	Joey	9.6	60	40	55	41.6	41.6	33.1	1190	1307	1185	1316
Trial Mean		9.8	62	38	50	41.9	41.9	34.2	1293	1179	1272	
C.V. %		12.1	12.1	19.5	6.7	0.6	0.6	1.2	11.8	13.6	8.2	
LSD 5%		NS	NS	NS	5.2	0.4	0.4	0.6	218	232	NS	
LSD 10%		NS	NS	NS	4.2	0.3	0.3	0.5	182	193	NS	

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

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.



Soybean Response to Row Spacing and Planting Rate, 2021

NDSU Langdon Research Extension Center

Bryan Hanson, Lawrence Henry, Jewel Faul

A field trial was conducted at the NDSU Langdon Research Extension Center to examine the response of soybean to row spacing and planting rate in northeast North Dakota. Experimental design was a randomized complete block split plot (whole plots = row spacing, sub-plot = planting rate) with four replications. A RR2X 00.7 maturity variety was planted on May 26 on a conventionally tilled Svea-Barnes loam soil in 24, 12 and 6-inch rows with planting rates of 125,000, 150,000, 175,000 and 200,000 pure live seeds (PLS)/acre. Harvest date was September 24.

There was no significant row spacing by planting rate interactions or significant responses to row spacing among the agronomic traits (Table 1). Plant stand and yield were the only traits that had significant responses to planting rate (Table 2). Plant stands increased with planting rates and had a 20 percent average mortality for each planting rate. The 200,000 PLS/a planting rate had the highest yield with no difference between the 125,000 to 175,000 PLS/a planting rate. No visual differences were observed in the trial for lodging or plant maturity.

Previous research on soybean response to planting rates and row spacings across North Dakota (NDSU Extension publication A1961, June 2020) indicated that in eastern North Dakota row spacing of 15 inches or less at a planting rate of about 170,000 PLS/a provided optimum yields. Seedling mortality averaged 8% across the various research trials. Yields averaged about 107 percent of the mean at 6-7 inch rows and 97 percent of the mean at 22-24 inch rows. Drier soil conditions at planting for this study may have increased seedling mortality and resulted in no significant differences in yield among row spacings.

Table 1. Soybean response to row spacing averaged over planting rates.

Row Spacing	Plant Stand	PLSE ¹	Seedling Mortality	Protein	Oil	Test Weight	Yield
inches	plt/a	%	%	%	%	lbs/bu	bu/a
6	130,831	81	19	31.7	16.5	57.1	43.1
12	131,690	81	19	31.8	17.0	57.1	46.9
24	131,690	81	19	31.6	16.8	57.0	44.2
LSD 5%	NS	NS	NS	NS	NS	NS	NS
C.V. %	8.3	6.5	27.6	1.1	1.5	0.4	8.6

¹Pure live seed emergence

Table 2. Soybean response to planting rate averaged over row spacings.

Planting Rate	Plant Stand	PLSE ¹	Seedling Mortality	Protein	Oil	Test Weight	Yield
pls/acre	plt/a	%	%	%	%	lbs/bu	bu/a
125,000	102,208	82	18	31.5	16.6	57.1	42.9
150,000	120,082	78	22	31.7	16.7	57.0	44.6
175,000	142,080	82	18	31.7	16.6	57.0	43.9
200,000	161,242	82	18	31.9	16.6	57.0	47.6
LSD 5%	9135	NS	NS	NS	NS	NS	3.2

¹Pure live seed emergence

Pinto Bean Response to Row Spacing and Plant Population, 2021

NDSU Langdon Research Extension Center

Bryan Hanson, Lawrence Henry and Jewel Faul

A 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 26 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 65,000, 85,000, and 105,000 pure live seeds/acre to establish targeted stands of 50,000, 70,000 and 90,000 plants/acre, respectively. No diseases were observed in the trial during the growing season. The trial was direct harvested with a plot combine on September 23.

There was no significant row spacing by planting rate interactions among the agronomic traits. Averaged across planting rates, plant stand, PLSE and seedling mortality were similar among row spacing (Table 1). Test weight and 100 KWT had small but significant differences between row spacings. The 30-inch row spacing yielded significantly lower than the 18-in or paired 6-inch row spacings.

Ratio of established plants compared to planting rates was 86, 78 and 78 percent, for 65,000, 85,000 and 105,000 planting rates, respectively (Table 2). This lower percentage may have been due to drier seedbed conditions and interplant competition at the higher planting rates. No differences were observed in 100 KWT or test weight among planting rates. Yield increased with increasing planting rates with a significant difference between the 65,000 and 105,000 planting rates. No practical visual differences were observed in the field for lodging, plant height, or days to mature.

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

Row Spacing	Plant Stand	PLSE ¹	Seedling Mortality	100 KWT	Test Weight	Yield
inches	plt/a	%	%	g	lbs/bu	lbs/a
30	67,166	80	20	37.9	58.4	983
18	67,588	83	17	38.0	58.2	1638
paired 6	69,528	80	20	36.4	59.3	1421
LSD (0.05)	NS	NS	NS	0.6	0.5	379
CV (%)	7.4	7.4	31.0	4.5	1.2	10.9

¹Pure live seed emergence

Table 2. Pinto Bean response to planting rate averaged over row spacings.

Planting Rate	Plant Stand	PLSE ¹	Seedling Mortality	100 KWT	Test Weight	Yield
pls/acre	plt/a	%	%	g	lb/bu	lbs/a
65,000	55,789	86	14	37.6	58.7	1262
85,000	66,307	78	22	37.6	58.7	1336
105,000	82,186	78	21	37.1	58.6	1444
LSD (0.05)	4344	5.1	5.1	NS	NS	126

¹Pure live seed emergence

Field Pea and Canola Intercropping Trial, 2021

NDSU Langdon Research Extension Center

Bryan Hanson, Lawrence Henry, Jewel Faul

Intercropping is the production practice of growing two or more crops together at the same time. The concept of “peola”, intercropping peas and canola, has been around Canada for decades. This concept is also being researched in North Dakota, as peas and canola have significant acres in various parts of the state. Intercropping provides several potential benefits including a more competitive crop for weed management, fewer insect pests, better fertility and water utilization, reduced soil erosion, improved crop harvestability and an increase in crop production compared to monocropping. Despite these benefits come challenges such as aligning maturities of the different crops, weed control, mechanical limitations, economic costs to separate the different crop types from one another, and insurance or program restrictions. In an intercropping system each individual crop will yield less than if the crop were grown alone. The potential benefit will be that the total yield will be greater than if the crops were grown as monocrops. Land Equivalent Ratio (LER) is a measure of the yield advantage gained by growing an intercrop compared to growing the same crops as a monocrop and is calculated as the ratio of land under monocropping vs intercropping. Total LER is the sum of each individual crop and will be a number >1. For example, a LER of 1.15 means it would take 15 percent more land to equal the intercrop yield if each crop was grown alone.

A field pea and canola intercropping trial was initiated to determine the optimum seeding ratios of these two crops to attain maximum LER. The 100% monocrop seeding rate for peas was 325,000 pure live seed (PLS)/a (7.5 seeds/ft²) and 522,000 PLS/a (12 seeds/ft²) for canola. The ratios for field pea at 66, 50, and 33% were 5.0, 3.7, and 2.4 seed/ft², respectively. The ratios for canola were 8, 6, and 4 seeds/ft² for 66, 50 and 33%, respectively. The trial was planted May 24 on conventionally tilled Svea-Barnes loam soil in 6-inch row spacing. The soil test for N-P-K was 55-10-260. Fertilizer added to the site included 100 lbs/a each of 11-52-0 and 0-0-60, and 76 lbs/a of 46-0-0. Granular inoculum was applied in furrow. A semi-leafless yellow pea and Clearfield canola variety were used. Trifluralin was applied PPI at 1 qt/a for weed control. The field design was a randomized complete block with four replications.

Intercropping spring stand, yield, LER and economic returns are presented in Table 1. Plant stands decreased with the corresponding reduction in seed ratios for each crop. Spring plant stands for monocrop pea and canola had a percent emergence of 92 and 68, respectively. Percent emergence at each ratio was similar to the monocrop ranging from 62 to 72 percent for canola and less for pea at 61 to 81 percent (data not shown). Pea and canola yields were the highest for the 100% monocrop. Average yield of the various seeding ratios for pea decreased by 69% compared to 100% monocrop while yield for the various ratios for canola decreased only 24% compared to the 100% monocrop canola. The individual LER's for the peas was much lower than the canola indicating that canola was the dominant crop in this study. No significant differences were seen between the total LER's indicating that no benefit was seen from combining these crops in an intercropping system. Previous pea-canola intercropping research in North Dakota and Canada has generally indicated LER's ranging from 1.05 to 1.25. Economic

returns increased slightly compared to monocrop values alone, but does not include cost of production and additional seed cleaning costs associated with intercrops, which would result in lower net revenue.

Table 1. Pea – Canola intercropping spring stand, yield, LER and gross revenue.

Pea/Canola Seeding Ratio	Spring Stand		Yield		Land Equivalent Ratio		Gross Economic Returns		
	Pea	Canola	Pea	Canola	Pea	Canola	Pea	Canola	Gross Revenue
	plants/ft ²		bu/a	lbs/a			-----	-----	-----
100/0	6.9	-	43.6	-	1	-		659	659
0/100	-	8.2	-	1847	-	1		-	675
66/66	4.0	5.8	12.6	1392	0.29	0.75	195	470	665
33/66	1.8	5.6	6.3	1694	0.14	0.92	98	605	703
50/50	2.7	4.2	12.4	1459	0.28	0.79	192	521	713
66/33	3.7	2.6	14.2	1346	0.33	0.73	220	481	701
100/33	4.6	2.5	21.1	1065	0.49	0.56	327	380	707
LSD (0.05)	1.4	1.9	3.9	233	0.08	0.13			NS
C.V. %	24.1	25.6	14.0	10.5	13.2	10.8			7.3

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 (FHB) 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 4, 2021. 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: Wide Match (1.33 pt/a) + Axial Bold (15 fl oz/a) + 2, 4-D Amine (1 pt/a) applied on June 4, 2021.

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

Disease development: Supplemental moisture was provided by running overhead irrigation from boot 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 water volume at 20 GPA. Fungicide (Miravis Ace) application was made at full head emergence on June 25. Miravis Ace, Prosaro, Sphaerex and Caramba were applied at 10% flowering (anthesis or 10.5.1 stage) on June 30 and 5 days after anthesis sprays were done on July 5. Refer to Table 1 for the treatments, rates and application timings.

Disease assessment: FHB incidence was obtained on 50 random heads showing FHB symptoms at hard dough stage. FHB head severity was rated using 0 -100% scale on 50 random 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 2 with a small plot combine and the yield was determined at 13.5% moisture.

Data analysis: Statistical analysis was done using Agrobases Generation II software. Fisher's least significant difference (LSD) was used to compare means at $p (\alpha = 0.05)$.

Results: There were significant differences found between the non-treated check and the fungicide applied treatments at different timings among the variables tested except yield. However, there were no significant differences found among the application timings or the fungicides tested (Table 1).

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 (bu/a)	Test Weight (lbs/bu)
		Incidence (%)	Severity (%)	INDEX (0-100)	DON (ppm)		
Non-Treated Control	0	16	14.6	2.21	0.53	39	60
PROSARO	6.5	7	5.3	0.37	0.15	41	59
CARAMBA	13.5	6.5	4.9	0.34	0.16	41	60
MIRAVIS ACE@ FULLHEAD	13.7	5.5	3.9	0.22	0.18	45	59
MIRAVIS ACE@ 10.5.1	13.7	4.5	2.8	0.15	0.05	44	60
MIRAVIS ACE@ 5 DAYS AFTER 10.5.1	13.7	3	2.1	0.07	0.09	41	59
MIRAVIS ACE@10.5.1+PROSARO@5 Days After	13.7 + 6.5	0.5	0.4	0.01	0.03	42	60
MIRAVIS ACE@10.5.1+ CARAMBA@5 Days After	13.7 + 13.5	2	1.4	0.04	0.06	45	60
MIRAVIS ACE@10.5.1+ TEBUCONAZOLE@5 Days After	13.7 + 4	5	2.8	0.24	0.07	45	60
SPHAEREX@ 10.5.1	7.3	10	5.3	0.72	0.28	38	59
PROSARO Higher Rate @ 10.5.1	8.2	6	4.6	0.37	0.28	45	60
Mean		6	4.4	0.43	0.17	42	59.58
CV (%)		65	72	108	71	11.6	1.01
LSD		5.7	4.5	0.67	0.17	NS	0.86
P-Value (0.005)		0.0006*	0.0001	.0001*	0.0001*	NS	0.0143*

* Indicates treatments are statistically significant.

Note: All treatments were applied with non-ionic surfactant (NIS) @ 0.125 v/v.

Funded by: This irrigated trial was funded by the US Wheat and Barley Scab Initiative.



Management of Bacterial Blight in Field Pea Using Pesticide Compounds

Venkat Chapara and Amanda Arens

A research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of pesticide compounds to manage bacterial blight (BB) on field pea. The trial was planted on May 12, 2021 with the field pea variety ‘Salamanca’ 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 field pea border on either side of each plot. Pesticide compounds were applied at the Vn stage (nth true leaf unfolded at nth node with tendril present) using a CO₂-pressurized backpack style sprayer with a three-nozzle boom (XR-8002) at 20 GPA. Prevailing weather conditions were dry during the crop growth period so the second spray at R-stage was not applied. The amount of BB infection obtained in the research plots was based on natural infections. A rating scale of 0 – 9 was adopted from Chaudhary 1996, where the severity of BB in a plot was recorded as the percentage of tissue area infected out of total leaf area examined. Fifty leaves from each plot were sampled and measured for the average percentage of lesion area. The rating scale was 0 = 0, 1 = >1-10 %, 3 = >11-30 %, 5 = >31-50 %, 7 = >51-75 %, and 9 = >76-100.

A Disease Index (DI) was calculated based on severity ratings using a formula:

$$DI = \frac{n(1) + n(3) + n(5) + n(7) + n(9)}{tn}$$

Where: n (1), n (3), n (5), n (7) and n (9) = Number of leaves showing severity score of 1, 3, 5, 7 and 9. tn = Total number of leaves scored

Results: Dry weather during the major part of the growth stages influenced bacterial blight incidence on field pea (Figure 1). There were no significant differences in the bacterial blight index (average ranged from 0.1 to 0.2 which was less than 1% of bacterial blight severity on the total rated leaves), yield (at 13.5% moisture), and test weight (Table 1) among the pesticide compounds tested and the non-treated check (p-value non-significant).

Figure 1: Low levels of bacterial blight infections observed on lower leaves of field pea plants.



Table 1: Efficacy of pesticide compounds in managing bacterial blight of field pea and their influence on yield and test weight.

Treatments	Rate	Bacterial Blight	Yield	Test Weight
		DI (1-9)*	(bu/a)	(lbs/bu)
Kocide (Copper Hydroxide)	5 lbs/a	0.1	59	65
Copper Sulfate	5 lbs/a	0.2	58	65
Guarda	3.3 liters/a	0.2	63	65
Zinc Oxide	400 ppm	0.1	63	65
Zinx Oxide	800 ppm	0.2	59	65
Surround WP	10 lb/a	0.1	65	65
Resozurin Sodium Salt	10 mg/a	0.2	61	65
Kanamycin	50 ppm	0.2	59	65
Streptomycin sulfate	200 ppm	0.1	59	65
Oxidate	1% V/V	0.2	56	65
Non-Treated Check	CHK	0.1	57	65
Mean		0.14	60	65
CV%		46	11	0.51
LSD		NS	NS	NS
P-Value (0.05)		NS	NS	NS

* DI = Disease Index

NS: Non-significant

Reference: Chaudhary, R. C. 1996. Internationalization of elite germplasm for farmers: Collaborative mechanisms to enhance evaluation of rice genetic resources. Paper presented in: MAFF, International workshop on genetic resources held in Fukuyi, Japan Oct.22-24, 1996; pp. 221. [The 4th MAFF International Workshop on Genetic Resources: Characterization and Evaluation - New Approach for Improved Use of Plant Genetic Resources \(affrc.go.jp\)](http://www.affrc.go.jp)

Acknowledgements: National Pulse Growers Association for funding this project.

Evaluation of Various Fungicide Treatments at Different Application Times on Two Cultivars of Barley

Venkat Chapara, Amanda Arens and Andrew Friskop

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 April 30, 2021. 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: Wide Match (1.33 pt/a) + Axial Bold (15 fl oz/a) and 2 4-D Amine (1 pt/a) on June 14, 2021.

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

Disease development: Supplemental moisture was provided for a month starting from boot to soft dough stage 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 June 25. Miravis Ace, Prosaro, and Caramba were applied at full head emergence stage on June 29 and repeated 5 days after the full head emergence (July 5) as per protocol requirements. Refer to Table 2 for the treatments, dosages and application timings.

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

Harvest: Plots were harvested on August 23 with a small plot combine and the yield was determined at 13.5% moisture.

Data analysis: Statistical analysis was done using Agrobases Generation II software. Fisher's least significant difference (LSD) was used to compare means at $p (\alpha = 0.05)$.

Results: There were no statistically significant differences found in any of the variables tested among the two barley cultivars (Table 1). However, there were significant differences in FHB incidence, severity, index, DON, and test weight observed between non-treated check and the fungicide treatments tested at different application stages (Table 2). There was no interaction effect found between the main plot (cultivars) and the subplot (fungicide) treatments.

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)	Plump (%)
	Incidence (%)	Severity (%)	Index	DON (ppm)			
ND Genesis	15	8	1.87	1.6	74	48	87
AAC Synergy	21	12	4.41	2.2	72	48	97
Mean	18	10	3.14	1.9	73	48	93
CV (%)	83	65	156	107	17	1	20
LSD	NS	NS	NS	NS	NS	NS	NS
P-Value (0.05)	NS	NS	NS	NS	NS	NS	NS

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 and their application timings	Rate (fl.oz/a)	Fusarium Head Blight				Yield (bu/a)	Test Weight (lbs/bu)	Plump (%)
		Incidence (%)	Severity (%)	INDEX (0-100)	DON (ppm)			
NON-INOCULATED, NON-TREATED	CHK	47	19	11.84	3.7	73	48	86
SPHAEREX@10.5.1	7.3	11	8	1.05	0.6	62	48	97
CARAMBA@10.5.1	13.5	20	11	2.63	2.4	74	48	96
MIRAVICE ACE@10.5.1	13.7	5	4	0.28	1.2	72	49	97
PROSARO@10.5.1	6.5	9	6	0.83	1.3	73	49	97
MIRAVIS ACE@10.5.1+TEBUCONAZOLE @5 DAYS AFTER INOCULATED, NON-TREATED	13.7 + 4	5	3	0.22	0.7	73	49	97
MIRAVIS ACE @HALFSPIKE	13.7	11	9	1.2	1.4	78	49	86
Mean		18	10	3.1	1.9	73	48.4	93
CV%		82.8	65	156	106.5	17.4	1.1	19
LSD		15	6	4.9	1.02	NS	0.53	NS
P-Value (0.05)		0.00001*	0.0001*	0.0001*	0.04*	NS	0.003*	NS

* Indicates treatments are statistically significant.

Note: All treatments were applied with non-ionic surfactant (NIS) @ 0.125 v/v.

Funded By: US Wheat and Barley Scab Initiative

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 27, 2021 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 mean disease severity index (MDS) 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 (oz/a)	White Mold		Yield (lbs/a)	Test Weight (lbs/bu)
		Incidence (%)	MDS (0-5)		
NON-TREATED CHECK	0	4	0.08	2622	52
PROLINE	5.7	2.5	0.07	2769	52
EXPERIMENTAL-1	8.2	6	0.11	2929	52
EXPERIMENTAL-2	10.9	5	0.11	3000	52
QUADRIS	15.5	5.5	0.13	3175	52
ENDURA	6	2	0.06	3084	52
INCOGNITO	1.6	5	0.15	3048	52
EXPERIMENTAL-3	12	4.5	0.07	3182	52
Mean		4.3	0.1	2977	52
CV%		112	133	10.5	0.5
LSD		NS	NS	NS	NS
P-Value (0.05)		NS	NS	NS	NS

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

NS: Statistically non-significant

Results: Dry weather played a role in low disease incidences of white mold in canola. No significant differences in white mold incidence, mean disease severity, test weight and yield were observed among the fungicides tested and the non-treated check (p-value non-significant).

Acknowledgements: Bryan Hanson, Carmen Ewert, and Lawrence Henry for their technical support.

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. Gongjun Shi, Dr. Zhaohui Liu, Dr. Luis del Rio, Dr. Chittem and Dr. Anitha Chirumamilla

Co-operators: Dante Marino and Amanda Arens

Take Home Message: An ongoing clubroot survey for over six 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 following 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. One field in every 5000 acres was targeted for scouting in each county. Soil samples were collected from fields to determine the pH of the soil and the number of resting spores per gram of soil. 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)

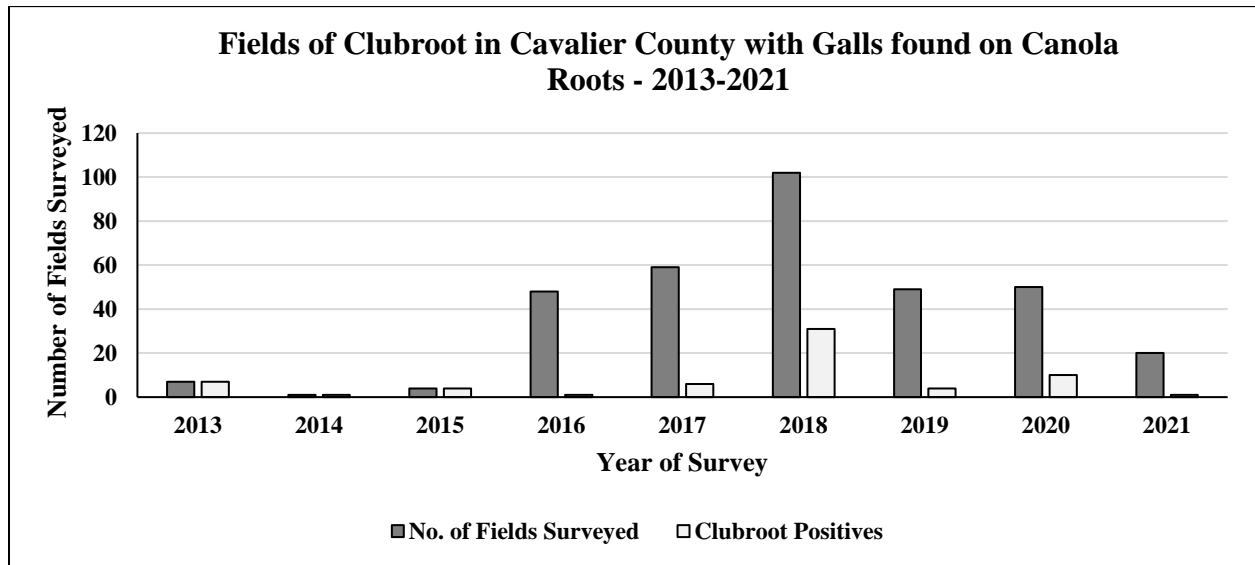
Plants were sampled from distinct stunted patches or prematurely senescing plants in the field during the growing season. Patches visible from the edge of the field were checked by digging and observing the roots for symptoms of clubroot and soil samples were collected from those spots.

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 probability of finding clubroot was higher if scouted at the field entrances. Hence, the survey was done starting from the main entrances/approaches in each field the survey group visited and walked in 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. Roots of 50 stems were evaluated for the presence of clubroot and incidence. After removing excess soil, 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. An additional half-pound of soil was sent to the NDSU Soil Testing Laboratory for pH determination.

Results: Over 49 counties in North Dakota were surveyed in 2021 for visual symptoms of galls on canola roots. Clubroot galls on canola roots were only found in 1 out of 20 fields surveyed in Cavalier County (Figure 1).

Figure 1: Fields surveyed from 2013 to 2021 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:

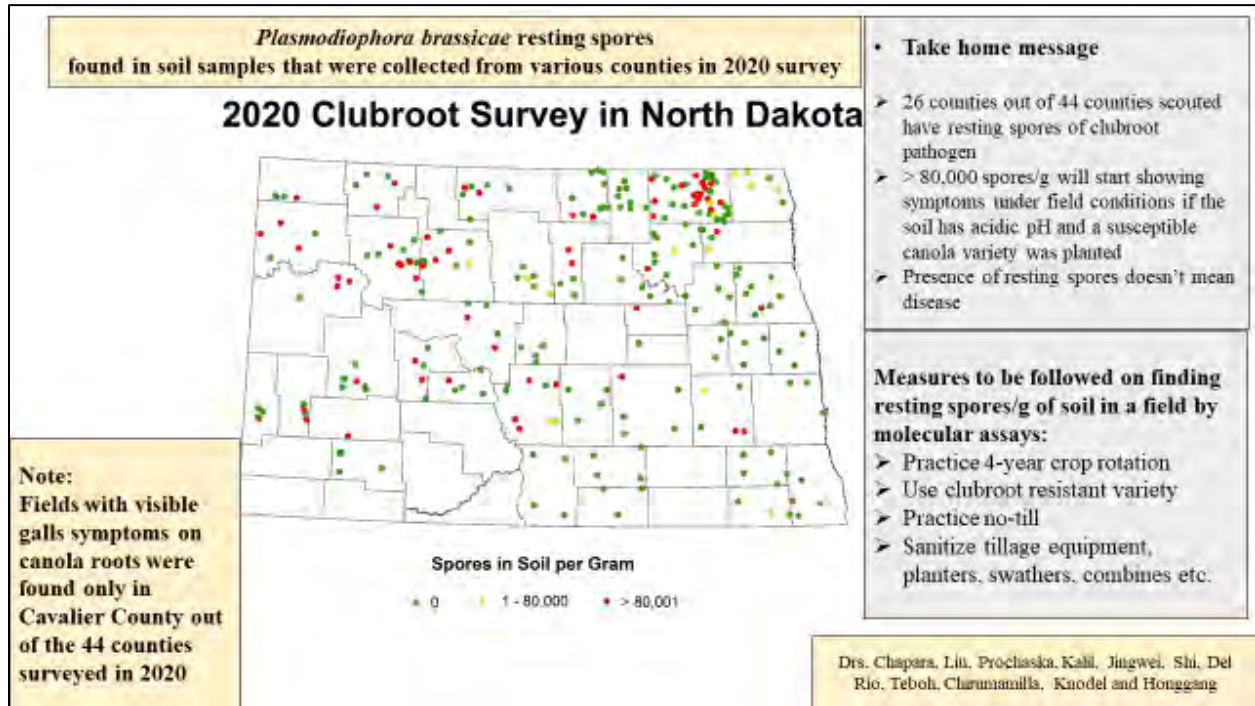
Since a large number of samples were submitted for quantification in 2020, results were delayed and not available until March 2021. They are presented in this report. Likewise, approximately 400 soil samples have been submitted for the 2021 season from 49 counties and are awaiting results which will be presented in the 2022 annual report.

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

Results from molecular assays on soil samples in 2020: The molecular assays indicated the clubroot pathogen resting spores have been found in 26 out of 44 counties (Figure 2) surveyed. Although, there were no visible symptoms observed when the roots were uprooted. Quantified resting spores of *P. brassicae* from those samples ranged from 500 to 40,000,000 spores 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 (Figure 3). In general, clubroot infections are expressed on canola plants where soil resting spore population total about 80,000 spores per gram of soil (Canadian Research). These results indicate that there is a need for continuous annual monitoring.

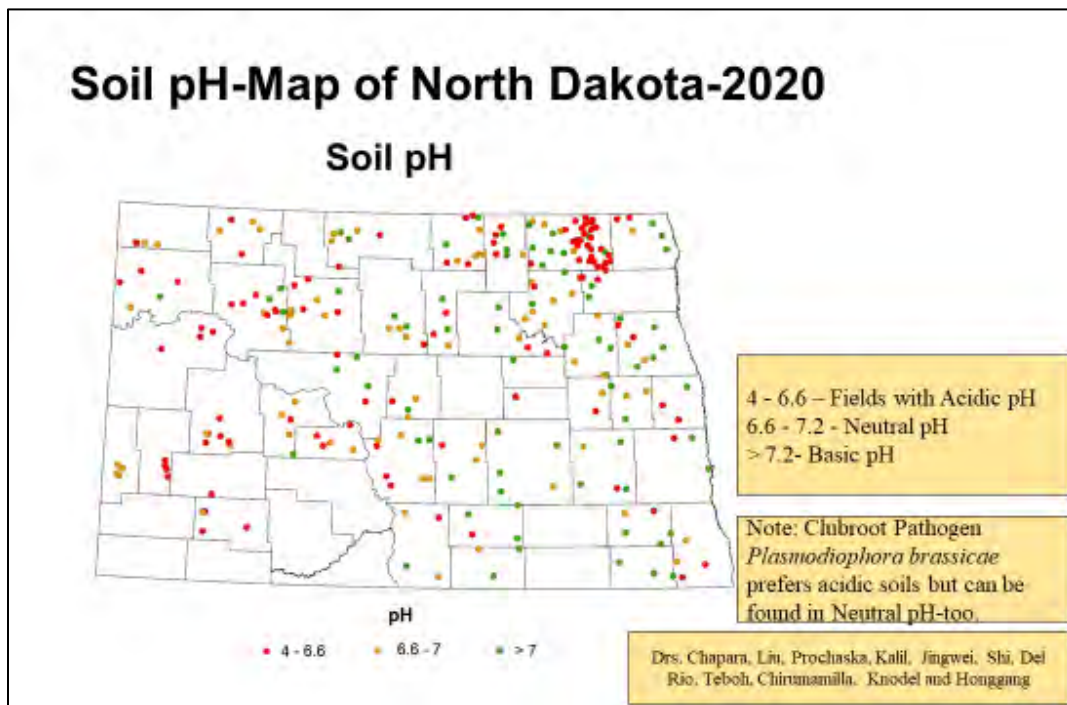
Notice: Growers who are curious about the presence of clubroot/resting spores in their field(s) are encouraged to contact Dr. Venkat Chapara at the Langdon REC (701-256-2582), NDSU Cavalier County Extension Office (701-256-2560), or NDSU Extension (701-231-8363).

Figure 2: Map of counties in North Dakota indicating *Plasmodiophora brassicae* (the clubroot pathogen) resting spores detected by molecular assays in the soil samples submitted in 2020.



Note: The green dot indicates zero, yellow dot indicates range of 1-80,000 and the red dot indicates more than 80,000 resting spores per gram of soil.

Figure 3: Map of counties in North Dakota indicating pH ranges detected by soil assays in the soil samples submitted in 2020.



Evaluate Commercial Cultivars of Canola to Monitor the Breakdown of Resistance to Clubroot

Venkat Chapara

Objective: To monitor the resistance potential of commercial canola cultivars against the mutant clubroot pathotype in field conditions.

Canola cultivars/varieties: Eight commercial canola cultivars having resistance to the clubroot pathogen were planted to monitor the level of resistance against the known mutant pathotype in the research ground (Table 1). The field had a natural soil population of *P. brassicae* of 140,625 resting spores/g of soil. The clubroot susceptible canola cultivars, InVigor L233P and CP9978TF were planted as the checks.

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: 10 ft. x 5 ft.

Table 1: Commonly cultivated canola cultivars/varieties in North Dakota.

Cultivar	Description
InVigor L255PC	BASF
InVigor L234PC	BASF
InVigor L233P	BASF
InVigor L340PC	BASF
InVigor L345PC	BASF
InVigor LR344PC	BASF
CP7130LL	Croplan Genetics
CP9978TF	Croplan Genetics
CP7144LL	Croplan Genetics
Resistant Cultivar	-

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

Clubroot Disease Index (DSI):

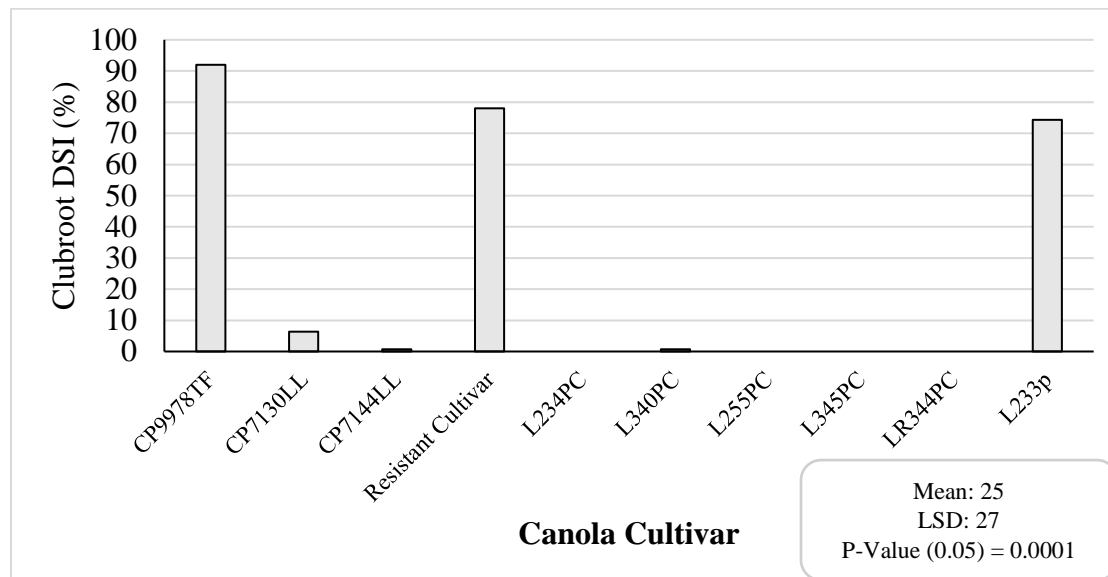
CRDI: <30% of Susceptible Check = Resistant (R)

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 tested in 2021.



Results: Clubroot susceptible cultivars InVigor L233P and CP9978TF were used as reference checks to compare the clubroot resistance showed 74 and 92 percent of DSI, respectively, indicating the validity of the trial. Canola cultivars CP7130LL, CP7144LL, InVigor L234PC, InVigor L340PC, InVigor L255PC, InVigor L345PC, and InVigor LR344PC, showed resistance to clubroot and were significantly different from the other cultivars tested. A clubroot resistant cultivar showed high clubroot DSI (78%) indicating the resistance breakdown to clubroot. However, the trial has to be repeated to confirm the resistance breakdown.

Future research: Screening large numbers of commercial cultivars of canola will be helpful to growers. Monitoring clubroot resistance breakdown in commercially available resistant cultivars each year will be a crucial survey objective.

Canola Council of Canada’s Monitoring Clubroot in Resistant Varieties

“Growers using clubroot-resistant cultivars 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 longer crop rotations in clubroot endemic areas and use a clubroot resistant variety every three years minimum.

Management of White Mold of Dry Bean Using Fungicides

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 dry bean. The trial was planted on May 27, 2021 with the dry bean cultivar ‘Palomino’ in a randomized complete block design replicated four times with 30 inch row spacing. 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 dry bean 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 when 50 to 100 percent of the plants had one or more flowers and small pods of less than 1/4 inch long 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 on August 25 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 mean disease severity index (MDS) was calculated with a weighted mean of incidence and the number of plants in each severity rating.

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

Treatments	Rate (oz/a)	Incidence (%)	MDS (0-5)	Yield (lbs/a)	Test Weight (lbs/bu)
NON-TREATED CHECK	CHK	30	0.07	2989	59
PROLINE	5.7	26	0.6	2719	58
EXPERIMENTAL-1	9.6	32	0.91	3145	59
EXPERIMENTAL-2	10.9	33	0.71	2957	59
QUADRIS	15.5	33	0.85	3284	58
ENDURA	6	6	0.06	3383	59
INCOGNITO	1.6	16	0.23	3396	59
EXPERIMENTAL-3	12	13	0.26	2744	59
Mean		23	0.54	3077	59
CV%		88	96	14	1
LSD		NS	NS	NS	NS
P-Value (0.05)		NS	NS	NS	NS

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

Acknowledgements: Bryan Hanson, Carmen Ewert, Travis Hakanson and Lawrence Henry for their technical support.

Management of Clubroot (*Plasmodiophora brassicae*) with Non-Traditional Products
Venkat Chapara and Amanda Arens

Objective: To determine the effect of non-traditional products alone and in combination to manage clubroot on canola.

Methods: The following non-traditional products (OR-079-B, OR 009-A, OR-369-A and OR-329-H) were tested alone and in combination in a randomized complete block design (RCBD) with six replications under field conditions. The field had a natural soil population of *P. brassicae* of 5.5 million resting spores/g of soil. Treatments of non-traditional products and the fungicide Ranman®, were applied in-furrow as soil drenches just before planting at the rate listed in Figure 1. A susceptible canola cultivar to clubroot ‘InVigor L233P’ was planted at a depth of one half inch. The trial was planted the first week of June and was evaluated in the first week of August (exactly 60 days after planting) at growth stage BBCH-65. The trial was hand harvested the last week of August and the yield data was calculated in lbs/a at 13.5% moisture.

Rating scale: A 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 Severity Index (DSI) has been calculated using the incidence and severity data of clubroot obtained.

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

Figure 1: Means of the Clubroot DSI and their effect on the yield observed in various treatments of non-traditional products.

Treatments and Rates	Clubroot		Yield (lbs/a)
	Incidence (%)	Disease Severity Index (0-100)	
Ranman 20 fl. oz/a	87	82	1380
OR-079-B 4 pts/a	95	95	720
OR 009-A 4 pts/a	86	84	900
OR-369-A 4 pts/a	92	88	1020
Non-Treated	92	90	720
OR-079-B 4 pts/a+OR-329-H 2.8 fl. oz/a	94	89	979
Mean	91	87	973
CV (%)	12	17	54
LSD	NS	NS	NS
P- Value (0.05)	NS	NS	NS

Results: Statistically no significant differences observed among the treatments for clubroot disease severity indexes or yields. Likewise, there were no differences observed in the soil pH from samples collected before application of treatments to those collected 60 days after application.

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

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

Email: ndsulanddon.rec@ndsu.edu

RESULTS AND DISCUSSION

The findings below are based on the statistical analysis of soil electrical conductivity (EC dS/m), sodium adsorption ratio (SAR), pH and bulk density (g/cm^3) and its corresponding gravimetric water content (%). 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 and potential evapotranspiration (Penman) were noted on the resulting average annual growing-season groundwater depths from May to October. The treatment means of EC, SAR and pH represent 2014 and 2016-2021 results of three replications for the zero to four-foot soil

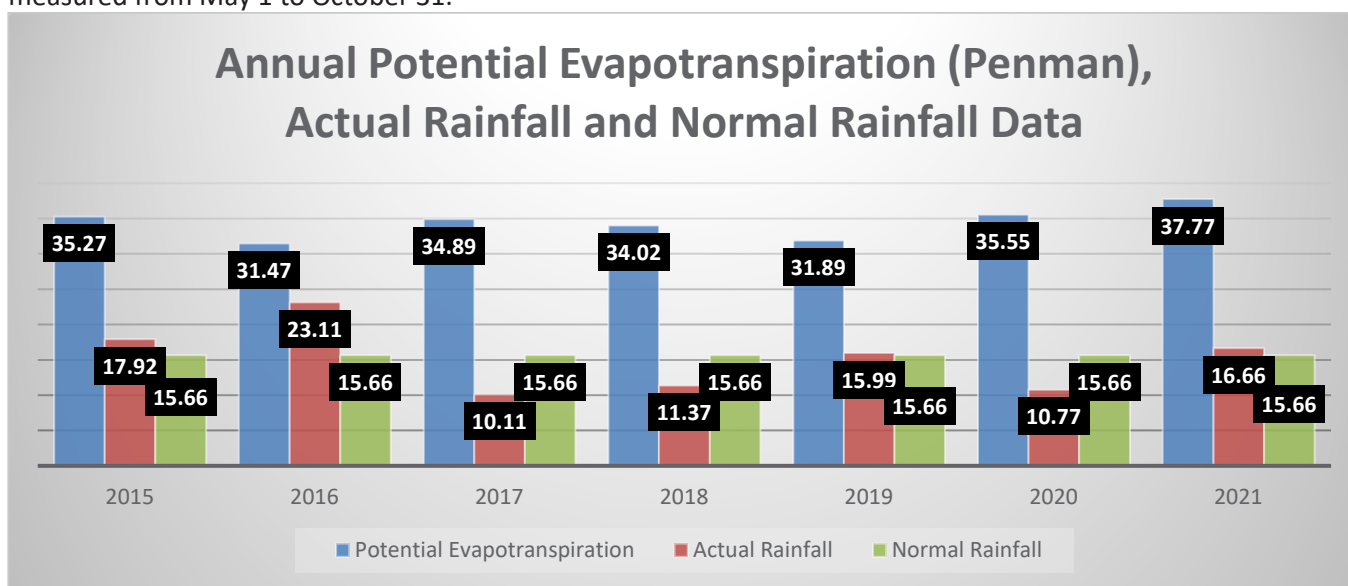
depths. The treatment means of groundwater depths represent 2015 to 2021 results of three replications measured for zero to seven and a half-foot soil depth.

In addition, included are the results of conductivity (mmhos/cm), dissolved solids (mg/L), SAR and pH of the tile-drained water quality analysis. 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. Water quality analysis results represent 2015 to 2021 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 at times when significant rain (an inch or more) allowed the fresh flow of tiled-drained water and measurable water level in the drainage ditch for collecting upstream and downstream water samples.

Annual Changes in Weather and Soil Groundwater Depths

Changes in soil chemical properties are 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.

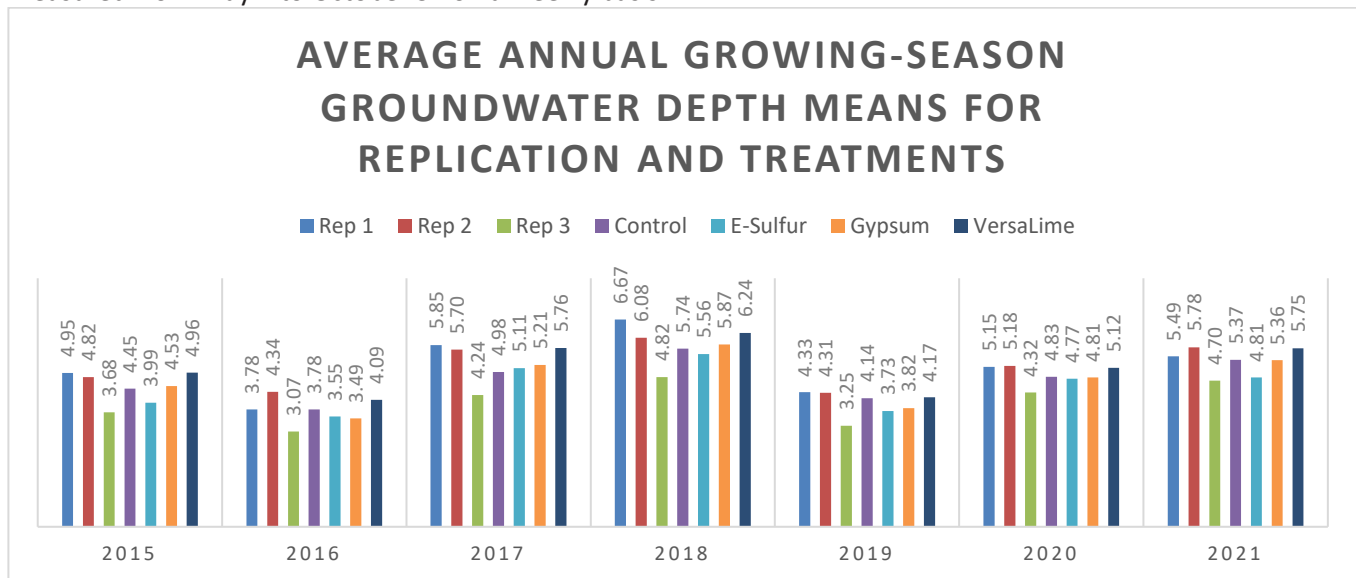


A bigger gap between evapotranspiration and rainfall generally results in lower groundwater depths, but less leaching of soluble salts, increased capillary rise of soil water and slower dissolution of soil amendments. A smaller gap between these two could result in shallower groundwater depths, however, 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 smaller 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 small 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 tilled 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, 2020 and 2021 due to the drier weather.

It is important to note that while the total annual evapotranspiration and rainfall numbers are important, they do not reflect the weather trends for the entire growing-season. For example, from May 1 to October 31, 2021, Langdon Research Extension Center NDAWN station recorded 37.77 inches of total potential evapotranspiration

and 16.66 inches of actual rainfall versus a normal of 15.66 inches. That means Langdon area received 106.38 percent rain versus the normal in 2021. However, during the early part of the 2021 growing-season from May 1 to August 8, Langdon NDAWN recorded 25.62 inches of total potential evapotranspiration and only 6.43 inches of actual rainfall versus a normal of 10.49 inches. That was a gap of 19.19 inches between total annual evapotranspiration and rainfall and 38.70 percent less rainfall versus normal for that period, which created moderate to severe drought. On August 9, Langdon area received 3.68 inches of rain and kept getting significant showers afterwards. Overall, Langdon NDAWN recorded 12.16 inches of total annual evapotranspiration and 10.22 inches of rain versus a normal of 5.17 inches from August 9 to October 31. So, during the latter part of the growing-season, the gap between total annual evapotranspiration and rainfall was only 1.94 inches with 197.67 percent rain compared to the normal. It was important to receive the much-needed moisture during that time, however, most of the growing-season was over.

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 2019 growing-season roughly had the same weather pattern when 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 1 to July 30 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 31 to October 5, 2019. The total potential evapotranspiration (Penman) for the same period was 9.04 inches. On July 31, 0.77 inch 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.

Figure 3 has the average annual growing-season groundwater depth means for replications and treatments for 2015 to 2021. These means of groundwater depths represent actual annual measurements of groundwater depths measured from May 1 to October 31 on a weekly basis.

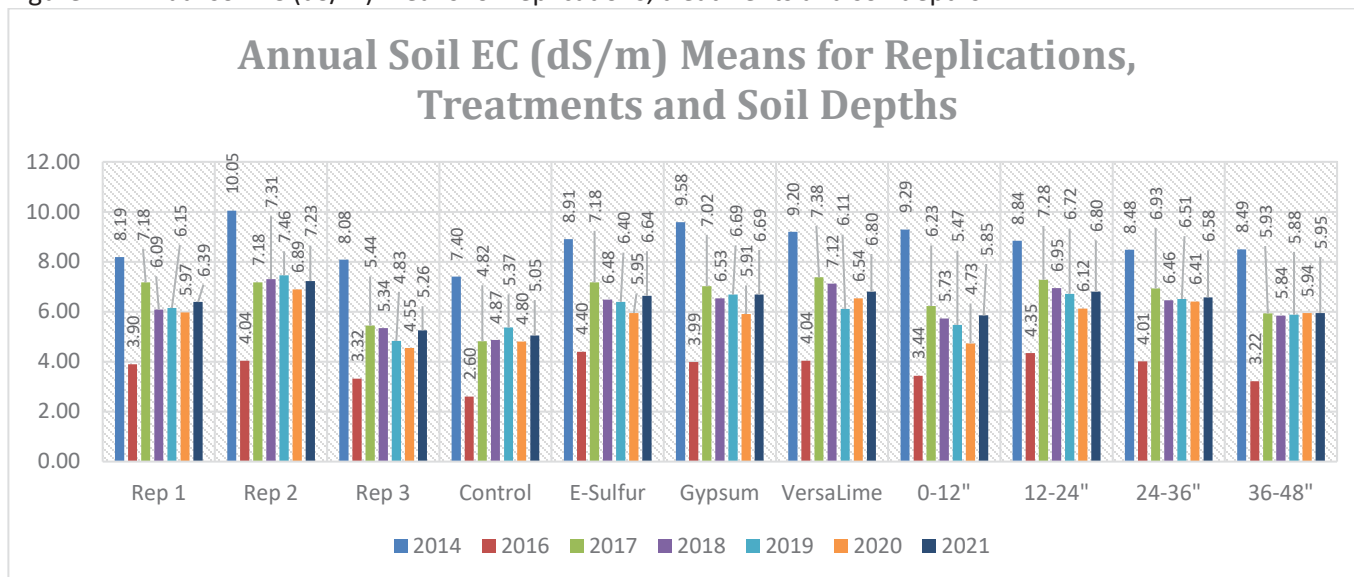
The 2016 average growing-season groundwater depths for treatments and replications were shallowest (3.07 to 4.34 feet deep) followed by the depths in 2015, 2017, 2018, 2019, 2020 and 2021. The 2018 average growing-season groundwater depths were the deepest (4.82 to 6.67 feet deep) versus rest of the 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, 2018, 2020 and 2021.

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 2018-2021 despite land being tilled and average annual growing-season groundwater depths being deeper than the depth of the tiles, which is four-feet deep (Figure 4). That was a result of increased capillary rise of soil water due to low rainfall and higher evapotranspiration.

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



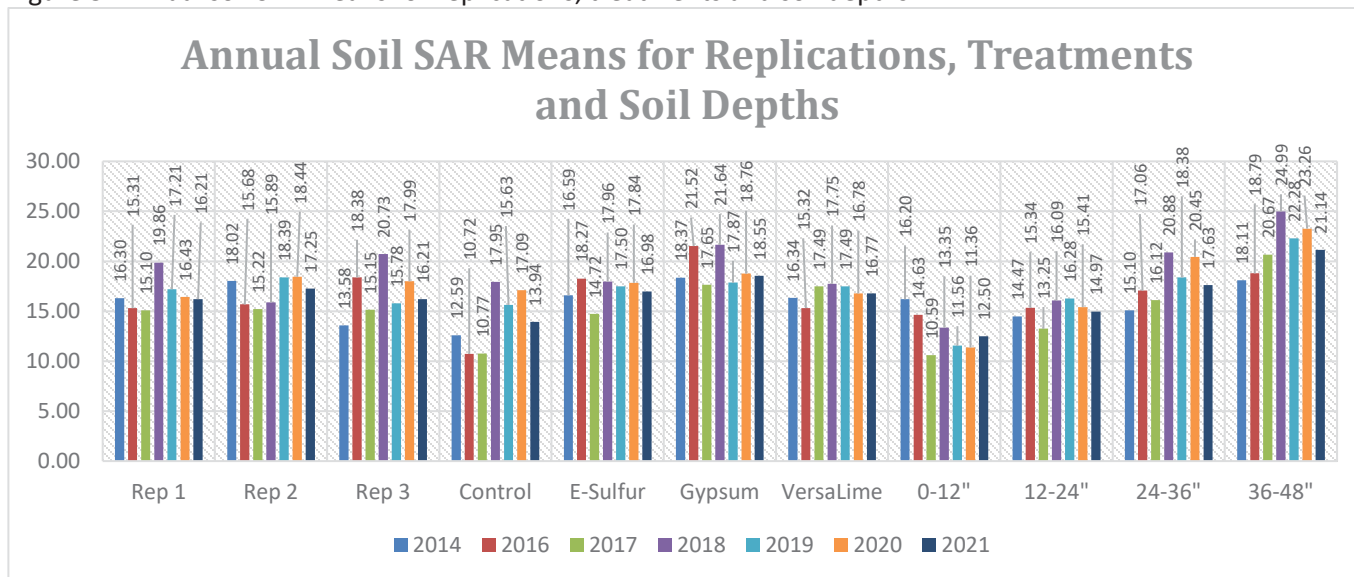
This defies the common belief that just lowering the groundwater depths will cause excess salts to leach out. Lowering soil EC levels will need an optimum combination of low enough groundwater depths combined with sufficient rain and good soil water infiltration to push the salts into deeper depths. 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 (especially under lower sodicity levels), however, much slower water movement through the second and third feet of soil resulting in higher levels of salts. An example of slower soil water infiltration in the 12-24 and 24-36 inch depths could be that despite receiving 3.68 inches in less than twenty-four hours on August 9, 2021. It took the lift station pump four to seven days to start pumping the excess water into the drainage ditch. A similar event occurred in fall-2019 when the Langdon NDAWN recorded 1.52 inches from September 9 to 13. There was standing water at the soil surface in low areas with the lift station pump not running. Sufficient rain will 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 salt-tolerant grass mix is also very important as that will reduce evaporation and consequently capillary rise.

Electrical conductivity levels in 2014 were the highest followed by the levels in 2021 and 2017-2020 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.

Differences in Soil Sodium Adsorption Ratio SAR (Sodicity) Levels

Soil SAR levels have been inconsistent despite tiling the site in 2014 and applying soil amendment in 2015. It could be due to the drier weather in 2017-2021 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 and that it will take a longer time and equal or higher than normal annual rainfall to remediate sodicity. Too little will not be enough and too much coming down too fast will not infiltrate through the soils. A slow and steady rain of at least ½ inch, preferably up to two inches spread over three to four days will be ideal for dissolving soil amendments and leaching excess salts into deeper depths. Despite the recent drier annual weather, for the first time in six-years, SAR levels in 2021 were the lowest compared to rest of the years. This could be beginning of a positive trend (Figure 5).

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



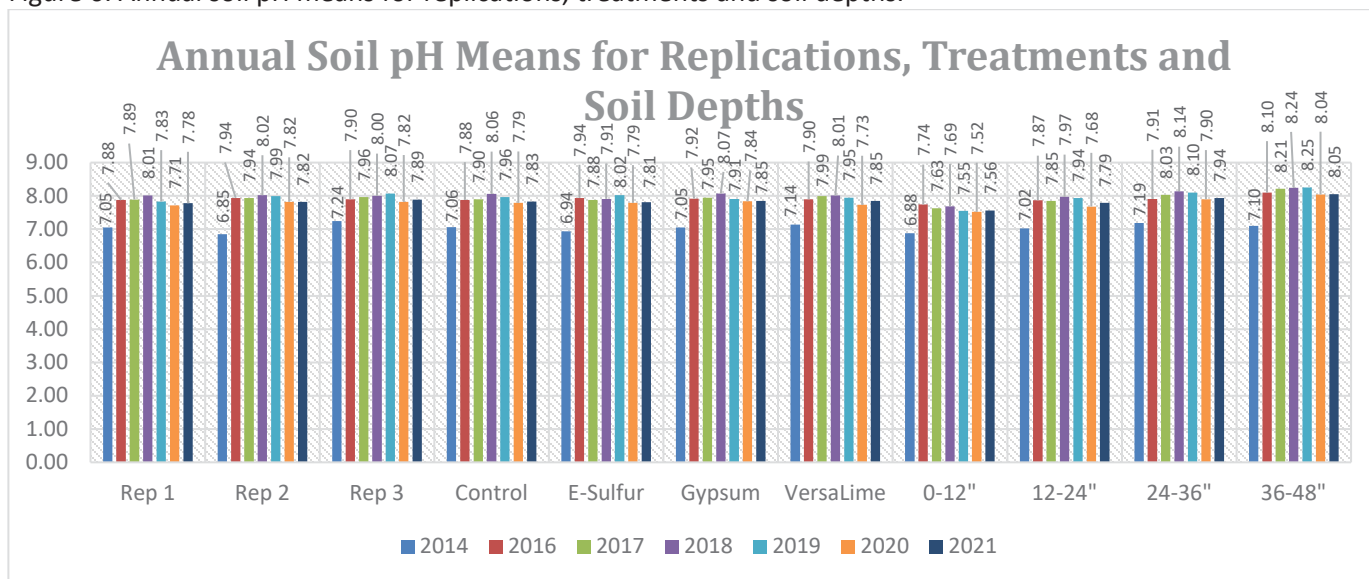
Overall, sodium adsorption ratio remained the highest in 2018 followed by 2020, 2019, 2016, 2014, 2017 and 2021. Replication 2 had the highest SAR levels, whereas, replications 1 and 3 had similar SAR levels. Gypsum treatments had the highest levels followed by E-sulfur, VersaLime and control treatments. 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. Details of soil SAR levels are shown in Figure 5.

Differences in Soil pH Levels

Soil pH levels were generally consistent with the soil moisture levels at the time of sampling and have had no impact so far related to the application of soil amendments (Figure 6).

Overall, soil pH levels remained the highest in 2021 followed by 2018, 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 in most years. VersaLime and gypsum treatments had the highest levels followed by control and E-sulfur treatments. Like SAR, soil pH significantly increased with soil depth and 0-12 inch depths had the lowest pH levels, whereas, 36-48 inch depths had the highest pH levels. An increase in pH with soil depth was due to the increase in soil moisture levels. Details of soil pH levels are shown in Figure 6.

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

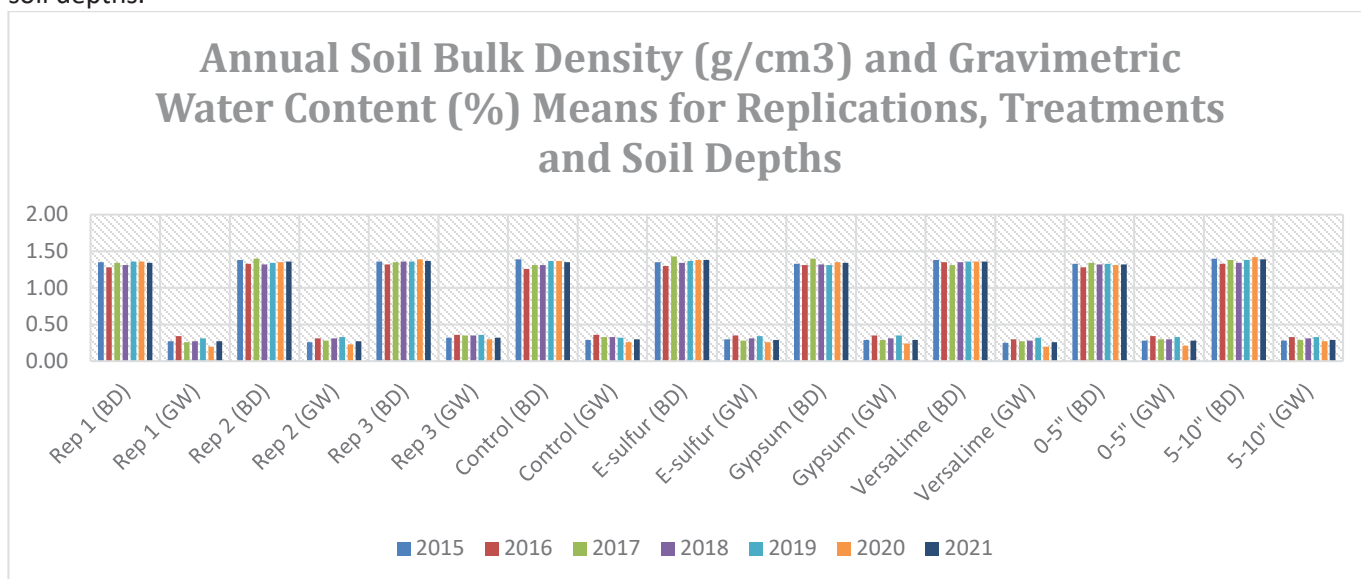


Differences in Soil Bulk Density Levels

Soil bulk density increased with soil depths. In addition, despite not being a clear trend, bulk density increased as the gravimetric soil water content decreased (Figure 7).

Bulk density levels in 2021 were the highest followed by 2020, 2015 and 2017, 2019, 2018 and 2016 at 21, 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 32, 27 and 27 percent gravimetric water levels. E-sulfur treatments had the highest levels followed by VersaLime, control and gypsum treatments at 29, 26, 30 and 29 percent gravimetric water levels. The 0-12 inch soil depths had lower bulk density levels compared to 5-10 inch depths at 28 and 29 percent gravimetric water levels. Soil bulk density (g/cm^3) and corresponding gravimetric water content (%) levels are shown in Figure 7.

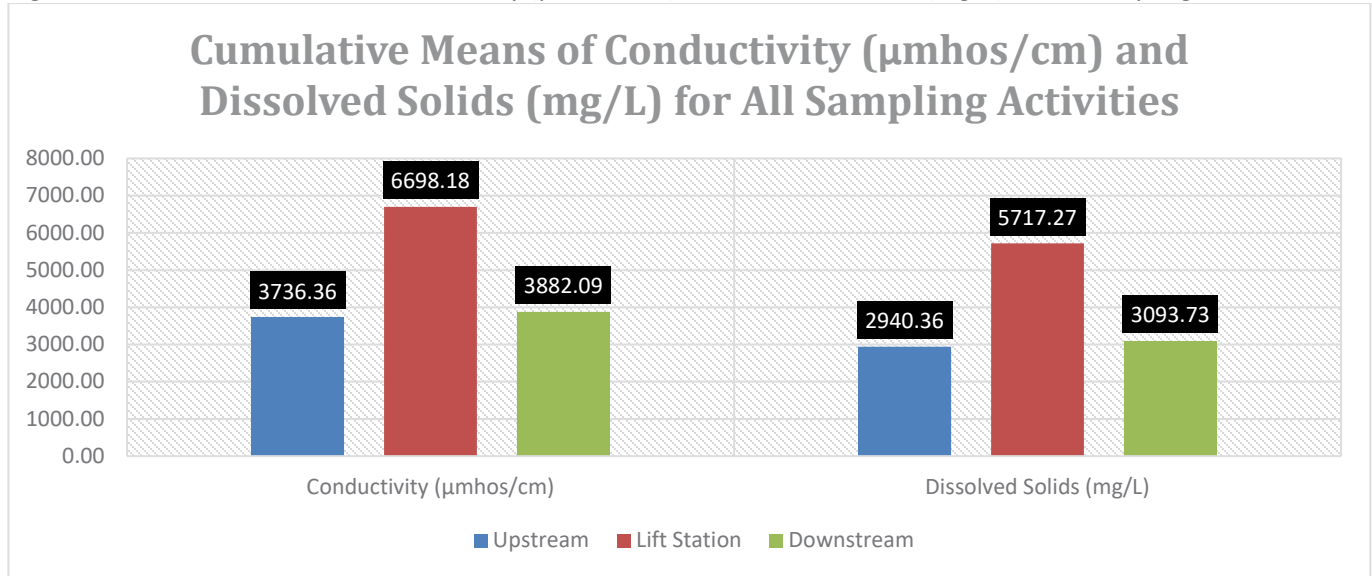
Figure 7. Annual means of soil bulk density (g/cm^3) and gravimetric water (%) levels for replications, treatments and soil depths.



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

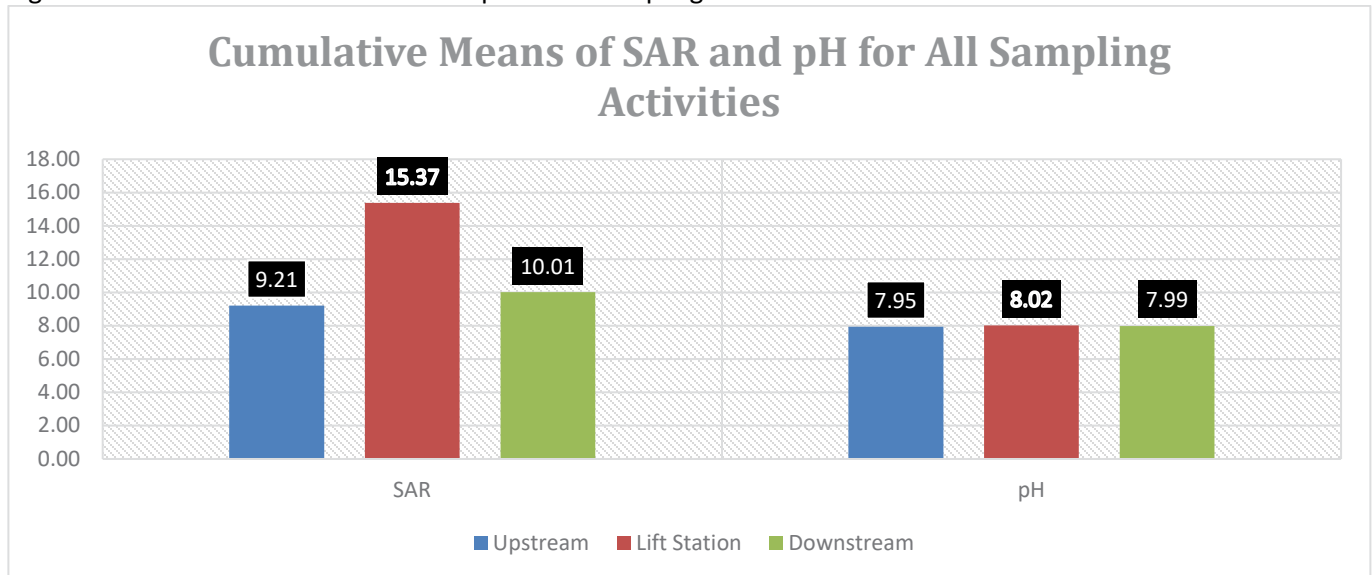
Based on the cumulative means of all sampling times, conductivity, total dissolved solids and SAR levels of the lift station samples were higher than the upstream and downstream samples (Figures 8 and 9).

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



The pH means of upstream, lift station and downstream samples were roughly equal (Figure 9). 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.

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



SUMMARY

Research data and observations are not conclusive at this point. However, 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 clayey 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.

Based on the observations seven-years after tiling and six-years after applying the soil amendments, below are the answers for the three main objectives of this long-term research trial:

Does soil sodicity negatively affect tile drainage performance?

Yes, soil sodicity has negatively affected the performance of tile drainage at this site and despite heavy rains and standing water at the soil surface, sometimes it takes days for the lift station pump to start draining excess water. That eventually happens, however, it takes time. Another evidence of slower water infiltration is roughly no change in groundwater depths for two to three days even after a heavy rain. Two specific examples are:

- Despite receiving 3.68 inches in less than twenty-four hours on August 9, 2021, it took lift station pump four to seven days to start pumping the excess water into the drainage ditch.
- In 2019, the Langdon NDAWN recorded 1.52 inches from September 9 to 13 and there was visible standing water at the soil surface in low areas, however, lift station pump was not running. It took lift station pump three to four days to start running and drain the excess soil water.

Will tiling lower soil salinity under wet and dry weather conditions?

Tiling has lowered soil salinity (EC) levels under wet weather in 2016. However, under drier weather, salinity levels have actually increased in 2017-2021. That is due to the lack of rain water to force excess water-soluble salts into deeper depths and increased rise of capillary water due to increased evapotranspiration.

Does the drained water from a tiled field increase salinity and sodicity levels of the surface water resources?

Yes, tile-drained water has added conductivity, total dissolved solids and SAR to the drainage ditch or the surface water resource. So, over time depending upon the site-specific soil chemistry, tile drainage water can add salts and sodicity to the surface water resources.

SALT AND SODICITY TOLERANCE OF BARLEY, OAT AND DURUM

Naeem Kalwar (Extension Soil Health Specialist)

Bryan Hanson (Research Agronomist)

David Franzen (Extension Soil Specialist)

Barley and oats are some 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 soils. Sensing the need to determine the economic threshold of soil salinity (Electrical Conductivity or EC) and sodicity (Sodium Adsorption Ratio or SAR) for barley and oats, four barley and four oat varieties were planted at the Langdon REC site in 2021 at three different levels of salinity and sodicity. This trial was a repeat of 2020 trial. In addition, three durum varieties were added to the trial in 2021 to compare salinity and sodicity tolerances of the durum varieties side by side with barley and oats.

Soil Analysis Results

Two-foot deep composite soil samples separated into 0-6 and 6-24 inch depths were taken on May 20, 2020 and April 23, 2021 by taking three cores for each sample. The three levels of salinity and sodicity were recognized as replications 1, 2 and 3 and were sampled separately. Replication 1 was described as having low to moderate levels of salinity and sodicity, replication 2 having moderate to high levels and replication 3 having very high levels. These descriptions were based on the salinity and sodicity tolerance of crops like barley and oats. However, these levels would be considered high for sensitive crops such as soybean. Soil EC, SAR and pH were analyzed by using the saturated paste extract method (Table 1), whereas, standard methods were used to analyze NO₃-N, P and K (Table 2).

Table 1. The 2020 and 2021 soil EC, SAR and pH results of the three replications for the 0-6 and 6-24 inch depths.

Site	Sample ID	Depth (inches)	EC (dS/m)	EC (dS/m)	SAR	SAR	pH	pH
			2020	2021	2020	2021	2020	2021
Rep 1	Low to moderate salinity-sodicity	0-6	3.99	4.63	7.12	6.20	7.18	7.54
		6-24	7.32	7.49	15.05	14.72	7.71	7.97
Rep 2	Moderate to high salinity-sodicity	0-6	7.80	13.20	18.13	22.88	7.61	8.17
		6-24	10.39	12.29	20.92	21.14	7.95	8.21
Rep 3	Very high salinity-sodicity	0-6	10.50	14.90	27.30	32.74	7.59	8.14
		6-24	9.86	12.98	32.87	32.04	7.81	8.16

The soil EC levels of 0-6 and 6-24 inch depths in replication 1 remained roughly the same in 2020 and 2021. However, EC levels of replication 2 and 3 had an increase in 2021 in both soil depths versus 2020. That could be due to the drier weather and resulting increase in capillary rise of soil water in 2021. Despite some differences in soil SAR levels in 2021 versus 2020, changes were mostly inconsistent. The 2021 soil pH results remained higher than 2020. That could be due to the differences in soil moisture levels at the time of soil sampling in 2021 versus 2020.

Table 2. The 2020 and 2021 soil NO₃-N, P and K results of the three replications for the 0-6 and 6-24 inch depths.

Site	Sample ID	Depth (inches)	NO ₃ -N (lbs/A)	NO ₃ -N (lbs/A)	P (ppm)	P (ppm)	K (ppm)	K (ppm)
			2020	2021	2020	2021	2020	2021
Rep 1	Low to moderate salinity-sodicity	0-6	5	37	20	15	299	450
		6-24	6	24	5	4	137	115
Rep 2	Moderate to high salinity-sodicity	0-6	6	53	29	24	247	350
		6-24	6	24	2	4	148	200
Rep 3	Very high salinity-sodicity	0-6	5	46	51	32	270	330
		6-24	6	27	4	6	169	180

All three replications showed an increase in available soil nitrate-nitrogen levels in 2021 versus 2020. That could be the residual nitrogen due to the application of 120 pounds of N applied in the spring of 2020 at the time of planting barley and oats. Before 2020, a mix of perennial salt-tolerant grasses was growing at the site with no fertilizer application since 2013. Soil P levels showed a moderate decrease in 2021 as no P was applied in 2020. Soil K levels in 2021 showed a slight increase versus 2020. Like pH, that could be due to the differences in soil moisture levels at the time of soil sampling.

Trial Design, Plot Sizes, Planting and Harvesting Details

Trial design was randomized split block and plot sizes were 4.7 X 22 feet. Details are in Table 3.

Table 3. 2020 and 2021 barley, oat and durum varieties, planting dates, seeding rates and fertilizer rates per acre, planting depths, and harvest dates.

Crop	Variety	Planting Date	Seeding Rates (live seeds/acre)	Seeding Depth (inches)	Fertilizer Application (lbs./acre)	Harvest Date
2020 Planting Details						
Barley	AAC Synergy (2-row)	June 1, 2020	1.25 million live seeds per acre	1 to 1.5	Based on soil NO ₃ -N, P and K analysis a uniform rate of 120 lbs. of N was applied through Urea to all three replications.	September 15 (rep 1) and 23 (rep 2 and 3), 2020
	ND Genesis (2-row)					
	Pinnacle (2-row)					
	Tradition (6-row)					
Oats	CS Camden		1.00 million live seeds per acre			
	ND Heart					
	Rockford					
	Souris					
2021 Planting Details						
Barley	AAC Synergy (2-row)	May 13, 2021	1.00 million live seeds per acre	1 to 1.5	Based on soil NO ₃ -N, P and K analysis, replication 1 received an NPK rate of 59-26-0, replication 2 received 43-20-0 and replication 3 received 47-20-0 pounds per acre through Diammonium Phosphate on the morning of May 13, 2021.	September 8, 2021
	ND Genesis (2-row)		1.25 million live seeds per acre			
	Pinnacle (2-row)					
	Tradition (6-row)					
Oats	CS Camden		1.00 million live seeds per acre			
	ND Heart					
	Rockford					
	Souris					
Durum	ND Stanley	1.50 million live seeds per acre				
	Divide					
	Joppa					

Results and Discussion

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

Differences in Seedbed

In 2020 and 2021, the seedbed was very mellow in replication 1, whereas, it started getting hard and cloddy with the increase in sodicity in replication 2 and 3. It seemed that sodicity had a prominent effect on seedbed quality, which is consistent with what sodicity does to soil aggregates and resulting structure and pore space. See seedbed pictures 1-3 below for comparisons.



Pictures 1-3: Differences in seedbed between replication 1 (low to moderate salinity-sodicity), 2 (moderate to high salinity-sodicity) and 3 (very high salinity-sodicity) on June 1, 2020.

Differences in Germination

In 2020 and 2021, germination was delayed in replication 2 and 3 compared to replication 1 due to the increase in soil salinity and sodicity levels. That was a result of decreased soil water due to salinity and poor seedbed due to sodicity. In addition, both years, barley completed germination three to five days earlier than oats and was more vigorous than oats initially. Despite slightly slower growth early on, oats did catch up with barley and had similar or better growth. Durum germination was even slower than oats in 2021.

In 2020, barley and oat germination in replication 1 started around seven days after planting (June 8th) and completed in about eleven days (June 11th). In replication 2, germination started around June 16th and completed around June 23rd. So, replication 2 germination was eight to twelve days delayed compared to replication 1. In replication 3, all four barley varieties had zero germination, whereas, some oat seeds started germinating around June 29th.

In 2021 as well, barley and oats started germinating around seven to eight days after planting in replication 1, whereas, it took durum around nine to ten days to start germinating. Germination for barley and oats completed around thirteen days after planting (May 26th), whereas, durum took three to four more days to complete germination. Germination in replication 2 was about 10 days delayed compared to replication 1 and barley, oats and durum (only Joppa and ND Stanley varieties) started germinating around seventeen days after planting. Germination completed in all four barley and oat plots around 22 days after planting (June 3rd). In durum plots, ND Stanley had decent germination (70-80%), whereas, Joppa had poor germination (10-15%). Divide durum variety had zero germination. In replication 3, barley and oats started germinating 22 days after planting (June 3rd) and completed germination around 28 days after planting (June 9th). All durum varieties had zero germination in replication 3.

Differences in Growth, Vigor and Maturity

Like germination, increase in salinity and sodicity negatively affected vigor of barley, oat and durum plants and delayed growth stages and maturity.

In 2020, on July 17th, average barley plant heights in replication 1 were 21.1 to 27.7 inches with 5 to 100 percent heading completed. Oat plant heights were 22.2 to 25.5 inches with 80 to 90 percent heading completed. In replication 2, barley plant heights ranged between 10.0 to 15.5 inches with no heading initiation. Oat plant heights in replication 2 were 9.1 to 15.2 inches with 5 percent heading completed only in the ND Heart plot. No data was taken from replication 3 due to no barley and very negligible growth of oats.

In 2021, on June 28th, average barley heights in replication 1 were 17.7 to 19.9 inches with zero heading initiation. Average oat plant heights were 12.3 to 17.6 inches and plants were in late boot growth stage. Durum plant heights ranged between 14.3 to 15.7 inches and crop growth stage was jointing. In replication 2, barley heights were 8.8 to 11.1 inches and growth stages were tillering to early boot. Oat heights were 5.1 to 10.1 inches with growth stages of five-leaf, tillering and early boot. Heights of ND Stanley and Joppa (durum) were 8.0 and 8.6 inches with growth stages of tillering to five-leaf. In replication 3, barley heights were 5.5 to 6.6 inches with growth stage of four to five-leaf. Oat heights were 6.1 to 8.8 inches with growth stage of five-leaf to tillering. There were no durum plants in replication 3.

It is important to note that despite some germination initially in replication 2 in 2021, ND Stanley and Joppa plants did not produce any quantifiable yields (zero to three grams per plot). Same was true for all four barley varieties in replication 3,

which did germinate initially, however, did not produce any yield in 2021. In 2020, all four barley varieties had zero germination in replication 3. Oat varieties did produce very low yields in replication 3 in 2020 and 2021. However, in 2021, Rockford, CS Camden and Souris did not yield at all in replication 2, which had slightly lower salinity and sodicity levels compared to replication 3. That could be caused by a difference in salinity and sodicity levels within replication 2.

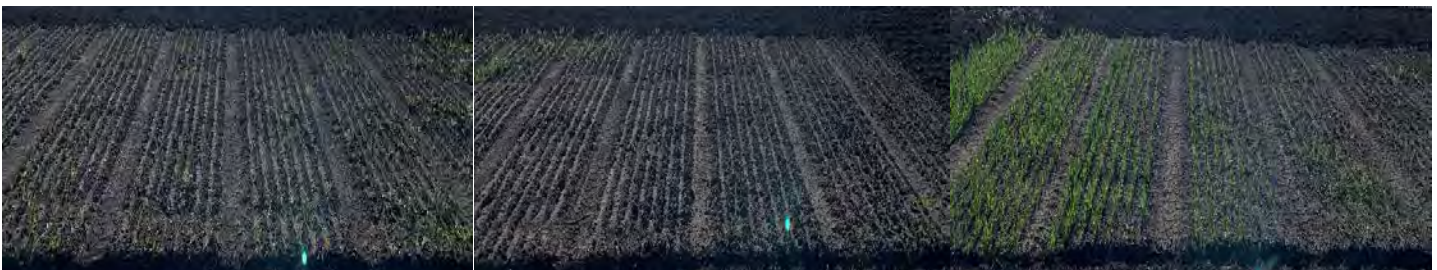
See pictures 4-12 below of replication 1, 2 and 3 to compare the differences in vigor of barley, oat and durum plots.



Pictures 4-6: Barley, durum and oat varieties growing in replication 1 (low to moderate salinity-sodicity) on June 24, 2021.



Pictures 7-9: Barley, durum and oat varieties growing in replication 2 (moderate to high salinity-sodicity) on June 24, 2021.



Pictures 10-12: Barley, durum and oat varieties growing in replication 3 (very high salinity-sodicity) on June 24, 2021.

How did Barley and Oats Survive High Levels of Salinity and Sodicity?

It was observed that barley and oat plants adapted to different salinity and sodicity levels by keeping the bulk of the roots in the top six inches of soil instead of growing into the deeper depths where salinity and sodicity levels were high to very high. That was especially true for replication 1 that had low to moderate levels in the 0-6 inch depth and moderate to high levels in the 6-24 inch depth. However, once surface salinity and sodicity reached moderately high to very high levels in replication 2 and 3, germination and growth was poor to negligible.

Differences in Yield and Quality

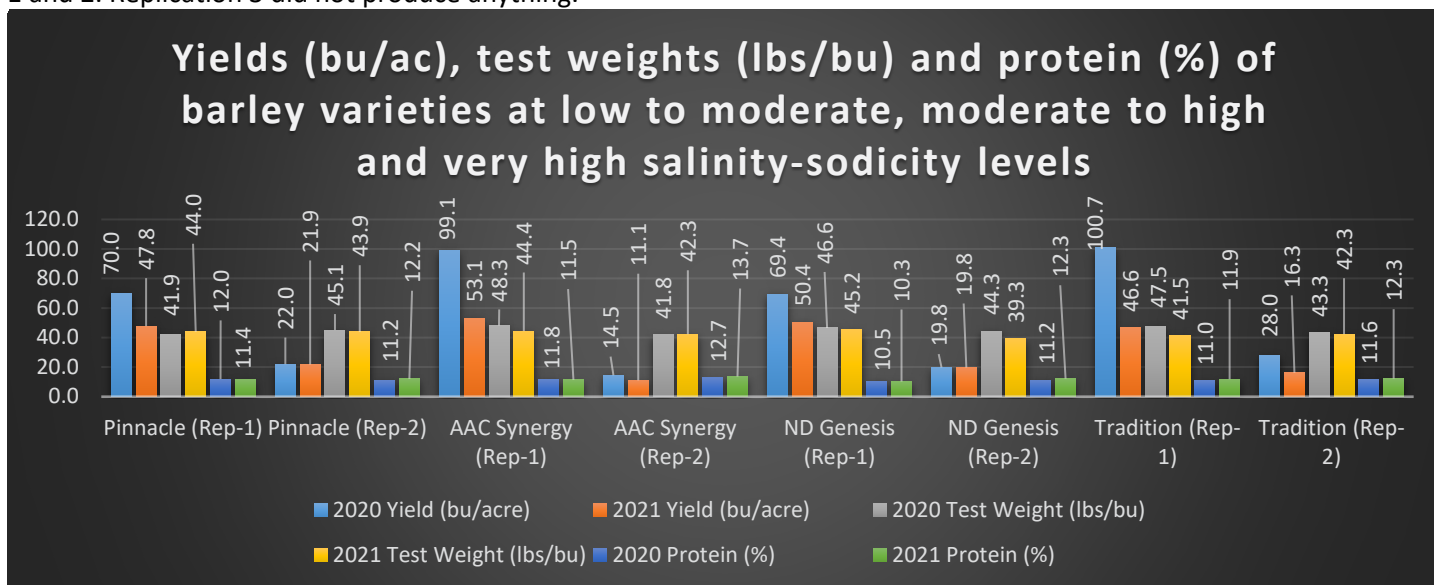
Barley

In 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 (0.36 percent) 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.

Due to dry weather in 2021, barley yields were lower than the 2020 yields. In addition, there was some shattering in barley plots. The average barley yield of replication 1 in 2021 was 49.4 bu./acre versus 17.2 bu./acre of replication 2. That was a 65 percent reduction in yield (Figure 1). Average barley test weight of replication 1 was also 4.1 percent higher than replication 2. However, protein percent of replication 2 was 11.8 percent higher than replication 1. Despite some barley germination in replication 3, all barley varieties did not yield anything.

The differences in yield and quality of barley varieties in 2020 and 2021 were very similar. The main difference was the change in weather.

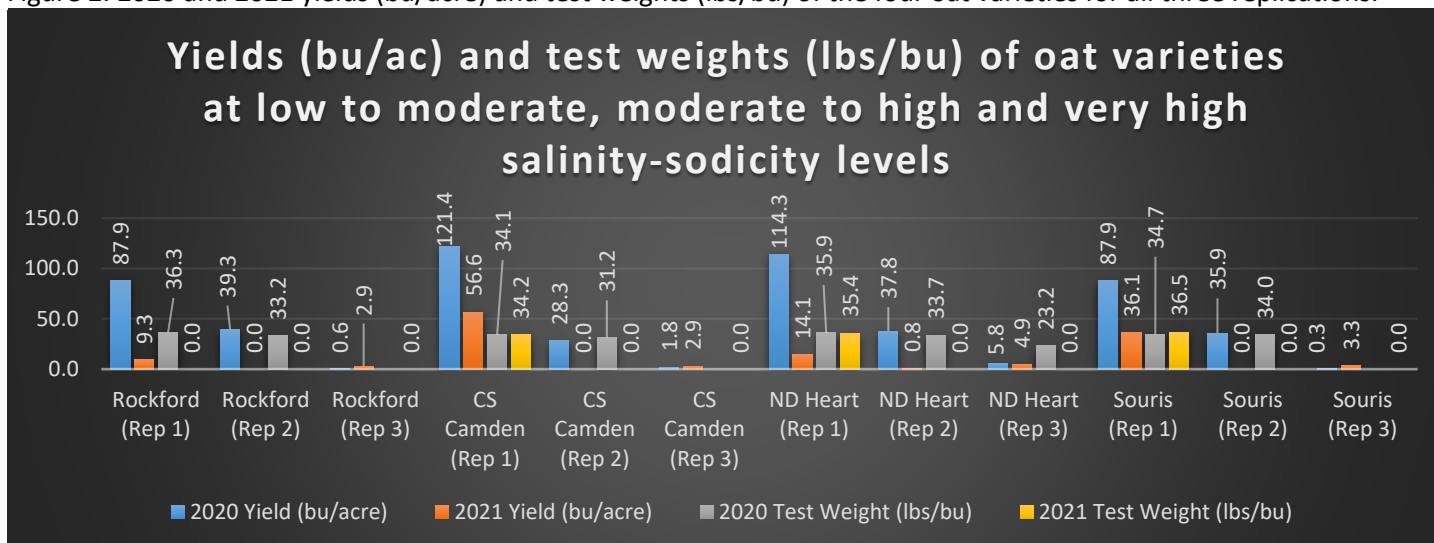
Figure 1. 2020 and 2021 yields (bu/acre), test weights (lbs/bu) and protein (%) of the four barley varieties for replications 1 and 2. Replication 3 did not produce anything.



Oats

In 2020, average oat yield of 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). Also, 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. 2020 and 2021 yields (bu/acre) and test weights (lbs/bu) of the four oat varieties for all three replications.



Like barley, oat yields in 2021 were lower due to dry weather. However, oat plots had significant shattering, in some cases at least 30 to 40 percent. Shattering in oat plots was much more severe than the shattering that happened in barley plots.

See pictures 13-14 below of replication 1 and 3 to compare the level of shattering in oat plots in 2021. Oat growth in replication 2 was negligible.



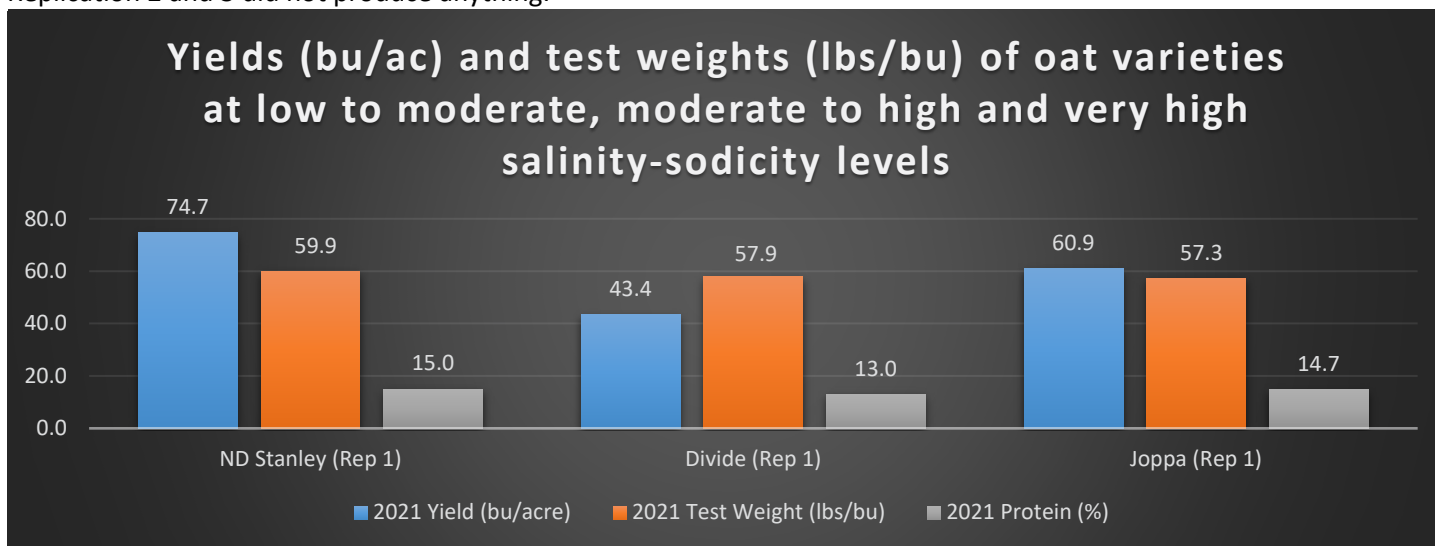
Pictures 13-14: Shattering in oat plots in replication 1 (low to moderate salinity-sodicity) and 3 (very high salinity-sodicity) on September 8, 2021.

In 2021, average oat yield of replication 1 was 29.0 bu/acre versus 3.5 bu/acre of replication 3 (Figure 2). That was a nearly 88 percent reduction in yield. In replication 2, it was only possible to record yield for ND Heart, which was 0.8 bu/acre. Rockford, CS Camden and Souris yielded zero in replication 2, which had slightly lower salinity and sodicity levels compared to replication 3. That could be a difference in salinity and sodicity levels within replication 2. Since there was not enough oats to record test weights for replication 2 and 3, no comparisons could be made between the replications for test weights.

Durum

The average 2021 durum yield for replication 1 was 59.6 bu/acre with an average test weight of 58.3 lbs/bu and average protein percent of 14.2 (Figure 3). ND Stanley yielded the most by producing 74.7 bu/acre, had the highest test weight (59.8 lbs/bu) and protein percent (15.0). Replications 2 and 3 resulted in 100 percent loss.

Figure 3. 2021 yields (bu/acre), test weights (lbs/bu) and protein (%) of the three durum varieties for replications 1. Replication 2 and 3 did not produce anything.



Summary:

- It is very important that crops receive close to normal rain at crucial growth stages, especially during the early growing-season. Drier than normal weather conditions create further competition for water between plants and salts and drought effects can be severe at same salinity (EC) and sodicity (SAR) levels in dry years (Picture 15) versus a year in which rain would be just adequate.
- Uneven germination in the spring resulted in uneven maturity and delayed harvest. In addition, harvest was delayed for another 10 days due to wet weather in August. During that time high winds caused significant shattering, especially in oats.
- Generally, at EC levels of 4.00 to 4.50 dS/m and SAR of 7.00 to 7.50 in the 0-6 inch soil depths, both barley and oats can produce high yields and quality. Increased EC and SAR levels in the topsoil may result in significant economic losses.



Picture 15: A saline and potentially sodic headland in Cavalier County on April 29, 2021.

Midges in Canola - Trap Survey in ND

Anitha Chirumamilla, Patrick Beauzay, Lesley Lubenow, T.J. Prochaska, Ryan Buetow, Greg Endres and Janet Knodel

(Trappers: Lindy Berg, Jolena Lowery, Traci Murphy, Sara Clemens, LoAyne Voigt, Riley Racine, Iris Dukart, Kia Ward, Carrie Nichols, Sean Nichols, Tommy Crompton, Veronica Calles-Torrez, Marc Michaelson)

Since 2015, the NDSU IPM team headed by Dr. Janet Knodel has been trapping for midges in canola. The trapping was initially focused on Swede midge (*Contarinia nasturtii*) a close relative of wheat midge belonging to the same family Cecidomyiidae, but attacks only cruciferous plants like canola, cabbage, cauliflower, radish, and broccoli. The adult midge looks like a small mosquito about 2mm long (Figure 1). The midge larvae are tiny translucent white maggots that feed on the growing points of the plants forming galls and deformed growing points (Figure 2). The good news for canola growers in ND is that all the trapping results were negative for this midge since 2015. Future survey work will be essential for early detection of swede midge to keep canola growers informed of new insect pests.



Figure 1: Swede Midge Adult and Larva
Photo courtesy: Susan Ellis, Canada

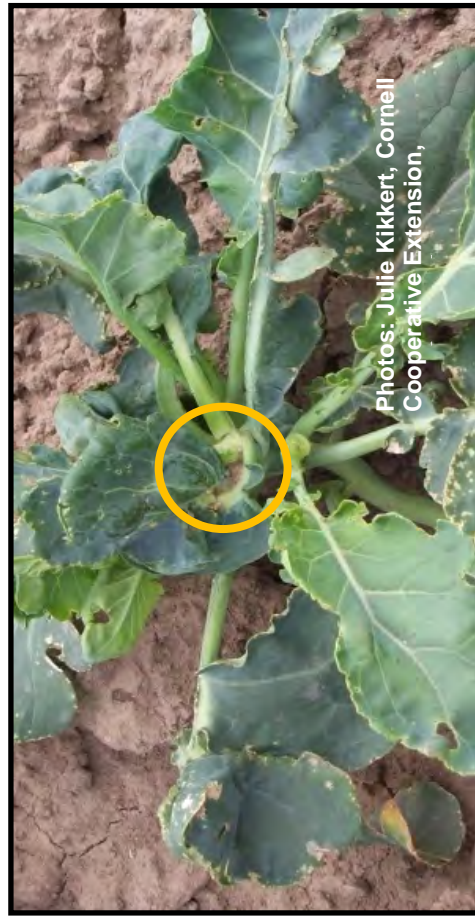


Figure 2: Swede Midge Crop Damage

A new insect damaging canola was identified in Canada in 2017 (northeastern Saskatchewan and east-central Alberta). The new insect, also a midge, is being called the 'canola flower midge,' *Contarinia brassicola*. Adults and larvae are similar to swede midge in size and appearance (Figure 3). Larval feeding causes bottle-shaped galled flowers which do not produce pods or seeds (Figure 4). The economic impact of this insect in canola is still under investigation.



Figure 3: Adult Canola Flower Midge
Photos courtesy: Boyd Mori, Canada

Trapping Protocol: Delta traps, with species specific pheromone lures, were placed in canola fields from mid-June (rosette) through mid-August (ripening crop stage) (Figure 5). Sticky trap liners were removed weekly and kept frozen until shipment to Dr. Knodel's laboratory in Fargo (Figure 6). The species of midges were identified by Patrick Beauzay. Data were summarized and maps were prepared to illustrate the presence or absence of swede and canola flower midges using ArcMap.



Figure 5: Delta traps used for swede and canola flower midge trapping. Photos courtesy: Canada.



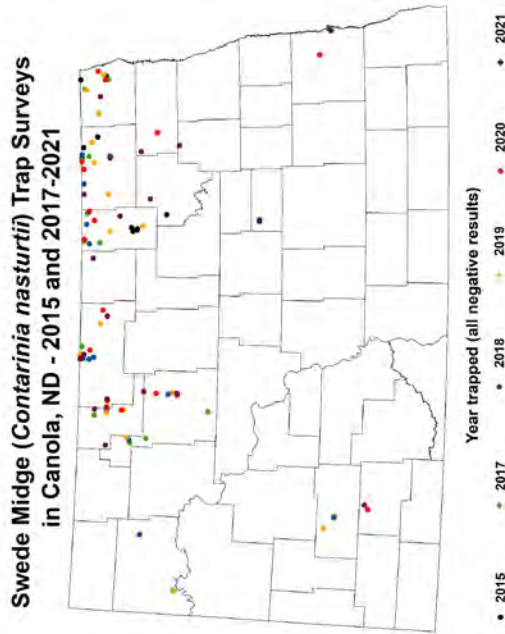
Figure 4: Canola flower midge feeding damage
A) Unopened caper-shaped flower galls
B) Midge larvae in canola flower bud
C) Missing pods with un-opened flower buds
Photos courtesy: Boyd Mori, Canada



Figure 6: Canola flower midges in trap liner.
Photo courtesy: Patrick Beauzay, NDSU

Swede Midge Results

All trap data were negative for swede midge from 117 trap sites in 15 counties during 6 years of pheromone trapping (2015-2021).



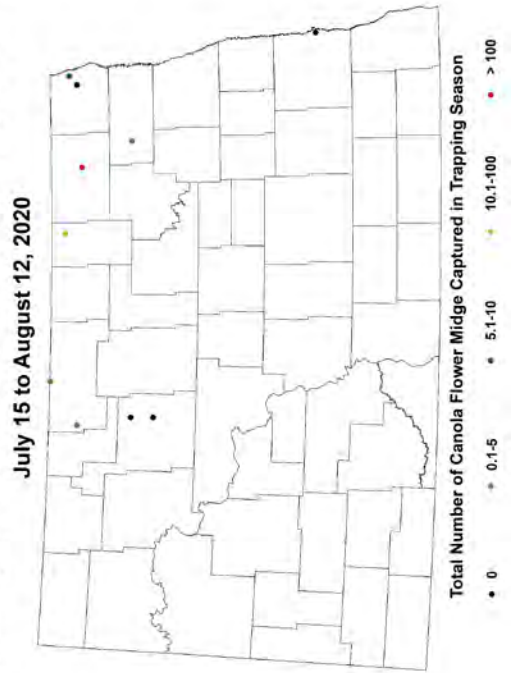
Canola Flower Midge Results

Pheromone trapping for canola flower midge in ND started in 2020 in 8 counties and in 10 counties in 2021. In 2020, 6 trap sites were positive out of a total of 10 trap sites. A total of 426 canola flower midges were captured. The three trap sites with the highest number of canola flower midges were:

1. Cavalier County- 333
2. Towner County- 77
3. Pembina County- 10

All midges were captured during late July through the first week of August.

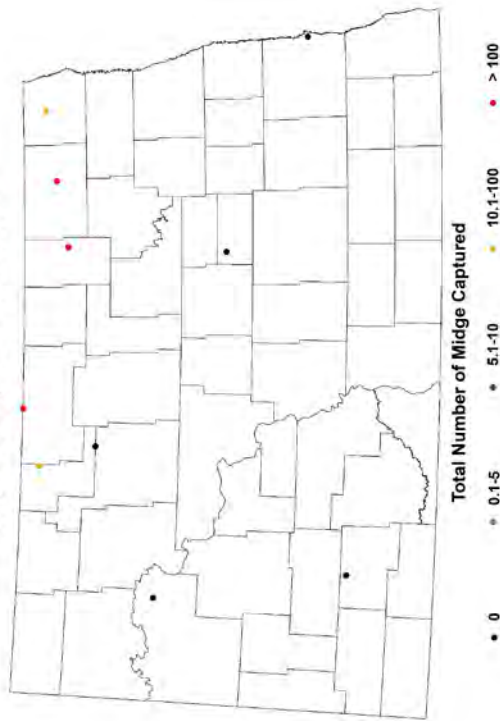
2020 Canola Flower Midge (*Contarinia brassicicola*) Trap Survey in Canola, North Dakota



Five out of 10 trap sites were positive in 2021. A total of 541 canola flower midges were captured which shows an increase of 12% from 2020. The three trap sites with the highest number of canola flower midges were:

1. Towner County- 277
 2. Cavalier County- 107
 3. Bottineau County- 105
- Midges were captured during early July through the first week of August with peak during late July into early August.

**2021 Canola Flower Midge (*Contarinia brassicola*)
Trap Survey in Canola, ND**



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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 2022 growing season are listed below:

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

Barley – Lacey

Soybeans – ND17009GT, ND21008GT20

Flax – ND Hammond, CDC Rowland

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.



DISCLAIMER. The information given herein is for educational purposes only. Any reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement is implied by the NDSU Langdon Research Extension Center faculty and staff.



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