Langdon Research Extension Center

NORTH DAKOTA STATE UNIVERSITY

Annual Research Report No. 99

December 2024

NDSU NORTH DAKOTA STATE UNIVERSITY

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NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

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The 2024 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 can be accessed at www.ag.ndsu.edu/varietytrials/ (old NDSU variety trial website) and https://vt.ag.ndsu.edu/ (new NDSU variety trial website). For NDSU crop publications and additional crop information visit: www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/crops.

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 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. The trial mean shown in the tables represent all named varieties and experimental lines tested in the trial. Experimental line data is not shown. Statistical analysis includes all varieties and experimental lines in the trial.

'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 2024. 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.

2024 Weather Summary

Fall recharge at Langdon from September through October 2023 was 4.38 inches, 1.03 inches below normal. Precipitation from November 2023 through March 2024 was 3.23 inches, 1.03 inches below normal. Snowfall for 2023-2024 from October through April was 33.4 inches, 2.3 inches above normal. October and January received the most snow. December-February temperatures averaged 17.0^{O} F, 11.4^{O} F above normal. December was the 2nd warmest on record, while February was the 4th warmest on record. Precipitation from April to September was 26.34 inches, 11.93 inches above normal. Temperatures averaged 2.2^{o} F above normal for the same time period. May had the most rainfall on record with 6.51 inches, while June was the 8th wettest and September the 6th wettest. September was also the 2nd hottest on record. The 2024 growing season precipitation ranged from 108-176 percent of normal across NE North Dakota from April-September according to the NDAWN stations. Areas in Cavalier, Ramsey, and Benson counties received the highest amount of rainfall. Small grain yields were generally very good with some variability in canola yields. Soybean and corn yields were good as well.

2024 Crop Management - Langdon					
Field Trial	**Previous Crop**	**Seeding Rate Unit/Acre**	**Planting Date**	**Harvest Date**	**Row Spacing**
Barley	soybean	1.0 million pls	May 20	Sept.4	6
Buckwheat	barley	50 lbs pls	May 22	Oct. 8	6
Canola	barley	435,000 pls	May 31	Sept. 25	6
Corn	barley	28,000 thinned	May 13	Oct. 14	30
Durum	soybean	1.50 million pls	May 20	Sept. 11	6
Dry Bean	barley	75,000-90,000 pls	May 30	Oct. 8	30
Field Pea	barley	325,000 pls	May 17	Sept. 9	6
Flax	barley	2.8 million pls	May 22	Oct. 7	6
HRSW	soybean	1.50 million pls	May 20	Sept. 12	6
HRWW	soybean	1.2 million pls	Sept. 28, 2023	Aug. 9	6
Oat	soybean	1.0 million pls	May 20	Sept. 10	6
Rye	soybean	1.0 million pls	Sept. 28, 2023	Aug. 19	6
Soybean – Conv.	barley	200,000 pls	May 17	Oct. 7	6
Soybean – RR	barley	200,000 pls	May 17	Oct. 7	6
Sunflower – Conf.	wheat	17,000 thinned	May 30	Oct. 25	30
Sunflower – Oil	wheat	20,000 thinned	May 30	Oct. 25	30

pls=pure live seed emergence

Langdon Soil Type: Svea-Barnes loam

2024 Crop Management – Off-Station					
Location (County/Field Trial)	**Previous Crop**	**Seeding Rate Unit/Acre**	**Planting Date**	**Harvest Date**	**Row Spacing**
Cavalier (Pembina County)					
HRSW (No-Till)	HRWW	1.50 million pls	May 29	Sept. 5	7
Soybean (No-Till)	HRWW	200,000 pls	May 29	*	7
Park River (Walsh County)					
HRSW	fallow	1.50 million pls	May 10	**	6
Soybean	wheat	200,000 pls	May 10	Oct. 2	6
Pekin (Nelson County)					
HRSW	soybean	1.50 million pls	May 15	Sept. 3	6
Soybean	wheat	200,000 pls	June 6	Oct .9	6
Cando (Towner County)					
HRSW	canola	1.50 million pls	May 15	Sept. 3	6

Location	**Soil Type**
Cavalier	Fargo silty clay
Park River	Antler clay loam
Pekin	Svea-Cresbard loam
Cando	Egeland-Embden fine sandy loam

pls = pure live seeds
* Soybeans were not harvested due to deer damage.
** Wheat trial results were too unreliable to publish.

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
Katie Thompson - Walsh County Extension Agent
Kent Schluchter - Cavalier
Madeleine Smith - former Pembina County Extension Agent
Jarvis Stein - Pekin

Record of Climatological Observation
Langdon, ND

	Precipitation		Dep. from		Temperature		Dep. from
	Normal*	2024	Normal		Normal*	2024	Normal
April	1.25	1.70	+0.45	April	37.9	40.9	+3.0
May	2.30	6.51	+4.21	May	51.6	51.9	+0.3
June	3.24	5.57	+2.33	June	61.1	60.6	-0.5
July	2.92	2.89	-0.03	July	66.3	68.1	+1.8
August	2.60	4.20	+1.60	August	64.5	64.9	+0.4
September	2.10	5.47	+3.37	September	54.7	62.8	+8.1
Total	14.41	26.34	+11.93	Total	56.0	58.2	+2.2

*121 year average

Monthly Growing Degree Days and Normals-Langdon

	Wheat Growing Degree Days			Corn Growing Degree Days			Sunflower Growing Degree Days		
	2024	Normal	Deviation	2024	Normal	Deviation	2024	Normal	Deviation
April	336	244	+92	--	--	--	--	--	--
May	614	619	-5	197	209	-12	301	308	-7
June	835	890	-55	342	360	-18	499	534	-35
July	1084	1027	+57	570	503	+67	754	689	+65
August	958	979	-21	449	472	-23	618	658	-40
September	887	704	+183	418	259	+159	574	372	+202
Total	4714	4463	+251	1976	1803	+173	2746	2561	+185

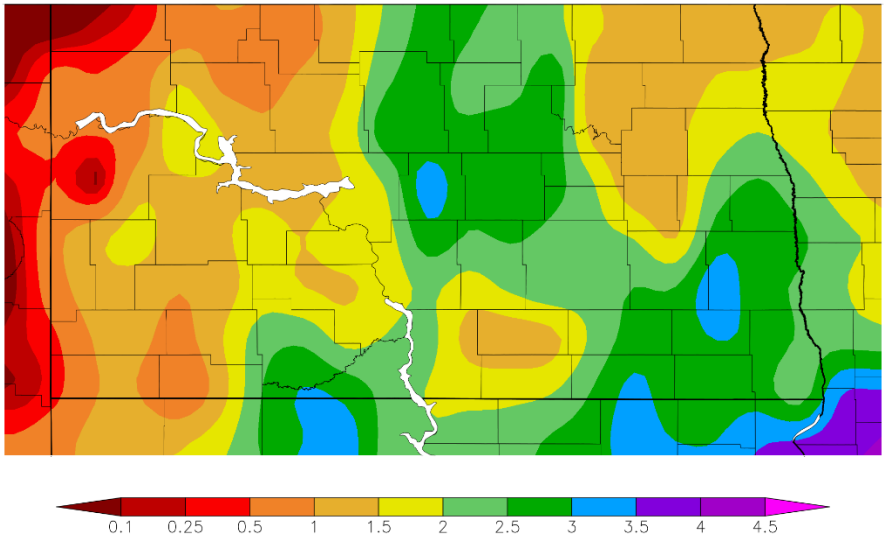
Frost Dates-Langdon and Selected Cities

	Last Spring Frost		First Fall Frost		Frost Free Days	
Langdon	32°F	28°F	32°F	28°F	32°F	28°F
Normal	20-May	9-May	19-Sep	29-Sep	122	143
2024	13-May	28-Apr	15-Oct	15-Oct	155	170
Cavalier						
Normal	16-May	5-May	24-Sep	5-Oct	131	153
2024	28-Apr	28-Apr	14-Oct	14-Oct	169	169
Park River						
Normal	8-May	30-Apr	30-Sep	10-Oct	145	163
2024	28-Apr	24-Apr	14-Oct	15-Oct	169	174
Pekin						
Normal	18-May	3-May	22-Sep	30-Sep	127	150
2024	28-Apr	24-Apr	14-Oct	14-Oct	169	173

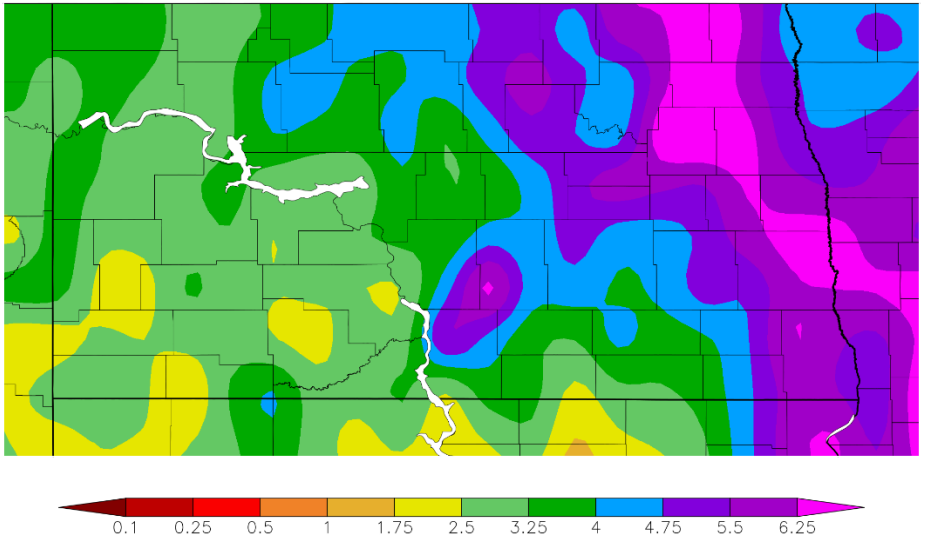
Normals are from the NWS. The 2024 frost dates are from the nearest reporting NDAWN station.

North Dakota 2024 Precipitation (inches) Maps

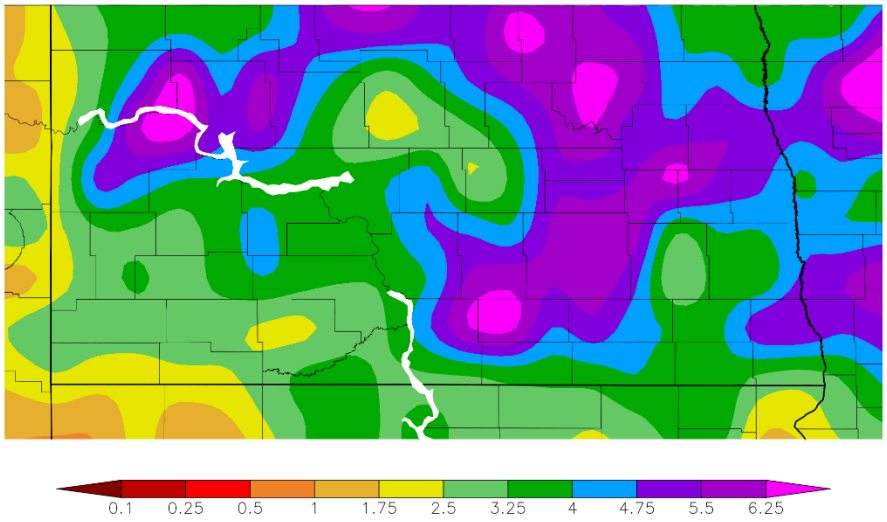
4/1/24 – 4/30/24



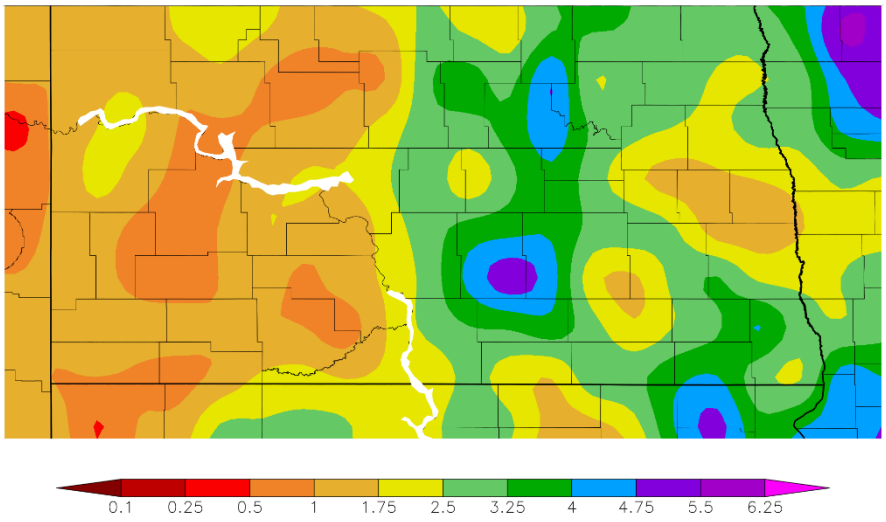
5/1/24 – 5/31/24



6/1/24 – 6/30/24

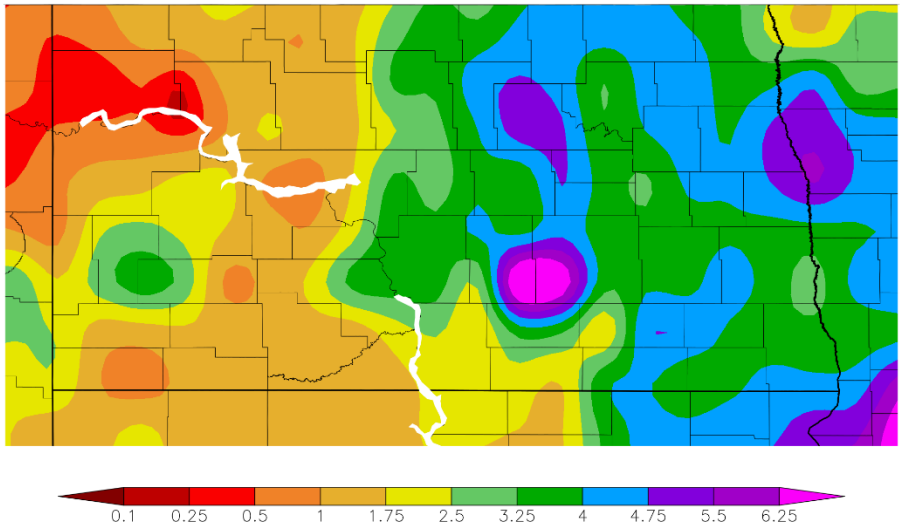


7/1/24 – 7/31/24

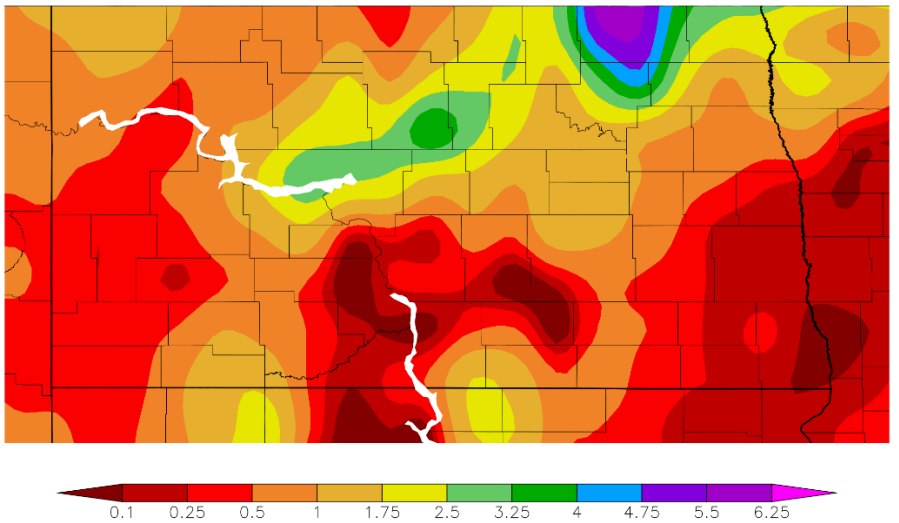


North Dakota 2024 Precipitation (inches) Maps Continued

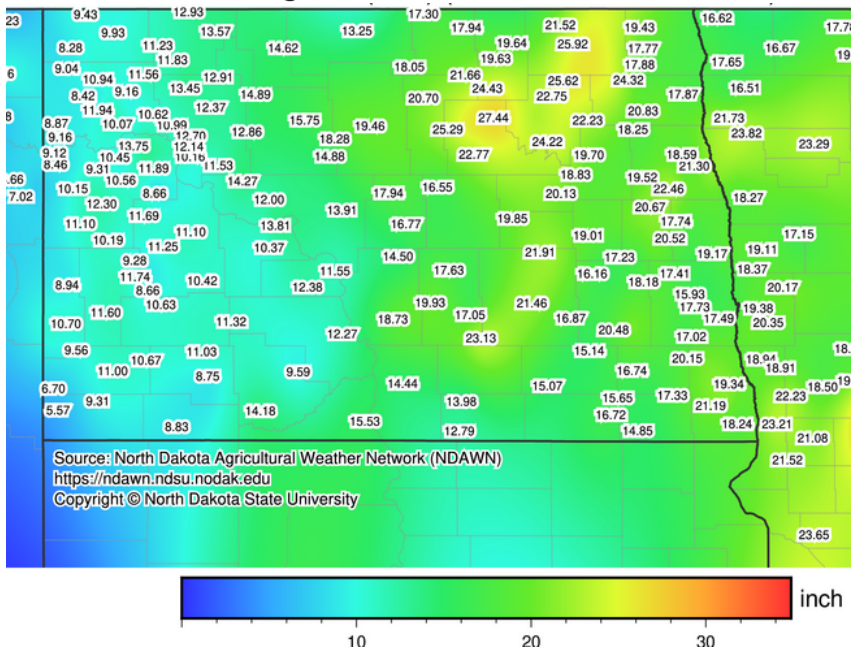
8/1/24 – 8/31/24



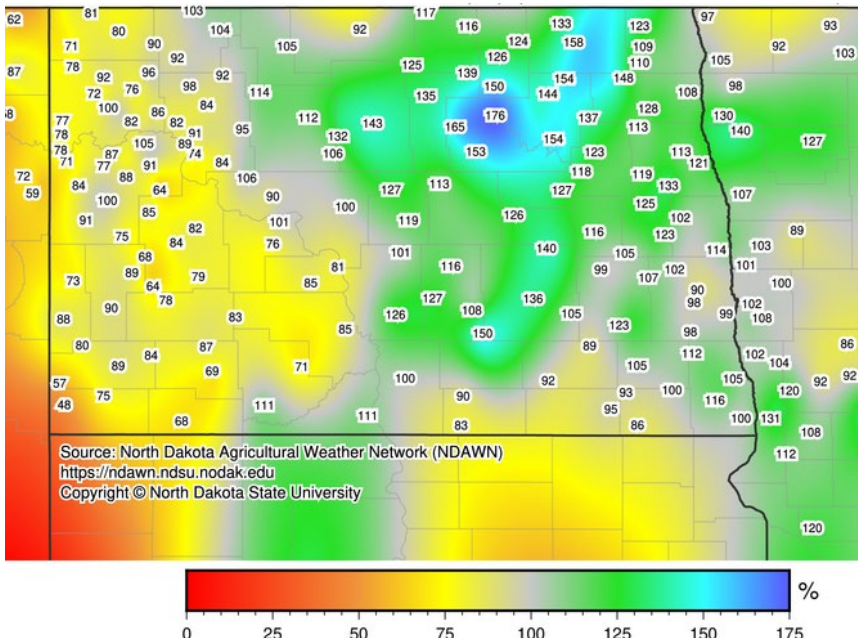
9/1/24 – 9/30/24

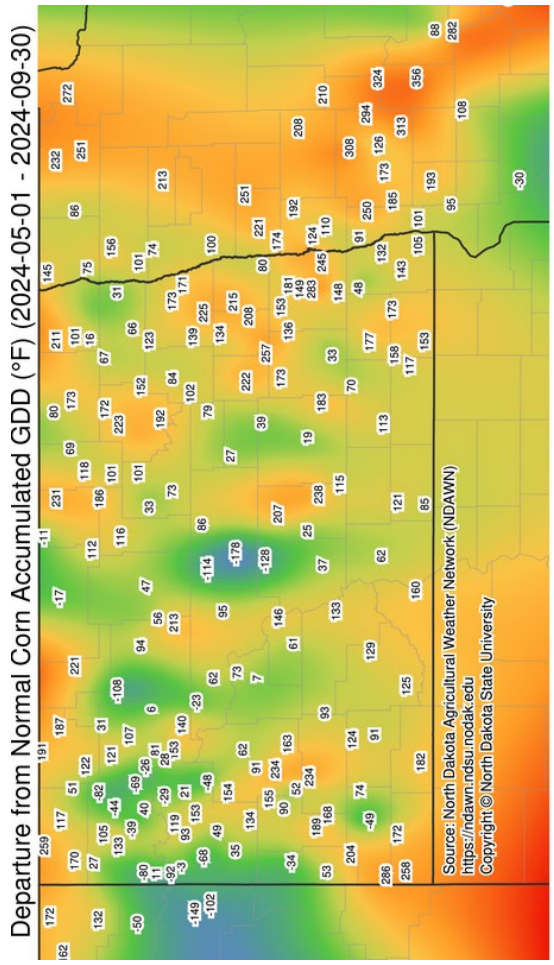


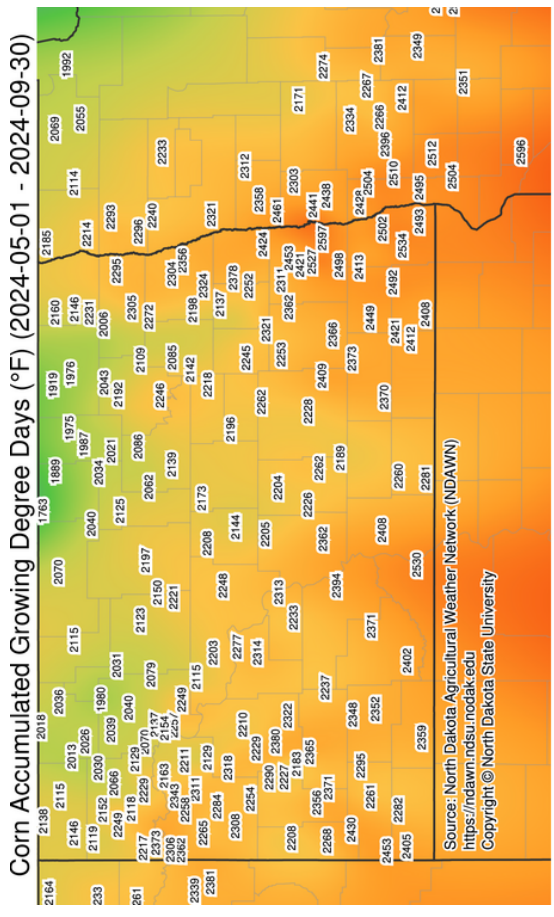
Growing Season 4/1/2024 – 9/30/2024

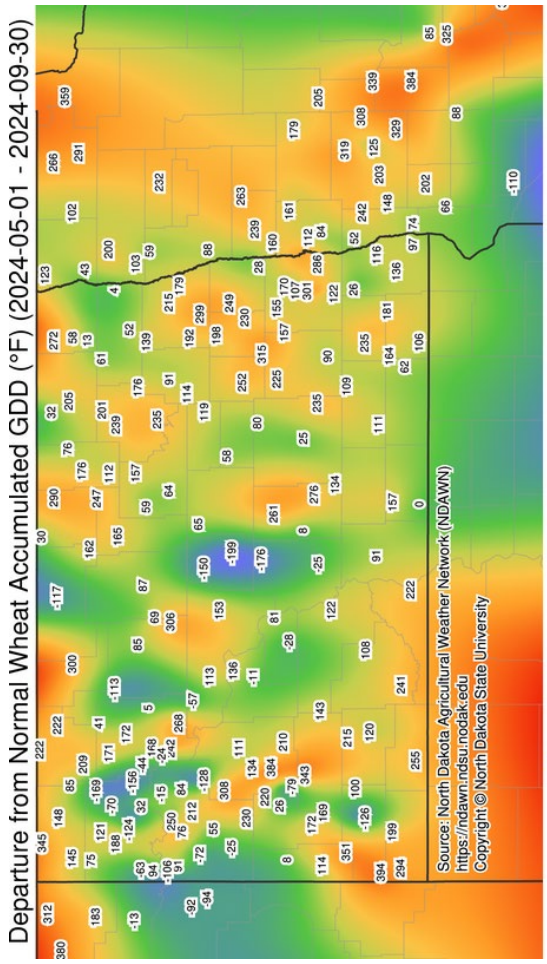


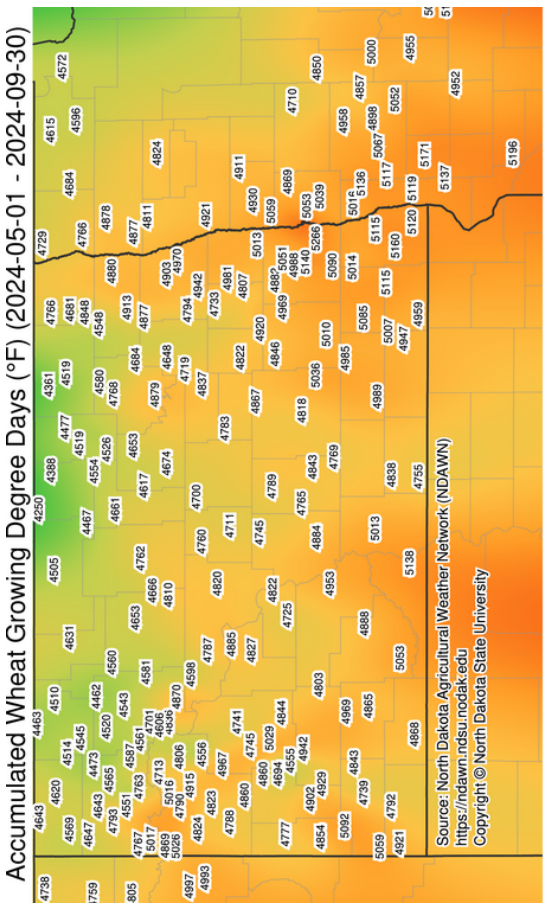
Percent of Normal Rainfall (%) (2024-04-01 – 2024-09-30)




Departure from Normal Corn Accumulated GDD (°F) (2024-05-01 - 2024-09-30)
Source: North Dakota Agricultural Weather Network (NDAWN)
https://ndawn.ndsu.nodak.edu
Copyright © North Dakota State University
°F
-200
-100
0
100
200
300
400


Corn Accumulated Growing Degree Days (°F) (2024-05-01 - 2024-09-30)
Source: North Dakota Agricultural Weather Network (NDAWN)
https://ndawn.ndsu.nodak.edu
Copyright © North Dakota State University
°F
1500
1750
2000
2250
2500
2750


Departure from Normal Wheat Accumulated GDD (°F) (2024-05-01 - 2024-09-30)
Source: North Dakota Agricultural Weather Network (NDAWN)
https://ndawn.ndsu.nodak.edu
Copyright © North Dakota State University
°F
-200
-100
0
100
200
300
400
500


Accumulated Wheat Growing Degree Days (°F) (2024-05-01 - 2024-09-30)
Source: North Dakota Agricultural Weather Network (NDAWN)
https://ndawn.ndsu.nodak.edu
Copyright © North Dakota State University
°F
4000
4250
4500
4750
5000
5250
5500

Durum Summary, Langdon 2020-2024

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)					Height (in)					Days to Head				
Variety	**20**	**21**	**22**	**23**	**24**	**5yr**	**20**	**21**	**22**	**23**	**24**	**5yr**	**16**	**17**	**20**	**24**	**4yr**	**21**	**22**	**23**	**24**	**4yr**	**21**	**22**	**23**	**24**	**4yr**
Alkabo	80	49	78	63	83	70	59.8	59.5	60.6	62.0	62.4	60.9	5.8	1.3	0.1	1.3	2.1	29	37	39	43	37	62	53	53	58	57
Maier	62	40	68	62	80	62	56.0	59.4	59.8	61.8	61.9	59.8	5.0	4.8	2.6	1.4	3.5	27	37	37	41	36	61	54	56	58	57
Mountrail	70	49	86	74	86	73	57.4	59.3	60.5	61.8	61.1	60.0	7.2	5.0	3.8	1.7	4.4	29	37	39	44	37	61	54	56	59	58
Strongfield	62	46	71	64	72	63	56.2	58.8	58.7	61.3	61.5	59.3	6.4	4.5	5.5	3.5	5.0	30	34	38	43	36	62	53	55	59	57
Carpio	77	50	81	67	81	71	59.5	59.8	62.7	61.9	63.1	61.4	7.6	6.5	2.7	1.6	4.6	31	37	38	43	37	63	55	59	60	59
Joppa	76	44	86	68	82	71	58.3	60.2	61.1	62.5	61.2	60.7	6.9	6.8	3.5	1.4	4.7	32	38	37	45	38	63	53	56	59	58
Divide	78	51	75	63	80	69	58.6	59.7	61.1	61.3	62.0	60.5	6.9	6.3	2.9	1.4	4.4	32	40	39	42	38	62	56	60	59	59
ND Grano	75	50	84	67	89	73	58.2	61.0	61.9	62.1	62.6	61.2	6.4	5.0	1.9	2.2	3.9	29	37	39	43	37	64	53	58	60	59
ND Riveland	79	45	81	64	88	72	58.7	59.5	61.6	61.1	62.5	60.7	5.9	3.3	3.1	1.6	3.5	32	39	40	46	39	63	55	58	59	59
ND Stanley	82	50	86	68	84	74	60.0	60.4	62.7	62.7	63.5	61.9	--	4.0	2.6	2.0	--	30	36	38	43	37	63	54	57	60	59
Tioga	77	48	81	64	--	--	58.4	59.3	62.1	61.1	--	--	6.4	6.0	4.0	--	--	33	40	41	--	--	61	55	58	--	--
Rugby	63	41	69	--	--	--	57.1	59.8	61.1	--	--	--	7.0	8.0	7.0	--	--	31	40	--	--	--	61	53	--	--	--
TCG Webster	55	40	71	--	--	--	57.7	59.6	59.9	--	--	--	--	--	0.2	--	--	24	29	--	--	--	59	50	--	--	--
CDC Defy	--	--	82	--	--	--	--	--	60.8	--	--	--	--	--	--	--	--	--	38	--	--	--	--	52	--	--	--
CDC Vantta	--	--	58	--	--	--	--	--	56.1	--	--	--	--	--	--	--	--	--	34	--	--	--	--	58	--	--	--
AC Commander	59	42	--	--	--	--	54.7	58.7	--	--	--	--	3.8	1.8	0.4	--	--	25	--	--	--	--	58	--	--	--	--
Ben	75	46	--	--	--	--	59.5	59.8	--	--	--	--	6.2	4.0	3.5	--	--	33	--	--	--	--	60	--	--	--	--
Grenora	84	49	--	--	--	--	58.4	59.1	--	--	--	--	6.7	5.8	4.3	--	--	29	--	--	--	--	61	--	--	--	--
Lebsock	75	45	--	--	--	--	60.4	60.0	--	--	--	--	5.7	3.8	2.0	--	--	29	--	--	--	--	61	--	--	--	--
Pierce	76	45	--	--	--	--	59.1	59.7	--	--	--	--	6.6	5.3	3.7	--	--	29	--	--	--	--	61	--	--	--	--
Alzada	48	39	--	--	--	--	54.1	57.3	--	--	--	--	3.0	0.3	0.4	--	--	26	--	--	--	--	59	--	--	--	--
CDC Verona	61	52	--	--	--	--	54.9	59.4	--	--	--	--	5.7	6.0	4.8	--	--	30	--	--	--	--	62	--	--	--	--
VT Peak	80	49	--	--	--	--	59.6	60.8	--	--	--	--	4.3	4.3	0.8	--	--	31	--	--	--	--	61	--	--	--	--
Trial Mean	74	48	79	66	83		58.3	59.8	61.3	61.9	62.3		6.1	5.9	3.3	1.7		30	38	40	43		62	55	58	59	
C.V. %	8.6	7.1	6.4	5.4	5.4		1.8	0.5	1.6	0.7	0.9		14.9	31.8	52.6	--		1.9	4.0	5.1	4.1		1.9	1.5	2.3	1.1	
LSD 5%	8.8	3.1	7.1	6.3	--		1.5	0.2	1.4	0.6	--		1.3	2.6	2.4	--		1.0	2.1	2.8	--		1.0	1.1	1.9	--	
LSD 10%	7.4	2.6	5.9	--	5.2		1.3	0.2	1.2	0.5	0.7		1.1	2.2	2.0	--		0.9	1.8	2.4	2.1		0.9	0.9	1.6	0.8	

Average Data by Crop and Year Across Sites

HRSW	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Height (in)					Days to Head					Lodging (0-9)				
No. Sites	**5**	**3[1]**	**5**	**4**	**4**	**12**	**5**	**5**	**5**	**4**	**4**	**14**	**5**	**5**	**5**	**4**	**4**	**14**	**4**	**5**	**4**	**4**	**13**	**3**	**5**	**4**	**4**	**12**	**4**	**1**	**1**	**2**	**6**
Variety	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**21**	**22**	**23**	**24**	**3yr**	**21**	**22**	**23**	**24**	**3yr**	**19**	**20**	**22**	**24**	**3yr**
SY Valda	71	59	72	83	82	79	59.6	59.7	59.9	61.0	60.5	60.5	14.3	14.7	14.0	13.8	13.3	13.7	25	30	29	33	31	57	46	45	53	48	1.6	0.5	2.0	1.2	1.1
LCS Trigger	75	65	72	85	83	80	59.9	59.2	60.4	59.7	60.6	60.2	12.3	13.0	12.6	11.9	11.3	11.9	26	34	34	37	35	61	52	51	59	54	1.4	3.7	1.8	1.7	2.6
AP Murdock	73	52	69	77	86	77	59.7	59.6	59.6	60.2	60.2	60.0	14.3	14.9	14.0	13.7	13.1	13.6	25	30	30	33	31	56	46	37	52	45	1.1	0.6	1.9	1.5	0.9
Ambush	64	58	71	85	82	79	59.9	60.8	58.8	62.2	61.7	60.9	15.6	15.5	14.3	14.2	14.4	14.3	25	32	32	33	32	56	47	45	51	48	0.5	0.2	2.4	1.4	0.4
Ballistic	66	66	63	96	86	81	57.6	58.9	60.1	60.2	60.7	60.3	14.9	14.7	15.1	13.5	13.0	13.9	27	30	33	36	33	58	45	47	53	48	1.4	1.9	2.0	2.5	1.7
Commander	66	54	63	80	84	76	59.3	60.2	59.5	61.1	60.6	60.4	14.6	15.0	14.5	14.1	13.7	14.1	25	31	31	35	32	55	44	43	51	46	0.2	0.0	1.0	1.1	0.1
LCS Cannon	66	54	63	80	80	74	60.1	61.0	60.6	61.7	61.5	61.3	14.6	14.9	14.4	14.0	13.6	14.0	23	29	28	32	30	53	42	40	49	44	0.6	0.0	0.0	1.0	0.3
MN-Torgy	68	59	65	80	83	76	59.4	60.0	59.9	61.5	61.2	60.9	15.5	15.4	15.2	14.8	14.0	14.7	26	33	33	36	34	58	49	49	53	50	--	2.4	1.0	1.8	2.4
AP Smith	65	59	66	79	81	75	59.0	59.9	59.1	60.7	60.4	60.1	14.9	15.2	14.6	14.1	13.9	14.2	23	29	29	32	30	57	47	46	54	49	--	--	0.4	1.0	--
MS Cobra	--	58	59	78	85	74	--	59.7	58.9	61.4	61.2	60.5	--	15.5	14.8	14.4	13.8	14.3	24	30	30	33	31	55	45	44	52	47	--	--	2.2	1.1	--
ND Thresher	--	55	62	76	67	68	--	58.5	59.1	59.6	59.6	59.4	--	15.6	14.8	14.3	14.0	14.4	25	30	31	32	31	58	48	49	53	50	--	--	0.7	1.3	--
LCS Ascent	--	--	67	84	83	78	--	--	59.9	61.8	61.5	61.1	--	--	13.7	13.3	12.8	13.3	--	30	29	34	31	--	43	42	51	45	--	--	4.4	1.9	--
LCS Dual	--	--	60	81	79	73	--	--	60.1	61.2	60.9	60.7	--	--	14.0	13.3	13.2	13.5	--	31	30	34	32	--	45	43	52	47	--	--	0.1	1.0	--
MN-Rothsay	--	--	64	83	84	77	--	--	59.0	60.5	60.6	60.0	--	--	14.6	14.1	13.6	14.1	--	30	28	32	30	--	49	48	55	51	--	--	1.9	1.1	--
MS Charger	--	--	75	88	84	82	--	--	59.4	60.4	60.1	60.0	--	--	12.9	12.7	12.2	12.6	--	30	29	33	31	--	43	43	52	46	--	--	2.5	1.5	--
ND Heron	--	--	57	79	76	71	--	--	60.6	62.0	62.2	61.6	--	--	15.4	14.4	14.2	14.7	--	31	30	34	32	--	43	42	50	45	--	--	4.4	2.6	--
LCS Buster	72	61	--	89	87	--	57.6	57.7	--	58.5	59.0	--	12.5	13.0	--	11.9	11.7	--	26	--	34	38	--	59	--	50	58	--	--	2.7	--	1.8	--
CP3915	67	--	--	80	80	--	60.2	--	--	60.8	61.2	--	14.6	--	--	14.1	13.6	--	--	--	30	33	--	--	--	46	52	--	--	0.0	--	1.0	--
ND Stampede	--	--	--	87	91	--	--	--	--	60.5	61.1	--	--	--	--	14.6	13.8	--	--	--	31	35	--	--	--	46	51	--	--	--	--	1.3	--
Ascend-SD	--	--	--	83	77	--	--	--	--	60.9	60.7	--	--	--	--	13.9	13.9	--	--	--	34	40	--	--	--	46	55	--	--	--	--	2.6	--
LCS Boom	--	--	--	78	84	--	--	--	--	61.8	61.6	--	--	--	--	14.3	13.6	--	--	--	28	33	--	--	--	40	50	--	--	--	--	1.1	--
LCS Hammer AX	--	--	--	79	79	--	--	--	--	60.4	60.5	--	--	--	--	13.8	13.5	--	--	--	29	34	--	--	--	44	51	--	--	--	--	1.1	--
WB 9590	--	--	--	83	84	--	--	--	--	60.8	61.0	--	--	--	--	14.6	14.0	--	--	--	27	30	--	--	--	45	52	--	--	--	--	1.1	--
CP3119A	--	63	65	--	80	--	--	56.7	56.3	--	56.4	--	--	13.4	13.1	--	12.3	--	28	33	--	38	--	61	52	--	60	--	--	--	0.8	1.0	--
CP3099A	--	--	72	--	83	--	--	--	58.5	--	56.5	--	--	--	13.0	--	11.4	--	--	34	--	39	--	--	50	--	58	--	--	--	0.9	1.1	--
AP Elevate	--	--	--	--	85	--	--	--	--	--	60.0	--	--	--	--	--	13.8	--	--	--	--	32	--	--	--	--	53	--	--	--	--	1.1	--
Brawn SD	--	--	--	--	83	--	--	--	--	--	62.0	--	--	--	--	--	13.0	--	--	--	--	37	--	--	--	--	52	--	--	--	--	3.4	--
CAG Ceres	--	--	--	--	80	--	--	--	--	--	60.8	--	--	--	--	--	13.8	--	--	--	--	34	--	--	--	--	52	--	--	--	--	1.1	--
CAG Justify	--	--	--	--	86	--	--	--	--	--	59.4	--	--	--	--	--	12.7	--	--	--	--	36	--	--	--	--	54	--	--	--	--	2.9	--
CAG Reckless	--	--	--	--	83	--	--	--	--	--	61.5	--	--	--	--	--	13.8	--	--	--	--	37	--	--	--	--	53	--	--	--	--	1.9	--
CAG Recoil	--	--	--	--	86	--	--	--	--	--	60.7	--	--	--	--	--	13.6	--	--	--	--	34	--	--	--	--	59	--	--	--	--	1.7	--
CP3360AX	--	--	--	--	79	--	--	--	--	--	61.6	--	--	--	--	--	12.8	--	--	--	--	33	--	--	--	--	50	--	--	--	--	1.1	--
MS Nova	--	--	--	--	75	--	--	--	--	--	60.2	--	--	--	--	--	13.9	--	--	--	--	33	--	--	--	--	51	--	--	--	--	1.0	--
Rocker	--	--	--	--	79	--	--	--	--	--	60.3	--	--	--	--	--	14.1	--	--	--	--	35	--	--	--	--	55	--	--	--	--	1.5	--
TW Olympic	--	--	--	--	82	--	--	--	--	--	60.8	--	--	--	--	--	13.6	--	--	--	--	36	--	--	--	--	53	--	--	--	--	1.4	--
TW Starlite	--	--	--	--	80	--	--	--	--	--	61.1	--	--	--	--	--	14.2	--	--	--	--	44	--	--	--	--	56	--	--	--	--	3.1	--
TW Trailfire	--	--	--	--	78	--	--	--	--	--	60.8	--	--	--	--	--	13.7	--	--	--	--	36	--	--	--	--	50	--	--	--	--	2.5	--
MS Ranchero	--	--	--	--	82	--	--	--	--	--	59.8	--	--	--	--	--	13.0	--	--	--	--	39	--	--	--	--	58	--	--	--	--	4.3	--
TCG-Spitfire	69	56	71	82	--	--	58.7	58.9	59.2	59.6	--	--	14.1	15.3	14.1	13.8	--	--	27	32	31	--	--	58	49	49	--	--	0.0	0.3	1.5	--	--
SY 611 CL2	66	58	67	80	--	--	59.8	60.4	60.0	61.7	--	--	15.1	15.5	14.6	14.6	--	--	23	29	29	--	--	55	46	45	--	--	0.2	0.2	1.3	--	--
TCG-Heartland	59	55	60	77	--	--	59.5	60.9	60.3	61.6	--	--	15.7	16.1	15.5	15.1	--	--	24	28	29	--	--	55	45	44	--	--	0.0	0.0	0.8	--	--
SY Ingmar	65	53	64	73	--	--	60.0	60.5	60.2	61.0	--	--	15.4	15.6	15.1	14.7	--	--	24	30	29	--	--	56	46	45	--	--	0.1	0.0	1.5	--	--
TCG-Wildcat	66	60	67	79	--	--	60.2	60.5	60.2	61.2	--	--	15.4	15.5	15.0	14.6	--	--	24	31	30	--	--	56	47	45	--	--	--	0.2	0.9	--	--
CP3530	--	62	69	82	--	--	--	59.0	59.7	60.3	--	--	--	14.8	14.9	14.1	--	--	26	33	34	--	--	60	48	47	--	--	1.9	--	2.5	--	--
TCG-Teddy	--	--	--	79	--	--	--	--	--	59.9	--	--	--	--	--	14.3	--	--	--	--	27	--	--	--	--	46	--	--	--	--	--	--	--
WB 9719	--	--	--	81	--	--	--	--	--	62.5	--	--	--	--	--	13.8	--	--	--	--	29	--	--	--	--	47	--	--	--	--	--	--	--
Faller	69	62	70	--	--	--	58.6	59.3	59.7	--	--	--	14.4	14.5	14.0	--	--	--	27	33	--	--	--	58	48	--	--	--	2.2	2.0	2.6	--	--

[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 2020-2024 (Page 1 of 2)

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Days to Head						Height (in)						Shatter (0-9)[1]	Lodging (0-9)
Variety	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**2021**	**2020**
Faller	81	28	86	81	89	85	59.7	58.6	61.4	59.0	61.7	60.7	14.1	15.3	13.6	12.8	12.8	13.1	48	63	51	48	57	52	34	24	34	34	38	35	1.3	2.0
Glenn	74	27	68	69	69	68	62.5	61.3	62.7	62.1	62.7	62.5	15.2	17.1	15.0	13.3	14.5	14.3	45	59	47	44	52	48	35	21	35	34	39	36	1.6	1.3
Bolles	68	15	71	74	77	74	58.8	59.4	60.4	59.3	61.1	60.3	16.6	18.5	15.8	14.4	14.4	14.9	50	62	52	48	57	52	33	23	33	33	35	34	4.1	0.6
SY Ingmar	77	21	75	71	74	74	60.6	60.9	61.5	59.8	61.2	60.8	15.2	17.1	15.0	13.3	14.2	14.2	47	59	50	44	57	50	31	20	31	28	32	30	0.9	0.0
SY Valda	79	28	86	79	87	84	59.9	60.4	60.8	59.5	60.7	60.3	14.2	16.4	14.1	12.5	13.2	13.3	47	62	50	44	55	50	32	21	32	28	34	31	1.5	0.5
ND VitPro	76	21	71	70	74	72	62.2	60.7	62.7	61.5	62.8	62.3	15.1	17.4	14.8	13.8	14.7	14.4	46	59	48	45	54	49	34	21	33	31	36	33	0.5	0.7
LCS Trigger	81	23	94	80	88	87	60.2	59.5	61.4	59.0	61.8	60.7	12.6	14.3	12.1	11.6	11.1	11.6	53	64	55	53	62	57	35	20	35	35	39	36	0.0	3.7
Ambush	68	17	78	81	83	81	59.6	60.1	59.5	61.6	61.7	60.9	15.6	17.3	14.4	12.6	14.4	13.8	46	61	51	44	53	49	32	21	33	31	34	33	2.2	0.2
SY 611 CL2	78	23	82	86	82	83	60.4	60.7	61.3	61.4	61.6	61.4	14.9	17.5	14.6	13.3	13.9	13.9	47	61	48	45	54	49	30	18	30	28	32	30	0.0	0.2
LCS Cannon	73	23	76	87	80	81	59.8	60.8	61.7	60.8	61.9	61.5	14.8	16.5	14.6	12.8	13.5	13.6	43	58	46	40	53	46	30	20	30	28	32	30	1.4	0.0
Ballistic	73	24	76	95	90	87	56.7	58.8	61.5	58.7	61.0	60.4	15.1	16.0	15.0	12.5	13.0	13.5	47	63	48	47	55	50	34	24	32	33	37	34	2.7	1.9
Commander	74	17	75	76	82	78	59.2	59.7	60.3	59.9	60.7	60.3	14.7	16.5	14.2	13.0	13.6	13.6	46	59	48	43	53	48	31	21	32	30	35	32	2.1	0.0
SY Longmire	78	26	70	72	76	73	59.4	60.9	60.1	59.8	60.8	60.2	15.2	17.4	15.2	13.2	13.8	14.1	46	60	50	46	54	50	31	21	31	29	33	31	1.2	0.0
AP Murdock	87	21	93	73	86	84	59.7	59.6	61.7	58.4	60.1	60.1	14.0	16.8	13.7	12.8	12.9	13.1	47	61	50	45	54	50	31	21	31	29	33	31	2.1	0.6
MN-Torgy	70	28	82	75	82	80	59.1	60.2	61.5	60.6	61.7	61.3	15.5	16.8	14.7	13.9	14.3	14.3	49	64	51	51	56	53	34	21	34	34	38	35	0.9	2.4
CP3915	80	29	84	75	82	81	61.1	60.5	61.4	59.5	61.7	60.9	14.9	16.6	14.5	13.5	13.8	13.9	46	61	50	45	55	50	32	21	32	29	34	32	0.1	0.0
ND Heron	65	24	68	81	74	74	59.9	60.4	62.1	61.1	62.4	61.9	15.7	17.1	15.1	12.7	14.1	14.0	45	59	47	41	52	47	34	21	32	30	36	33	0.3	2.7
MN-Rothsay	63	21	77	80	88	82	58.2	60.3	60.1	59.4	61.1	60.2	15.3	16.7	14.6	13.6	13.3	13.8	50	64	52	49	58	53	30	21	31	28	33	31	3.3	0.1
Driver	73	29	82	84	82	83	60.0	60.6	62.1	60.3	61.9	61.4	14.5	15.9	13.9	12.9	13.6	13.5	48	62	51	46	57	51	34	22	34	33	37	35	1.3	0.6
Lanning	57	28	61	75	79	71	55.1	58.6	58.2	59.2	60.6	59.3	16.6	17.4	15.3	13.9	14.3	14.5	49	62	49	51	55	52	32	21	32	33	37	34	0.4	0.2
LCS Buster	73	22	86	80	94	87	57.0	57.8	59.1	56.6	60.1	58.6	12.8	13.9	12.5	11.5	11.1	11.7	53	63	54	51	61	55	35	22	35	35	39	36	3.4	2.7
MS Ranchero	62	33	76	78	88	81	54.6	58.9	59.1	59.1	60.8	59.7	15.4	15.1	14.2	13.1	13.1	13.5	51	63	52	56	58	55	34	21	35	39	43	39	0.3	5.8
ND Frohberg	73	14	77	75	75	76	61.0	59.9	61.8	60.0	61.6	61.1	14.7	17.2	14.2	13.2	13.5	13.6	47	60	49	45	55	50	35	21	34	32	38	35	4.8	1.2
TCG-Wildcat	74	23	79	81	83	81	60.5	60.4	61.9	59.9	61.5	61.1	15.2	17.0	15.2	13.2	14.4	14.3	47	59	50	44	56	50	32	18	31	29	35	32	2.0	0.2
AP Gunsmoke CL2	77	24	81	77	77	78	58.0	59.4	60.4	59.0	60.5	60.0	15.5	17.4	14.8	13.7	13.3	13.9	46	61	49	45	54	49	33	19	30	29	34	31	2.0	2.0
AP Smith	76	24	80	75	86	80	59.6	60.9	60.6	59.6	60.4	60.2	14.9	16.6	14.7	13.1	14.1	14.0	48	60	52	45	56	51	30	18	31	28	31	30	1.7	0.0
CAG Justify	--	23	93	81	84	86	--	57.9	60.0	55.7	59.4	58.4	--	15.2	13.1	12.4	12.6	12.7	--	62	52	48	56	52	--	22	34	32	38	35	2.4	--
CAG Reckless	--	24	82	85	85	84	--	59.9	61.5	60.6	61.7	61.3	--	16.7	14.3	12.4	13.8	13.5	--	61	49	45	55	50	--	20	35	34	38	36	3.6	--
CP3099A	--	31	82	77	79	79	--	59.2	58.9	53.8	56.6	56.4	--	13.9	12.5	11.0	10.5	11.3	--	63	54	49	59	54	--	22	35	35	40	37	0.3	--
CP3188	--	27	81	71	79	77	--	58.2	59.9	57.6	59.3	58.9	--	14.2	13.0	11.8	12.1	12.3	--	61	50	44	54	49	--	20	33	32	36	34	1.2	--
MS Cobra	--	20	68	78	83	76	--	59.9	60.2	60.7	61.2	60.7	--	16.9	15.0	13.1	13.8	14.0	--	60	49	44	55	49	--	20	31	30	35	32	1.5	--
Allegiant 8175	--	21	75	79	80	78	--	60.0	61.7	59.7	62.0	61.1	--	17.0	14.0	12.6	13.2	13.3	--	60	50	45	55	50	--	22	32	31	34	32	0.6	--
WB9590	--	22	74	79	84	79	--	59.3	60.3	60.1	60.7	60.4	--	17.8	15.0	13.8	13.8	14.2	--	60	48	45	53	49	--	19	28	27	31	29	1.6	--
ND Thresher	--	--	76	73	75	75	--	--	60.7	58.3	60.4	59.8	--	--	14.8	13.6	14.0	14.1	--	--	51	48	55	51	--	--	31	30	34	32	0.5	--
Shelly	58	--	76	86	91	84	55.5	--	60.2	59.9	61.3	60.5	16.1	--	14.1	12.9	13.0	13.3	48	--	51	46	56	51	31	--	30	29	33	31	--	0.1
AAC Starbuck VB	--	--	80	85	83	83	--	--	61.2	61.4	62.2	61.6	--	--	15.3	12.7	14.1	14.0	--	--	49	44	54	49	--	--	33	32	36	34	--	--
Ascend-SD	--	--	90	81	80	84	--	--	62.3	59.4	61.7	61.1	--	--	14.1	12.2	13.9	13.4	--	--	51	46	57	51	--	--	36	35	41	37	--	--
LCS Ascent	--	--	85	84	84	84	--	--	61.4	60.5	61.8	61.2	--	--	13.6	12.6	12.9	13.0	--	--	47	42	53	47	--	--	31	29	34	31	--	--
LCS Dual	--	--	73	80	81	78	--	--	61.4	60.2	61.6	61.1	--	--	13.9	12.2	13.0	13.0	--	--	48	44	54	49	--	--	32	30	36	33	--	--
LCS Hammer AX	--	--	80	79	83	81	--	--	61.0	59.5	61.1	60.5	--	--	14.4	12.8	13.4	13.5	--	--	49	44	53	49	--	--	31	29	33	31	--	--
MS Charger	--	--	90	85	87	87	--	--	60.2	59.4	60.5	60.0	--	--	12.5	12.1	12.0	12.2	--	--	48	43	54	48	--	--	31	28	34	31	--	--
Brawn-SD	--	--	80	84	85	83	--	--	62.7	61.2	62.1	62.0	--	--	13.1	12.2	12.6	12.6	--	--	49	45	55	50	--	--	34	33	38	35	--	--
ND Stampede	--	--	86	81	90	86	--	--	61.3	59.2	61.2	60.6	--	--	14.5	13.9	13.6	14.0	--	--	49	46	53	49	--	--	33	31	35	33	--	--
PFS Buns	--	33	--	80	94	--	--	57.4	--	57.0	59.4	--	--	15.0	--	12.8	11.7	--	--	66	--	55	67	--	--	21	--	32	34	--	1.6	--

HRSW Summary, Langdon 2020-2024 (Page 2 of 2)

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Days to Head						Height (in)						Shatter	Lodging
Variety	20	21	22	23	24	3yr	20	21	22	23	24	3yr	20	21	22	23	24	3yr	20	21	22	23	24	3yr	20	21	22	23	24	3yr	(0-9)[1] 2021	(0-9) 2020
WB9719	--	--	--	79	81	--	--	--	--	61.2	63.2	--	--	--	--	12.6	13.6	--	--	--	--	46	56	--	--	--	--	30	32	--	--	--
CDC Landmark VB	--	--	--	81	81	--	--	--	--	61.3	61.9	--	--	--	--	13.0	14.4	--	--	--	--	45	55	--	--	--	--	33	37	--	--	--
CP3322	--	--	--	80	79	--	--	--	--	58.1	59.4	--	--	--	--	12.5	11.8	--	--	--	--	52	62	--	--	--	--	34	35	--	--	--
LCS Boom	--	--	--	81	86	--	--	--	--	60.1	61.8	--	--	--	--	13.0	13.3	--	--	--	--	40	52	--	--	--	--	29	35	--	--	--
TCG-Teddy	--	--	--	75	81	--	--	--	--	57.9	60.3	--	--	--	--	13.6	13.8	--	--	--	--	45	57	--	--	--	--	26	30	--	--	--
AAC Spike	--	--	--	--	76	--	--	--	--	--	61.0	--	--	--	--	--	14.2	--	--	--	--	--	52	--	--	--	--	--	32	--	--	--
AAC Westking	--	--	--	--	82	--	--	--	--	--	61.1	--	--	--	--	--	13.8	--	--	--	--	--	55	--	--	--	--	--	34	--	--	--
Allegiant 6343	--	--	--	--	81	--	--	--	--	--	61.4	--	--	--	--	--	13.4	--	--	--	--	--	53	--	--	--	--	--	34	--	--	--
AP Elevate	--	--	--	--	89	--	--	--	--	--	60.3	--	--	--	--	--	13.8	--	--	--	--	--	55	--	--	--	--	--	32	--	--	--
CAG Ceres	--	--	--	--	80	--	--	--	--	--	61.0	--	--	--	--	--	13.7	--	--	--	--	--	54	--	--	--	--	--	33	--	--	--
CAG Recoil	--	--	--	--	90	--	--	--	--	--	60.8	--	--	--	--	--	13.2	--	--	--	--	--	62	--	--	--	--	--	36	--	--	--
CP 3055	--	--	--	--	92	--	--	--	--	--	59.0	--	--	--	--	--	12.1	--	--	--	--	--	64	--	--	--	--	--	37	--	--	--
CP 3119A	--	--	--	--	86	--	--	--	--	--	57.8	--	--	--	--	--	12.2	--	--	--	--	--	65	--	--	--	--	--	38	--	--	--
CP 3360AX	--	--	--	--	83	--	--	--	--	--	62.2	--	--	--	--	--	12.7	--	--	--	--	--	53	--	--	--	--	--	83	--	--	--
MS Nova	--	--	--	--	73	--	--	--	--	--	60.3	--	--	--	--	--	14.1	--	--	--	--	--	53	--	--	--	--	--	34	--	--	--
MT Carlson	--	--	--	--	84	--	--	--	--	--	61.0	--	--	--	--	--	13.3	--	--	--	--	--	54	--	--	--	--	--	35	--	--	--
MT Dutton	--	--	--	--	81	--	--	--	--	--	60.0	--	--	--	--	--	13.6	--	--	--	--	--	54	--	--	--	--	--	37	--	--	--
MT Ubet	--	--	--	--	81	--	--	--	--	--	60.8	--	--	--	--	--	13.7	--	--	--	--	--	56	--	--	--	--	--	39	--	--	--
PFS Rolls	--	--	--	--	90	--	--	--	--	--	61.4	--	--	--	--	--	13.1	--	--	--	--	--	57	--	--	--	--	--	37	--	--	--
Rocker	--	--	--	--	78	--	--	--	--	--	60.3	--	--	--	--	--	14.0	--	--	--	--	--	56	--	--	--	--	--	37	--	--	--
TCG Badlands	--	--	--	--	78	--	--	--	--	--	60.5	--	--	--	--	--	13.4	--	--	--	--	--	56	--	--	--	--	--	36	--	--	--
TCG Zelda	--	--	--	--	88	--	--	--	--	--	61.2	--	--	--	--	--	13.5	--	--	--	--	--	53	--	--	--	--	--	32	--	--	--
TW Olympic	--	--	--	--	84	--	--	--	--	--	61.7	--	--	--	--	--	13.4	--	--	--	--	--	55	--	--	--	--	--	37	--	--	--
TW Starlite	--	--	--	--	78	--	--	--	--	--	61.1	--	--	--	--	--	14.7	--	--	--	--	--	59	--	--	--	--	--	45	--	--	--
TW Trailfire	--	--	--	--	81	--	--	--	--	--	60.6	--	--	--	--	--	13.7	--	--	--	--	--	52	--	--	--	--	--	36	--	--	--
CP3530	83	32	87	80	--	--	60.1	59.8	61.0	59.4	--	--	15.3	16.5	14.7	12.8	--	--	48	63	52	47	--	--	36	22	36	35	--	--	0.9	1.2
TCG-Spitfire	80	25	83	79	--	--	60.1	59.2	60.0	59.0	--	--	14.0	16.5	13.6	12.9	--	--	50	62	52	48	--	--	33	22	32	30	--	--	1.3	0.3
SY McCloud	76	23	75	82	--	--	61.2	61.1	61.9	61.0	--	--	15.1	18.0	15.0	13.0	--	--	47	60	48	45	--	--	33	20	32	30	--	--	0.2	0.0
TCG-Heartland	67	23	68	75	--	--	59.8	60.9	61.0	60.4	--	--	15.7	17.7	15.4	14.0	--	--	46	60	48	43	--	--	31	20	30	27	--	--	1.3	0.0
Allegiant 822	72	28	81	73	--	--	61.4	61.2	62.2	61.2	--	--	14.4	17.1	13.8	13.5	--	--	46	61	49	45	--	--	31	19	30	28	--	--	0.4	0.5
Allegiant 8432	74	22	67	83	--	--	58.8	60.6	59.4	60.1	--	--	15.2	17.2	14.7	12.9	--	--	45	59	47	43	--	--	32	21	30	30	--	--	3.7	0.0
Lang-MN	73	26	--	78	--	--	59.8	60.3	--	61.2	--	--	15.6	16.5	--	13.4	--	--	50	63	--	50	--	--	35	22	--	35	--	--	0.9	2.5
Elgin-ND	66	--	--	73	--	--	59.1	--	--	60.0	--	--	14.7	--	--	12.5	--	--	45	--	--	43	--	--	36	--	--	34	--	--	--	2.8
WB9606	--	--	--	81	--	--	--	--	--	59.9	--	--	--	--	--	12.2	--	--	--	--	--	46	--	--	--	--	--	33	--	--	--	--
LCS Rebel	76	22	77	--	--	--	61.5	59.6	62.3	--	--	--	15.4	17.4	14.6	--	--	--	45	58	48	--	--	--	35	22	33	--	--	--	0.9	5.4
MS Barracuda	66	15	73	--	--	--	57.9	58.4	60.6	--	--	--	14.8	17.4	15.0	--	--	--	44	58	46	--	--	--	29	19	29	--	--	--	1.2	0.1
MN-Washburn	78	22	80	--	--	--	60.0	59.6	61.1	--	--	--	14.4	16.8	14.1	--	--	--	49	62	53	--	--	--	31	21	32	--	--	--	0.6	0.0
Trial Mean	71	24	79	79	83		59.1	59.7	60.8	59.6	61.0		15.1	16.6	14.3	13.0	13.4		47	61	50	46	55		33	21	32	31	36		1.4	1.1
C.V. %	8.1	9.3	7.7	8.2	4.3		1.8	0.5	1.1	1.3	0.7		3.0	1.1	2.8	4.9	2.7		1.2	0.9	1.6	2.3	1.9		3.3	6.7	3.2	4.0	3.4		56.1	88
LSD 5%	8.1	2.0	8.4	9.0	--		1.5	0.3	0.9	1.1	--		0.6	0.2	0.6	0.9	--		0.8	0.4	1.1	1.5	--		1.5	1.2	1.4	1.7	--		0.7	1.4
LSD 10%	6.8	1.7	7.1	7.5	4.1		1.2	0.2	0.8	0.9	0.5		0.5	0.1	0.5	0.8	0.4		0.7	0.4	1.0	1.2	1.2		1.3	1.0	1.2	1.4	1.4		0.6	1.1

2021 had 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.

[1]Relative Rating 0-9

HRSW Summary, Nelson County 2021-2024

	Yield (bu/a)					Test Weight (lbs/bu)					Protein (%)					Lodging (1-9)	Shatter (1-9)[1]		
Variety	**21**	**22**	**23**	**24**	**3yr**	**21**	**22**	**23**	**24**	**3yr**	**21**	**22**	**23**	**24**	**3yr**	**24**	**21**	**22**	**2yr**
SY Valda	53	69	85	88	81	58.8	58.3	61.2	60.7	60.1	14.8	13.6	14.1	14.0	13.9	1.2	1.7	0.8	1.3
LCS Trigger	61	55	84	91	77	58.6	58.9	59.9	60.6	59.8	13.7	12.9	12.2	11.5	12.2	1.0	1.7	2.5	2.1
Ambush	41	68	85	95	82	60.2	57.6	62.2	61.6	60.5	15.9	14.1	15.0	14.7	14.6	1.1	2.0	1.9	2.0
Ballistic	49	59	95	92	82	58.2	59.8	60.6	59.9	60.1	14.8	14.6	13.9	13.3	13.9	2.5	3.3	2.4	2.9
Commander	27	56	83	93	77	59.6	59.1	61.0	60.0	60.0	15.0	14.0	14.6	13.7	14.1	0.9	6.7	3.8	5.3
LCS Cannon	58	61	82	94	79	60.6	60.6	61.4	61.0	61.0	15.4	14.1	14.1	13.8	14.0	0.9	1.3	1.1	1.2
AP Murdock	37	56	81	92	76	59.4	58.2	60.5	59.8	59.5	15.3	13.9	13.8	13.8	13.8	1.1	4.0	3.0	3.5
MN-Torgy	55	54	79	90	74	59.6	57.6	61.8	59.9	59.8	16.1	15.5	15.3	14.4	15.1	1.7	3.0	0.8	1.9
AP Smith	48	58	75	85	73	59.1	57.8	60.9	59.7	59.5	15.4	14.0	14.7	13.8	14.2	0.9	3.0	3.7	3.4
MS Cobra	41	52	84	94	77	59.1	58.8	61.4	60.5	60.2	15.7	14.4	14.6	14.0	14.3	1.1	4.3	2.6	3.5
LCS Ascent	--	61	88	87	79	--	59.0	62.2	60.5	60.6	--	13.8	13.6	12.7	13.4	2.2	--	3.2	--
LCS Dual	--	52	84	86	74	--	60.3	61.0	59.9	60.4	--	13.1	13.4	13.5	13.3	1.0	--	2.8	--
MN-Rothsay	--	50	84	89	74	--	58.6	60.7	59.5	59.6	--	14.2	14.4	14.1	14.2	1.1	--	3.8	--
MS Charger	--	76	90	94	86	--	58.9	60.6	59.3	59.6	--	12.2	12.8	12.7	12.6	1.3	--	0.4	--
ND Heron	--	52	82	87	73	--	59.9	62.2	61.2	61.1	--	14.3	14.8	14.4	14.5	2.3	--	1.4	--
ND Thresher	--	62	69	82	71	--	58.7	58.7	59.8	59.1	--	14.3	14.7	14.1	14.4	1.2	--	0.9	--
LCS Buster	40	--	88	93	--	57.3	--	59.2	58.7	--	13.6	--	12.1	12.3	--	0.8	3.0	--	--
CP3915	--	--	80	88	--	--	--	60.5	60.6	--	--	--	14.2	13.8	--	1.0	--	--	--
Ascend-SD	--	--	82	82	--	--	--	60.9	60.3	--	--	--	14.3	14.8	--	2.9	--	--	--
LCS Boom	--	--	84	95	--	--	--	62.0	61.3	--	--	--	14.4	13.9	--	1.0	--	--	--
LCS Hammer AX	--	--	82	81	--	--	--	60.6	59.1	--	--	--	14.1	13.6	--	1.1	--	--	--
WB9590	--	--	82	94	--	--	--	60.2	60.4	--	--	--	15.0	13.9	--	1.0	--	--	--
ND Stampede	--	--	90	104	--	--	--	61.2	61.2	--	--	--	14.6	14.1	--	1.5	--	--	--
CP3119A	47	56	--	75	--	55.8	54.1	--	54.6	--	14.4	13.5	--	12.8	--	1.0	2.7	1.0	1.9
CP3099A	--	59	--	73	--	--	57.3	--	53.3	--	--	13.3	--	11.1	--	0.9	--	1.2	--
AP Elevate	--	--	--	91	--	--	--	--	59.5	--	--	--	--	14.0	--	1.1	--	--	--
Brawn-SD	--	--	--	87	--	--	--	--	61.0	--	--	--	--	14.3	--	4.7	--	--	--
CAG Ceres	--	--	--	90	--	--	--	--	60.3	--	--	--	--	13.8	--	1.1	--	--	--
CAG Justify	--	--	--	91	--	--	--	--	59.1	--	--	--	--	13.2	--	2.0	--	--	--
CAG Reckless	--	--	--	91	--	--	--	--	61.0	--	--	--	--	14.1	--	1.2	--	--	--
CAG Recoil	--	--	--	89	--	--	--	--	59.8	--	--	--	--	14.6	--	1.0	--	--	--
CP3360AX	--	--	--	86	--	--	--	--	61.0	--	--	--	--	12.7	--	1.1	--	--	--
MS Nova	--	--	--	85	--	--	--	--	59.8	--	--	--	--	14.0	--	0.9	--	--	--
Rocker	--	--	--	82	--	--	--	--	59.4	--	--	--	--	14.4	--	1.0	--	--	--
TW Olympic	--	--	--	84	--	--	--	--	60.2	--	--	--	--	14.2	--	1.0	--	--	--
TW Starlite	--	--	--	82	--	--	--	--	60.6	--	--	--	--	14.1	--	1.7	--	--	--
TW Trailfire	--	--	--	90	--	--	--	--	60.8	--	--	--	--	14.1	--	1.6	--	--	--
MS Ranchero	--	--	--	81	--	--	--	--	58.8	--	--	--	--	13.3	--	4.7	--	--	--
SY Ingmar	45	60	72	--	--	60.2	59.2	60.5	--	--	16.0	14.6	14.8	--	--	--	2.0	0.8	1.4
TCG-Spitfire	50	68	81	--	--	58.5	57.7	59.7	--	--	15.8	13.9	14.5	--	--	--	1.0	0.3	0.7
SY 611 CL2	57	61	80	--	--	59.7	59.2	60.5	--	--	15.6	13.8	14.8	--	--	--	0.7	1.2	1.0
TCG-Heartland	54	64	78	--	--	60.5	60.1	61.2	--	--	16.8	15.0	15.5	--	--	--	2.0	0.7	1.4
TCG-Wildcat	44	61	84	--	--	60.0	58.9	61.2	--	--	15.9	14.2	14.8	--	--	--	4.3	1.9	3.1
CP3530	54	71	82	--	--	58.9	58.8	60.0	--	--	15.4	14.4	14.4	--	--	--	1.0	0.4	0.7
TCG-Teddy	--	--	81	--	--	--	--	60.0	--	--	--	--	14.6	--	--	--	--	--	--
WB9719	--	--	79	--	--	--	--	62.7	--	--	--	--	14.4	--	--	--	--	--	--
CP3188	50	64	--	--	--	56.7	57.7	--	--	--	13.9	13.6	--	--	--	--	1.3	1.1	1.2
MN-Washburn	56	61	--	--	--	59.1	58.4	--	--	--	15.4	14.6	--	--	--	--	0.0	0.1	0.1
Faller	44	67	--	--	--	59.0	58.2	--	--	--	14.9	13.6	--	--	--	--	2.3	0.5	1.4
ND Frohberg	20	60	--	--	--	59.8	60.0	--	--	--	16.0	14.2	--	--	--	--	6.0	2.5	4.3
AP Gunsmoke CL2	59	74	--	--	--	57.9	58.5	--	--	--	15.6	14.3	--	--	--	--	0.7	0.8	0.8
Trial Mean	48	61	83	89		59.1	58.5	60.8	59.9		15.4	14.0	14.3	13.7		1.4	2.4	1.7	
C.V. %	10.1	5.7	3.7	5.4		0.4	0.4	0.6	1.0		1.3	1.4	1.5	2.6		--	35.5	38.9	
LSD 5%	4.6	3.0	4.3	--		0.2	0.2	0.6	--		0.2	0.2	0.3	--		--	1.4	0.6	
LSD 10%	3.9	2.5	3.5	5.6		0.2	0.2	0.5	0.7		0.2	0.1	0.3	0.4		--	1.2	0.5	

[1]Relative Rating 1-9. There was significant negative correlation between yield and shatter of -0.62.

HRSW Summary, Pembina County 2020-2024

	Yield (bu/a)					Test Weight (lbs/bu)					Protein (%)				
Variety	**20**	**21**	**22**	**24**	**3yr**	**20**	**21**	**22**	**24**	**3yr**	**20**	**21**	**22**	**24**	**3yr**
SY Valda	71	48	65	57	57	59.5	57.8	58.6	60.1	58.8	13.6	12.8	14.3	12.3	13.1
Ambush	70	47	66	56	57	60.2	59.8	56.6	62.2	59.5	14.6	13.8	13.5	13.2	13.5
Ballistic	79	58	50	65	58	58.5	58.2	57.2	61.2	58.9	13.5	13.0	15.3	12.1	13.5
Commander	70	47	60	61	56	59.3	58.8	56.9	60.9	58.9	13.8	13.1	14.4	13.0	13.5
LCS Cannon	70	46	52	56	51	59.6	59.6	58.2	61.8	59.9	13.7	12.5	14.4	12.5	13.1
LCS Trigger	78	59	65	65	63	60.3	57.6	58.4	59.0	58.3	11.5	11.2	12.8	10.6	11.5
AP Murdock	74	41	59	69	56	59.1	58.2	58.0	60.3	58.8	13.4	13.2	14.0	12.1	13.1
MN-Torgy	77	49	58	65	57	59.8	58.3	58.4	61.7	59.5	14.3	12.9	14.8	12.9	13.5
AP Smith	72	52	61	64	59	59.0	58.0	56.6	60.4	58.3	13.8	13.4	14.3	12.9	13.5
CP3119A	--	57	60	72	63	--	55.4	54.5	56.4	55.4	--	11.6	13.2	11.4	12.1
MS Cobra	--	52	47	65	55	--	58.2	55.4	61.6	58.4	--	13.6	15.2	12.9	13.9
ND Heron	--	47	48	56	50	--	59.5	58.0	63.3	60.3	--	13.6	15.2	13.1	14.0
CP3099A	--	--	66	77	--	--	--	57.1	58.4	--	--	--	12.9	11.1	--
LCS Ascent	--	--	58	64	--	--	--	58.0	62.4	--	--	--	14.0	12.3	--
LCS Dual	--	--	49	50	--	--	--	56.3	60.6	--	--	--	14.4	12.2	--
MN-Rothsay	--	--	57	67	--	--	--	56.1	60.7	--	--	--	14.5	12.9	--
MS Charger	--	--	65	58	--	--	--	57.3	60.4	--	--	--	13.3	11.3	--
LCS Buster	79	51	--	73	--	57.9	55.8	--	58.4	--	11.4	11.5	--	10.8	--
CP3915	75	--	--	61	--	60.8	--	--	61.6	--	14.1	--	--	12.5	--
MS Ranchero	67	--	--	67	--	57.6	--	--	59.1	--	14.2	--	--	12.2	--
WB9590	--	--	--	58	--	--	--	--	61.2	--	--	--	--	13.2	--
AP Elevate	--	--	--	66	--	--	--	--	60.0	--	--	--	--	12.9	--
Ascend-SD	--	--	--	53	--	--	--	--	60.3	--	--	--	--	12.1	--
Brawn-SD	--	--	--	63	--	--	--	--	62.7	--	--	--	--	11.3	--
CAG Ceres	--	--	--	60	--	--	--	--	61.2	--	--	--	--	13.2	--
CAG Justify	--	--	--	66	--	--	--	--	59.4	--	--	--	--	11.5	--
CAG Reckless	--	--	--	62	--	--	--	--	61.7	--	--	--	--	12.8	--
CAG Recoil	--	--	--	67	--	--	--	--	59.3	--	--	--	--	12.7	--
CP3360AX	--	--	--	54	--	--	--	--	60.9	--	--	--	--	12.1	--
LCS Boom	--	--	--	59	--	--	--	--	62.1	--	--	--	--	12.6	--
LCS Hammer AX	--	--	--	56	--	--	--	--	61.0	--	--	--	--	12.8	--
MS Nova	--	--	--	53	--	--	--	--	60.0	--	--	--	--	12.8	--
ND Stampede	--	--	--	66	--	--	--	--	61.2	--	--	--	--	12.4	--
ND Thresher	--	--	--	36	--	--	--	--	59.0	--	--	--	--	13.6	--
Rocker	--	--	--	65	--	--	--	--	60.7	--	--	--	--	13.3	--
TW Olympic	--	--	--	61	--	--	--	--	60.7	--	--	--	--	12.5	--
TW Starlite	--	--	--	71	--	--	--	--	61.7	--	--	--	--	13.2	--
TW Trailfire	--	--	--	56	--	--	--	--	61.2	--	--	--	--	12.6	--
Faller	75	50	64	--	--	59.2	57.9	58.1	--	--	13.1	12.5	13.6	--	--
SY Ingmar	69	44	56	--	--	59.6	58.9	58.4	--	--	14.3	13.9	14.4	--	--
MN-Washburn	71	49	59	--	--	59.6	57.8	57.9	--	--	14.0	13.2	14.6	--	--
SY 611 CL2	72	58	60	--	--	60.1	59.1	57.6	--	--	14.3	13.4	14.8	--	--
TCG-Heartland	58	47	48	--	--	59.0	59.5	57.5	--	--	15.0	14.3	15.5	--	--
TCG-Spitfire	69	48	67	--	--	58.4	58.0	57.5	--	--	13.4	13.7	13.6	--	--
ND Frohberg	65	46	51	--	--	60.1	59.2	58.9	--	--	13.7	13.6	14.5	--	--
TCG-Wildcat	73	51	58	--	--	59.9	59.2	58.9	--	--	14.0	13.5	14.6	--	--
CP3530	--	50	56	--	--	--	57.2	57.9	--	--	--	12.8	14.4	--	--
AP Gunsmoke CL2	--	44	51	--	--	--	58.0	56.2	--	--	--	13.5	14.9	--	--
CP3188	--	44	53	--	--	--	56.4	56.6	--	--	--	12.0	13.8	--	--
Driver	--	47	--	--	--	--	58.8	--	--	--	--	12.9	--	--	--
LCS Rebel	71	47	--	--	--	60.9	59.3	--	--	--	14.5	13.4	--	--	--
MS Barracuda	68	41	--	--	--	58.7	58.6	--	--	--	15.1	13.5	--	--	--
SY McCloud	70	52	--	--	--	60.0	59.6	--	--	--	14.6	13.8	--	--	--
Trial Mean	70	49	58	62		59.3	58.2	57.3	60.6		14.0	13.1	14.3	12.4	
C.V. %	5.0	6.4	7.8	5.9		0.8	0.6	0.9	0.9		2.2	2.5	1.5	2.2	
LSD 5%	5.0	3.3	6.4	--		0.7	0.3	0.7	--		0.4	0.5	0.3	--	
LSD 10%	4.2	2.8	5.3	4.2		0.5	0.2	0.6	0.7		0.4	0.4	0.3	0.3	

2023 trial abandoned due to drought/weather and poor emergence.

HRSW Summary, Towner County 2020-2024

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (1-9)
Variety	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**2024**
SY Valda	65	72	71	79	94	81	60.2	59.2	61.0	61.2	60.6	60.9	15.6	14.4	15.3	14.2	13.7	14.4	1.1
LCS Trigger	65	69	75	81	86	80	60.8	57.9	61.4	58.7	60.9	60.3	13.9	12.9	13.2	12.1	11.8	12.4	2.4
AP Murdock	57	68	66	74	98	79	59.8	58.8	60.0	59.4	60.6	60.0	16.4	14.6	15.2	14.1	13.7	14.3	1.8
Commander	59	65	64	73	100	79	59.5	60.2	60.5	61.2	60.7	60.8	15.4	14.8	15.9	14.2	14.5	14.9	1.2
Ambush	57	74	72	82	95	83	59.9	61.1	59.9	61.7	61.4	61.0	17.1	15.1	15.6	14.2	15.2	15.0	1.7
Ballistic	58	80	67	92	98	86	58.4	57.7	61.1	59.6	60.8	60.5	16.1	14.1	16.4	13.3	13.7	14.5	2.4
LCS Cannon	62	67	58	74	91	74	61.4	60.4	61.6	61.6	61.4	61.5	15.8	14.7	15.4	14.5	14.5	14.8	1.1
MN-Torgy	61	72	64	85	94	81	60.0	59.6	60.7	60.9	61.3	61.0	16.9	15.2	16.2	14.5	14.5	15.1	1.8
AP Smith	55	72	62	81	90	78	59.7	59.4	60.2	60.7	60.9	60.6	15.9	14.6	15.5	14.3	14.6	14.8	1.0
ND Thresher	--	67	50	80	75	68	--	57.8	59.1	59.8	59.3	59.4	--	15.5	16.2	14.1	14.3	14.9	1.4
MS Cobra	--	70	63	73	98	78	--	59.4	60.1	61.1	61.3	60.8	--	15.0	15.7	14.7	14.5	15.0	1.0
ND Heron	--	70	60	76	88	74	--	60.5	61.9	61.6	61.9	61.8	--	15.7	16.7	15.0	15.3	15.7	2.8
LCS Ascent	--	--	63	87	95	82	--	--	61.1	61.5	61.4	61.3	--	--	14.4	13.5	13.4	13.8	1.6
LCS Dual	--	--	66	76	99	80	--	--	61.4	60.8	61.3	61.2	--	--	15.3	13.7	14.1	14.4	1.0
MN-Rothsay	--	--	69	88	93	83	--	--	60.5	60.2	61.2	60.6	--	--	16.2	14.0	14.0	14.7	1.0
MS Charger	--	--	74	84	98	85	--	--	60.5	60.4	60.2	60.4	--	--	13.9	12.8	12.8	13.2	1.6
LCS Buster	66	69	--	89	88	--	59.7	56.2	--	57.7	58.8	--	14.1	12.7	--	11.8	12.5	--	2.8
CP3915	60	--	--	78	87	--	61.1	--	--	60.6	60.7	--	15.4	--	--	13.9	14.5	--	1.0
Ascend-SD	--	--	--	83	94	--	--	--	--	60.7	60.6	--	--	--	--	13.9	14.7	--	2.2
LCS Boom	--	--	--	72	94	--	--	--	--	61.6	61.3	--	--	--	--	14.9	14.7	--	1.1
LCS Hammer AX	--	--	--	78	96	--	--	--	--	60.1	60.9	--	--	--	--	13.8	14.0	--	1.0
WB9590	--	--	--	79	98	--	--	--	--	60.8	61.5	--	--	--	--	14.9	15.1	--	1.1
ND Stampede	--	--	--	82	104	--	--	--	--	59.8	60.9	--	--	--	--	14.5	14.9	--	1.1
CP3119A	--	65	73	--	86	--	--	55.0	57.3	--	56.6	--	--	13.7	13.6	--	12.8	--	1.0
CP3099A	--	--	78	--	101	--	--	--	58.9	--	57.7	--	--	--	13.6	--	12.9	--	1.2
MS Ranchero	62	--	--	--	90	--	57.7	--	--	--	60.5	--	15.5	--	--	--	13.5	--	3.9
AP Elevate	--	--	--	--	95	--	--	--	--	--	60.2	--	--	--	--	--	14.5	--	1.1
Brawn-SD	--	--	--	--	95	--	--	--	--	--	62.1	--	--	--	--	--	13.6	--	2.0
CAG Ceres	--	--	--	--	89	--	--	--	--	--	60.8	--	--	--	--	--	14.5	--	1.1
CAG Justify	--	--	--	--	101	--	--	--	--	--	59.7	--	--	--	--	--	13.6	--	3.7
CAG Reckless	--	--	--	--	92	--	--	--	--	--	61.5	--	--	--	--	--	14.5	--	2.6
CAG Recoil	--	--	--	--	95	--	--	--	--	--	60.3	--	--	--	--	--	13.9	--	2.3
CP3360AX	--	--	--	--	92	--	--	--	--	--	62.4	--	--	--	--	--	13.6	--	1.0
MS Nova	--	--	--	--	90	--	--	--	--	--	60.5	--	--	--	--	--	14.7	--	1.1
Rocker	--	--	--	--	92	--	--	--	--	--	60.8	--	--	--	--	--	14.8	--	2.0
TW Olympic	--	--	--	--	99	--	--	--	--	--	60.7	--	--	--	--	--	14.4	--	1.7
TW Starlite	--	--	--	--	90	--	--	--	--	--	60.9	--	--	--	--	--	14.7	--	4.4
TW Trailfire	--	--	--	--	85	--	--	--	--	--	60.5	--	--	--	--	--	14.5	--	3.3
SY Ingmar	54	66	63	73	--	--	60.0	59.9	60.8	61.5	--	--	16.7	15.2	16.4	15.0	--	--	--
TCG-Spitfire	63	67	72	83	--	--	59.3	58.1	60.3	59.6	--	--	15.1	15.4	15.2	13.7	--	--	--
SY 611 CL2	57	65	70	77	--	--	60.5	59.6	61.0	61.9	--	--	15.6	15.3	15.4	14.8	--	--	--
TCG-Heartland	56	73	61	75	--	--	60.8	60.7	61.6	61.8	--	--	16.9	15.9	16.4	15.3	--	--	--
TCG-Wildcat	51	74	69	69	--	--	60.5	60.1	60.4	61.5	--	--	17.4	15.4	16.5	15.3	--	--	--
CP3530	--	78	62	77	--	--	--	57.9	60.2	59.6	--	--	--	14.3	16.7	14.1	--	--	--
WB9719	--	--	--	82	--	--	--	--	--	63.0	--	--	--	--	--	14.0	--	--	--
TCG-Teddy	--	--	--	79	--	--	--	--	--	60.2	--	--	--	--	--	14.3	--	--	--
MN-Washburn	50	67	67	--	--	--	58.4	59.1	60.1	--	--	--	15.9	14.7	15.3	--	--	--	--
Faller	59	76	67	--	--	--	58.3	58.8	60.4	--	--	--	15.7	14.4	15.4	--	--	--	--
ND Frohberg	59	63	67	--	--	--	60.1	60.3	61.5	--	--	--	16.5	15.0	16.5	--	--	--	--
AP Gunsmoke CL2	--	77	71	--	--	--	--	59.2	60.8	--	--	--	--	15.3	16.5	--	--	--	--
CP3188	--	61	71	--	--	--	--	56.4	60.1	--	--	--	--	13.3	13.8	--	--	--	--
LCS Rebel	60	75	--	--	--	--	60.8	60.1	--	--	--	--	16.4	15.1	--	--	--	--	--
MS Barracuda	62	62	--	--	--	--	60.2	59.4	--	--	--	--	17.0	15.4	--	--	--	--	--
SY McCloud	54	66	--	--	--	--	59.6	60.9	--	--	--	--	16.3	16.1	--	--	--	--	--
Driver	--	77	--	--	--	--	--	59.8	--	--	--	--	--	14.6	--	--	--	--	--
Trial Mean	58	70	67	80	93		59.7	59.1	60.4	60.6	60.6		16.0	14.7	15.5	14.1	14.1		1.7
C.V. %	8.3	7.0	7.6	6.3	6.2		0.8	0.5	0.5	0.7	1.1		2.4	1.1	2.5	1.9	1.9		55.4
LSD 5%	6.8	4.2	7.3	7.1	--		0.7	0.3	0.5	0.6	--		0.5	0.1	0.5	0.4	--		--
LSD 10%	5.7	3.6	6.0	5.9	6.8		0.6	0.2	0.4	0.5	0.8		0.5	0.1	0.4	0.3	0.3		1.1

HRSW Summary, Walsh County 2019-2023

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (0-9)		
Variety	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**22**	**2yr**
SY Ingmar	82	67	50	67	76	64	61.2	61.5	62.5	61.0	62.3	61.9	14.3	15.2	15.7	14.9	15.5	15.4	0.2	1.5	0.9
SY Valda	86	73	57	68	88	71	61.0	59.8	62.4	60.9	62.0	61.8	13.5	13.5	15.1	13.7	14.4	14.4	0.8	2.0	1.4
LCS Trigger	95	80	68	73	97	79	61.3	60.0	62.5	61.7	61.0	61.7	11.7	11.1	12.9	11.9	11.6	12.1	1.5	1.8	1.7
SY 611 CL2	82	71	50	64	78	64	61.9	60.8	62.7	61.0	63.1	62.3	13.6	14.7	15.8	14.5	15.3	15.2	0.1	1.3	0.7
TCG-Spitfire	82	74	54	68	86	69	60.4	58.2	60.8	60.5	59.9	60.4	13.8	13.8	15.2	14.0	14.1	14.4	0.0	1.5	0.8
Ambush	80	70	51	72	91	72	61.2	61.3	62.7	60.6	63.1	62.1	14.9	15.1	15.6	13.9	14.9	14.8	1.7	2.4	2.1
Ballistic	98	74	60	61	103	74	60.5	59.9	61.5	61.1	61.8	61.5	13.7	14.8	15.7	14.1	14.2	14.7	0.7	2.0	1.4
Commander	89	74	51	61	87	67	61.2	60.6	62.5	60.7	62.3	61.8	14.1	14.3	15.7	14.2	14.5	14.8	0.7	1.0	0.9
LCS Cannon	85	73	48	67	78	64	61.5	62.9	63.4	61.1	63.0	62.5	13.7	14.0	15.6	13.7	14.4	14.6	0.8	0.0	0.4
TCG-Heartland	77	63	46	56	81	61	62.1	61.4	62.9	61.4	63.0	62.4	14.9	15.3	15.9	15.1	15.6	15.5	0.0	0.8	0.4
AP Murdock	84	76	48	72	80	67	59.7	61.1	61.9	60.0	62.4	61.4	13.8	13.4	14.8	13.1	14.1	14.0	2.0	1.9	2.0
MN-Torgy	--	77	54	66	81	67	--	60.5	62.1	61.3	62.6	62.0	--	14.5	15.8	14.6	15.5	15.3	--	1.0	--
TCG-Wildcat	--	69	55	68	81	68	--	60.9	62.6	60.9	62.2	61.9	--	15.6	15.6	14.4	15.1	15.0	--	0.9	--
AP Smith	--	67	54	69	84	69	--	59.2	61.9	60.5	61.5	61.3	--	14.7	15.8	14.5	14.4	14.9	--	0.4	--
CP3530	82	--	59	68	88	72	60.6	--	61.1	60.6	62.3	61.3	15.1	--	15.0	14.5	15.0	14.8	2.7	2.5	2.6
MS Cobra	--	--	51	62	77	63	--	--	61.9	60.2	62.2	61.4	--	--	16.3	13.9	15.2	15.1	--	2.2	--
ND Heron	--	--	49	57	77	61	--	--	63.2	61.1	63.1	62.5	--	--	16.4	14.9	15.2	15.5	--	4.4	--
ND Thresher	--	--	50	62	82	65	--	--	60.9	59.9	61.6	60.8	--	--	15.9	14.3	14.8	15.0	--	0.7	--
LCS Ascent	--	--	--	68	76	--	--	--	--	60.1	63.0	--	--	--	--	12.9	13.4	--	--	4.4	--
LCS Dual	--	--	--	58	83	--	--	--	--	61.2	62.7	--	--	--	--	13.5	13.8	--	--	0.1	--
MN-Rothsay	--	--	--	67	82	--	--	--	--	59.7	61.8	--	--	--	--	13.6	14.3	--	--	1.9	--
MS Charger	--	--	--	71	91	--	--	--	--	60.1	61.3	--	--	--	--	12.8	13.1	--	--	2.5	--
CP3915	--	69	--	--	86	--	--	61.3	--	--	62.7	--	--	13.9	--	--	14.7	--	--	--	--
ND Stampede	--	--	--	--	93	--	--	--	--	--	62.2	--	--	--	--	--	15.2	--	--	--	--
WB9590	--	--	--	--	93	--	--	--	--	--	62.2	--	--	--	--	--	14.8	--	--	--	--
WB9719	--	--	--	--	84	--	--	--	--	--	63.1	--	--	--	--	--	14.2	--	--	--	--
Ascend-SD	--	--	--	--	86	--	--	--	--	--	62.6	--	--	--	--	--	15.3	--	--	--	--
LCS Boom	--	--	--	--	76	--	--	--	--	--	63.4	--	--	--	--	--	14.8	--	--	--	--
LCS Buster	--	--	--	--	98	--	--	--	--	--	60.5	--	--	--	--	--	12.0	--	--	--	--
LCS Hammer AX	--	--	--	--	74	--	--	--	--	--	61.5	--	--	--	--	--	14.6	--	--	--	--
TCG-Teddy	--	--	--	--	83	--	--	--	--	--	61.5	--	--	--	--	--	14.8	--	--	--	--
AP Gunsmoke CL2	--	--	54	67	--	--	--	--	61.8	59.8	--	--	--	--	15.6	13.9	--	--	--	2.5	--
CP3119A	--	--	67	62	--	--	--	--	59.9	58.2	--	--	--	--	13.5	12.5	--	--	--	0.8	--
CP3188	--	--	56	61	--	--	--	--	61.4	59.0	--	--	--	--	13.7	12.7	--	--	--	2.8	--
ND Frohberg	--	70	53	60	--	--	--	61.4	62.8	60.9	--	--	--	15.2	16.1	13.6	--	--	--	0.9	--
MN-Washburn	81	65	52	63	--	--	61.1	60.5	61.8	60.3	--	--	14.5	13.9	15.7	14.2	--	--	0.3	0.0	0.2
Faller	91	80	60	65	--	--	61.0	60.3	62.2	60.6	--	--	13.6	14.0	15.2	13.6	--	--	2.5	2.6	2.6
CP3099A	--	--	--	76	--	--	--	--	--	60.5	--	--	--	--	--	12.8	--	--	--	0.9	--
LCS Rebel	84	66	52	--	--	--	62.5	61.0	63.1	--	--	--	14.3	14.8	16.5	--	--	--	2.7	--	--
MS Barracuda	80	69	47	--	--	--	61.3	60.9	61.8	--	--	--	13.9	14.6	15.8	--	--	--	0.5	--	--
SY McCloud	84	60	51	--	--	--	61.8	61.7	63.1	--	--	--	14.7	15.9	16.0	--	--	--	1.3	--	--
LCS Buster	--	82	62	--	--	--	--	58.4	61.2	--	--	--	--	11.5	13.5	--	--	--	--	--	--
Driver	--	--	50	--	--	--	--	--	62.7	--	--	--	--	--	15.4	--	--	--	--	--	--
Linkert	75	66	--	--	--	--	61.2	61.7	--	--	--	--	15.2	14.8	--	--	--	--	0.0	--	--
Bolles	82	61	--	--	--	--	60.8	58.5	--	--	--	--	15.7	16.3	--	--	--	--	0.3	--	--
Shelly	85	75	--	--	--	--	61.1	60.8	--	--	--	--	13.8	14.1	--	--	--	--	0.2	--	--
ND VitPro	76	66	--	--	--	--	62.5	62.0	--	--	--	--	15.0	15.2	--	--	--	--	0.0	--	--
Lang-MN	74	72	--	--	--	--	61.5	61.3	--	--	--	--	15.2	14.9	--	--	--	--	3.2	--	--
CP3055	--	76	--	--	--	--	--	57.4	--	--	--	--	--	12.0	--	--	--	--	--	--	--
Velocity	--	64	--	--	--	---	--	61.9	--	--	--	---	--	15.8	--	--	--	---	--	--	--
MS Ranchero	--	75	--	--	--	--	--	59.5	--	--	--	--	--	13.3	--	--	--	--	--	--	--
Trial Mean	82	71	54	65	85		61.2	60.6	62.1	60.4	62.1		14.4	14.3	15.3	13.8	14.5		1.1	1.7	
C.V. %	4.2	6.9	4.0	6.1	4.7		0.6	1.2	0.5	0.5	0.7		2.6	3.1	1.9	2.2	2.0		87	65	
LSD 5%	4.8	6.9	1.8	3.6	5.6		0.5	1.0	0.2	0.3	0.6		0.5	0.6	0.2	0.3	0.4		1.4	0.9	
LSD 10%	4.0	5.7	1.5	3.0	4.7		0.4	0.8	0.2	0.2	0.5		0.4	0.5	0.2	0.2	0.3		1.2	0.8	

2024 trial results were too unreliable to publish.

HRWW Summary, Langdon 2020-2024*

	Yield (bu/a)					Test Weight (lbs/bu)					Heading Date	Height (in)	Protein (%)				
Variety	**20**	**22**	**23**	**24**	**3yr**	**20**	**22**	**23**	**24**	**3yr**	**24**	**24**	**20**	**22**	**23**	**24**	**3yr**
AC Emerson	41	71	51	92	71	59.5	61.1	63.3	58.0	60.8	6/22	39	14.7	13.4	14.4	12.0	13.3
Jerry	44	81	63	80	75	58.9	60.8	62.8	56.1	59.9	6/23	42	14.3	12.8	13.3	12.1	12.7
Northern	43	62	69	88	73	58.3	57.9	63.8	53.9	58.5	6/23	37	14.3	13.3	13.6	12.1	13.0
SY Monument	36	61	60	81	67	56.3	56.4	62.7	53.3	57.5	6/21	34	35.8	12.8	12.6	12.2	12.5
Keldin	36	62	71	95	76	58.5	58.4	64.0	56.1	59.5	6/22	35	14.0	13.0	12.9	12.1	12.7
ND Noreen	48	85	62	98	82	61.6	62.8	64.5	58.9	62.1	6/22	42	14.1	13.0	14.1	11.7	12.9
AAC Wildfire	45	70	66	87	75	58.7	57.4	63.8	55.1	58.8	6/26	40	14.0	13.5	12.4	11.8	12.6
AAC Vortex	--	91	61	104	86	--	61.6	63.3	58.3	61.1	6/23	37	--	13.0	14.0	12.4	13.1
MS Maverick	--	67	58	88	71	--	60.8	63.7	56.3	60.3	6/19	33	--	12.9	13.9	13.0	13.3
SD Andes	--	87	66	97	83	--	61.2	64.4	57.8	61.1	6/23	37	--	12.3	12.9	11.7	12.3
SD Midland	--	79	69	97	82	--	61.2	64.1	57.7	61.0	6/21	38	--	12.6	12.5	11.2	12.1
WB4309	--	69	55	78	67	--	60.0	63.4	55.7	59.7	6/21	34	--	13.8	14.2	12.9	13.6
Winner	--	82	58	99	79	--	61.9	63.4	57.1	60.8	6/20	33	--	12.4	13.2	12.4	12.7
ND Allison	--	85	69	98	84	--	60.9	63.7	57.1	60.6	6/23	40	--	11.5	12.0	11.0	11.5
Goldrush	--	--	66	85	--	--	--	63.4	57.0	--	6/23	39	--	--	13.4	12.0	--
SD Pheasant	--	--	69	79	--	--	--	63.9	55.0	--	6/22	38	--	--	14.1	11.6	--
AAC Overdrive	--	--	--	96	--	--	--	--	56.2	--	6/22	34	--	--	--	12.3	--
AAC Coldfront	--	--	--	101	--	--	--	--	57.7	--	6/22	37	--	--	--	11.2	--
WB4422	--	--	--	88	--	--	--	--	55.7	--	6/20	34	--	--	--	12.2	--
LCS Steel AX	--	--	--	89	--	--	--	--	54.1	--	6/22	37	--	--	--	11.1	--
LCS Chrome	--	--	--	94	--	--	--	--	57.5	--	6/21	36	--	--	--	12.1	--
SY Wolverine	39	50	48	--	--	58.9	58.5	63.3	--	--	--	--	14.4	13.2	14.2	--	--
AP Bigfoot	--	61	48	--	--	--	59.8	63.1	--	--	--	--	--	12.4	13.5	--	--
MS Sundown	--	--	55	--	--	--	--	63.0	--	--	--	--	--	--	13.2	--	--
Draper	--	72	--	--	--	--	60.4	--	--	--	--	--	--	12.6	--	--	--
MS Iceman	--	44	--	--	--	--	59.6	--	--	--	--	--	--	14.9	--	--	--
Ray	--	63	--	--	--	--	54.1	--	--	--	--	--	--	13.1	--	--	--
WB4510CLP	--	59	--	--	--	--	60.9	--	--	--	--	--	--	12.7	--	--	--
Ideal	43	--	--	--	--	59.2	--	--	--	--	--	--	13.3	--	--	--	--
Peregrine	44	--	--	--	--	60.2	--	--	--	--	--	--	13.2	--	--	--	--
SY Wolf	41	--	--	--	--	59.5	--	--	--	--	--	--	14.3	--	--	--	--
SY Sunrise	24	--	--	--	--	57.9	--	--	--	--	--	--	13.4	--	--	--	--
Oahe	39	--	--	--	--	59.3	--	--	--	--	--	--	14.0	--	--	--	--
Thompson	40	--	--	--	--	58.6	--	--	--	--	--	--	13.8	--	--	--	--
TCG-Boomlock	41	--	--	--	--	59.9	--	--	--	--	--	--	14.2	--	--	--	--
WB4462	35	--	--	--	--	58.1	--	--	--	--	--	--	13.8	--	--	--	--
WB4595	21	--	--	--	--	59.4	--	--	--	--	--	--	13.5	--	--	--	--
CP7017AX	40	--	--	--	--	57.7	--	--	--	--	--	--	13.0	--	--	--	--
CP7050AX	32	--	--	--	--	59.6	--	--	--	--	--	--	14.9	--	--	--	--
CP7909	27	--	--	--	--	59.2	--	--	--	--	--	--	13.8	--	--	--	--
Trial Mean	39	69	61	91		58.9	59.7	63.5	56.2		6/22	37	14.0	12.9	13.3	12.0	
C.V. %	12.4	9.5	6.5	7.6		1.1	1.3	0.4	1.4		0.7	2.5	2.4	2.7	1.9	2.6	
LSD 5%	6.8	6.3	5.6	--		1.0	0.7	0.4	--		--	--	0.5	0.5	0.4	--	
LSD 10%	5.7	5.2	4.7	8.2		0.8	0.6	0.3	0.9		1.4	1.1	0.4	0.4	0.3	0.4	

No lodging in the trials above.

Winter survival was 100% for all varieties in 2024.

Overwinter leaf stage ranged from 1.5 to 2 leaf.

Fungicides were not used in any of the trials above.

*The 2021 trial was lost due to winter kill.

Buckwheat, Langdon 2024

Variety	Days to Flower	Plant Height (in)	1000 KWT (g)	Test Weight (lbs/bu)	Lodging (1-9)	Yield 2024	Yield 2 yr Avg	Yield 3 yr Avg
						----------lbs/a----------		
Devyatka	33	46	31	46.4	4.5	2447	2184	2174
Horizon	38	55	35	45.5	2.0	1635	1892	2203
KenMar	38	55	32	45.4	2.5	1773	1980	--
Manor	38	52	31	46.3	4.3	1621	--	--
Mean	37	53	32	45.6	3.6	1821		
C.V. %	2.0	3.4	4.7	0.8	--	12.6		
LSD 10%	0.9	2.3	1.8	0.5	--	283		

Winter Rye, Langdon 2024

Variety	Heading Date	Plant Height (in)	Lodging (1-9)	Test Weight (lbs/bu)	Yield 2024	Yield 2 yr avg.	Yield 3 yr avg.
					---------- bu/a----------		
ND Dylan	6/5	52	4.0	52.3	105.8	82.9	79.1
ND Gardner	5/30	49	5.0	51.7	82.5	66.1	61.7
AC Hazlet	6/5	51	3.0	53.3	99.7	80.1	80.9
Danko	6/5	51	1.0	54.4	115.8	86.9	83.1
Aroostok	6/6	48	3.0	53.1	93.7	70.4	64.7
Rymin	6/5	49	3.4	52.0	93.7	71.5	70.6
Spooner	6/2	52	4.5	51.7	85.6	68.1	63.3
KWS Receptor	6/8	46	1.1	54.3	143.4	110.9	110.9
KWS Serafino	6/7	45	1.0	53.7	136.2	106.0	102.3
KWS Tayo	6/8	45	1.1	52.9	129.7	101.6	100.8
SU Cossani	6/5	47	1.3	53.3	129.5	--	--
SU Perspectiv	6/4	48	1.0	53.1	142.8	--	--
SU Karlsson	6/5	47	1.0	53.9	140.4	--	--
SU Performer	6/6	48	1.0	52.4	137.8	--	--
SU Bebop	6/6	49	1.2	53.6	120.5	--	--
Trial Mean	6/4	47.4	1.9	53.0	124.4	--	--
C.V. %	0.6	3.3	--	0.8	6.0	--	--
LSD 10%	1.0	1.9	--	0.5	8.9	--	--

Winter survival was 100% for all varieties.

Corn Grain, Langdon 2024

Brand	Hybrid	RM[1]	Hybrid Traits[1]	Insect Traits	Days to Silk	Harvest Moisture	Test Weight	Yield		
								2023	2024	2yr Avg
						(%)	(lbs/bu)	----------bu/a----------		
Channel	173-11VT2P	73	RR2	VT2Pro	78	23	57.4	126.6	164.7	145.6
Channel	180-24VT2P	80	RR2	VT2Pro	80	27	54.1	147.5	216.5	182.0
Innvictis	A7883VT2PRIB	78	GT	VT2P	80	24	56.3	133.3	191.6	162.4
Integra	3009VT2	80	RR2	VT2	79	24	56.0	137.2	185.6	161.4
Integra	3114VT2	81	RR2	VT2	81	25	55.2	141.3	206.7	174.0
Legacy	LC311-20	81	RR2	VT2P	82	31	53.0	132.6	186.3	159.5
Proseed	1974 RR	74	RR2		78	22	58.3	134.9	170.7	152.8
Thunder	T4072 RR	72	RR2		77	22	57.8	120.9	171.1	146.0
Thunder	T4477 GT	77	GT		81	24	53.0	127.0	178.3	152.7
Thunder	T6278 VT2P	78	RR2	VT2P	78	22	56.0	126.0	192.1	159.0
Thunder	T6977 VT2P	77	RR2	VT2P	78	24	56.2	137.5	195.1	166.3
Channel	169-09VT2P	69	RR2	VT2Pro	76	21	59.0	--	187.2	--
Channel	174-14VT2P	74	RR2	VT2Pro	78	23	58.9	--	190.5	--
Channel	180-33VT2P	80	RR2	VT2Pro	81	27	53.4	--	199.4	--
Dyna-Gro	D14VC45RIB	74	RR2	VT2P	79	24	54.6	--	193.5	--
Dyna-Gro	D20VC24RIB	80	RR2	VT2P	82	28	53.7	--	208.3	--
Legacy	LC261-24	76	RR2	VT2P	79	24	55.7	--	195.0	--
Proseed	2478PCE	78	Enlist	BT	83	34	50.9	--	170.1	--
Trial Mean					79	24	55.8	131.8	187.8	
C.V. %					1.2	7.8	1.3	6.9	7.3	
LSD 10%					1.3	2.6	1.0	13.0	18.9	

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

Yield reported at 15.5% moisture.

GDD from May 13 to October 4 were 1922. Normal is 1754.

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

Barley Summary, Langdon 2020-2024

	Height (in)						Protein (%)						Days to Head					
Variety	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**
Tradition*	28	24	32	33	31	32	12.9	13.5	10.9	12.0	10.8	11.2	47	57	50	46	54	50
AAC Synergy	27	26	30	33	31	31	12.1	13.6	10.4	12.9	10.4	11.2	51	62	54	51	55	53
Explorer	24	22	24	25	26	25	12.4	13.9	9.7	12.1	9.8	10.5	50	61	55	51	56	54
AAC Connect	26	24	28	32	29	30	12.5	14.5	10.3	12.8	10.9	11.3	50	62	54	52	56	54
ABI Cardinal	25	22	29	30	31	30	12.8	14.2	10.3	12.2	10.5	11.0	51	61	57	52	57	55
ND Treasure*	--	22	27	31	29	29	--	12.7	10.3	11.7	10.6	10.9	--	59	51	45	54	50
CDC Fraser	--	25	29	30	31	30	--	13.7	10.3	13.2	10.9	11.5	--	62	57	53	58	56
Lacey*	--	--	30	34	30	31	--	--	11.0	12.4	11.7	11.7	--	--	50	44	52	49
CDC Prairie	--	--	--	33	30	--	--	--	--	13.1	10.7	--	--	--	--	51	56	--
Firefoxx	--	--	--	27	28	--	--	--	--	11.3	8.9	--	--	--	--	51	56	--
Winston	--	--	--	26	28	--	--	--	--	11.5	10.1	--	--	--	--	54	58	--
ND Genesis	28	26	33	34	--	--	10.6	12.5	9.7	11.3	--	--	50	61	54	51	--	--
Pinnacle	27	23	30	31	--	--	11.5	13.7	10.0	11.2	--	--	49	61	52	50	--	--
Conlon	28	25	29	31	--	--	11.9	14.1	10.5	12.6	--	--	47	58	51	42	--	--
Brewski	26	24	30	32	--	--	11.6	13.0	10.1	11.8	--	--	50	61	54	53	--	--
BC Ellinor	--	22	28	--	--	--	--	13.0	10.5	--	--	--	--	62	57	--	--	--
BC Lexy	--	22	27	--	--	--	--	13.1	10.0	--	--	--	--	62	57	--	--	--
BC Leandra	--	20	27	--	--	--	--	14.5	9.5	--	--	--	--	62	56	--	--	--
Trial Mean	27	23	29	31	29		11.5	13.2	10.0	12.1	10.3		49	61	53	49	55	
C.V. %	4.1	7.3	5.4	5.4	5.6		3.6	3.7	4.6	4.9	4.2		1.4	2.2	2.1	2.9	1.4	
LSD 5%	1.6	2.0	2.2	2.4	--		0.6	0.6	0.7	0.9	--		0.9	2.0	1.6	2.0	--	
LSD 10%	1.3	2.0	1.9	2.0	2.0		0.5	0.4	0.6	0.7	0.5		0.4	1.0	1.4	1.7	1.0	

Barley Summary, Langdon 2020-2024

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)				Plump (%)					
Variety	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**17**	**19**	**20**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**
Tradition*	119	79	99	111	88	99	46.4	47.2	50.0	48.5	46.6	48.4	2.3	0.0	0.2	0.8	90	93	95	97	99	97
AAC Synergy	132	92	105	113	89	102	46.2	48.2	50.5	51.2	48.0	49.9	3.5	1.3	2.7	2.5	86	94	97	99	99	98
Explorer	99	80	106	102	88	99	43.6	48.2	48.9	49.9	46.7	48.5	0.0	0.0	0.1	0.0	76	96	95	99	100	98
AAC Connect	127	90	100	109	92	100	45.5	47.1	49.5	50.9	48.4	49.6	--	0.5	2.0	--	77	90	95	98	99	97
ABI Cardinal	109	83	103	109	84	99	46.5	46.9	50.6	50.3	47.8	49.6	--	1.0	1.7	--	87	93	97	98	99	98
ND Treasure*	--	83	112	113	98	108	--	44.5	48.5	46.6	45.6	46.9	--	--	--	--	--	89	97	94	99	97
CDC Fraser	--	82	105	113	92	104	--	46.3	49.4	48.9	46.9	48.4	--	--	--	--	--	95	97	98	99	98
Lacey*	--	--	98	110	86	98	--	--	49.3	49.2	47.3	48.6	0.3	0.0	--	--	--	--	95	97	99	97
CDC Prairie	--	--	--	117	85	--	--	--	--	50.4	48.5	--	--	--	--	--	--	--	--	96	98	--
Firefoxx	--	--	--	125	79	--	--	--	--	48.4	44.0	--	--	--	--	--	--	--	--	99	99	--
Winston	--	--	--	117	87	--	--	--	--	49.5	45.5	--	--	--	--	--	--	--	--	100	100	--
ND Genesis	131	91	100	117	--	--	46.7	48.8	48.8	51.2	--	--	0.0	0.3	0.5	--	92	98	95	100	--	--
Pinnacle	106	84	99	109	--	--	45.3	50.2	51.6	51.7	--	--	0.0	0.0	0.1	--	85	99	97	100	--	--
Conlon	109	57	100	107	--	--	48.4	49.9	51.1	51.6	--	--	--	1.8	0.3	--	90	98	98	99	--	--
Brewski	120	91	109	108	--	--	45.4	48.3	50.1	50.6	--	--	--	--	1.1	--	82	98	96	99	--	--
BC Ellinor	--	92	98	--	--	--	--	48.1	47.8	--	--	--	--	--	--	--	--	99	95	--	--	--
BC Lexy	--	90	117	--	--	--	--	47.1	47.9	--	--	--	--	--	--	--	--	97	95	--	--	--
BC Leandra	--	73	112	--	--	--	--	46.0	47.3	--	--	--	--	--	--	--	--	92	96	--	--	--
Trial Mean	124	85	107	112	87		46.3	47.7	49.5	49.8	46.8		1.7	0.5	0.5		89	96	96	98	99	
C.V. %	4.2	9.9	5.0	6.8	6.3		0.9	1.5	1.1	1.0	1.0		122	149	126		2.4	2.8	1.8	1.0	0.3	
LSD 5%	7.5	9.9	7.6	11.0	--		0.6	0.8	0.8	0.7	--		2.8	1.0	0.9		3.0	3.0	2.4	1.4	--	
LSD 10%	6.2	7.7	6.3	9.1	6.5		0.5	0.6	0.7	0.7	0.6		2.4	0.9	0.7		2.5	2.0	2.0	1.1	0.3	

*6-row

ND Genesis seed lot had a poor stand. Results are not published.

Oat Summary, Langdon 2019-2024

	Yield (bu/a)						Test Weight (lbs/bu)						Days to Head						Height (in)						Lodging (0-9)[1]					Crown Rust (1-9)[2]
Variety	**19**	**20**	**22**	**23**	**24**	**3yr**	**19**	**20**	**22**	**23**	**24**	**3yr**	**19**	**20**	**22**	**23**	**24**	**3yr**	**19**	**20**	**22**	**23**	**24**	**3yr**	**17**	**19**	**20**	**24**	**3yr**	**2024**
Beach	152	185	160	119	153	144	40.6	39.9	43.2	40.9	41.2	41.8	58	47	50	48	56	51	38	42	43	42	48	44	3.4	0.2	2.5	4.5	2.4	1.3
HiFi	155	188	185	137	167	163	38.5	36.5	41.1	36.6	37.5	38.4	59	50	51	51	58	53	42	40	44	43	48	45	3.4	0.0	2.6	2.3	1.6	1.5
Killdeer	185	199	189	128	171	163	38.0	36.3	40.0	35.0	35.5	36.8	57	48	49	50	56	52	35	38	40	37	41	39	5.2	0.0	2.4	4.2	2.2	2.5
Otana	175	181	165	145	151	154	39.5	35.1	41.0	39.1	35.7	38.6	59	50	51	51	59	54	42	42	45	43	49	46	6.1	1.3	5.3	7.6	4.7	4.3
Rockford	168	170	182	127	160	156	40.4	37.7	42.8	37.5	38.7	39.7	59	50	52	50	60	54	39	44	45	42	51	46	5.4	0.2	2.4	2.4	1.7	2.7
Newburg	167	195	205	136	182	174	37.8	34.9	40.5	38.9	34.8	38.1	58	50	51	50	60	54	42	43	43	38	47	43	6.3	1.1	4.3	4.3	3.2	2.2
Leggett	189	193	186	140	173	167	39.5	36.6	41.5	38.3	37.9	39.2	59	49	50	48	58	52	37	40	42	42	45	43	5.4	0.2	2.5	3.7	2.1	1.2
Jury	192	191	183	140	184	169	37.6	35.4	40.8	36.8	36.3	38.0	61	49	50	51	56	52	40	45	47	49	52	49	5.3	0.7	4.8	8.2	4.6	2.3
Paul*	129	146	126	91	115	111	44.1	44.0	46.8	39.0	43.5	43.1	61	51	53	50	62	55	40	47	45	51	49	48	5.0	0.1	1.7	6.5	2.8	1.0
Deon	184	223	185	145	180	170	38.0	36.6	41.0	37.4	37.3	38.6	60	51	52	51	61	55	39	47	44	43	47	45	3.6	0.0	0.9	3.8	1.6	1.0
CS Camden	188	209	197	143	143	161	36.3	33.6	38.9	34.1	32.5	35.2	59	49	49	50	57	52	36	42	39	41	42	41	0.5	0.0	0.5	1.0	0.5	6.7
ND Heart	157	194	175	127	163	155	39.5	37.3	41.5	33.4	38.4	37.8	58	48	50	51	56	52	39	42	45	45	47	46	6.3	0.5	3.6	3.6	2.6	1.1
ND Carson	182	220	205	148	188	180	37.8	41.1	41.1	37.7	37.3	38.7	60	50	51	52	58	54	38	44	42	44	46	44	--	0.0	1.0	1.1	0.7	1.5
ND Spilde	184	209	187	148	178	171	37.7	39.8	39.8	38.5	36.7	38.3	58	49	50	53	57	53	39	43	43	47	49	46	--	0.1	3.3	4.8	2.7	1.0
ND Crema*	120	133	125	87	103	105	46.1	48.2	48.2	36.6	44.5	43.1	60	52	53	52	61	55	41	45	48	42	50	47	--	0.0	2.2	3.7	2.0	1.3
AAC Douglas	--	--	187	156	145	163	--	--	39.8	36.9	34.5	37.1	--	--	49	48	55	51	--	--	42	42	45	43	--	--	--	2.0	--	7.3
MN-Pearl	--	--	192	129	186	169	--	--	39.7	36.0	37.1	37.6	--	--	50	49	57	52	--	--	42	41	46	43	--	--	--	1.8	--	1.2
SD Buffalo	--	--	189	132	177	166	--	--	41.2	37.7	39.2	39.4	--	--	48	57	55	53	--	--	43	44	49	45	--	--	--	3.1	--	1.0
CDC Endure	--	--	--	153	177	--	--	--	--	35.7	36.2	--	--	--	--	51	57	--	--	--	--	43	46	--	--	--	--	1.1	--	2.3
SD Momentum	--	--	--	--	173	--	--	--	--	--	40.7	--	--	--	--	--	62	--	--	--	--	--	55	--	--	--	--	6.6	--	1.0
SD Titan	--	--	--	--	173	--	--	--	--	--	39.0	--	--	--	--	--	57	--	--	--	--	--	51	--	--	--	--	4.9	--	1.0
Ore Level 48	--	--	--	136	--	--	--	--	--	37.9	--	--	--	--	--	48	--	--	--	--	--	43	--	--	--	--	--	--	--	--
CDC Minstrel	177	199	189	--	--	--	37.2	34.5	40.2	--	--	--	58	49	50	--	--	--	36	42	42	--	--	--	3.4	0.1	0.2	--	--	--
Warrior	163	179	169	--	--	--	38.7	35.8	41.2	--	--	--	56	46	48	--	--	--	35	39	39	--	--	--	--	0.0	1.0	--	--	--
CDC Dancer	189	192	--	--	--	--	39.5	36.9	--	--	--	--	59	49	--	--	--	--	40	44	--	--	--	--	5.0	0.0	2.3	--	--	--
Hytest	160	181	--	--	--	--	40.5	38.9	--	--	--	--	57	47	--	--	--	--	41	44	--	--	--	--	4.3	0.8	1.6	--	--	--
Souris	166	186	--	--	--	--	38.5	36.7	--	--	--	--	58	48	--	--	--	--	37	39	--	--	--	--	2.6	0.1	0.0	--	--	--
Stallion	165	170	--	--	--	--	40.8	38.3	--	--	--	--	58	48	--	--	--	--	39	43	--	--	--	--	5.1	0.1	2.7	--	--	--
Hayden	177	181	--	--	--	--	40.3	38.0	--	--	--	--	58	48	--	--	--	--	40	41	--	--	--	--	4.3	0.1	2.3	--	--	--
AC Pinnacle	151	--	--	--	--	--	38.9	--	--	--	--	--	58	--	--	--	--	--	42	--	--	--	--	--	6.7	1.0	--	--	--	--
Trial Mean	170	192	182	135	167		39.2	37.2	41.5	37.5	38.3		59	49	51	51	58		40	42	44	44	47		4.4	0.2	2.1	3.8		1.7
C.V. %	4.1	3.7	3.7	6.1	6.4		1.1	1.6	0.8	1.9	1.3		1.0	1.5	1.2	1.9	1.6		4.1	4.3	3.2	5.0	2.5		37.6	234	76	--		29.1
LSD 5%	11.5	11.7	9.4	11.5	--		0.7	1.0	0.5	1.0	--		1.0	1.2	0.8	1.4	--		2.6	3.0	2.0	3.0	--		2.3	0.8	2.6	--		--
LSD 10%	9.6	9.8	7.9	9.6	12.6		0.6	0.8	0.4	0.8	0.6		0.8	1.0	0.7	1.1	1.1		2.2	2.5	1.7	2.5	1.4		2.0	0.7	2.2	--		0.6

*Hull-less variety

The 2021 trial was not harvested.

[1]2024 scale is 1-9.

[2]1=none, 9=severe

Flax Summary, Langdon 2020-2024

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)			Height (in)						Days to Flower						Oil (%)
Variety	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**17**	**22**	**2yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**20**	**21**	**22**	**23**	**24**	**3yr**	**2024**
Carter*	43	21	57	35	35	42	53.1	53.1	53.7	51.5	51.9	52.4	0.0	0.4	0.2	25	21	28	30	26	28	47	52	48	47	53	49	45.9
CDC Glas	50	21	65	28	39	44	52.0	51.2	52.9	48.4	50.4	50.6	0.1	0.0	0.1	25	19	29	30	26	28	51	54	50	52	54	52	47.5
Omega*	40	21	50	31	34	38	53.2	53.2	53.8	51.8	52.2	52.6	0.4	1.9	1.2	20	19	27	31	25	28	45	54	50	45	54	50	45.6
Webster	46	23	59	31	39	43	53.7	52.6	54.0	50.4	52.0	52.1	0.6	0.0	0.3	26	21	30	30	27	29	50	52	51	49	53	51	46.3
York	48	20	63	35	40	46	53.4	52.3	53.6	51.2	51.9	52.2	0.0	0.0	0.0	25	20	31	33	28	31	47	53	48	51	53	51	46.3
Gold ND*	48	21	56	32	39	42	53.4	53.0	52.6	52.2	52.0	52.3	0.1	0.6	0.4	23	20	31	32	27	30	49	55	51	50	54	52	46.1
CDC Neela	43	22	59	35	38	44	53.0	52.1	53.7	51.3	52.0	52.3	0.0	0.5	0.3	24	20	29	33	27	30	50	53	50	50	54	51	46.2
ND Hammond	40	21	58	31	36	42	52.9	52.3	53.0	49.2	51.4	51.2	0.0	0.0	0.0	23	21	32	32	27	30	46	52	48	49	53	50	44.2
AAC Bright*	51	21	62	32	36	43	51.1	51.0	51.0	47.0	49.2	49.1	--	0.0	--	25	20	29	31	25	28	49	54	51	52	53	52	49.3
CDC Dorado*	38	18	55	30	32	39	52.8	51.8	53.9	47.2	50.4	50.5	--	0.1	--	23	19	29	29	23	27	43	51	49	44	51	48	47.0
AAC Marvelous	--	22	64	30	39	44	--	52.5	53.9	50.5	51.7	52.0	--	0.1	--	--	20	28	29	26	28	--	53	49	51	54	51	48.3
CDC Rowland	--	21	68	35	42	49	--	52.5	53.4	50.2	51.3	51.6	--	0.1	--	--	17	29	29	26	28	--	55	49	50	53	51	46.9
CDC Kernen	--	--	57	23	35	38	--	--	53.7	46.0	51.4	50.4	--	1.8	--	--	--	29	31	27	29	--	--	51	47	55	51	46.2
CDC Plava	39	21	--	--	--	--	52.1	52.1	--	--	--	--	0.0	--	--	26	19	--	--	--	--	46	53	--	--	--	--	--
CDC Buryu	40	21	--	--	--	--	53.1	52.4	--	--	--	--	--	--	--	26	19	--	--	--	--	48	52	--	--	--	--	--
Prairie Thunder	44	--	--	--	--	--	53.2	--	--	--	--	--	0.1	--	--	28	--	--	--	--	--	50	--	--	--	--	--	--
Trial Mean	45	21	58	31	37		53.1	52.6	53.5	50.7	51.8		0.2	0.6		25	20	30	31	27		48	53	50	50	54		46.5
C.V. %	5.2	5.0	5.0	8.3	8.5		0.5	0.3	0.7	2.1	0.5		340	131		6.9	4.0	3.3	5.6	3.9		1.8	0.7	1.5	2.6	2.1		1.9
LSD 5%	3.9	1.4	4.7	5.6	--		0.4	0.2	0.6	1.7	--		1.1	1.2		2.8	1.1	1.6	2.8	--		1.4	0.6	1.2	2.1	--		--
LSD 10%	3.3	1.2	4.0	--	3.7		0.4	0.2	0.5	1.5	0.3		0.9	1.0		2.4	0.9	1.3	2.4	1.2		1.2	0.5	1.0	1.7	1.3		1.1

*Yellow seed color.

Canola - Conventional/Clearfield, Langdon 2024

Company/Brand	Variety	Type[1]	Blackleg Rating[2]	Clubroot Resistant[4]	Days to First Flower	Flower Duration	Days to Mature	Plant Height	Cover[3]	Oil[5]	Yield[5]	
					(days)	(days)	(days)	(in)	(%)	(%)	(lbs/a)	2 yr avg.
Rubisco Seed	RUB368-D	CL	MR	N/A	41	23	89	56	53	43.7	2451	2593
Rubisco Seed	RUB378-M	CL	MR	N/A	43	20	93	57	63	46.0	2482	2761
Rubisco Seed	RUBCL-0924	CL	MR	N/A	41	23	92	56	40	43.2	2592	--
	RR Check	RR	R	Yes	47	22	94	54	53	43.4	2849	2934
	LL Check	LL	R	Yes	40	20	87	54	58	42.5	3522	3400
Trial Mean					41	21	90	54	63	43.4	2459	
C.V. %					2.4	5.9	1.3	5.4	13.5	1.3	12.2	
LSD 10%					1.1	1.4	1.4	3.4	10.0	0.7	357	

All varieties are traditional oil type and commercially available.

[1]CL-Clearfield, LL-Liberty Link.

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

[3] % 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.

[4]Has clubroot resistance gene(s).

[5]8.5% moisture

No lodging in the trial.

Canola - Liberty Link, Langdon 2023-2024

Company/Brand	Variety	Type[1]	Blackleg Rating[2]	Clubroot Resistant[4]	Days to First Flower			Flower Duration (days)			Days to Mature			% Cover[3]		
					23	24	2yr	23	24	2yr	23	24	2yr	23	24	2yr
BASF	InVigor L345PC	LL	R	Yes	46	40	43	17	20	19	87	87	87	88	86	87
BASF	InVigor L340PC	LL	R	Yes	43	39	41	18	21	20	85	86	86	85	76	81
CANTERRA SEEDS	CS4000 LL	LL	R	Yes	42	40	41	19	20	20	85	87	86	85	79	82
BASF	InVigor L350PC	LL	R	Yes	48	45	47	17	16	17	90	92	91	88	81	85
BASF	InVigor LR354PC	TFLL	R	Yes	47	44	46	17	17	17	88	92	90	86	71	79
BASF	InVigor L343PC	LL	R	Yes	43	39	41	17	19	18	86	86	86	82	73	78
CROPLAN	CP7250LL	LL	R	Yes	44	43	44	20	19	20	89	91	90	87	75	81
Dyna-Gro	DG 661 LCM	LL	R	Yes	43	39	41	19	21	20	88	88	88	85	83	84
Pioneer	P612L	LL	R	Yes	47	43	45	18	20	19	89	92	91	83	46	65
BASF	InVigor L333PC	LL	R	Yes	--	41	--	--	17	--	--	87	--	--	78	--
BASF	InVigor LR344PC	TFLL	R	Yes	--	42	--	--	17	--	--	89	--	--	76	--
BrettYoung	BY7204LL	LL	R	Yes	--	42	--	--	19	--	--	91	--	--	64	--
CANTERRA SEEDS	CS4100 LL	LL	R	Yes	--	41	--	--	20	--	--	90	--	--	68	--
CROPLAN	CP7130LL	LL	R	Yes	--	40	--	--	20	--	--	87	--	--	71	--
DEKALB	DK400TL	TFLL	R	Yes	--	37	--	--	20	--	--	87	--	--	84	--
Pioneer	P516L	LL	R	Yes	--	41	--	--	21	--	--	90	--	--	73	--
BASF	InVigor L233P	LL	R	No	42	--	--	18	--	--	84	--	--	86	--	--
Bayer	DKTFLL21SC	TFLL	R	No	40	--	--	21	--	--	84	--	--	81	--	--
Bayer	DKLL82SC	LL	R	No	41	--	--	21	--	--	86	--	--	86	--	--
Bayer	DKLL83SC	LL	R	No	39	--	--	21	--	--	84	--	--	78	--	--
Pioneer	P505MSL	LL	R	Yes	44	--	--	17	--	--	85	--	--	88	--	--
Trial Mean					44	41		19	20		87	89		85	73	
C.V. %					3.4	1.7		7.6	5.5		2.0	1.3		5.7	10.4	
LSD 5%					2.1	--		2.0	--		2.5	--		6.9	--	
LSD 10%					1.8	0.8		1.7	1.3		2.1	1.4		5.8	8.9	

All varieties are traditional oil type and commercially available.

[1]LL-Liberty Link, TFLL-Roundup Ready Truflex- Liberty Link stacked.

[2]Blackleg Rating: R-Resistant. Rating provided by the company.

[3] % 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.

[4]Has clubroot resistance gene(s).

Canola - Liberty Link, Langdon 2020-2024

Company/Brand	Variety	Height (in)			Lodging (0-9)			Oil[1] (%)			Yield[1] (lbs/a)					
		23	24	2yr	20	22	2yr	23	24	2yr	2021	2022	2023	2024	2yr	3yr
BASF	InVigor L345PC	55	51	53	6.3	4.1	5.2	41.0	43.6	42.3	1512	3734	2454	3391	2923	3193
BASF	InVigor L340PC	51	50	51	5.3	4.2	4.8	40.1	43.0	41.6	1351	3573	2644	3406	3025	3208
CANTERRA SEEDS	CS4000 LL	53	54	54	--	4.0	--	41.5	45.3	43.4	1076	3237	2907	2529	2718	2891
BASF	InVigor L350PC	58	55	57	--	1.7	--	41.4	46.1	43.8	--	3615	2668	3140	2904	3141
BASF	InVigor LR354PC	57	58	58	--	1.1	--	41.7	44.8	43.3	--	3351	2429	3186	2808	2989
BASF	InVigor L343PC	52	50	51	--	3.8	--	41.2	43.4	42.3	--	3627	2541	3304	2923	3157
CROPLAN	CP7250LL	52	52	52	--	--	--	41.2	44.7	43.0	--	--	2554	2432	2493	--
Dyna-Gro	DG 661 LCM	52	55	54	--	--	--	41.4	44.4	42.9	--	--	2243	2738	2491	--
Pioneer	P612L	58	55	57	--	--	--	42.0	45.0	43.5	--	--	2584	2607	2596	--
BASF	InVigor L333PC	--	52	--	--	--	--	--	43.7	--	--	--	--	3110	--	--
BASF	InVigor LR344PC	--	55	--	--	--	--	--	44.1	--	--	--	--	3258	--	--
BrettYoung	BY7204LL	--	55	--	--	--	--	--	46.9	--	--	--	--	2805	--	--
CANTERRA SEEDS	CS4100 LL	--	53	--	--	--	--	--	46.6	--	--	--	--	2822	--	--
CROPLAN	CP7130LL	--	56	--	--	--	--	--	45.0	--	--	--	--	3149	--	--
DEKALB	DK400TL	--	50	--	--	--	--	--	46.2	--	--	--	--	3048	--	--
Pioneer	P516L	--	53	--	--	--	--	--	44.2	--	--	--	--	2733	--	--
BASF	InVigor L233P	53	--	--	5.8	4.5	5.2	41.0	--	--	1436	3171	2892	--	--	--
Bayer	DKTFLL21SC	48	--	--	4.8	2.9	3.9	41.0	--	--	978	2793	2473	--	--	--
Bayer	DKLL82SC	46	--	--	4.5	5.0	4.8	40.8	--	--	812	3094	2428	--	--	--
Bayer	DKLL83SC	48	--	--	--	3.9	--	41.3	--	--	--	3182	2314	--	--	--
Pioneer	P505MSL	56	--	--	--	5.8	--	40.9	--	--	--	2647	2346	--	--	--
Trial Mean		53	54		5.2	3.8		41.3	44.7		1308	3261	2530	2912		
C.V. %		4.3	3.6		18.4	12.9		1.3	1.2		17.6	3.9	9.9	9.5		
LSD 5%		3.3	--		1.3	0.5		0.8	--		204	122	360	--		
LSD 10%		1.7	2.3		1.1	0.4		0.6	0.6		172	102	299	326		

[1]8.5% moisture

Canola - Roundup Ready, Langdon 2022-2024

Company	Variety	Height (in)			Lodging (0-9)	Oil[1] (%)			Yield[1] (lbs/a)		
		23	24	2yr	22	23	24	2yr	23	24	2yr
CROPLAN	CP9978TF	51	50	51	3.8	41.1	44.9	43.0	2932	2933	2933
Star	StarFlex	52	49	51	2.0	42.7	45.9	44.3	2676	2871	2774
Nuseed	NC527CR TF	52	50	51	3.2	41.3	45.0	43.2	2471	2534	2503
CANTERRA SEEDS	CS3100 TF	53	52	53	2.3	42.7	44.3	43.5	2609	2457	2533
BASF InVigor	LR354PC	55	52	54	--	41.1	45.4	43.3	2344	3076	2710
CROPLAN	CP9221TF	46	49	48	--	40.6	43.2	41.9	2412	2446	2429
Dyna-Gro	DG 781 TCM	53	50	52	--	42.2	45.0	43.6	2526	2753	2640
Pioneer	P515G	50	48	49	--	41.3	46.0	43.7	2551	2819	2685
Proseed	TR 23127	53	50	52	--	42.1	44.9	43.5	2709	2566	2638
Dyna-Gro	DG 760 TM	49	51	50	--	41.7	44.5	43.1	2818	2603	2711
BASF InVigor	LR344PC	--	52	--	--	--	44.4	--	--	2919	--
BrettYoung	BY 6219TF	--	53	--	--	--	44.4	--	--	2819	--
CANTERRA SEEDS	CS3200 TF	--	52	--	--	--	45.4	--	--	3051	--
CANTERRA SEEDS	CS3300 TF	--	51	--	--	--	45.1	--	--	2669	--
CANTERRA SEEDS	CS2600 CR-T	50	--	--	3.7	42.6	--	--	2608	--	--
BrettYoung	BY 6211TF	51	--	--	2.8	40.4	--	--	2515	--	--
CANTERRA SEEDS	CS3000 TF	49	--	--	3.6	41.6	--	--	2578	--	--
Nuseed	NC155 TF	53	--	--	2.0	40.8	--	--	2412	--	--
Nuseed	NC471 TF	53	--	--	1.8	41.8	--	--	2072	--	--
Pioneer	P511G	55	--	--	--	42.2	--	--	2391	--	--
Bayer	DK900TF	52	--	--	--	42.4	--	--	2757	--	--
Trial Mean		52	51		2.5	41.6	44.9		2516	2727	
C.V. %		5.1	2.8		15.1	2.3	1.4		5.1	11.3	
LSD 10%		3.7	1.7		0.3	1.3	0.8		--	366	

[1] 8.5% moisture

No lodging in the 2024 trial.

Canola - Roundup Ready, Langdon 2023-2024

Company	Variety	Type[1]	Blackleg Rating[2]	Oil Type	Clubroot Resistant[4]	Days to First Flower			Flower Duration (days)			Days to Mature			% Cover[3]		
						23	24	2yr	23	24	2yr	23	24	2yr	23	24	2yr
CROPLAN	CP9978TF	TF	R	Trad.	N/A	38	39	39	24	22	23	86	90	88	90	83	87
Star	StarFlex	TF	R	Trad.	No	38	38	38	25	22	24	86	87	87	92	81	87
Nuseed	NC527CR TF	TF	R	Trad.	Yes	39	39	39	22	22	22	86	89	88	90	75	83
CANTERRA SEEDS	CS3100 TF	TF	R	Trad.	Yes	43	44	44	25	22	24	92	93	93	83	66	75
BASF InVigor	LR354PC	TFLL	R	Trad.	Yes	47	42	45	17	18	18	89	88	89	83	82	83
CROPLAN	CP9221TF	TF	R	Trad.	Yes	38	38	38	22	20	21	83	85	84	78	78	78
Dyna-Gro	DG 781 TCM	TF	R	Trad.	Yes	42	39	41	18	21	20	89	88	89	88	80	84
Pioneer	P515G	OptG	R	Trad.	Yes	41	39	40	21	22	22	84	87	86	83	78	81
Proseed	TR 23127	TF	R	Trad.	Yes	42	41	42	22	21	22	88	87	88	80	68	74
Dyna-Gro	DG 760 TM	TF	R	Trad.	No	39	39	39	21	20	21	83	86	85	90	77	84
BASF InVigor	LR344PC	TFLL	R	Trad.	Yes	--	41	--	--	18	--	--	87	--	--	76	--
BrettYoung	BY 6219TF	TF	R	Trad.	Yes	--	38	--	--	23	--	--	88	--	--	73	--
CANTERRA SEEDS	CS3200 TF	TF	R	Trad.	Yes	--	43	--	--	19	--	--	90	--	--	100	--
CANTERRA SEEDS	CS3300 TF	TF	R	Trad.	Yes	--	38	--	--	24	--	--	88	--	--	63	--
CANTERRA SEEDS	CS2600 CR-T	TF	R	Trad.	Yes	39	--	--	21	--	--	83	--	--	88	--	--
BrettYoung	BY 6211TF	TF	R	Trad.	No	40	--	--	21	--	--	85	--	--	87	--	--
CANTERRA SEEDS	CS3000 TF	TF	R	Trad.	Yes	37	--	--	22	--	--	83	--	--	85	--	--
Nuseed	NC155 TF	TF	R	Trad.	No	39	--	--	25	--	--	89	--	--	82	--	--
Nuseed	NC471 TF	TF	R	Trad.	No	41	--	--	22	--	--	89	--	--	65	--	--
Pioneer	P511G	OptG	R	Trad.	Yes	43	--	--	21	--	--	87	--	--	72	--	--
Bayer	DK900TF	TF	R	Trad.	Yes	42	--	--	21	--	--	85	--	--	88	--	--
Trial Mean						41	41		22	21		87	89		84	75	
C.V. %						2.9	1.9		6.9	16.8		2.4	1.4		10.6	11.2	
LSD 10%						1.7	0.9		2.0	4.3		2.9	1.5		12.3	10.0	

[1]All varieties are Hybrids. TF-Roundup Ready TruFlex, TFLL-Roundup Ready Truflex-Liberty Link stacked, OptG-Optimum GLY.

[2]Blackleg Rating: R-Resistant. Rating provided by the company.

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

[4]Has clubroot resistance gene(s).

Dry Bean Summary, Langdon 2022-2024

Variety	Market Class	Days to Maturity	Plant Height	Lodging	100 Seed Weight	Yield					
						2022	2023	2024	2 yr Avg.	3 yr Avg.	4 yr Avg.
			(in)	(1-9)	(g)	(lbs/a)					
Black Tails	Black Turtle	116	15	1.0	21.4	3463	3512	2698	3105	3224	2934
Eclipse	Black Turtle	116	15	1.4	21.6	3132	2935	2726	2830	2931	2710
ND Twilight	Black Turtle	112	13	2.6	22.0	2901	2458	2021	2240	2460	2226
Zorro	Black Turtle	--	--	--	--	2421	3209	--	--	--	--
ND Pegasus	Great Northern	117	15	3.8	38.7	4098	3176	2570	2873	3281	3041
Powderhorn	Great Northern	114	15	5.1	38.7	--	3078	1475	2277	--	--
Blizzard	Navy	117	12	1.2	19.6	3350	3210	1920	2565	2827	2611
HMS Medalist	Navy	118	13	1.4	18.0	2847	3238	2268	2753	2784	2638
ND Polar	Navy	119	15	1.7	19.0	3172	2994	2086	2540	2751	--
T9905	Navy	120	12	3.1	22.2	3326	3118	1994	2556	2813	2568
Armada	Navy	--	--	--	--	3194	3064	--	--	--	--
Rosetta	Pink	115	14	1.9	40.5	2580	3128	1448	2288	2385	2300
ND Rosalind	Pink	116	12	3.4	34.9	--	--	2245	--	--	--
Cowboy	Pinto	114	14	4.4	37.4	3074	3246	2283	2764	2868	2560
LaPaz	Pinto	115	12	4.1	35.9	3155	3496	2351	2924	3001	2707
Lariat	Pinto	117	15	4.8	41.4	3026	3416	2474	2945	2972	2658
Monterrey	Pinto	114	13	2.9	36.4	3189	3254	2839	3046	3094	2847
ND Falcon	Pinto	117	14	2.8	38.8	3278	2684	1957	2320	2640	2403
ND Palomino	Pinto	118	13	3.7	40.2	2632	2557	2284	2420	2491	2264
Torreon	Pinto	116	12	3.8	36.9	3558	2767	2242	2504	2856	2683
Vibrant	Pinto	114	13	3.8	35.0	3626	3227	2857	3042	3237	2956
Windbreaker	Pinto	113	12	4.1	39.7	2490	3109	2525	2817	2708	2428
Diamondback	Pinto	118	13	3.4	40.9	--	3050	2163	2606	--	--
ND Rodeo	Pinto	119	15	3.6	40.9	--	2868	2778	2823	--	--
Rattler	Pinto	110	14	2.2	38.6	--	3546	2417	2981	--	--
Stampede	Pinto	--	--	--	--	3432	--	--	--	--	--
Merlot	Small Red	116	13	5.3	37.4	2875	2493	1952	2222	2440	2339
Viper	Small Red	118	15	3.2	27.7	3626	--	2033	--	--	--
Ruby	Small Red	--	--	--	--	--	2799	--	--	--	--
Trial Mean		116.0	13.5	3.1	33.0	3160	3063	2225			
C.V. %		1.8	12.2	--	--	8.9	7.0	12.0			
LSD 5%		--	--	--	--	463	480	--			
LSD 10%		2.8	2.3	--	--	336	--	552			

Days to mature (R9) at least 80% of pods showing yellow and mostly ripe.
Trials were direct harvested 2021-2024.

Field Pea, Langdon 2022-2024 (Page 1 of 2)

Variety	Brand	Days to 1st Flower	Mature	Canopy Ht. at Harvest	Harvest Ease[1]	1000 KWT	Seeds/ Pound	Test Weight	Protein[2]	Yield				
										2022	2023	2024	2 yr Avg.	3 yr Avg.
			(days)	(in)	(1-9)	(g)		(lbs/bu)	(%)	bu/a				
Yellow Cotyledon Type														
EP_8971	Equinom	50	101	16	6	232	1960	61.8	30.2	48.4	64.8	62.7	63.7	58.6
CDC Inca	Meridian Seeds	53	98	28	3	219	2071	63.6	26.1	71.7	77.7	90.8	84.2	80.1
CDC Spectrum	Meridian Seeds	52	99	21	7	233	1950	62.6	26.5	61.0	83.9	84.3	84.1	76.4
MS GrowPro	Meridian Seeds	52	98	23	4	302	1504	63.2	29.3	69.9	80.0	87.3	83.6	79.1
ND Dawn	NDSU/NDCISA	50	88	12	9	214	2127	62.7	24.9	46.4	73.7	66.0	69.9	62.0
AAC Profit	Premier Genetics	52	101	18	6	202	2245	64.0	27.8	73.4	81.0	76.8	78.9	77.1
Orchestra	Premier Genetics	49	90	14	7	277	1642	63.0	27.8	55.9	82.1	85.4	83.7	74.5
DS Admiral	Pulse USA	49	90	15	7	226	2011	62.1	26.5	70.3	82.1	66.3	74.2	72.9
AAC Chrome	Valesco	51	99	17	7	254	1796	63.1	25.8	70.8	84.5	72.3	78.4	75.9
AAC Julius	Valesco	51	94	17	7	193	2351	61.5	27.9	58.6	86.6	70.3	78.4	71.8
CP5222Y	Winfield/Croplan	48	95	20	5	240	1899	63.2	27.1	71.2	81.8	81.5	81.7	78.2
CP5244Y	Winfield/Croplan	48	95	18	6	284	1601	62.5	28.3	64.0	85.5	79.9	82.7	76.5
5206	Valesco	51	95	23	4	225	2027	62.7	26.8	--	83.1	78.5	80.8	--
2822	Valesco	51	101	19	6	201	2259	61.9	28.7	--	83.5	72.8	78.2	--
EP_6816	Equinom	50	96	20	6	205	2212	62.3	28.5	--	77.0	67.9	72.4	--
Spider	LaFrenz Seed	50	96	15	8	243	1866	61.6	28.1	--	80.4	77.6	79.0	--
AAC Beyond	Meridian Seeds	52	92	14	8	196	2316	62.3	26.8	--	87.8	70.5	79.1	--
MS Prostar	Meridian Seeds	50	93	16	6	240	1894	62.6	27.3	--	78.0	82.0	80.0	--
PS1710022	NDCISA	49	90	4	9	242	1879	62.6	27.1	--	80.0	57.5	68.7	--
PG-Cash	Premier Genetics	50	91	14	8	251	1812	62.5	27.5	--	75.9	83.7	79.8	--
EP_6381	Equinom	51	97	14	5	196	2325	63.2	29.2	--	--	58.8	--	--
GTPC001	GeneTech	50	90	12	8	226	2015	63.5	26.1	--	--	81.8	--	--
GTPR004	GeneTech	54	93	14	7	228	1996	63.4	26.8	--	--	74.3	--	--
GTPR005	GeneTech	54	95	16	7	228	1993	63.3	26.4	--	--	75.5	--	--
AAC Carver	Meridian Seeds	49	90	20	6	223	2039	62.3	24.7	--	--	91.7	--	--
MS23-Y1	Meridian Seeds	52	99	22	5	208	2186	61.5	26.5	--	--	86.5	--	--
CDC Boundless	NDCISA	52	98	13	8	258	1763	63.1	25.8	--	--	74.6	--	--
Caphorn	NDCISA	51	98	20	5	268	1693	62.3	27.7	--	--	82.9	--	--

Field Pea, Langdon 2022-2024 (Page 2 of 2)

Variety	Brand	Days to 1st Flower	Mature	Canopy Ht. at Harvest	Harvest Ease[1]	1000 KWT	Seeds/ Pound	Test Weight	Protein[2]	Yield				
										2022	2023	2024	2 yr Avg.	3 yr Avg.
			(days)	(in)	(1-9)	(g)		(lbs/bu)	(%)	bu/a				
Yellow Cotyledon Type														
Iconic	NDCISA	51	94	19	6	292	1557	63.4	27.7	--	--	96.0	--	--
Protin	Photosyntech	50	93	19	5	321	1417	62.4	28.4	--	--	93.6	--	--
PSTSPS54	Photosyntech	53	97	21	4	235	1939	63.5	25.8	--	--	84.7	--	--
PSTSPS55	Photosyntech	48	89	18	6	247	1836	62.9	26.1	--	--	88.8	--	--
PSTSPS56	Photosyntech	49	96	19	6	269	1689	63.9	26.4	--	--	73.4	--	--
PG-Prairie	Premier Genetics	49	96	23	4	268	1693	64.0	26.3	--	--	80.4	--	--
PG-Bank	Premier Genetics	50	97	20	6	233	1948	61.5	27.2	--	--	80.4	--	--
McMurphy	Valesco	51	96	22	5	232	1957	62.9	27.6	--	--	78.0	--	--
2119	Valesco	52	96	23	4	211	2155	64.2	27.0	--	--	70.7	--	--
Lacross	Valesco	49	94	16	6	172	2645	63.3	26.2	--	--	62.8	--	--
Green Cotyledon Type														
Aragorn	Great Northern AG	48	87	17	9	200	2299	62.0	26.8	40.4	67.6	61.5	64.6	56.5
ND Victory	NDSU/NDCISA	56	104	20	5	166	2740	63.7	26.5	44.9	72.4	68.3	70.3	61.9
PSTSPS49	Photosyntech	52	93	18	4	238	1908	63.9	25.1	69.6	82.0	81.9	81.9	77.8
CDC Striker	Pulse USA	50	90	7	9	200	2277	62.3	26.0	43.9	78.5	63.1	70.8	61.8
Arcadia	Pulse USA	50	90	17	8	225	2018	63.8	27.9	46.6	70.2	67.0	68.6	61.3
Shamrock	Valesco	53	91	14	7	245	1851	62.8	26.0	61.4	81.4	75.8	78.6	72.9
MS22-G1	Meridian Seeds	51	100	24	4	215	2108	63.4	27.4	--	--	81.3	--	--
PSTSPS57	Photosyntech	52	94	23	5	210	2168	63.7	26.0	--	--	88.1	--	--
PSTSPS58	Photosyntech	53	99	24	5	274	1656	63.7	25.8	--	--	81.2	--	--
PG-Greenback	Premier Genetics	51	93	20	6	230	1974	63.4	25.7	--	--	85.4	--	--
Maple Cotyledon Type														
PSTSPS48	Photosyntech	48	96	25	4	264	1723	63.9	27.4	61.7	80.2	72.8	76.5	71.6
Trial Mean		51	95	18	6	232	1995	62.9	26.9	60.8	78.9	76.7		
C.V. %		1.6	2.7	19.6	14.5	4.0	4.3	1.0	2.2	7.4	7.4	11.4		
LSD 10%		1	3	4	1	11	99	0.7	0.7	5.0	7.9	10.2		

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

[2] 0% moisture basis

Soybean - RR2XF, Enlist E3, and GT, Langdon 2024

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Oil (%)	Protein (%)	Yield 2024 (bu/a)	Yield 2-yr Avg. (bu/a)
Allegiant	009F23	RR2XF	00.9	9/24	27	15.5	34.5	59.3	--
Allegiant	01F24N	RR2XF	0.1	9/25	32	14.6	34.8	55.1	--
Attain	01A5N	Enlist E3	0.1	9/24	28	15.4	35.0	65.5	--
Channel	00924RXF	RR2XF	00.9	9/24	30	15.0	33.0	56.6	--
Channel	0225RXF	RR2XF	0.2	9/27	31	14.9	34.1	62.9	--
Dyna-Gro	S01XF25	RR2XF	0.1	9/25	32	14.8	34.6	61.5	--
Fortus	0084E	Enlist E3	00.9	9/25	30	15.5	34.5	68.6	--
Fortus	0089E	Enlist E3	00.8	9/25	32	15.6	33.8	59.5	--
Fortus	0165E	Enlist E3	0.1	9/25	30	15.1	35.5	64.6	--
Golden Harvest	GH00864XF	RR2XF	00.8	9/23	29	15.2	34.6	63.2	46.6
Golden Harvest	GH00973E3	Enlist E3	00.9	9/24	29	14.9	35.3	69.2	50.9
Golden Harvest	GH0225XF	RR2XF	0.2	9/26	31	15.4	34.4	60.1	--
Golden Harvest	GH0295E3	Enlist E3	0.2	9/26	29	15.2	35.9	71.7	--
Integra	XF0063	RR2XF	00.6	9/21	26	15.6	33.7	52.7	43.6
Integra	XF0082	RR2XF	00.9	9/25	28	15.4	34.5	49.5	41.0
Legacy	LS0068-23 XF	RR2XF	00.6	9/23	32	15.3	32.9	60.3	46.5
Legacy	LS088-23 E	Enlist E3	00.8	9/25	30	15.2	34.5	70.4	52.2
Legacy	LS0098-23 XF	RR2XF	00.9	9/24	31	15.8	34.0	69.4	52.1
Legacy	LS012-23 E	Enlist E3	0.1	9/26	29	15.3	35.8	68.4	51.4
Legacy	LS014-23 XF	RR2XF	0.1	9/25	33	15.1	34.5	58.8	46.1
Legacy	LS022-24 E	Enlist E3	0.2	9/27	29	14.9	35.2	63.5	--
Legacy	LS024-23 XF	RR2XF	0.2	9/26	32	16.0	35.0	58.1	43.7
Legacy	LS034-24 XF	RR2XF	0.2	9/28	34	15.7	34.4	71.7	--
NDSU	ND17009GT	GT	00.9	9/23	32	16.1	36.5	48.5	38.8
NDSU	ND21008GT20	GT	00.8	9/22	32	15.2	35.4	54.5	41.5
Proseed	EL 40-093N	Enlist E3	00.9	9/25	28	15.3	35.0	66.6	47.6
Proseed	EL 50-063N	Enlist E3	00.6	9/20	25	14.7	37.2	63.2	--
Proseed	XF 30-062	RR2XF	00.6	9/19	27	15.6	33.5	56.5	44.3
Proseed	XF 30-092N	RR2XF	00.9	9/25	29	15.7	33.7	66.0	50.2
Proseed	XF 40-12	RR2XF	0.1	9/25	31	14.6	34.7	56.7	47.1
Thunder Seed	DE54007	Enlist E3	00.7	9/25	30	15.4	34.8	66.5	--
Thunder Seed	TE71008N	Enlist E3	00.8	9/26	31	15.2	34.2	59.2	--
Thunder Seed	TE7502N	Enlist E3	0.2	9/25	30	14.9	35.8	75.1	--
Thunder Seed	TX82008N	RR2XF	00.8	9/24	30	15.3	34.5	62.2	--
Thunder Seed	TX8402N	RR2XF	0.2	9/24	32	14.5	35.2	55.7	46.4
Thunder Seed	TX85008	RR2XF	00.8	9/21	30	14.9	35.0	62.1	--
Xitavo	XO 0094E	Enlist E3	0.0	9/26	30	15.6	34.3	65.7	51.6
Xitavo	XO 0234E	Enlist E3	0.2	9/26	29	15.3	35.6	67.9	51.0
Trial Mean				9/24	29.9	15.3	34.7	61.8	
C.V. %				1.1	6.1	1.5	1.2	6.3	
LSD 10%				1.6	2.2	0.4	0.7	4.6	

[1]Herbicide Trait - RR2XF=Xtend + Flex (Liberty Link), GT=Glyphosate Tolerant.

[2]Maturity Group provided by company.

[3]Date of physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

Yield, oil and protein reported at 13% moisture.

Soybean - RR2XF, Enlist E3, and GT, Nelson County 2024

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity	Oil	Protein	Yield 2024	Yield 2 yr Avg.	Yield 2-site Avg.[4]
				date[3]	(%)	(%)	bu/a	bu/a	bu/a
Channel	0225RXF	RR2XF	0.2	9/30	15.1	34.4	55.3	--	57.7
Channel	0325RXF	RR2XF	0.3	10/1	15.8	34.8	58.4	--	64.8
Fortus	0084E	Enlist E3	00.9	9/29	15.1	35.0	48.4	--	58.0
Fortus	0165E	Enlist E3	0.1	9/29	15.7	35.1	46.5	--	57.8
Fortus	0324E	Enlist E3	0.3	9/30	15.3	35.2	50.7	--	56.0
Fortus	0544E	Enlist E3	0.5	10/1	15.6	34.5	49.4	--	57.0
Golden Harvest	GH0225XF	RR2XF	0.2	9/25	15.9	34.2	58.6	--	59.2
Golden Harvest	GH0384XF	RR2XF	0.3	9/26	15.7	34.2	62.5	59.6	59.3
Integra	XF0115	RR2XF	0.1	9/27	14.9	34.4	51.7	--	59.6
Integra	XF0212	RR2XF	0.2	9/28	15.5	34.8	45.5	--	55.5
Integra	XF0493	RR2XF	0.4	10/1	15.6	34.4	46.1	49.0	56.3
Legacy	LS014-23 XF	RR2XF	0.1	9/26	15.3	33.9	48.1	50.8	58.5
Legacy	LS022-24 E	Enlist E3	0.2	9/27	14.7	34.6	57.3	--	61.2
Legacy	LS024-23 XF	RR2XF	0.2	9/27	16.4	34.1	47.3	47.5	53.1
Legacy	LS032-23 E	Enlist E3	0.3	9/30	15.3	34.8	59.9	56.4	64.1
Legacy	LS034-24 XF	RR2XF	0.2	9/28	15.5	34.7	61.6	--	68.9
Legacy	LS044-23 XF	RR2XF	0.4	9/28	15.5	34.8	63.2	59.1	68.0
NDSU	ND17009GT	GT	00.9	9/26	16.2	36.1	47.0	46.2	54.7
NDSU	ND21008GT20	GT	00.8	9/27	15.8	34.5	44.8	44.6	51.8
Proseed	EL 50-33N	Enlist E3	0.3	9/29	15.3	35.1	56.6	--	60.0
Proseed	XF 30-42	RR2XF	0.4	9/28	15.8	34.2	62.1	57.5	62.3
Proseed	XF 40-12	RR2XF	0.1	9/26	15.1	34.1	53.2	53.7	60.7
Proseed	XF 50-52N	RR2XF	0.5	9/26	15.1	34.9	66.7	--	67.6
Xitavo	XO 0094E	Enlist E3	0.0	9/30	15.1	35.2	51.0	50.4	58.4
Xitavo	XO 0234E	Enlist E3	0.2	9/29	15.1	35.6	60.7	56.2	65.3
Trial Mean				9/28	15.5	34.7	53.0		
C.V. %				1.3	1.9	1.4	8.2		
LSD 10%				1.7	0.5	0.9	5.1		

[1]Herbicide Trait - RR2XF=Xtend + Flex (Liberty Link), GT=Glyphosate Tolerant.

[2]Maturity Group provided by company.

[3]Date of physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2XF, Enlist E3, and GT, Walsh County 2024

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	IDC (1-5)[5]	Plant Height (in)	Oil (%)	Protein (%)	Yield 2024	Yield 2 yr Avg.	Yield 2-site Avg.[4]
									bu/a		
Channel	00924RXF	RR2XF	00.9	9/8	1.6	29	16.8	32.8	61.3	--	--
Channel	0225RXF	RR2XF	0.2	9/16	2.9	23	16.3	33.4	60.0	--	57.7
Channel	0325RXF	RR2XF	0.3	9/14	1.0	27	16.6	34.2	71.3	--	64.8
Dyna-Gro	S01XF25	RR2XF	0.1	9/8	1.0	30	16.7	32.4	70.2	--	--
Fortus	0084E	Enlist E3	00.9	9/11	1.0	26	16.7	33.9	67.5	--	58.0
Fortus	0165E	Enlist E3	0.1	9/12	1.4	28	17.0	33.8	69.1	--	57.8
Fortus	0324E	Enlist E3	0.3	9/17	1.0	26	16.6	34.3	61.3	--	56.0
Fortus	0544E	Enlist E3	0.5	9/20	1.9	27	16.9	33.7	64.6	--	57.0
Golden Harvest	GH0225XF	RR2XF	0.2	9/12	3.1	25	16.9	34.0	59.8	--	59.2
Golden Harvest	GH0384XF	RR2XF	0.3	9/15	2.8	27	16.1	35.1	56.1	47.6	59.3
Integra	XF0115	RR2XF	0.1	9/8	1.0	30	16.4	33.0	67.5	--	59.6
Integra	XF0212	RR2XF	0.2	9/10	1.0	34	16.7	33.7	65.4	--	55.5
Integra	XF0493	RR2XF	0.4	9/18	1.2	29	16.6	35.0	66.6	52.3	56.3
Legacy	LS014-23 XF	RR2XF	0.1	9/8	1.0	31	16.5	32.2	69.0	54.4	58.5
Legacy	LS022-24 E	Enlist E3	0.2	9/12	1.0	26	16.8	32.6	65.2	--	57.3
Legacy	LS024-23 XF	RR2XF	0.2	9/11	1.3	26	17.6	34.2	58.9	47.4	53.1
Legacy	LS032-23 E	Enlist E3	0.3	9/16	1.1	27	16.7	33.7	68.4	54.2	64.1
Legacy	LS034-24 XF	RR2XF	0.2	9/15	1.0	28	16.8	33.8	76.2	--	68.9
Legacy	LS044-23 XF	RR2XF	0.4	9/18	1.0	28	16.6	35.1	72.8	56.4	68.0
NDSU	ND17009GT	GT	00.9	9/9	1.6	30	17.1	35.7	62.4	48.9	54.7
NDSU	ND21008GT20	GT	00.8	9/6	1.0	28	17.0	33.2	58.7	47.7	51.8
NK Seeds	NK006-U6E3	Enlist E3	00.6	9/2	1.1	21	16.6	33.9	50.8	--	--
NK Seeds	NK006-Z5XF	RR2XF	00.6	9/3	1.0	24	17.4	33.5	51.4	--	--
NK Seeds	NK009-G7E3	Enlist E3	00.9	9/8	1.0	25	16.3	34.3	65.6	51.3	--
NK Seeds	NK02-W8E3	Enlist E3	0.2	9/15	2.3	26	16.6	35.0	67.4	--	--
NK Seeds	NK03-V5E3	Enlist E3	0.3	9/12	1.0	25	16.3	34.2	71.3	55.4	--
Proseed	EL 50-13N	Enlist E3	0.1	9/10	1.0	27	17.2	33.7	70.2	--	--
Proseed	EL 50-33N	Enlist E3	0.3	9/17	1.3	27	16.8	33.5	63.4	--	60.0
Proseed	XF 30-42	RR2XF	0.4	9/16	1.0	28	16.5	35.2	62.6	51.1	62.3
Proseed	XF 40-12	RR2XF	0.1	9/8	1.0	31	16.6	33.1	68.1	53.3	60.7
Proseed	XF 50-52N	RR2XF	0.5	9/16	1.0	25	15.6	35.9	68.6	--	67.6
Xitavo	XO 0094E	Enlist E3	0.0	9/12	1.0	24	16.7	34.4	65.7	50.4	58.4
Xitavo	XO 0234E	Enlist E3	0.2	9/15	1.1	25	16.3	35.1	69.9	55.1	65.3
Trial Mean				9/12	1.3	27.1	16.7	33.9	64.3		
C.V. %				1.5	34.3	6.5	1.5	1.0	9.4		
LSD 10%				2.2	0.5	2.1	0.4	0.6	7.1		

[1]Herbicide Trait - RR2XF=Xtend + Flex (Liberty Link), GT=Glyphosate Tolerant.

[2]Maturity Group provided by company.

[3]Date of physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

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

[5]IDC score - 1=green, 5=dead tissue.

Yield, oil and protein reported at 13% moisture.

Soybean - Conventional, Langdon 2024

Brand	Variety	Maturity Group[1]	Maturity	Plant Height	Oil	Protein	Yield 2024	Yield 2 yr Avg.	Yield 2 -site Avg.[3]
Conventional:			**date[2]**	**(in)**	**(%)**	**(%)**	**---------bu/a--------**		
Legacy	LS0090-20C	00.7	9/22	28	15.6	38.2	54.7	40.9	48.7
Legacy	LSX020-23C	0.2	9/23	32	15.6	36.7	57.3	47.8	55.3
NDSU	ND Benson	0.4	9/29	33	15.7	35.4	58.4	46.2	61.2
NDSU	ND Rolette	00.9	9/23	30	15.9	34.1	60.3	47.8	61.1
Peterson Farm	HANA	00.9	9/25	31	14.9	38.2	63.0	--	61.0
Proseed	PC 50-099	00.9	9/23	33	15.6	35.9	52.8	--	56.7
Richland IFC	MK009	00.9	9/26	29	15.3	33.8	49.4	40.0	50.6
Richland IFC	MK0249	0.2	9/28	27	15.4	33.8	54.5	45.5	53.3
Trial Mean			9/25	30.3	15.7	35.1	58.6		
C.V. %			1.4	7.2	1.5	0.9	5.0		
LSD 10%			2.3	2.6	0.4	0.6	3.5		

[1]Maturity Group provided by company.

[2]Date of physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

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

Yield, oil and protein reported at 13% moisture.

Soybean - Conventional, Walsh County 2024

Brand	Variety	Maturity Group[1]	Maturity	Plant Height	IDC	Oil	Protein	Yield 2024	Yield 2 yr Avg.	Yield 2-site Avg.[3]
Conventional:			**date[2]**	**(in)**	**(1-5)[4]**	**(%)**	**(%)**	**---------bu/a--------**		
Legacy	LS0090-20C	00.7	9/11	20	3.1	16.3	38.0	42.6	37.4	48.7
Legacy	LSX020-23C	0.2	9/13	25	2.5	16.6	36.2	53.4	45.1	55.3
NDSU	ND Benson	0.4	9/16	28	1.0	16.8	35.5	64.0	52.0	61.2
NDSU	ND Rolette	00.9	9/10	27	1.3	17.4	33.2	62.0	49.3	61.1
Peterson Farm	HANA	00.9	9/10	25	2.4	16.0	37.4	59.1	--	61.0
Proseed	PC 50-099	00.9	9/10	28	1.1	17.2	33.1	60.7	--	56.7
Proseed	PC 50-59	0.5	9/17	29	1.0	15.1	37.2	70.4	--	--
Richland IFC	MK009	00.9	9/15	25	2.9	16.1	33.1	51.7	44.6	50.6
Richland IFC	MK0249	0.2	9/15	24	2.0	16.4	32.5	52.1	45.3	53.3
Trial Mean			9/12	26.3	1.7	16.7	34.5	59.7		
C.V. %			1.4	6.4	23.0	1.2	1.0	7.8		
LSD 10%			2.1	2.0	0.5	0.4	0.6	5.6		

[1]Maturity Group provided by company.

[2]Date of physiological maturity at R7 stage (one brown pod on the main stem obtains mature brown or tan color).

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

[4]IDC score - 1=green, 5=dead tissue.

Yield, oil and protein reported at 13% moisture.

Oil Sunflower, Langdon 2024

Brand	Hybrid	Hybrid Type[1]	Days to Flower (days)[2]	Days to Mature (days)[2]	Plant Height (in)	Oil (%)	Test Weight (lbs/bu)	Harvest Moist. (%)	Yield 2022 (lbs/a)	Yield 2023 (lbs/a)	Yield 2024 (lbs/a)	Yield 2yr Avg. (lbs/a)	Yield 3yr Avg. (lbs/a)
CROPLAN	CP455E	HO,EX,DMR	76	127	59	43.1	33.1	14.0	2814	2609	2629	2619	2684
Dyna-Gro	H45HO10EX	HO,EX	76	125	66	44.5	29.6	11.3	2437	2064	2462	2263	2321
Dyna-Gro	H45NS16CL	NS,CL,DMR	73	126	55	44.3	33.7	13.3	3045	2279	2185	2232	2503
Dyna-Gro	H49HO19CL	HO,CL,DMR	78	128	58	45.3	30.2	18.1	2734	2950	2777	2864	2820
Dyna-Gro	H47HO11EX	HO,EX,DMR	77	130	67	44.2	35.4	17.8	2534	2472	2205	2339	2404
Dyna-Gro	H50HO20CP	HO,CP,DMR	78	127	63	48.0	30.8	13.3	2533	2029	2473	2251	2345
Nuseed	N4H422 CL	HO,CL,DMR	76	128	64	44.9	32.3	14.1	2720	2478	2715	2597	2638
Nuseed	N4H470 CLP	HO,CP,DMR	76	127	64	48.3	31.9	13.6	2409	1971	2332	2151	2237
Pioneer	P63HE920	HO,EX,DMR	78	130	71	43.9	34.6	16.0	2618	2226	2483	2355	2442
Proseed	E-2446 E	HO,EX,DMR	78	127	68	40.2	32.0	15.9	2275	2274	2093	2183	2214
Sunrich	4415 HO/DMR/CLP	HO,CP,DMR	77	127	64	42.9	31.4	14.0	2651	2117	2580	2348	2449
Sunrich	4425CL	MO,CL,CON	74	129	66	38.8	32.6	14.5	2768	2407	2203	2305	2459
CROPLAN	CP4255E	HO,EX,DMR	73	131	65	43.5	34.2	17.2	--	2687	2146	2417	--
CROPLAN	CP5249CL	HO,CL,DMR	74	125	58	47.7	31.1	11.1	--	2120	2148	2134	--
CROPLAN	CP4475E	HO,EX,DMR	69	128	69	44.3	33.1	13.0	--	2768	2500	2634	--
Proseed	50068 CL	HO,CL,DMR	76	128	63	45.2	31.7	15.3	--	2240	2249	2244	--
CROPLAN	CP7919CL	HO,CL,DMR	77	129	57	44.1	31.6	17.6	--	--	2346	--	--
CROPLAN	CP5238CL	HO,CL	78	130	65	46.8	31.0	19.1	--	--	2687	--	--
LIDEA	LS002	HO,EX,DMR	72	126	65	42.6	33.0	13.1	--	--	2135	--	--
LIDEA	LS003	HO,EX	78	127	68	39.0	30.2	18.0	--	--	1449	--	--
LIDEA	LS004	HO,EX	77	128	76	39.7	30.9	15.7	--	--	1433	--	--
LIDEA	LS005	HO,EX	77	127	65	44.3	34.2	12.7	--	--	2532	--	--
LIDEA	LS007	HO,EX	78	127	69	43.3	32.7	15.2	--	--	2004	--	--
Nuseed	N4H205 E	HO,EX,DMR	76	123	61	45.8	28.9	11.2	--	--	2199	--	--
Nuseed	N4H490 E	HO,EX,DMR	78	128	65	45.9	32.5	14.6	--	--	2777	--	--
Pioneer	P64HE188	HO,EX,DMR	78	131	62	43.8	32.8	19.0	--	--	2104	--	--
Proseed	2508 CP	HO,CP,DMR	77	128	74	42.0	32.4	14.8	--	--	2308	--	--
Proseed	2534 E	HO,EX,DMR	78	128	61	47.2	32.6	15.6	--	--	2597	--	--
Proseed	2591 CP	HO,CP,DMR	77	127	66	49.9	32.2	13.4	--	--	2641	--	--
USDA[3]	894	Trad.	73	125	65	45.3	31.4	11.6	2797	2515	2073	--	--
Trial Mean			77	127	65	43.6	32.0	15.1			2236		
C.V. %			1.0	1.2	4.9	3.4	2.7	10.9			14		
LSD 10%			1.1	2.1	4.3	2.0	1.2	2.2			426		

[1]Type: HO = High Oleic, NS = NuSun, Trad. = Traditional (linoleic), CL = Clearfield, CP = Clearfield Plus, EX = ExpressSun, DMR = Downy Mildew Resistant, CON = ConOil, MO = Mid-Oleic

[2]Days after planting

[3]Long-term hybrid check

Oil and yield were adjusted to 10% moisture.

Days after planting maturity checks: Honeycomb NS=123, 8N270CLDM=124, 559CL=126.

Confection (non-oil) Sunflower, Langdon 2024

Brand	Hybrid	Hybrid Type[1]	Days to Flower (days)[3]	Days to Mature (days)[3]	Plant Height (in)	Test Weight (lbs/bu)	Harvest Moist. (%)	Seed over screen 22/64 (% over)	Seed over screen 20/64 (% over)	Seed over screen 18/64 (% over)	Yield 2024 (lbs/a)	Yield 2-yr Avg. (lbs/a)
Sunrich	SS91	Trad.	73	131	62	26.3	20.0	49	90	94	1893	2160
Sunrich	SS92CL	CL	69	127	51	24.7	18.0	30	60	81	2625	2508
USDA	924[2]	Trad.	68	112	58	27.4	12.7	0	17	54	2412	2551
Trial Mean			71	128	58	25.9	18.9				1887	
C.V. %			1.2	1.2	5.5	4.9	15.9				13.1	
LSD 10%			1.1	2.0	4.0	1.6	3.8				312.0	

[1]Type: Trad. - no herbicide tolerance trait. CL - Clearfield.

[2]Long term hybrid check.

[3]Days after planting

Yield adjusted to 10% moisture.

Dry Pea Response to Seeding Date and Variety, 2024

NDSU Langdon Research Extension Center

Bryan Hanson, Lawrence Henry and Rick Duerr

A field trial was conducted at the NDSU Langdon Research Extension Center to examine the response of dry pea to seeding dates on two varieties. Earlier research from 1998-2000 indicated that the optimum timing for maximum yields was May 10 before dropping to 80 percent of the maximum by May 19. After that date yields dropped off rapidly. Much of the yield loss was due to varieties not having resistance to the disease downy mildew. With new genetics for downy mildew offered in most of the new pea varieties, yield trends the past several years have been increased at the later seeding dates. This study was initiated to examine seeding date trends with the newer varieties available.

Experimental design was a randomized complete block split plot (whole plots = seeding date, sub-plot = variety) with four replications. Yellow pea varieties 'AAC Chrome' and 'Spider' were planted on May 13, May 23, and June 7 on a conventionally tilled Svea-Barnes loam soil in 6, 7-inch rows at a seeding rate of 325,000 pure live seeds/acre, 7.5 seeds/ft^2. An early May planting was planned but weather conditions prevented this.

There were no significant or small differences between the traits observed when averaged over seeding dates or averaged over varieties. 'Spider' did have a lower plant stand but was able to compensate with more pods/plant to have a similar yield (Table 2). Days to flower and protein was greatest at the May 13 seeding date (Table 1). The greatest yield occurred at the May 23 seeding date but the differences were not significantly different from other seeding dates.

This one-year study would seem to indicate that the planting window for field peas may be extended for northeastern North Dakota. Additional studies are needed to verify this information.

Table 1. Field Pea response to seeding date averaged over varieties.

Seeding Date	Plant Stand	Days to Flower	1000 KWT	Test Weight	Protein	Yield
	plt/ft^2		g	lbs/bu	%	bu/a
May 13	6.1	53	239	62.4	26.1	71.7
May 23	5.1	50	244	64.3	25.2	80.8
June 7	6.1	46	215	65.0	25.5	74.3
LSD (0.10)	0.6	1.8	11.0	0.8	0.3	NS
CV (%)	9.3	2.0	3.0	1.0	1.3	8.4

Table 2. Field Pea response to variety averaged over seeding date.

Variety	Plant Stand	Days to Flower	1000 KWT	Test Weight	Protein	Yield
	plt/ft^2		g	lbs/bu	%	bu/a
AAC Chrome	6.2	49	234	63.9	24.8	76.1
Spider	4.7	50	231	63.9	26.4	75.2
LSD (0.05)	0.4	0.7	NS	NS	0.4	NS

Evaluation of Seed Treatments to Manage Blackleg on Canola

Venkat Chapara, Amanda Arens, and Larissa Jennings

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

Materials and Methods:
The objective of this research trial, conducted at the Langdon Research Extension Center, was to evaluate the performance of seed treatments to manage blackleg on canola. The trial, which commenced on May 17, 2024, involved the planting of treated seed with various treatments on the canola cultivar 'InVigor L233P'. These treatments were then compared with the non-treated seed. The design was a randomized complete block with four replications. The trial adhered to state recommended practices for land preparation, fertilization, seeding rate, weed and insect control. The plot size was 5 ft. wide x 16 ft. long, and the research plots were inoculated twice with ascospores of the blackleg pathogen at the 2-4 leaf stage. Twenty-five canola stubbles were rated within each plot, and the incidence and severity of blackleg infections were recorded on a 0-100 scale after swathing on August 5. The data were subjected to analysis of variance using complete block, balanced orthogonal designs of Agrobase generation II software.

Table 1: Effect of fungicide seed treatments on mean plant stand, phytotoxicity, blackleg (disease) incidence, severity, yield and test weights.

Treatments	Plant Stand	Phytotoxicity	Vigor	Blackleg		Yield	Test Wt.
	3 ft/row	(0-9)	(1-5)	% Incidence	% Severity	lbs/A	lbs/bu
Experimental	24	0.3	2	46	26	2642	51
Saltro	20	0.0	2	41	20	2066	51
Evergol Energy	16	0.5	2	57	34	1874	52
Intego Solo	17	0.0	2	51	24	2077	52
Rancona Summit	15	0.3	2	42	23	1873	52
Trilex	19	0.0	2	61	37	1894	52
Non-Treated	16	0.0	3	71	43	1563	52
Mean	**18**	**0.14**	**2.04**	**53**	**29**	**1998**	**51.5**
CV%	**30**	**211**	**14.84**	**17**	**24**	**11**	**0.4**
LSD	**8**	**0.45**	**0.45**	**14**	**11**	**314**	**0.3**
P-Value (0.05)	**NS**	**NS**	**NS**	**0.0018***	**0.0024***	**0.0001***	**0.0034***

Results: The research results show canola seed treatments have practical implications for crop protection. Canola seed treated with the fungicide Saltro® showed the lowest blackleg incidence and severity, followed by Rancona Summit® and the experimental. These results, which are statistically different from the other treatments tested, provide crucial insights into blackleg incidence and can guide farmers and agronomists in their crop protection strategies (Table 1).

Evaluation of Pesticide Compounds to Manage Bacterial Leaf Blight of Field Peas

Venkat Chapara, Amanda Arens, and Larissa Jennings

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 peas. The trial was planted on May 10, 2024, with the field pea variety 'Salamanca' in a randomized complete block design replicated four times. The trial adhered to 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 wet during the crop growth period, hence repeated treatment sprays at R-stage. The amount of BB infection obtained in the research plots was based on natural infections. A rigorous rating scale of 0 - 100 was adopted from Chaudhary 1996, where the severity of BB in a plot was recorded as the percentage of tissue area infected out of the total leaf area examined. This method ensured precision and accuracy. Fifty leaves from each plot were sampled and measured for the average percentage of lesion area.

Results: Significant differences were observed in bacterial blight control when sprayed with pesticide compounds compared to the non-treated check. There were no differences among the pesticide compounds evaluated, indicating that all options are equally viable. The bacterial blight incidence on various treatments on the field peas ranged from 3 to 20%, with a mean disease incidence of 8%. The severity of bacterial blight infections ranged from 2 to 14%, with a mean severity of 4%. The highest incidence and severity of bacterial blight were recorded in the non-treated check (Table 1). No significant differences were found in the yield (at 13.5% moisture) and test weight (Table 1) among the pesticide compounds tested and the non-treated check (P-value non-significant).

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

		Bacterial Blight		Phytotoxicity	Yield	Test Wt.
Treatments	**Rate**	**% Incidence**	**% Severity**	**(0-10)**	**(bu/A)**	**(lbs/bu)**
Kocide (Copper Hydroxide)	6 lbs/a	12	5	0.0	78	62.5
Copper Sulfate	6 lbs/a	9	4	0.0	74	62.5
Guarda	3.3 lts/a	8	4	0.3	70	63.0
Non-treated	CHK	20	14	0.0	68	62.5
Zinx Oxide	800mg/a	12	6	0.5	68	62.8
Kaolin Clay WP	½ lb/gallon of water	3	2	0.0	71	62.8
Resozurin Sodium Salt	10 mg/a	4	2	0.1	70	62.8
Neomycin	50 µg/ml	4	2	0.3	69	62.5
Streptomycin sulfate (Agrimycin)	3 lbs/a	3	2	0.0	71	62.8
Oxidate 5	1% V/V	4	3	1.8	71	62.7
	Mean	**8**	**4**	**0.6**	**70**	**63**
	CV%	**64**	**86**	**151.0**	**10**	**1.1**
	LSD	**7**	**5**	**1.4**	**NS**	**NS**
	P-Value (0.05)	**0.0007***	**0.0022***	**0.0047***	**NS**	**NS**

Acknowledgements: Funding from the North Dakota Crop Protection Product Harmonization and Registration Board.

Special thanks to Brock Freer, Kartheek Chapara, Carter Mosher, and Tucker Gellner.

Clubroot Resistance Breakdown Alert!

Venkat Chapara

In the ongoing annual clubroot survey in canola fields, a crucial research initiative was conducted in 18 counties of North Dakota. The survey revealed a breakdown of first-generation resistance to clubroot in three resistant canola cultivars in Cavalier County (Table 1). The breakdown of cultivar resistance to clubroot is a significant threat to the canola crop. However, with the proper measures, such as the practice of longer crop rotations (one in four years) in acidic soils, the use of multi-gene clubroot-resistant canola cultivar and proper equipment sanitation in endemic areas, growers can play a crucial role in preventing its spread. These measures have been proven effective and we urge you, as key stakeholders, to implement them with confidence. A grower's commitment to cleaning equipment thoroughly after working in a clubroot-infected field is critical, as the primary mechanism of spread between fields is the movement of infested soil on farm equipment.

Table 1: Level of clubroot damage observed in clubroot-resistant cultivars released by four different seed companies that are widely planted to manage clubroot in NE North Dakota.

Clubroot Resistance Breakdown-2024		
Characteristics of Clubroot Resistant Cultivar*	**Herbicide Trait**	**Level of Clubroot Damage**
1. First-generation	LibertyLink +RoundUp Ready	Severe (100% DSI) /Heavy Yield Losses
2. CR4	LibertyLink	Severe (100% DSI) in Patches
3. Resistant to Predominant Pathotypes	LibertyLink + RoundUp Ready	Severe (100% DSI) in Patches
4. Next-generation	LibertyLink	Found galls in low levels (5% DSI)

*Clubroot resistant cultivars of canola were designated differently by respective industries.

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 1: Severe galling of the canola roots.

Monitoring the Clubroot Spread in the Major Canola Growing Counties

Principle Investigator: Venkat Chapara
Collaborators: Zhaohui Liu, Luis del Rio, Neeraja Narra, Dante Marino, Ibukunoluwa Bankole, Amanda Arens, Larissa Jennings, Gongjun Shi, and Anitha Chirumamilla

Objective: Survey and quantification of resting spores of *Plasmodiophora brassicae* from soil samples collected in North Dakota fields.

Survey Procedure:
The objective of 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: A comprehensive clubroot disease survey was carried out in eighteen counties of North Dakota, leaving no stone unturned in our quest to determine the prevalence of *Plasmodiophora brassicae*. The survey involved a visual inspection of canola crop roots, with one field in every 5,000 acres targeted for scouting in each county. Soil samples were meticulously collected from the visited fields to determine the pH of the soil and the number of resting spores per gram of soil. A minimum of three to ten fields per county were the focus of our scouting efforts.

The survey was done in two phases.

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

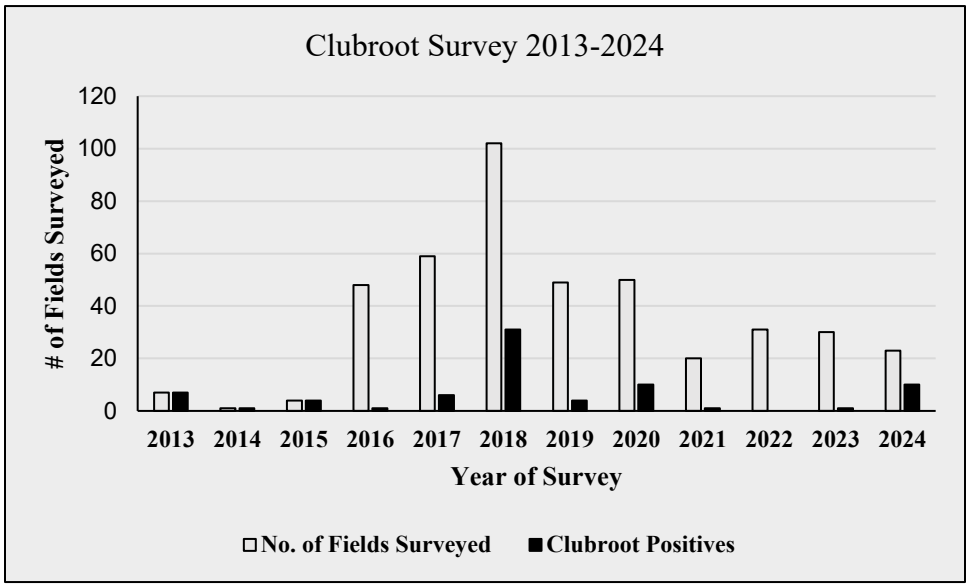
Plants were sampled from distinct stunted patches or prematurely senescing plants in the field during the growing season. Patches visible from the edge of the field were checked by digging and observing the roots for clubroot symptoms, then soil samples were collected from those specific areas.

2nd phase: after swathing
Scouting at swathing was based on the methodology followed in Canada by the Alberta Agricultural and Rural Development (AARD) for their annual clubroot disease survey. Reports of AARD indicated that the 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 walked in a "W" pattern stopping at five spots and uprooting ten consecutive stems from the ground at each spot. Each sampling point was separated by 100 meters or 328 feet. Roots of fifty 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: The results of the clubroot survey in North Dakota indicate ten out of the 108 fields surveyed in North Dakota showed canola roots with galls were infused by the clubroot pathogen. All the clubroot positives were found in Cavalier County (Figure 1). A sudden increase in clubroot was observed in 2024, increasing to 48% in the number of clubroot-infected canola fields. These clubroot-positive findings are the highest incidence after the endemic observed in 2018. The rise in clubroot could be attributed to the breakdown of clubroot resistance in the first-generation clubroot-resistant cultivars that were released by different companies. A drastic implementation of change in crop production practices by the growers, such as crop rotation of one in four years, is urgently needed. This situation calls for a collaborative effort

between researchers, farmers, and policymakers. Additionally, growing multiple cultivars by a grower can spread the risk and provide some insurance to the crop.

Figure 1: Fields with clubroot infections found in the last twelve years of the survey in Cavalier County.



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

Soil samples were collected from major canola growing counties of North Dakota and were submitted for resting spore quantification and pH determination.

The main objective of this procedure is to quantify resting spores of the clubroot pathogen from the soil and to determine the pH of the soil. The information will be useful for growers to decide on a suitable crop for the rotation and to be aware of the infection levels of the clubroot pathogen in their fields.

<u>Results from molecular assays on soil samples</u>: The molecular assays on the soil samples collected from the year 2023 (Table 1) indicated that Walsh (75%) and Cavalier (73%) counties had the highest percentages of fields with clubroot resting spores, followed by Towner (67%) and Bottineau (60%), and the lowest obtained was in Nelson County (25%). The highest number of resting spores (807,000) per gram of soil was obtained in a field in Cavalier County and the lowest (11,000) per gram of soil was in Rolette and Towner Counties. However, the visible gall symptoms on roots were seen only in Cavalier County when the roots were uprooted in the surveyed fields.

Table 1: List of counties surveyed, the range of resting spores of clubroot obtained per gram of soil and the percentage of positive fields obtained with resting spores in various counties.

		Percent Fields with CR
County	**CR Resting Spore Range**	**Positives**
Cavalier	22/30 (17,000-807,000)	73
Rolette	2/5 (11,000-37,000)	16
Towner	4/6 (11,000-62,000)	67
Nelson	1/4 (35,000)	25
Walsh	3/4 (18,000-65,000)	75
Pembina	3/6 (62,000-546,000)	50
Bottineau	3/5 (546,000-1,500,000)	60
Ramsey	2/5 (306,000-318,000)	40
McLean	2/5 (550,000-1,450,000)	40
Renville	2/4 (141,000-197,000)	50
Ward	2/4 (110,000-173,000)	50
Grand Forks	2/5 (60,000-154,000)	40

Obtained pH of soil samples in various counties: The range of pH obtained in soil samples across 12 counties collected from canola-grown fields in our survey was 5.2-8.2 (Table 2). Out of which, 65% are of basic (≥7) pH, 30% are of acidic (< 6.6), and 5% are of neutral (6.6 - 7). It's crucial to note that the fields with acidic to neutral pH are significantly more vulnerable to clubroot infections. Since most of the fields surveyed have basic pH, they do not have visible galls on canola roots even though the resting spores of the clubroot pathogens are found.

Table 2: The range of pH of the soil obtained in each county in our survey.

County	**Low**	**High**
Bottineau	5.4	7.4
Cavalier	4.9	7.9
Grand Forks	6.9	8.2
McLean	5.1	7.8
Nelson	7.1	8.1
Pembina	5.6	8.2
Ramsey	6.3	7.5
Renville	5.7	8.1
Rolette	6.8	7.7
Towner	5.2	7.9
Walsh	7.4	8.1
Ward	4.9	6.1

Management of Fusarium Head Blight in Barley

Venkat Chapara, Amanda Arens, Larissa Jennings and Andrew Friskop

This field study was planted on May 13, 2024 at the Langdon Research Extension Center. The experimental trial was designed in a randomized complete block with four replications. Plots were arranged in seven rows with six-inch row spacing and a row length of 20 feet trimmed to 15 feet for harvest. The cultivar 'ND Genesis' barley was seeded at a rate of 1.2 million pure live seeds/a. An untreated border plot was planted between treated plots to minimize interference from spray drift. The previous crop was field pea. No pre-emergent herbicide was applied before the research area was tilled. Huskie FX (18 oz/a) + Axial Bold (15 oz/a) were used to control weeds. The plots were inoculated by spreading corn spawn inoculum at boot stage (Feekes 9-10) at a rate of 300 g/plot. Supplemental moisture was provided by running overhead irrigation from Feekes 10.5 to 11.25 for one hour per day to provide a conducive environment for Fusarium Head Blight (FHB) development. Fungicides were applied with a CO_2 backpack sprayer equipped with a three-nozzle boom (XR8001) operated at 40 psi delivering a water volume of 15 GPA. Fungicide application was made at Feekes 10.51 (10% flowering) on July 6 (wind speed 5 MPH, 77^{O} F at 3:00 pm).

Percent FHB incidence (INC) was calculated by counting the number of heads showing FHB symptoms from 50 randomly selected panicles/heads, excluding the two outer rows from each plot. FHB severity (SEV) on the heads rated using a 0-100% scale from the same 50 heads. FHB index (FHBI) was calculated using the formula FHBI=(SEV*INC)/100. Plots were harvested on August 29 with a plot combine. Yield, test weight, and percent plump were determined. Statistical analysis was done using Genovix Generation II software. Fisher's least significant difference (LSD) was used to compare means at p ($\alpha = 0.05$).

Results: Our research has unveiled significant differences in the percent incidence of Fusarium Head Blight (FHB) between the non-treated control and the various fungicide treatments tested. There are also significant differences in the severity and index of FHB between the non-treated control and the fungicide treatments. The only exception to this is seen with Miravis Ace and the experimental treatments. No significant differences were found in the yield, test weight, and plump percentage traits among the fungicide groups tested (Table 1).

Table 1: Mean values of the variables tested on application of various fungicide treatments in barley.

	Rate	FHB			Yield	Test wt.	Plump
	fl. oz/a	Incidence %	Severity %	Index	bu/a	lbs/bu	%
NON-TREATED	Check	39	14	5.6	68	43	95
PROSARO 421SC	8.2	16	9	1.6	69	43	97
PROSARO PRO LOW	10.3	16	7	1.1	71	43	96
PROSARO PRO HIGH	13.6	11	7	0.9	71	44	98
MIRAVIS ACE	13.7	24	9	3.0	74	45	95
Experimental	7.3	25	17	4.6	68	44	96
	Mean	22	11	3	70	44	96
	CV%	38	37	79	11	3	2
	LSD	12	11	3	11	2	4
	P-Value (0.05)	0.0036*	0.0171*	0.0399*	NS	NS	NS

Note: All treatments of fungicide were mixed with an adjuvant NIS: 0.125% v/v

Acknowledgements: Special thanks to Brock Freer, Kartheek Chapara, Tucker Gellner and Carter Mosher.

Efficacy of Fungicides to Fusarium Head Blight in Spring Wheat

Venkat Chapara, Amanda Arens, and Larissa Jennings

A field study was planted on May 13, 2024 at the Langdon Research Extension Center. The experimental design was laid out as a randomized complete block with four replications. Plots were seven rows spaced at six-inch row spacing with a row length of 20 feet trimmed to 15 feet for harvest. The variety 'WB 9590' HRSW was seeded at a rate of 1.2 million pure live seeds/a. An untreated border plot was planted between treated plots to minimize interference from spray drift. The previous crop was canola. No pre-emergent herbicide was applied. A post-emergent herbicide, Huskie FX (18 fl oz/a) + Axial Bold (15 fl oz/a) + Prowl (2.5 pt/a), was applied on June 7, 2024.

The plots were inoculated by spreading corn spawn inoculum at boot stage (Feekes 9-10) at a rate of 300 g/plot. Supplemental moisture was provided by running overhead irrigation from Feekes 10.5 to 11.25 for one hour per day to provide a conducive environment for Fusarium Head Blight (FHB) development. Fungicides were applied with a CO_2 backpack sprayer equipped with a three-nozzle boom (XR8001) operated at 40 psi delivering a water volume of 15 GPA. Fungicide applications were made at Feekes 10.51 (10% flowering) on July 11 (wind speed 15 MPH, 84^{O} F at 1:00 pm).

Percent FHB incidence (INC) was calculated by counting the number of heads showing FHB symptoms out of 50 randomly selected heads, excluding the two outer rows in the plot. FHB severity (SEV) was rated using a 0-100% scale from those same heads. FHB index (FHBI) was calculated using the formula FHBI=(SEV*INC)/100. Plots were harvested on September 5 with a plot combine. Yield and test weight were determined. Statistical analysis was done using Genovix Generation II software. Fisher's least significant difference (LSD) was used to compare means at p ($\alpha = 0.05$).

Results

Compared with the non-treated check, all the fungicides evaluated were effective in managing the percent incidence, severity, and index of Fusarium Head Blight (FHB). The lowest FHB incidence, severity, and index were observed in the treatment Miravis Ace fb Sphaerex, followed by the treatment of the 'experimental compound' when sprayed at the respective application stages (Table 1). All of the fungicide treatments were statistically significant compared to the non-treated check, validating the effectiveness of the treatments. The treatment 'experimental compound' led to the highest yields, underscoring its potential practical implications, while the lowest yield was recorded in the non-treated check (Table 1).

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

Treatment	Rate (oz/A)	Stage of Application	Fusarium Head Blight			Yield	Test Weight
			% Incidence	% Severity	Index	bu/a	lbs/bu
Non-Treated Check	Check	Check	54	25	15	60	56
Prosaro	13.7	Feekes 10.5.1 (early anthesis)	7	6	0.4	75	57
Experimental	13.6	Feekes 10.5.1 (early anthesis)	3	3	0.2	84	58
Miravis Ace	15	Feekes 10.5.1 (early anthesis)	9	8	0.8	83	58
Prosaro Pro	13.7	Feekes 10.5.1 (early anthesis)	6	3	0.3	76	57
Sphaerex	13.6	Feekes 10.5.1 (early anthesis)	6	7	0.5	74	57
Miravis Ace fb Prosaro Pro	13.7+10.3	Early anthesis fb 4 days after	3	7	0.3	77	58
Miravis Ace fb Sphaerex	13.7+7.3	Early anthesis fb 4 days after	3	1	0.0	78	57
Miravis Ace fb Tebuconazole	13.7+4	Early anthesis fb 4 days after	5	4	0.2	81	58
Sphaerex LATE	7.3	4-5 days after early anthesis	3	6	0.2	83	58
		Mean	10	7	2	77	57
		CV %	108	72	187	11	2
		LSD	15	7	5	12	NS
		P-Value (0.05)	0.00001*	0.00001*	0.00001*	0.0225*	NS

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

Acknowledgements: Special thanks to Brock Freer, Kartheek Chapara, Tucker Gellner and Carter Mosher.

Evaluation of Seed Treatments to Manage Interveinal Chlorosis in Soybeans

Venkat Chapara, Amanda Arens and Larissa Jennings

Objective: To evaluate seed treatments to manage interveinal chlorosis in soybeans.

Materials and Methods:

This research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of seed treatments to manage interveinal chlorosis in soybeans. The trial was planted on May 17, 2024 with fungicide seed treatments on the soybean cultivar 'ND21008GT20'. These treatments were then compared with non-treated seed. The design was randomized complete block with four replications. The trial followed state recommended practices for land preparation, fertilization, seeding rate, weed and insect control. The plot size was 5 ft. wide x 16 ft. long. Interveinal chlorosis was rated for foliar disease incidence (DI) and disease severity (DS) in the middle two rows of each plot at full seed to beginning maturity (R6 to R7) growth stages. DI refers to the percentage of plants with interveinal chlorosis foliar disease symptoms, and disease severity (DS) was rated using a 1–9 scale where 1 refers to low foliar disease pressure and 9 refers to the premature death of the plant. The foliar Interveinal Chlorosis disease index (FDX) was then calculated using the equation FDX = DI × DS/9 (Table 1). The plots were harvested with a Almaco plot combine, and yields were calculated and adjusted to 13% moisture prior to analysis. Data was subjected to analysis of variance using complete block, balanced orthogonal designs of Genovix Generation II software.

Table 1: Effect of fungicide seed treatments on mean plant stand, phytotoxicity, interveinal chlorosis (disease) incidence, severity, yield and test weights.

Treatment	Rate Fl oz/100lbs seed	Interveinal Chlorosis FDX**	Plant Stand in 3ft length	Plant Vigor (1 to 5 scale)	Yield (bu/a)	Test Weight (lbs/bu)
Ilevo	3.62	5	5	3	42	58
Saltro	3.04	8	4	3	37	58
Trunemco	0.31	5	5	3	48	58
Dynasty	0.459	5	4	3	44	58
Non-Treated	CHK	21	5	3	37	58
Intego Solo	0.148782/ (140,000) seed	6	6	4	46	58
Rancona Summit	4	6	5	3	44	58
Trilex	1	16	4	3	39	58
	Mean	**8.8**	**4.5**	**3**	**42**	**58**
	CV%	**57**	**34**	**10.5**	**12**	**0.46**
	LSD	**7.4**	**2.2**	**0.48**	**7**	**0.4**
	P-Value	**0.0289***	**NS**	**0.0151***	**0.0252***	**NS**

* Indicates the treatments have significant differences at P-Value 0.05

**FDX: Normalized Disease Index: 0-100 scale incidence x severity/9

NS: Indicates the treatments have non-significant differences at P-Value 0.05

Results: Soybean seed treated with Trunemco®, Ilevo®, and Dynasty® had the lowest interveinal chlorosis FDX. These results are significantly statistically different from the other treatments tested. The seed treatments Trunemco® followed by Intego Solo®, Dynasty®, and Rancona Summit® showed significant difference in yield from the non-treated check (Table 1).

Figure 1: Interveinal chlorosis observed on soybean leaves in the seed treatment trial.

Acknowledgements: Special thanks to Brock Freer, Kartheek Chapara, Carter Mosher and Tucker Gellner.

Evaluation of Seed Treatments to Manage Verticillium Stripe on Canola

Venkat Chapara, Amanda Arens and Larissa Jennings

This research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of seed treatments to manage Verticillium on canola. The trial was planted on May 23, 2024 with various fungicide treatments applied on the canola cultivar 'InVigor L233P'. These treatments were then compared with non-treated seed. The design was a randomized complete block with four replications. The trial followed state recommended practices for land preparation, fertilization, seeding rate, and weed control. The plot size was 5 ft. wide x 16 ft. long. Data of Verticillium infections were rated following the scale of 0-5 (same as the blackleg rating scale). Inoculum was prepared by inoculating Verticillium cultures/isolates onto wheat spawn in the lab during March 2024 and was applied at planting. Twenty-five canola stubbles were rated within each plot and the incidence (number of plants that had Verticillium infections out of twenty-five cut stems) and severity on each was recorded after swathing (August 18). A 0-5 scale was used to rate disease severity, where 0 = no disease tissue visible in the cross section; 1 = ≤ 25% of the cross section has disease tissue; 2 = 26 to 50% of the cross section has disease tissue; 3 = 51 to 75% of the cross section has disease tissue; 4 = > 75% of the cross section has disease tissue; 5 = 100% diseased tissue/plant dead. A Verticillium mean disease severity index was calculated using the weighted mean of incidence and number of plants in each severity rating. Data was subjected to analysis of variance using complete block, balanced orthogonal designs of Genovix Generation II software.

Table 1: Mean Verticillium stripe incidence, severity and effect on plant stand, yield and test weight on the application of different seed treatments on canola.

Treatments	Plant Stand 3 ft length	Verticillium Stripe			Yield	Test Weight
		% Incidence	% Severity	Index	lbs/a	lbs/bu
Experimental	14	51	24	13	2525	51.5
Saltro	12	49	24	15	1812	52.0
Evergol Energy	14	67	34	25	1808	52.0
Intego Solo	11	55	30	17	1652	52.0
Rancona Summit	13	68	39	27	1875	51.9
Trilex	13	56	34	21	1835	51.7
Non-Treated	11	82	59	49	1685	52.0
Mean	13	61	35	24	1884	52
CV%	32	20	33	50	10	0.4
LSD	NS	18	17	17	285	0.3
P-Value (0.05)	NS	0.0158*	0.0063*	0.0071*	0.0001*	0.0028*

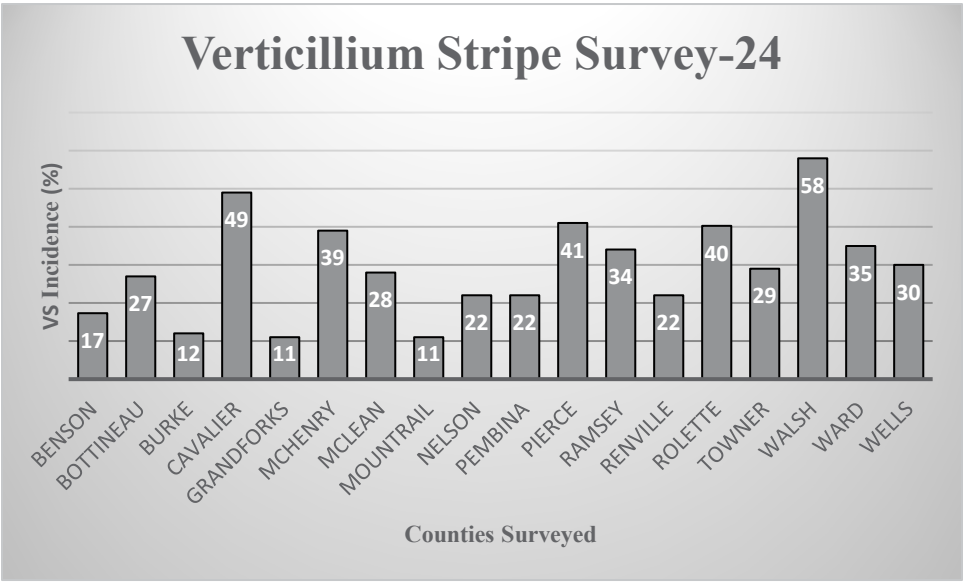
Results: The tested seed treatments had no effect on plant stand. There were significant differences observed for Verticillium stripe incidence, severity, yield and test weight (Table 1).

Verticillium Stripe on Canola: Survey and Cultivar Screening

Venkat Chapara, Amanda Arens and Larissa Jennings

This Verticillium stripe survey was conducted in major canola-growing counties of North Dakota to determine the prevalence of the disease-causing pathogen *Verticillium longisporum*. The survey was done by inspecting canola stubbles for disease infections with Verticillium stripe. A minimum of four to five fields were scouted in each county. Thirty fields were scouted in Cavalier County, the central canola-growing county in North Dakota. The survey was done after swathing or harvest in the fall. The survey group walked in a "W" pattern, stopping at five spots and uprooting twenty stem stubbles from the ground at every spot. Each sampling point was separated by 100 meters or 328 feet. The roots of one hundred stems were evaluated for the presence of Verticillium stripe in the surveyed field. The stubbles with likely infection of Verticillium were collected, bagged, and labeled with the field location. All the symptomatic stems with roots were evaluated for incidence (% infected stems) by cross-section clipping of canola stems just half an inch below ground level in the Langdon REC laboratory.

Figure 1: Percent incidence of Verticillium stripe from canola growing counties in North Dakota, 2024.



Results: The survey, done from fields of major canola-growing counties in North Dakota, indicated the presence of the disease Verticillium stripe in all eighteen counties surveyed (Figure 1). The county-wide incidence data suggest that the disease was found in high amounts, ranging from 11% to 58%.

Cultivar Screening to Manage Verticillium Stripe

Canola cultivars/varieties: Twelve commercial canola cultivars with unknown resistance to Verticillium stripe were planted to monitor the level of resistance against the pathogen *Verticillium longisporum* (Table 1). The trial was planted on May 22, 2024 in a randomized complete block design (RCBD) with four replications. The amount of Verticillium stripe infection obtained in the research plots was from a meticulously developed artificial inoculum in the lab, using wheat grain as the source.

Table 1: Canola cultivars evaluated for Verticillium longisporum in North Dakota.

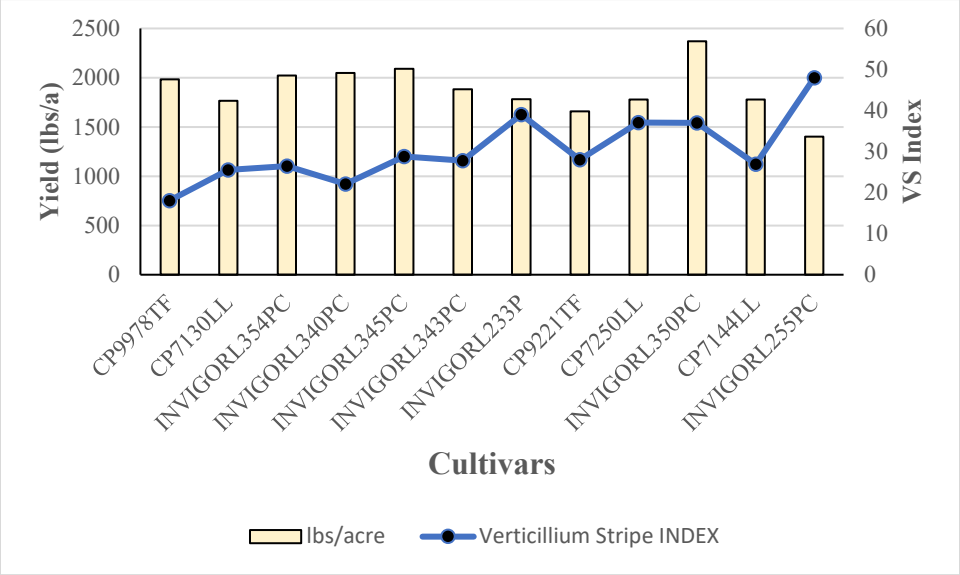
Cultivar	Description
CP9978TF	Croplan Genetics
CP7130LL	Croplan Genetics
CP7144LL	Croplan Genetics
InVigor LR354PC	BASF
InVigor L340PC	BASF
InVigor L255PC	BASF
InVigor L345PC	BASF
InVigor L343PC	BASF
InVigor L233P	BASF
CP9221TF	Croplan Genetics
CP7250LL	Croplan Genetics
InVigor L350PC	BASF

Percent incidence and severity of Verticillium stripe was evaluated on September 4, 2024 by cross-section clipping of canola stems a half inch below ground level. Percent incidence was determined by the percent of infected stems, and percent severity was determined by the percent of the pith infected in each stem.

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

Results: The cultivars exhibited significant differences in verticillium stripe resistance. Notably, the cultivar CP9978TF showed the lowest verticillium stripe disease index (18%), while the InVigor L255PC cultivar displayed the highest disease index (48%) of verticillium stripe (shown by the blue curve in Figure 1). These findings, along with the statistically significant differences in yield (shown by the vertical bars in Figure 1), with a mean yield of 1880 lbs, underscore the reliability of our research. The InVigor L350PC cultivar, in particular, recorded the highest yield (2369 lbs/a), further validating our findings and providing a solid foundation for future agricultural practices.

Figure 1: Mean Verticillium stripe Index (VS Index) and the average yield obtained on various commercial cultivars of canola tested in 2024.



The picture below depicts Verticillium stripe disease on the cross-section of canola stubbles. An index of Verticillium stripe disease (VS Index) was calculated using the percent incidence of the number of stubbles with pith discoloration out of the total rated stubbles. Severity was obtained by meticulously rating the percent area of each stubble that is discolored when cut in cross-section, ensuring the precision and reliability of our assessment.

Photo Credit: Kristie Sundeen, Pioneer Seeds

Evaluation of Fungicides to Manage White Mold in Canola

Venkat Chapara, Amanda Arens, and Larissa Jennings

This 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 17, 2024 with the Roundup Ready canola variety 'DKL DKTFLL21SC' 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 and continuing four weeks after bloom to help increase disease infection levels. Fungicides were applied at 20% bloom using a CO_2-pressurized backpack style sprayer with a three-nozzle boom (XR-8002) at 20 GPA. Ascospores were sprayed at the 20% flowering stage to obtain white mold infection in the research plots. Disease assessments were done on fifty plants within each plot and the levels of incidence and severity were recorded for each plant prior to swathing (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 weighted mean of incidence and the number of plants in each severity rating.

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

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

	White Mold		Yield	Test Weight
Treated	**% Incidence**	**% MDS**	**lbs/a**	**lbs/bu**
Non-treated Check	35	30	965	52.0
Miravis Neo @ 13.7 fl oz/a + MasterLock @ 6 oz/a	3	1	1368	52.5
Propulse @ 13.6 fl oz/a + MasterLock @ 6 oz/a	4	3	1438	51.9
Priaxor @ 4 fl oz/a + MasterLock @ 6 oz/a	13	9	1641	52.1
Topsin 70% @ 2 lb/a + MasterLock @ 6 oz/a	10	6	1054	51.9
Endura @ 6 fl oz/a + MasterLock @ 6 oz/a	13	12	1403	52.1
Proline 5.7 fl oz	0	0	1850	52.3
Mean	**11**	**8**	**1582**	**52.1**
CV%	**78**	**91**	**15**	**0.5**
LSD	**13**	**12**	**NS**	**0.4**
P-Value (0.05)	**0.0004***	**0.0006***	**NS**	**0.0367***

NS: Statistically non-significant

Results: There were significant differences observed in white mold incidence and mean disease severity (MDS) among the treatments tested. The fungicide Proline® followed by Miravis Neo® and Propulse® provided the best control of white mold over any of the other fungicides tested (Table 1). There were no significant differences found among the treatments tested (p-value non-significant) in terms of yield. However, statistical significance was observed in test weights among the treatments tested.

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COMPARING CONVENTIONAL-TILL VERSUS NO-TILL IN NE NORTH DAKOTA

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Figure 1. The Langdon Research Extension Center conventional-till versus no-till demonstration sites on August 29, 2024.

Conventional tillage practices and resulting topsoil disturbance and losses are well-documented. Early adopters of no-till in western North Dakota stopped performing tillage for planting several decades ago. Their main reasons were to conserve soil moisture, protect topsoil and build soil structure. However, in the northeast, producers mostly kept tilling their soils in fall and then again in spring. The common reason was, and still is, to dry the top four to six-inches of soil for planting early as northeast ND has a slightly shorter growing-season compared to the other parts of the state. As per the North Dakota Agricultural Weather Network (NDAWN), the Langdon area has the lowest accumulated growing degree days for growing canola, wheat, sunflower and soybean compared to the Carrington, Dickinson, Fargo, Hettinger, Minot and Williston stations.

The recent wet weather cycle, beginning in 1993, made switching to no-till difficult as producers became leery about wet field conditions in the spring resulting in late planting. A shorter growing season resulting in late planting can not only cause significant yield losses but there could be difficulties during harvest due to a wet fall or early frost. Depending upon the soil type, landscape and agronomic practices, it can take several years for the no-till practices to improve soil structure and water infiltration to help overcome challenges posed by a wet spring or fall. Several producers in the NE in the past have tried no-till. However, due to the wet weather, they faced numerous challenges such as muddy and saturated fields, cooler soil temperatures, poor seedbed, late planting, soil crusting, poor germination and stands during spring and muddy and sometimes snowy fields during fall harvest. Most of them gave up no-till after one or two years and went back to conventional-till thus making the transitioning to no-till for future optimists more challenging.

Objectives

Short-term objectives of this study were and are to determine how early each field can be planted and record differences in input costs, germination, stands, yields, profits and losses. Long-term objectives include recording effects on soil health such as soil salinity, sodicity, pH, structure, pore space and water infiltration (movement through soil layers).

Site Details

An approximately 35-acre field was divided to create a conventional-till and a no-till site into rectangular shapes from north to south. The no-till field measures approximately 13.7 acres and the conventional-till side measures around 20.6 acres with a 15-foot border between the two fields. Both sites include productive, marginal and unproductive areas in order to be truly representative of farmer fields.

Field Work Details

This report provides a summary of all of the work that has been done to the conventional-till and no-till sites since the inception of this demonstration in fall-2021 in order to provide a complete picture to the readers.

Conventional-till

Fall-2021

- After harvesting soybeans, site was chiseled once on October 6.

Spring and Summer of 2022

- A uniform rate of 125 pounds of N per acre of urea was spread on May 29 followed by one-pass of the cultivator for incorporation.
- Fargo and Treflan (PPI) were sprayed on June 6 followed by two-passes of a cultivator.
- On June 7, Prosper (HRSW) was planted at the seeding rate of 1.7 bushels per acre using a Concord 40-foot wide air seeder.

Fall-2022

- Site was swathed on September 19 and combined on September 28.
- Site was disked once on October 5.

Spring and Summer of 2023

- Site was cultivated and harrowed once followed by planting ND21008GT20 (soybean) at the seeding rate of 60 pounds/acre (174960 seeds/acre) on May 26, 2023.
- On June 16, Roundup PowerMax 3 at 30 ounces/acre + Kicker at 2.5 gallons/100 gallons of water was sprayed at the rate of 10 gallons/acre.
- On July 10, Roundup PowerMax 3 at 30 ounces/acre + Kicker at 2.5 gallons/100 gallons of water was sprayed at the rate of 10 gallons/acre.

Fall-2023

- Site was straight combined on October 12.
- Site was chiseled twice on October 18 and 19.

Spring and Summer of 2024

- Site was cultivated once on April 25.
- Site was applied 80 pounds of nitrogen and 60 pounds of P2O5 through monoammonium phosphate (MAP) and urea, followed by one-pass of the cultivator for incorporation on May 18.
- Site was planted with foundation grade Faller HRSW with air seeder at the rate of 100 pounds of wheat per acre on May 19.

- A herbicide mix of Everest 3.0, Husky FX, Starane Ultra and Cue (a basic blend such as Linkage, Quad 7 or Ascension) was sprayed on June 26.
- Prosaro Pro 400 SC was sprayed on July 16.

Fall-2024

- Site was straight combined September 26.
- Site was cultivated once October 1.
- Site was cultivated again on October 3.

No-till

Spring and Summer of 2022

- No-till site was planted with Prosper (HRSW) on June 13 using a John Deere 1895 disk no-till drill. Seeding rate was 1.7 bushels per acre. Due to an issue of the no-till drill not able to flow high fertilizer rates, only 62.5 pounds per acre of N (136 pounds of urea per acre) was applied at the time of planting. The rest of the 62.5 pounds of N per acre was top dressed later in order to make the no-till fertilizer rate comparable to the conventional-till site.
- No-till site was sprayed with Roundup PowerMax 3 at 20 ounces/acre with Kicker (active ingredient ammonium sulfate) at 2.5 gallons per 100 gallons of water (0.27 gallons of Kicker per acre).

Fall-2022

- Site was swathed on September 19 and combined on September 28.

Spring and Summer of 2023

- No-till side was planted on May 30, 2023 with ND21008GT20 (soybeans) at the seeding rate of 60 pounds/acre (174960 seeds/acre).

Note: Both conventional-till and no-till fields appeared ready for planting on the same day. However, conventional-till field was planted on May 26, 2023, whereas, no-till was planted on May 30, 2023. The delay in planting was due to equipment issues.

- On May 31, Roundup PowerMax 3 at 20 ounces/acre mixed with 0.5 gallons of Flame per 100 gallons of water was applied at the rate of 10 gallons/acre.
- On June 13, Roundup PowerMax 3 at 29 ounces/acre mixed with 16 ounces of Varisto + 24 ounces of Invade CNL + 24 ounces of Kicker/acre mixed in 100 gallons of water was applied at the rate of 10 gallons/acre.
- On June 30, Flexstar at 13 ounces + MSO at 35 ounces + Avatar at 6.6 ounces and Kicker at 70 ounces/acre was applied at 20 gallons/acre.

Fall-2023

- About 70% (10 acres out of 14) of the no-till site was straight combined on October 13. The remaining 30% (4 acres) could not be harvested due to very high weed pressure (mainly kochia, green foxtail and volunteer spring wheat).
- Remaining 30% of the no-till site was cleaned up using a combine in order to evenly spread the residue for spring-2024.

On October 22, Roundup PowerMax 3 at 30 ounces/acre with 2,4-D at 19 ounces/acre and Kicker at 64 ounces/acre was sprayed at 10 gallons/acre.

Spring and Summer of 2024

- Site was sprayed with a mix of Paraquat 3SL, Roundup PowerMax3, Ammonium Sulfate and Vincitro (Non-ionic surfactant) pre-emergence herbicide on May 15.
- A total of 15 pounds of P2O5 with 100 pounds of nitrogen was banded on May 23. Since the total fertilizer quantity would have been more than what the no-till drill could flow through, half of the fertilizer was banded with one-pass of the no-till drill and the remaining half of the fertilizer was banded at the time of planting foundation grade Faller HRSW at the rate of 100 pounds per acre on the same day (May 23).

- A mix of Everest 3.0 + Husky FX + Starane Ultra + Cue (a basic blend such as Linkage, Quad 7 or Ascension) was sprayed on June 21.

Fall-2024

- Site was swathed on September 5 and combined on September 26.
- A mix of Roundup PowerMax, Havok LV6, Valor SX and Kicker (AMS) herbicides was sprayed on October 16.

Soil Sampling and Analysis

In fall 2021-2023, the following type of soil sampling and analysis was performed.

- Separate composite four-foot deep soil samples for 0-12", 12-24", 24-36" and 36-48" depths were taken from the conventional-till productive ground (CT-PG), conventional-till unproductive ground (CT-UG), no-till productive ground (NT-PG) and no-till unproductive ground (NT-UG). Fall-2021 soil samples were analyzed for textural and chemical analysis, whereas, fall-2022-2023 samples were analyzed for chemical analysis only.
- Separate soil bulk density samples were taken from CT-PG, CT-UG, NT-PG and NT-UG for 0-5" and 5-10" depths in fall 2021-2023.

Soil Chemical Analysis Results

Based on the 2021-2023 soil EC (for salinity) and SAR (for sodicity) results, the conventional-till productive ground had no salinity to low levels of salinity and no issue of sodicity in the 0-12 inch depth. The conventional-till unproductive ground had low to high levels of salinity with moderate levels of sodicity in the 0-12-inch soil depth. The no-till productive ground had low to moderately high levels of salinity and low levels of sodicity in the 0-12-inch depth. The no-till unproductive ground had high to very high levels of salinity and high levels of sodicity in the 0-12-inch soil depth. Details are in Table 1.

Table 1. The 2021-2023 soil EC and SAR results of the conventional-till and no-till productive and unproductive sites for the 0-12, 12-24, 24-36 and 36-48-inch depths.

Site	Depth (inches)	2021	2022	2023	2021	2022	2023
		EC (dS/M)			SAR		
Conventional-till PG	0-12	2.44	0.95	0.86	2.06	1.46	1.35
	12-24	4.90	0.67	2.23	3.99	3.58	1.53
	24-36	5.25	1.08	1.95	5.89	4.19	2.43
	36-48	2.09	1.17	1.44	7.67	5.53	4.58
Conventional-till UG	0-12	10.43	14.11	4.81	10.88	18.78	14.41
	12-24	11.28	12.12	5.11	11.27	17.15	14.05
	24-36	10.39	8.05	4.16	11.36	16.05	11.11
	36-48	8.47	6.42	2.84	10.19	11.13	10.80
No-till PG	0-12	4.18	3.06	2.54	4.45	5.09	6.58
	12-24	7.10	7.31	3.84	10.74	13.94	12.88
	24-36	8.16	9.69	2.91	18.11	21.80	18.48
	36-48	8.19	9.01	3.07	17.47	19.32	19.14
No-till UG	0-12	13.52	17.83	8.57	24.15	24.21	23.01
	12-24	13.34	12.84	5.98	23.02	17.64	16.67
	24-36	11.82	11.45	5.43	23.50	15.96	16.69
	36-48	10.86	9.61	3.85	18.14	17.19	15.50

Soil Bulk Density Analysis Results

Soil bulk density levels remained more or less the same in 2021-2023 and changed slightly depending upon the gravimetric soil water content. High soil water content resulted in slightly lower bulk density. The main difference was in 2021 0-5-inch soil depth had higher bulk density than the 5-10-inch depth. However, in 2022-2023, 0-5-inch bulk density mostly had

lower bulk density than the 5-10-inch depth. These trends were consistent in both conventional-till and no-till sites. Details are in Table 2.

Table 2. The 2021-2023 soil bulk density results of the conventional-till and no-till productive and unproductive sites for the 0-5, 5-10-inch depths.

Site	Depth	2021	2022	2023
	(inches)			
	Soil Bulk Density (grams/cm^3)			
Conventional-till PG	0-5”	1.36	1.34	1.23
	5-10”	1.26	1.44	1.39
Conventional-till UG	0-5”	1.45	1.36	1.17
	5-10”	1.22	1.37	1.27
No-till PG	0-5”	1.44	1.32	1.35
	5-10”	1.25	1.36	1.35
No-till UG	0-5”	1.50	1.36	1.33
	5-10”	1.34	1.47	1.34

Measurement of Soil Water Infiltration

Soil water infiltration rates were measured by pounding a six-inch diameter ring into the surface soil. Once the ring was in place, 444 ml of deionized water was used to simulate one inch of rain. Once there was no standing water, while soil was still saturated, a second inch of rain was simulated by pouring 444 ml of additional deionized water. Both simulations were timed for water absorption into the soil. Annual infiltration rates are in Table 3. There have been a few key observations regarding soil water infiltration rates:

- In 2021-2022, soil water infiltration rates of conventional-till productive and unproductive grounds (despite moderately high sodicity in the 0-12 inch depth) were much faster than the no-till productive and unproductive grounds.
- On the no-till site, water infiltration was much faster on productive ground versus unproductive ground. That was mainly an effect of higher sodicity level that causes soil dispersion resulting in dense soil layers.
- In 2023 and 2024, the no-till unproductive ground infiltration rates were much slower compared to 2021-2022.

Table 3. The 2021-2024 soil water infiltration rates of the conventional-till and no-till productive and unproductive sites.

2021		
Site	**Time for infiltrating First-inch**	**Time for infiltrating Second-inch**
Conventionally-Tilled Productive Ground (CT-PG)	53.18 seconds	3 minutes and 3.29 seconds
Conventionally-Tilled Un-productive Ground (CT-UG)	36.45 seconds	3 minutes and 33.87 seconds
No-Tilled Productive Ground (NT-PG)	2 minutes and 5.74 seconds	8 minutes and 21.19 seconds
No-Tilled Un-productive Ground (NT-UG)	23 minutes and 1.88 seconds	1 hour, 16 minutes and 20.97 seconds
2022		
Site	**Time for infiltrating First-inch**	**Time for infiltrating Second-inch**
Conventionally-Tilled Productive Ground (CT-PG)	1 minute and 17.83 seconds	5 minutes and 58.50 seconds
Conventionally-Tilled Un-productive Ground (CT-UG)	3 minutes and 0.16 seconds	12 minutes and 40.98 seconds
No-Tilled Productive Ground (NT-PG)	2 minutes and 57.55 seconds	5 minutes and 35.16 seconds

No-Tilled Un-productive Ground (NT-UG)	26 minutes and 54.37 seconds	1 hour, 20 minutes and 41.87 seconds
2023		
Site	**Time for infiltrating First-inch**	**Time for infiltrating Second-inch**
Conventionally-Tilled Productive Ground (CT-PG)	30.82 seconds	4 minutes and 50.60 seconds
Conventionally-Tilled Un-productive Ground (CT-UG)	2 minutes and 08.37 seconds	16 minutes and 59.58 seconds
No-Tilled Productive Ground (NT-PG)	1 minute and 30.03 seconds	3 minutes and 38.96 seconds
No-Tilled Un-productive Ground (NT-UG) Site-A	4 hours, 41 minutes and 02.18 seconds	18 hours and 58.05 seconds
No-Tilled Un-productive Ground (NT-UG) Site-B	1 hour, 20 minutes and 30.76 seconds	5 hours, 20 minutes and 58.51 seconds
2024		
Site	**Time for infiltrating First-inch**	**Time for infiltrating Second-inch**
Conventionally-Tilled Productive Ground (CT-PG)	5 seconds	36.08 seconds
Conventionally-Tilled Un-productive Ground (CT-UG)	6 minutes, 30.47 seconds	30 minutes and 53.74 seconds
No-Tilled Productive Ground (NT-PG)	17 minutes and 33.93 seconds	37 minutes and 36.86 seconds
No-Tilled Un-productive Ground (NT-UG)	8 hours, 12 minutes and 23.4 seconds	46 hours, 41 minutes and 61.46 seconds

Note:

- In fall-2023, one NT-UG Site (NT-UG Site-A) site was measured for soil water infiltration that had much slower water infiltration compared to 2021-2022. In order to verify the infiltration rates, another site was measured (NT-UG Site-B) that recorded infiltration rates that were still much higher than 2021-2022, however, slightly more rapid than the NT-UG Site A.
- The fall-2024 infiltration rates of NT-UG were very similar or even slower than the 2023 rates for the same site. 2024 measurement details are below:
  - CT-PG, CT-UG and NT-PG sites were measured on October 21, 2024 at 11:21 a.m., 12:48 p.m. and 11:28 a.m.
  - The NT-UG Site-A was started on October 21, 2024 at 1:33 p.m. It was abandoned around 6:09 p.m. as there was still water standing in the ring.
  - NT-UG site B was measured on October 22, 2024 at 8:08 a.m. The 1st inch was not fully absorbed into the soil. Since it had been more than 8 hours, around 4:30 p.m. the second inch was started in the ring.
  - It seemed that in the NT-UG site ring initially water moves into the soil, but then it just sits there with no infiltration at all.
  - The NT-UG Infiltration Site-B never fully absorbed the 2nd inch even after 46 hours and 41 minutes. It was abandoned at 3:06 p.m. on October 24, 2024.

Growing-Season Observations

2022

The conventional-till side was planted six days earlier than the no-till side, but the no-till side had better germination and plant stands. This could be due to saturated soil a few inches below the soil surface on the conventional-till side and had slightly poorer germination in the tire tracks. Stands were thin and were still green at the time of swathing. Despite the late planting, the no-till side had improved germination due to no soil disturbance and uniform stands. That could also be due to the differences in seeding equipment; a Concord 40-foot wide air seeder was used on the conventional-till side, whereas, a John Deere 30-foot wide no-till drill was used on the no-till side. In addition, the no-till side was harvested at the same time and yielded three bushels per acre more than the conventional-till.

2023

No-till productive and unproductive sides had severe weed issues from the beginning of the growing-season, mainly with herbicide resistant kochia, volunteer wheat, green foxtail barley and horseweed, which continued until fall. In addition, the no-till side will have a much larger seed bank to cause weed issues in the 2024 growing-season compared to conventional-till. This was a result of southerly winds in fall-2022 that rolled over a lot of kochia plants to the no-till and conventional-till fields to an extent where some plants were stuck on the shelterbelt trees on the north side. The conventional till side was cultivated and harrowed in the spring eliminating most of the weeds while the no-till field was not and had a lot of kochia and foxtail. A PPI herbicide may have improved weed control. Pre-emergence herbicide application could have produced better results; however, it needed to be incorporated in the soil or timed with a good rain. Incorporation on no-till was not an option. Several pre-herbicides can be used on no-till soybeans but need rain for incorporation. Spring of 2023 was very dry and this would have probably resulted in ineffective weed control. The end result was severe kochia contamination in the no-till field despite three sprays versus two sprays on the conventional-till side where weed pressure was much lower.

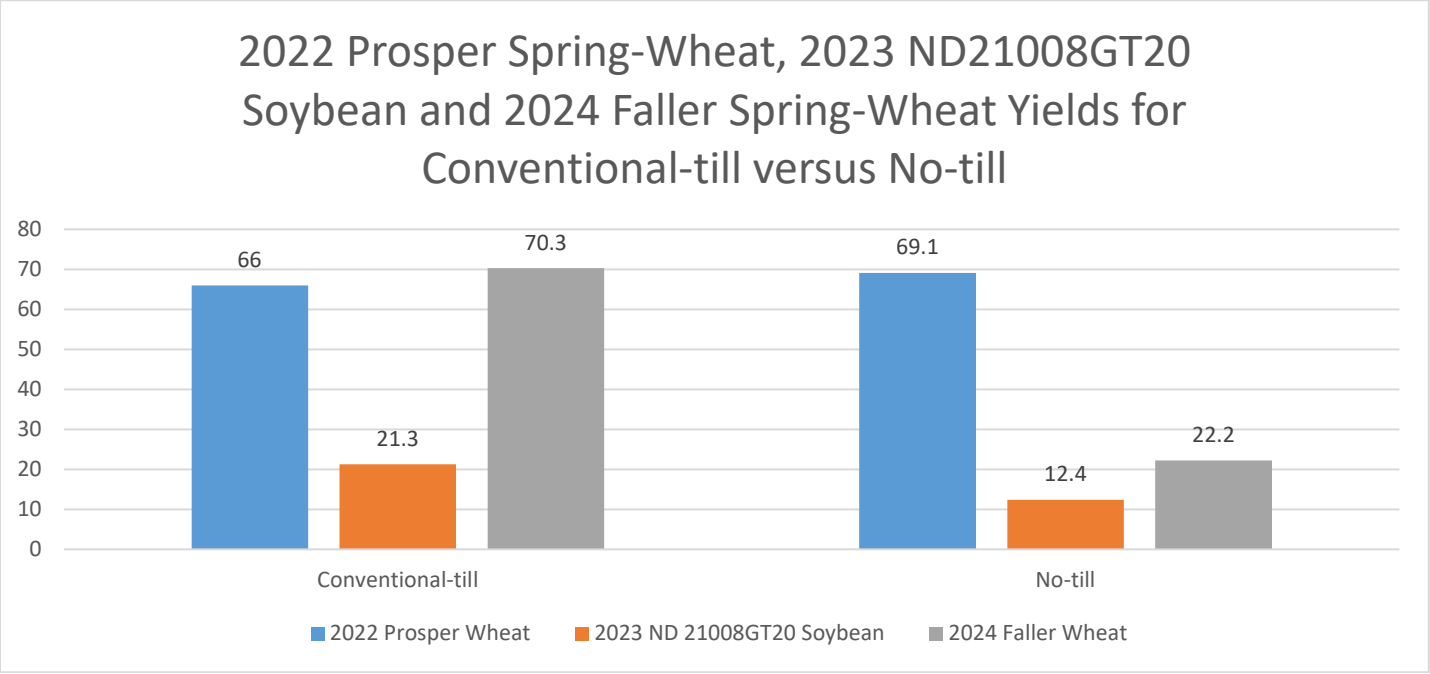
2024

No-till had big areas where wheat germination was poor and slow due to heavy rains right after planting that left soil saturated, cooler and drowned out compared to conventional-till. Conventional-till had much better germination, growth and vigor except the drowned-out areas. No-till lost the competition right there in the beginning. In addition, no-till areas with poor or no-growth had high weed pressure versus where wheat germinated good and had good stand. Over all, weed pressure in the no-till was lower in 2024 versus 2023. In comparison, conventional-till had a better start versus no-till and it resulted in higher yields.

Yield Differences in 2021-2024

Like 2023, conventional-till yielded higher than the no-till in 2024. In 2023, lower no-till yield was due to high weed pressure compared to conventional-till. In 2024, weed pressure was lower in no-till compared to 2023, however, heavy rains right after planting resulting in saturated, cooler and drowned out areas leading to poor germination and stands in large areas of the no-till. Details are in Figure 2.

Figure 2. The Langdon Research Extension Center conventional-till versus no-till demonstration 2022-2024 yield comparisons.



Differences in Costs and Profitability

Fall-2021 to 2022

Conventional-till area yielded 1364 bushels (without moisture adjustment) or 66 bushels per acre. No-till area yielded 949 bushels (without moisture adjustment) or 69.1 bushels per acre. Costs and profit details are in Table 4.

Table 4. Fall-2021 to 2022 differences in costs and profitability between conventional-till and no-till sites.

Site	Year	Prosper Spring-wheat Yield per Acre (bushels)	Revenue per Acre ($)	Cost per Acre ($)	Profit per Acre ($)
Conventional-till	Fall 2021-2022	66.0	$462.0 (at $7.00 per bushel)	$316.21	**+ $146.0**
No-till		69.0	$483.0 (at $7.00 per bushel)	$246.21	**+ $237.0**

2023

Conventional-till area yielded 440 bushels or 21.3 bushels per acre, whereas, no-till area yielded 170 bushels or 12.4 bushels per acre. Due to very high weed pressure, 30% of the no-till site was not harvested. The entire no-till area was considered in the yield calculations (170 bushels/13.7 acres = 12.4 bushels/acre). Both conventional-till and no-till soybeans were taken to CHS, the local elevator in Langdon, and sold for $12.74/bushel. Due to very high weed pressure, conventional-till soybeans had dockage of 0.5%. The no-till soybeans had 1.0% dockage. These dockages were considered in Table 5 below.

Table 5. 2023 differences in costs and profitability between conventional-till and no-till sites.

Site	Year	ND21008GT20 Soybeans Yield per Acre (bushels)	Revenue per Acre ($)	Cost per Acre ($)	Profit per Acre ($)
Conventional-till	2023	21.3	$271.3 (at $12.74 per bushel)	$171.95	**+ $99.4**
No-till		12.4	$158.0 (at $12.74 per bushel)	$256.18	**- $98.1**

2024

Conventional-till area yielded 48.1 bushels per acre more than the no-till site due to improved germination, less weed pressure and good plant stands. Wet weather resulting in saturated, cool and drowned out areas was the main reason no-till yielded lower than the conventional-till site in 2024.

Table 6. 2024 differences in costs and profitability between conventional-till and no-till sites.

Site	Year	Faller Spring-wheat Yield per Acre (bushels)	Revenue per Acre ($)	Cost per Acre ($)	Profit per Acre ($)
Conventional-till	2024	70.3	$405.6 (at $5.77 per bushel)	$287.67	**+ $117.9**
No-till		22.2	$128.0 (at $5.77 per bushel)	$334.93	**- $206.9**

Summary Based on Three-Years

Differences in Planting Dates: In year-one of transitioning to no-till (2022), conventional-till sites looked ready for planting four to five days earlier than no-till. In year-two (2023), both conventional-till and no-till sites seemed ready for planting on the same day. The only reason the no-till site was planted four days later in 2023 was due to equipment issues. In year-three (2024), no-till was planted two-days after conventional-till (May 21 versus May 19). It could have been planted a day or two later as the soil was still a little wet, however, as another heavy rain was forecast, it was planted on May 21.

Differences in Costs and Profitability: In year-one (2022), the no-till site was slightly more profitable than conventional-till. However, in year-two (2023), no-till site resulted in loss of revenue due to much higher cost of herbicides, lower yield due to weed contamination and higher dockage by the elevator, whereas, conventional-till was profitable. It is crucial to have a very proactive weed control program when transitioning from conventional-till to no-till, otherwise, weed issues can jeopardize the entire no-till program. In year-three (2024), no-till again resulted in loss of revenue due to very wet weather at the time of planting and early growth and higher cost of herbicides versus conventional-till.

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 and sodic site. **The main objectives of the trial have been:**

- Does existing soil sodicity negatively affect tile drainage performance?
- Will tiling lower soil salinity under wet and dry weather conditions?
- Does the tile-drained water 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, soil bulk density and tiled-drained water quality results. If information about the trial background, objectives, location, site description, design, methodology and complete set of data collected annually is needed, please contact the NDSU Langdon Research Extension Center:

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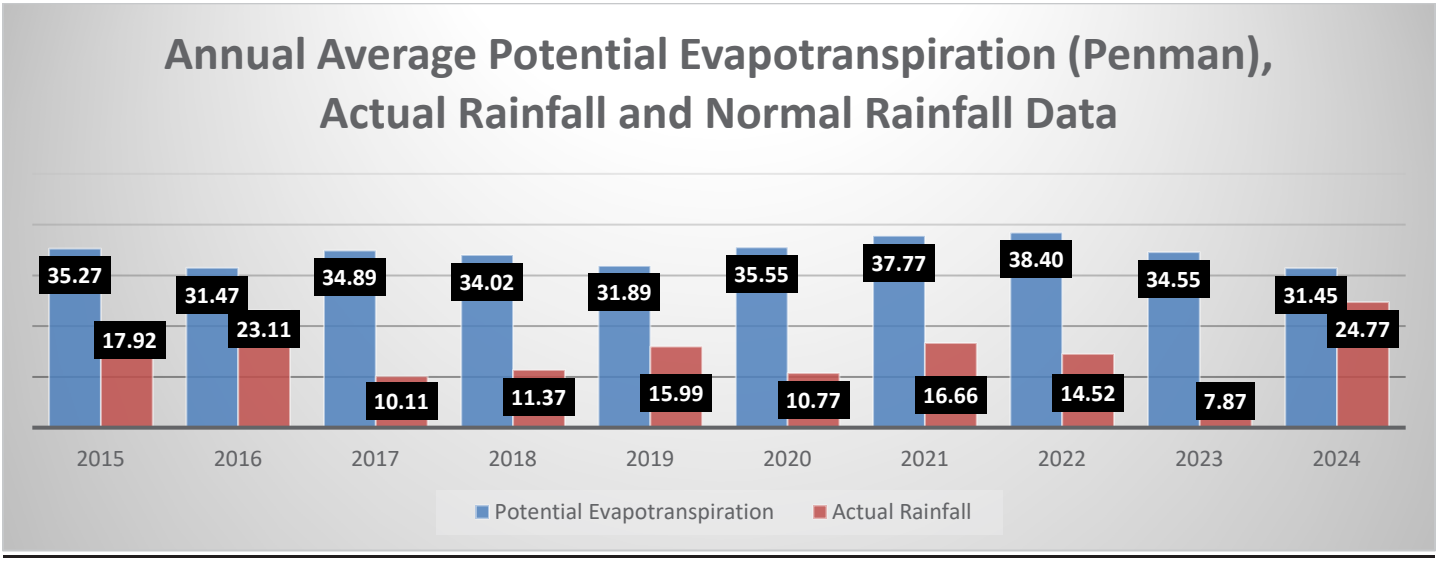
RESULTS AND DISCUSSION

Considering the main objectives of the study, this report includes the statistical analysis of soil EC (salinity), SAR (sodicity), pH and soil bulk density (BD) and its corresponding gravimetric water content (GW in %). Differences in these properties are compared at the time of tiling in 2014 versus after applying the soil amendments (treatments) on tiled land in 2015 and onwards. The treatment means of EC, SAR and pH represent 2014 and 2016-2024 results of three replications for the zero to four-foot soil depths. The treatment means of soil bulk density represent 2015-2024 results of three replications for the zero to ten-inch soil depths. The water quality results of the tile-drained field were compared with the results of upstream and downstream water samples.

Annual Changes in Weather

Changes in the soil chemical, physical and biological properties are greatly influenced by the fluctuations in the weather such as annual evapotranspiration and rainfall and resulting groundwater depths and capillary rise of soil water. In this report focus is given to the effects of weather on the soil chemical and physical properties. The annual growing-season rainfall and potential evapotranspiration (Penman) data was collected from the NDAWN (North Dakota Agricultural Weather Network) Langdon station from May 1 to October 31. The average annual growing-season groundwater depths were calculated by averaging the actual weekly measurements for the same time period.

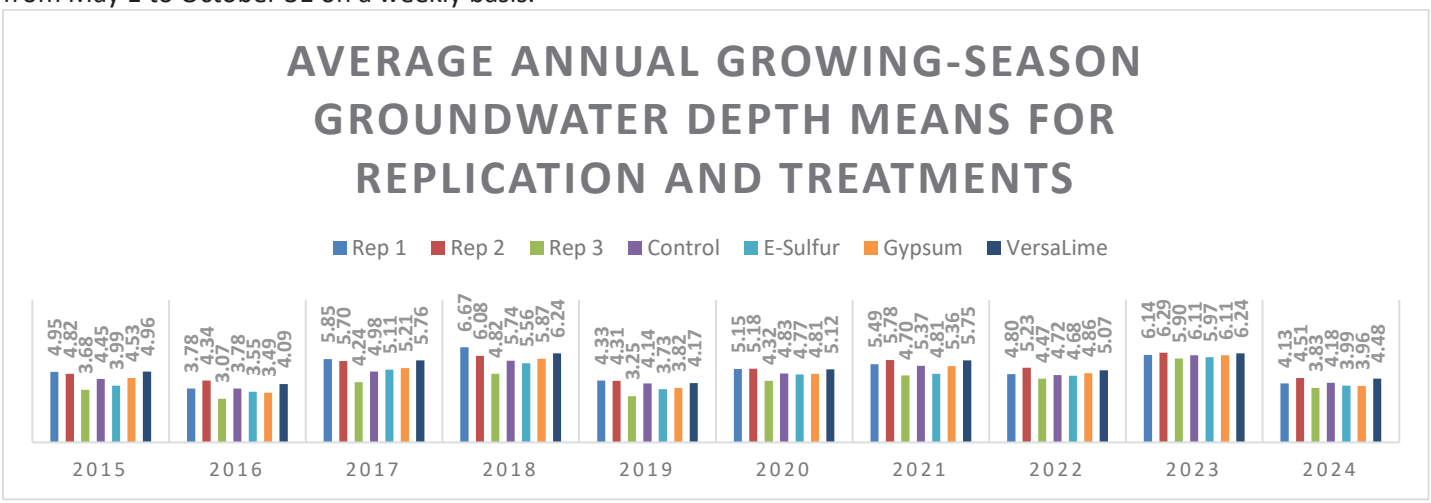
Figure 2. Annual average growing-season potential evapotranspiration (Penman), actual rainfall and normal rainfall in inches measured from May 1 to October 31 by the NDSU Langdon NDAWN (North Dakota Agricultural Weather Network) station.



Note: The normal rainfall for 2015-2024 for May 1 to October 31 was 16.82-inches.

Increased evapotranspiration versus lower rainfall generally result in lower groundwater depths but less leaching of water-soluble salts, increased capillary rise of soil water (or groundwater) and slower breakdown of soil amendments. A smaller gap between these two (high rainfall combined with lower evapotranspiration) could result in shallower groundwater depths. However, under good soil water infiltration and improved drainage, not only excess salts can be moved (or leached) out of the fields but soil amendments can also produce favorable results. A smaller gap between evapotranspiration and rainfall will also result in reduced capillary rise of soil water (wicking up) as capillary water moves from higher to lower moisture levels.

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.



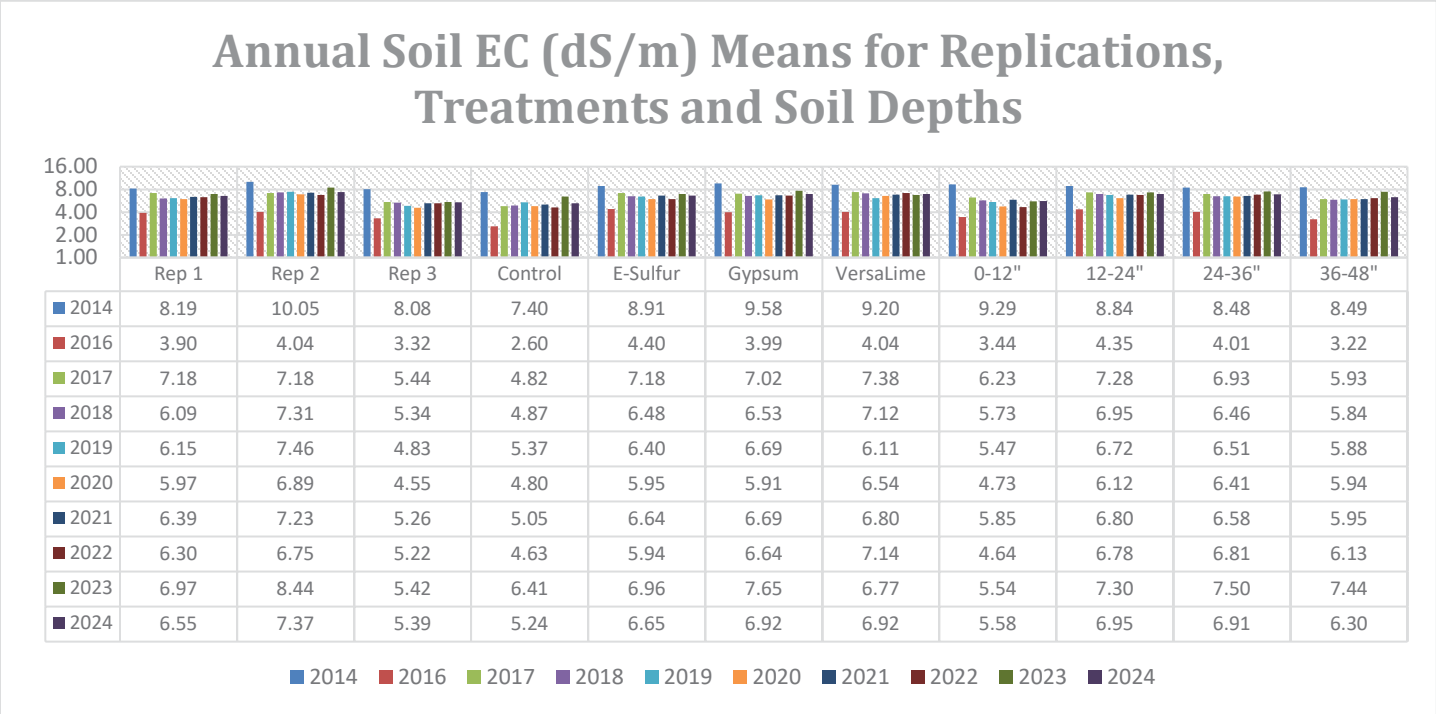
Note: In 2015, groundwater depths were only measured from mid-June to the end of October.

The average annual growing-season groundwater depths (also called water table levels) varied annually depending upon the rainfall. The shallowest groundwater depths were observed in 2016. The deepest groundwater depths were recorded in 2018 and 2023. It is important to note that weekly groundwater depths were measured randomly; sometimes right after a heavy rain and sometimes during dry periods. Those differences in the timings of recording the groundwater depths reflect on the averages and should be taken into consideration.

Differences in Soil EC (Salinity) Levels

Soil EC levels have been directly related to the annual growing-season rainfall and resulting moisture levels in the topsoil. Details of soil EC levels are shown in Figure 4.

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



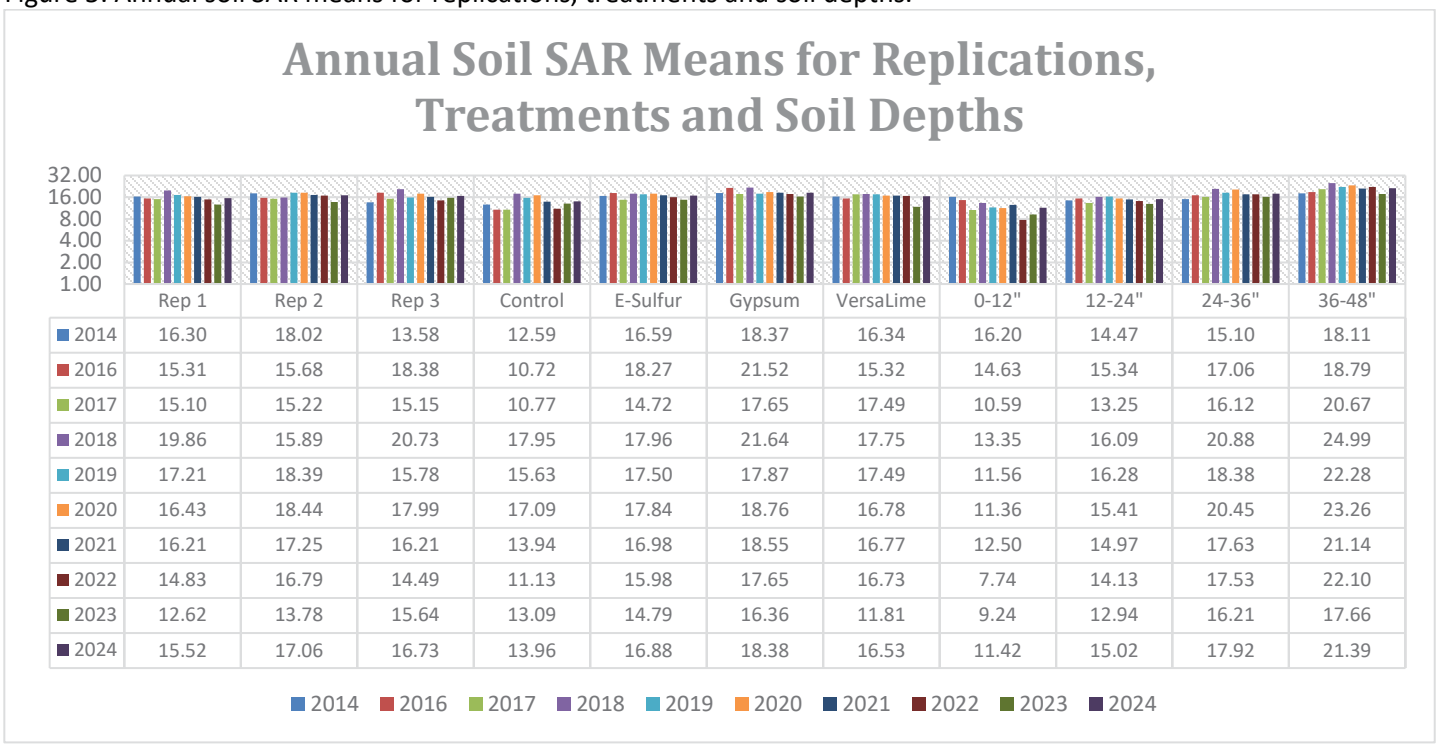
	Rep 1	Rep 2	Rep 3	Control	E-Sulfur	Gypsum	VersaLime	0-12"	12-24"	24-36"	36-48"
2014	8.19	10.05	8.08	7.40	8.91	9.58	9.20	9.29	8.84	8.48	8.49
2016	3.90	4.04	3.32	2.60	4.40	3.99	4.04	3.44	4.35	4.01	3.22
2017	7.18	7.18	5.44	4.82	7.18	7.02	7.38	6.23	7.28	6.93	5.93
2018	6.09	7.31	5.34	4.87	6.48	6.53	7.12	5.73	6.95	6.46	5.84
2019	6.15	7.46	4.83	5.37	6.40	6.69	6.11	5.47	6.72	6.51	5.88
2020	5.97	6.89	4.55	4.80	5.95	5.91	6.54	4.73	6.12	6.41	5.94
2021	6.39	7.23	5.26	5.05	6.64	6.69	6.80	5.85	6.80	6.58	5.95
2022	6.30	6.75	5.22	4.63	5.94	6.64	7.14	4.64	6.78	6.81	6.13
2023	6.97	8.44	5.42	6.41	6.96	7.65	6.77	5.54	7.30	7.50	7.44
2024	6.55	7.37	5.39	5.24	6.65	6.92	6.92	5.58	6.95	6.91	6.30

Soil EC levels in 2016, were significantly lower versus 2014 (at the time of tiling) despite shallow average annual growing-season groundwater depths due to excess rainfall and improved drainage under tiling. EC levels increased in 2017 and that trend continued in 2018-2023 despite the land being tiled and the average annual growing-season groundwater depths mostly deeper than the depth of the tiles (four-feet). The increase in salinity on tiled-land was a result of increased capillary rise of soil/groundwater water due to low rainfall and higher evapotranspiration. This indicates that tiling the land is just one-tool in the toolbox and 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. Sufficient rain will also result in higher moisture levels in the topsoil resulting in decreased capillary rise of groundwater and water-soluble salts. In 2024, EC means showed a slight decrease versus 2017-2023 under high rainfall (24.77-inches).

Differences in Soil SAR (Sodicity) Levels

Changes in soil SAR levels have been inconsistent. That could be due to the relatively dry weather resulting in the slow breakdown of soil amendments for lowering sodicity from 2017-2023. The major change in the SAR level was in 2022 in the 0-12-inch depth that significantly decreased compared to 2014-2021. That trend continued in 2023. The SAR levels in the 0-12-inch depth in 2024 increased slightly versus 2022-2023. Details of soil SAR levels are shown in Figure 5.

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

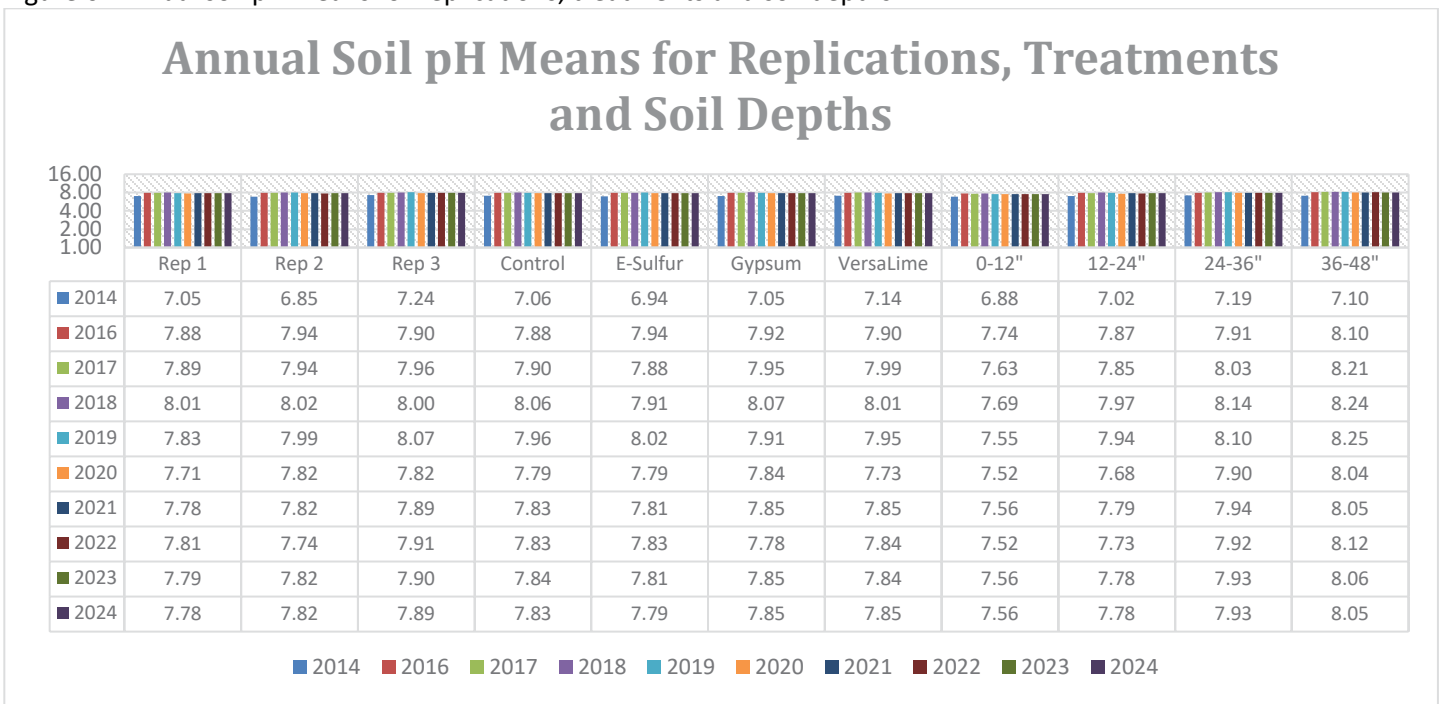


	Rep 1	Rep 2	Rep 3	Control	E-Sulfur	Gypsum	VersaLime	0-12"	12-24"	24-36"	36-48"
2014	16.30	18.02	13.58	12.59	16.59	18.37	16.34	16.20	14.47	15.10	18.11
2016	15.31	15.68	18.38	10.72	18.27	21.52	15.32	14.63	15.34	17.06	18.79
2017	15.10	15.22	15.15	10.77	14.72	17.65	17.49	10.59	13.25	16.12	20.67
2018	19.86	15.89	20.73	17.95	17.96	21.64	17.75	13.35	16.09	20.88	24.99
2019	17.21	18.39	15.78	15.63	17.50	17.87	17.49	11.56	16.28	18.38	22.28
2020	16.43	18.44	17.99	17.09	17.84	18.76	16.78	11.36	15.41	20.45	23.26
2021	16.21	17.25	16.21	13.94	16.98	18.55	16.77	12.50	14.97	17.63	21.14
2022	14.83	16.79	14.49	11.13	15.98	17.65	16.73	7.74	14.13	17.53	22.10
2023	12.62	13.78	15.64	13.09	14.79	16.36	11.81	9.24	12.94	16.21	17.66
2024	15.52	17.06	16.73	13.96	16.88	18.38	16.53	11.42	15.02	17.92	21.39

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).

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



	Rep 1	Rep 2	Rep 3	Control	E-Sulfur	Gypsum	VersaLime	0-12"	12-24"	24-36"	36-48"
2014	7.05	6.85	7.24	7.06	6.94	7.05	7.14	6.88	7.02	7.19	7.10
2016	7.88	7.94	7.90	7.88	7.94	7.92	7.90	7.74	7.87	7.91	8.10
2017	7.89	7.94	7.96	7.90	7.88	7.95	7.99	7.63	7.85	8.03	8.21
2018	8.01	8.02	8.00	8.06	7.91	8.07	8.01	7.69	7.97	8.14	8.24
2019	7.83	7.99	8.07	7.96	8.02	7.91	7.95	7.55	7.94	8.10	8.25
2020	7.71	7.82	7.82	7.79	7.79	7.84	7.73	7.52	7.68	7.90	8.04
2021	7.78	7.82	7.89	7.83	7.81	7.85	7.85	7.56	7.79	7.94	8.05
2022	7.81	7.74	7.91	7.83	7.83	7.78	7.84	7.52	7.73	7.92	8.12
2023	7.79	7.82	7.90	7.84	7.81	7.85	7.84	7.56	7.78	7.93	8.06
2024	7.78	7.82	7.89	7.83	7.79	7.85	7.85	7.56	7.78	7.93	8.05

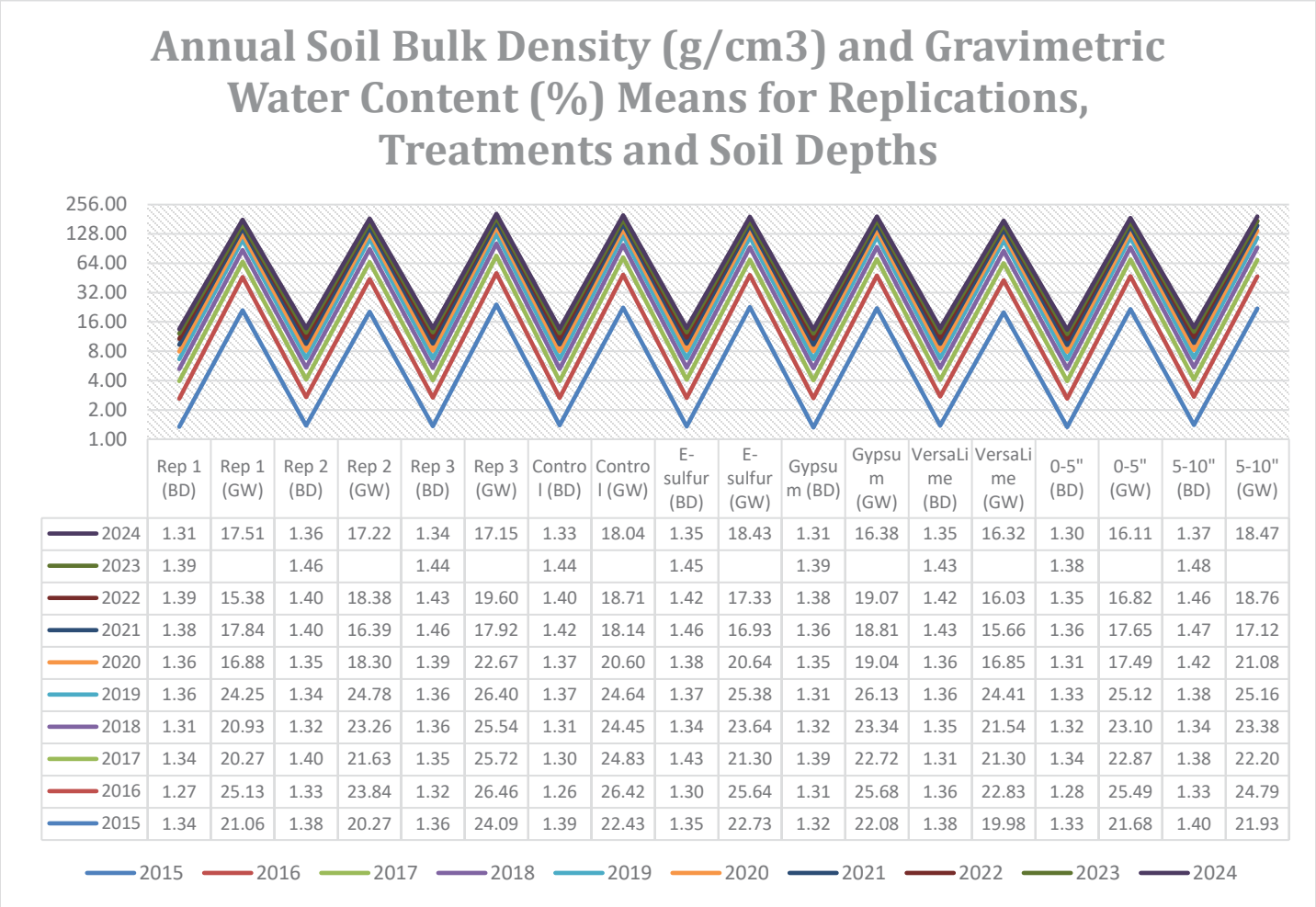
Overall, soil pH levels remained the highest in 2021 followed by 2018, 2019, 2017, 2016, 2022, 2020 and 2014. Replication 3 had the highest pH levels followed by replications 2 and 1. Replication 3 has the shallowest average annual growing-season groundwater depths followed by replications 2 and 1 in most years. VersaLime treatment had the highest pH levels followed by gypsum, control and E-sulfur treatments. Soil pH significantly increased with soil depth and 0-12-inch depths

had the lowest pH levels, like SAR. The highest pH levels were at the 36-48 inch depths. Soil pH typically increases with moisture and soil moisture generally increases with increase in depth. Details of soil pH levels are shown in Figure 6.

Differences in Soil Bulk Density Levels

There were no significant changes in soil bulk density due to the application of soil amendments. The site has not been tilled since 2015 when a perennial salt-tolerant grass mix was established. This may have also contributed to no significant differences in bulk density. There was a relationship between the gravimetric soil water contents and the corresponding bulk density. For example, 2023 was a very dry year and the bulk density levels remained one of the highest where the 2024 bulk density levels have been one of the lowest under wet weather.

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



	Rep 1 (BD)	Rep 1 (GW)	Rep 2 (BD)	Rep 2 (GW)	Rep 3 (BD)	Rep 3 (GW)	Control (BD)	Control (GW)	E-sulfur (BD)	E-sulfur (GW)	Gypsum (BD)	Gypsum (GW)	VersaLime (BD)	VersaLime (GW)	0-5" (BD)	0-5" (GW)	5-10" (BD)	5-10" (GW)
2024	1.31	17.51	1.36	17.22	1.34	17.15	1.33	18.04	1.35	18.43	1.31	16.38	1.35	16.32	1.30	16.11	1.37	18.47
2023	1.39		1.46		1.44		1.44		1.45		1.39		1.43		1.38		1.48	
2022	1.39	15.38	1.40	18.38	1.43	19.60	1.40	18.71	1.42	17.33	1.38	19.07	1.42	16.03	1.35	16.82	1.46	18.76
2021	1.38	17.84	1.40	16.39	1.46	17.92	1.42	18.14	1.46	16.93	1.36	18.81	1.43	15.66	1.36	17.65	1.47	17.12
2020	1.36	16.88	1.35	18.30	1.39	22.67	1.37	20.60	1.38	20.64	1.35	19.04	1.36	16.85	1.31	17.49	1.42	21.08
2019	1.36	24.25	1.34	24.78	1.36	26.40	1.37	24.64	1.37	25.38	1.31	26.13	1.36	24.41	1.33	25.12	1.38	25.16
2018	1.31	20.93	1.32	23.26	1.36	25.54	1.31	24.45	1.34	23.64	1.32	23.34	1.35	21.54	1.32	23.10	1.34	23.38
2017	1.34	20.27	1.40	21.63	1.35	25.72	1.30	24.83	1.43	21.30	1.39	22.72	1.31	21.30	1.34	22.87	1.38	22.20
2016	1.27	25.13	1.33	23.84	1.32	26.46	1.26	26.42	1.30	25.64	1.31	25.68	1.36	22.83	1.28	25.49	1.33	24.79
2015	1.34	21.06	1.38	20.27	1.36	24.09	1.39	22.43	1.35	22.73	1.32	22.08	1.38	19.98	1.33	21.68	1.40	21.93

Note: In 2023 soil gravimetric water could not be measured and results are missing in Figure 7.

SUMMARY

Research data and observations are not conclusive at this point and this trial is ongoing. Since most soils in North Dakota are clayey, the general belief is that these soils will infiltrate water slow. That is correct if clayey soils are compared with silty or sandy soils. A clayey soil with high to very high dispersion or swelling caused by sodicity will infiltrate water much slower than the same clay type not having these issues. Reducing soil dispersion and/or swelling with the application of soil amendments that add free Ca^{2+} to the soils directly or indirectly combined with no or minimum-till practices and practices that help increase organic matter will improve soil particle aggregation, structure, pore space and water infiltration.

Below are the answers for the three objectives of this long-term research trial:

Does existing soil sodicity negatively affect tile drainage performance?

Soil sodicity has negatively affected the performance of tile drainage at this site. Despite heavy rains, and standing water at the soil surface, it generally takes 3-5 days for the lift station pump to start pumping the excess water in the surface water ditch. High soil sodicity results in slow soil water infiltration caused by dispersion. Excess water drains but it takes time. Slow water infiltration also results in very little changes in groundwater depth for three to five days after a heavy rain despite ponding of water at the soil surface.

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

Tiling helped lower soil salinity (EC) levels under wet weather in 2016. The drier weather from 2017-2023 resulted in increased salinity levels compared to 2016 levels. The lack of rain water fails to produce excessive and non-plant available "gravitational soil water" which forces water-soluble salts into deeper depths. This increases the rise of "capillary soil water" due to increased evapotranspiration. This data indicates salinity can occur or increase on tiled-lands under dry weather. This happens due to the fact that capillary water is not intercepted by tiles. Tiles only collect gravitational water, which will be prominent during wet weather. Capillary water will be more prominent and relevant with dry weather.

Does the tile-drained water increase salinity and sodicity levels of the surface water resources?

Depending upon the soil chemistry of the site, it does. Based on the average 2015-2024 water quality analysis results, tile-drained water added conductivity, total dissolved solids, sodium adsorption ratio (SAR), calcium carbonate ($CaCO_3$), calcium (Ca), magnesium (Mg), sodium (Na), sulfates (SO_4), chloride (Cl), bicarbonates (HCO_3), total Nitrogen (N), copper (Cu), zinc (Zn), selenium (Se) and bromide (Br) to the surface water-ditch or the surface water resources. That means over time depending upon the site-specific soil chemistry, tile drainage water can add salts and sodicity to the surface water resources.

CANOLA FERTILITY TRIAL

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Lawrence Henry (Research Specialist II/Agronomy)
Richard Duerr (Research Specialist/Agronomy)

Introduction

Nitrogen and sulfur are two of the thirteen essential nutrients that plant roots absorb from the soil. Nitrogen is not only an essential component of all proteins, but is also taken up by the plants in large quantities. Its deficiency often results in slow and growth stunted plants along with chlorosis. Being a secondary plant nutrient, sulfur is also required in higher quantities by the plants. Apart from being a structural component of the amino acids, proteins, vitamins and enzymes, sulfur is also essential for the production of chlorophyll.

Since canola is especially responsive to sulfur, North Dakota State University fertilizer recommendations for nitrogen and sulfur are 130 to 150 pounds of nitrogen and 15 to 30 pounds of sulfur in sulfate form (SO_4^{--})/acre for a yield potential of 2000 to 3000 pounds of canola per acre for the Langdon area. (North Dakota Fertilizer Recommendation Tables and Equations, 2010. SF-882, Revised).

In order to fulfill these nutritional requirements, producers often apply physical blends of urea and ammonium sulfate (AMS). While a physical blend may have the nutrient quantities applicators would be aiming for, once spread on the field it may result in uneven nutrient streaking. Another option could be a homogenized blend of macro and secondary-nutrients such as nitrogen (N), potassium (K) and sulfate-sulfur (SO4-S), containing optimum quantities of these nutrients suitable for most soils.

Objectives

Considering the high nutritional requirements of canola versus most crops, a fertilizer trial was conducted at the Langdon Research Extension Center in 2024. The trial was sponsored by UKT Chicago. The objective of the trial was to compare the effects of two homogenized new fertilizers, NKS (28-0-5-6SO4-S) and NKS (26-0-7-9SO4-S) versus straight fertilizers such as urea and AMS. The nitrogen in the new fertilizers is in the ammonium ($NH4^+$) and nitrate ($NO3^-$) form, so unlike urea, they are not subject to ammonia volatilization losses. The study used three different rates of nitrogen, potassium and sulfate-sulfur (SO4-S) and measured yield and quality of canola seed. A uniform application of P was made to all treatments based on soil available P results.

Trial Location

Trial site was located at the NDSU Langdon Research Extension Center, Langdon, North Dakota.

Treatments and Replications

Based on the soil analysis results, all treatments received a full rate of phosphorous that was 72 pounds per acre, whereas straight fertilizer treatments (T2, T3 and T4) that received a combination of urea and AMS did not receive any potassium. However, these treatments did receive equal amounts nitrogen and equal or close amounts of SO4-S. Since the homogenized fertilizers NKS 28 and NKS 26 had potassium in them, T5 to T10 treatments received potassium in addition to nitrogen, phosphorus and SO4-S. In addition, in T2 to T4, urea was treated with urease inhibitor at the rate of 14 ml for 10 pounds, and all fertilizers were applied as a surface broadcast. Details of fertilizer and nutrient types and quantities are in Table 1.

Soil Analysis Results

A two-foot deep composite soil sample separated into 0-6 and 6-24 inch depths was taken on April 11, 2024 by taking three cores. The soil N and P levels were low, whereas K and SO4-S levels were medium and organic matter was high in

the 0-6 inch soil depth. All of the fertilizer was hand broadcasted to individual treatments or plots followed by a shallow pass of a cultivator on May 29, 2024. Details of soil analysis results are in Table 2.

Planting Details

At the time of planting, plot sizes were five-feet wide (with two extra rows on the outside that were pulled out on August 30, 2024 before harvest) and 22-feet long. On June 26, 2024 borders and alleyways were made that left the plot length as 15.25-feet. Final plot sizes at the time of harvest were 5.16-feet X 15.25-feet. Canola variety that was planted was BASF InVigor L340 PC. Seeding rate was 10 live-seeds per square foot (435600 live seeds per acre).

Table 1. Treatments and fertilizer/blend types and nutrients quantities per acre for the UKT Chicago trial.

Treat. #	Fertilizer Type / Blend	Explanation	N (lb/ac)	P (lb/ac)	K (lb/ac)	SO4-S (lb/ac)
T1	TSP	Full rate of P only (control)	0	72	0	0
T2	Urea + AMS	1/3 rates of N & SO4-S, full rate of P and no K	50	72	0	11.0
T3	Urea + AMS	2/3 rates of N & SO4-S, Full rate of P and no K	100	72	0	21.0
T4	Urea + AMS	Full rates of N & SO4-S, and P with no K	150	72	0	32.0
T5	NKS 28 (28-0-5-6S)	1/3 rates of N, SO4-S & K and full rate of P	50	72	9.0	11.0
T6	NKS 28 (28-0-5-6S)	2/3 rates of N, SO4-S & K and full rate of P	100	72	18.0	21.0
T7	NKS 28 (28-0-5-6S)	Full rates of N, SO4-S & K and P	150	72	27.0	32.0
T8	NKS 26 (26-0-9S)	1/3 rates of N, SO4-S & K and full rate of P	50	72	14.0	17.0
T9	NKS 26 (26-0-9S)	2/3 rates of N, SO4-S & K and full rate of P	100	72	27.0	35.0
T10	NKS 26 (26-0-9S)	Full rates of N, SO4-S & K and P	150	72	40.0	52.0

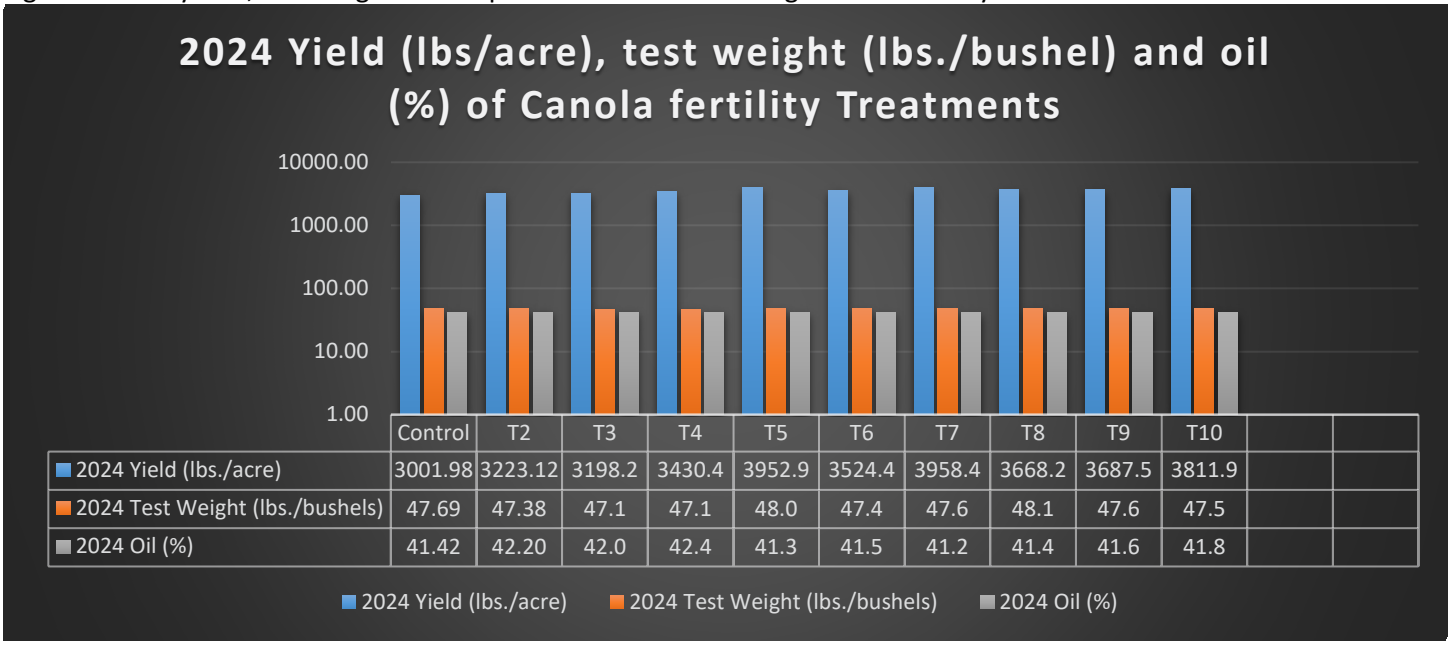
Table 2. The 2024 soil N, P, K, SO4-S, EC, SAR and pH results of the UKT Chicago trial site for the 0-6 and 6-24 inch depths.

Sample ID	Depth (inches)	NO3-N (lbs./acre)	P (ppm)	K (ppm)	SO4-S (lbs./acre)	OM %	EC (dS/m)	SAR	pH
NOK-1	0-6	4	6	435	24	5.0	0.76	1.13	7.1
	6-24	34	2	213	308	2.6	1.02	5.13	7.8

Results and Discussion

Yields for treatments 5 and 7 had significantly higher yields versus the rest of the treatments. Both T5 and T7 received NKS 28 fertilizer. Overall, NKS 28 treatments had the highest yields followed by NKS 26 and combination of urea and AMS. Control treatment had the lowest mean. Treatment 8 had the highest test weight, whereas, T3 had the lowest. Highest oil percent was observed in T4 and T7 had the lowest. Details are in Figure 1.

Figure 1. 2024 yields, test weight and oil percent of the UKT Chicago canola fertility trial.



	Control	T2	T3	T4	T5	T6	T7	T8	T9	T10
2024 Yield (lbs./acre)	3001.98	3223.12	3198.2	3430.4	3952.9	3524.4	3958.4	3668.2	3687.5	3811.9
2024 Test Weight (lbs./bushels)	47.69	47.38	47.1	47.1	48.0	47.4	47.6	48.1	47.6	47.5
2024 Oil (%)	41.42	42.20	42.0	42.4	41.3	41.5	41.2	41.4	41.6	41.8

Summary:

- Best yielding treatments received NKS 28 fertilizer.
- Control treatments had the lowest yield mean.
- Homogenized fertilizers (NKS 26 and NKS 28) out yielded the straight fertilizer (urea and AMS) treatments.
- The best yielding treatments were T5 and T7 (3952 and 3958 lbs/acre). They both received NKS 28 homogenized fertilizer. The main difference between these two treatments was T5 received 50 pounds of nitrogen per acre with the full rate of phosphorus, 9.0 pounds of potassium and 11.0 pounds of SO4-S. T7 received 150 pounds of nitrogen, the full rate of phosphorus, 27.0 pounds of potassium and 32.0 pounds of SO4-S. Given the very small yield difference (5.5 lbs/acre) between T5 and T7, T5 would have the highest rate of return because of the lower nitrogen, potassium and SO4-S rates.

SALT AND SODICITY TOLERANCE OF BARLEY, OAT AND SUGARBEET

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Barley and oats are some of the most salt and sodicity tolerant annual crops producers can profitably grow in North Dakota. 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. To determine the economic threshold of soil salinity (Electrical Conductivity or EC) and sodicity (Sodium Adsorption Ratio or SAR) for barley, oats and other major annual crops, four barley and four oat varieties were planted at the Langdon REC site in 2024 at three different levels of soil salinity and sodicity. This trial-demonstration was a repeat of 2020-2023. Additionally, six sugarbeet varieties were added in 2024 to compare salinity and sodicity tolerances of sugarbeets versus barley and oat crops.

Soil Analysis Results

Two-foot deep composite soil samples separated into 0-6- and 6-24-inch depths were taken on April 11, 2024 from each level of salinity and sodicity by taking three cores for each sample. The three levels of salinity and sodicity were described as Levels 1, 2 and 3. Level 1 was described as having low to moderate levels of salinity and sodicity, Level 2 having moderate to high levels and Level 3 having very high levels based on the 0-6-inch depth soil EC and SAR results. These descriptions were based on the salinity and sodicity tolerances of annual crops of barley and oats and not the sensitive crops such as soybeans. Soil EC and SAR were analyzed by using the saturated paste extract method (Table 1).

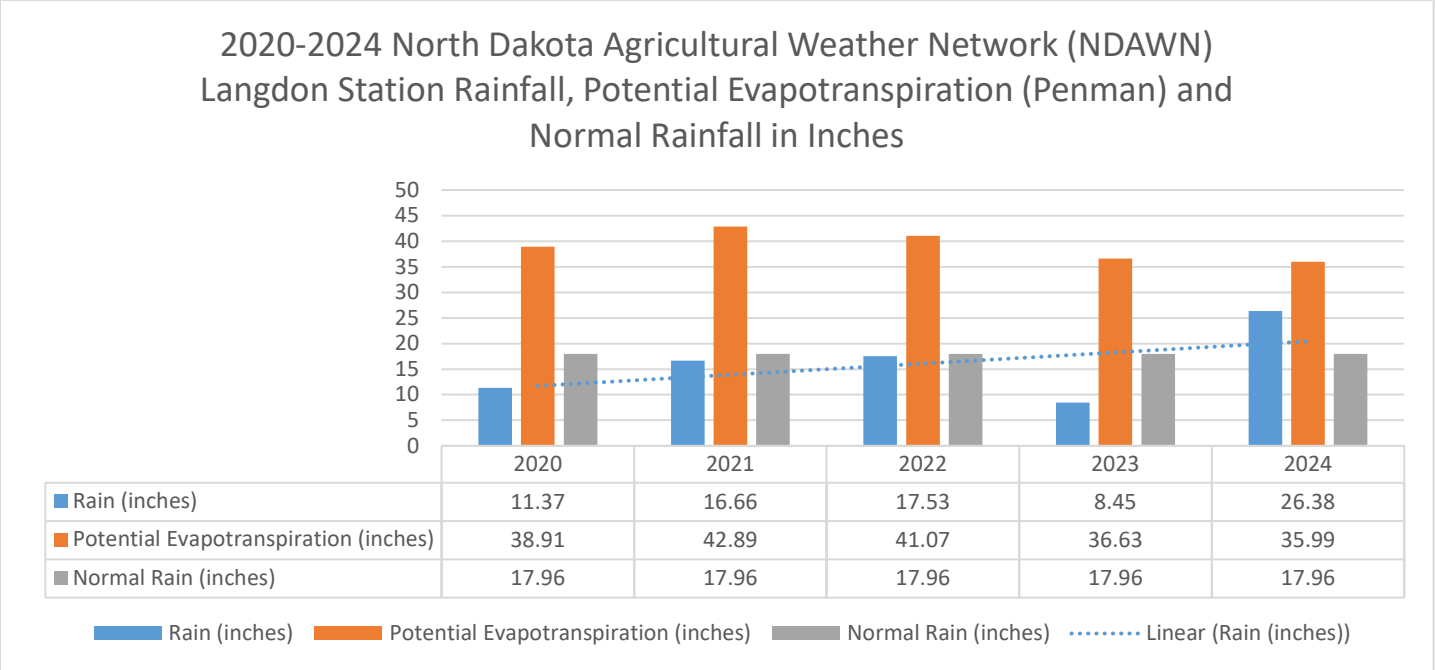
Table 1. The 2020-2024 soil EC and SAR results of the three levels for the 0-6- and 6-24-inch depths.

			EC (dS/m)					SAR				
Site	**Sample ID**	**Depth (inches)**	**2020**	**2021**	**2022**	**2023**	**2024**	**2020**	**2021**	**2022**	**2023**	**2024**
Level 1	Low to moderate salinity-sodicity	0-6	3.99	4.63	1.64	5.44	3.90	7.12	6.20	4.95	6.68	4.37
		6-24	7.32	7.49	6.70	8.02	6.57	15.05	14.72	15.50	12.52	16.05
Level 2	Moderate to high salinity-sodicity	0-6	7.80	13.20	7.92	10.30	7.40	18.13	22.88	16.28	17.07	18.18
		6-24	10.39	12.29	11.03	12.27	10.21	20.92	21.14	39.54	19.12	28.93
Level 3	Very high salinity-sodicity	0-6	10.50	14.90	11.21	11.99	9.37	27.30	32.74	30.00	22.06	28.87
		6-24	9.86	12.98	11.10	11.44	12.32	32.87	32.04	31.83	22.32	37.91

The main difference between the three levels has been the low to moderate salinity and sodicity levels in the 0-6 inch soil depth of Level 1, while Levels 2 and 3 had moderate to high and very high levels in the 0-6 and 6-24 inch depths. The 6-24 inch depth of Level 1 had moderate to high salinity and sodicity levels. The lower salinity and sodicity levels in the 0-6 inch depth of Level 1 and corresponding germination, stands, yields and quality in 2020-2024 indicate that the levels of salinity and sodicity in the surface layers (0-6 inch) are more important than the subsurface layers (6-24 inches).

Annual snowfall, resulting spring-melt and rainfall in spring and the early growing-season also had an impact on salinity and sodicity, especially in the 0-6 inch depths. The weather in 2020 was slightly drier for the Langdon area, 2021 was normal (spring and early growing-season), 2022 was wet (spring and early growing-season), 2023 was mostly dry and 2024 was wet again. In 2021 there was a slight increase in EC in all levels at the 0-6 inch soil depths versus 2020. Wet weather in 2022 resulted in slightly lower EC levels compared to 2021. Dry weather in 2023 resulted in the highest EC levels in the 0-6 inch depth in Level 1. Due to high rainfall in 2024, EC levels dropped slightly in the 0-6 inch depth of Level 1. Lower EC levels combined with high moisture availability in 2022 and 2024 spring and early growing-season resulted in improved germination, stands and higher yields even at higher salinity and sodicity levels compared to 2020, 2021 and 2023. Details of the annual 2020-2024 North Dakota Agricultural Weather Network (NDAWN) Langdon station rainfall, evapotranspiration (Penman) and normal rainfall for the periods of April 1 to October 31 are in Figure 1.

Figure 1. The annual 2020-2024 North Dakota Agricultural Weather Network (NDAWN) Langdon station rainfall, evapotranspiration (Penman) and normal rainfall for the periods of April 1 to October 31.



It is also very important to differentiate between timely rains resulting in optimum soil moisture versus excessive rains resulting in saturated, cool soils and drowned out areas, especially during germination and other critical growth stages. 2022 weather provided optimum soil moisture conditions, and 2024 weather resulted in saturated and cool soils and drowned out areas.

Plot Sizes, Planting and Harvesting Details

Plot sizes were 4.5 X 22 feet. Planting and harvest details are in Table 2.

Table 2. 2024 crop, variety, planting date, seeding rates and depth, fertilizer rate and harvest date information.

Crop	Variety	Planting Date	Seeding Rates (live seeds/acre)	Seeding Depth (inches)	Fertilizer Application (lbs./acre)	Harvest Dates
2024 Planting Details						
Barley	AAC Synergy (2-row)	June 13, 2024	1.0 million	1 to 1.5	10 pounds of AMS + 1.6 pounds of urease inhibitor treated urea was hand broadcasted and then incorporated with one-pass of a cultivator. A total of 2.8 pounds of N (10 pounds of AMS had 2.10 pounds of N + 2.40 pounds of SO4-S and 1.6 pounds of urea had 0.73 pounds of N) + 2.4 pounds of SO4-S was applied to Level 1 only.	Level 1, 2 and 3 barley and oats were straight combined on October 1, 2024.
	ND Genesis (2-row)					
	ND Treasure (6-row)		1.25 million			
	Tradition (6-row)					
Oat	CS Camden		1.0 million			
	ND Heart					
	Rockford					
	ND Spilde					
Sugarbeet	Seedex 1815		175-180 plants per 100-feet length			All three levels were hand-harvested on October 14, 2024.
	BTS 8927					
	BTS 8018					
	Hilleshog					
	Crystal 912					
	Crystal 793					

Results and Discussion

Similar to 2020-2023, there were differences between the three levels in seedbed, germination, plant growth and vigor, maturity, yield, and quality in 2024.

Differences in Seedbed

Similar to previous years, the seedbed was rough and cloddy with an increase in soil sodicity (Levels 2 and 3) compared to areas with low sodicity (Level 1) in the surface layers (0-6 inch depths). This effect has been decreasing every year due to continuous tillage, but was still observed in 2024. An increase in soil sodicity always resulted in wet, saturated and drowned out areas in cases of heavy rains. That was also evident from the field-readiness of each level for tillage or planting. On May 31, 2024 the low to moderate level seemed 100% ready in terms of soil moisture, moderate to high level seemed wet, and the very high salinity and sodicity level was very wet. See seedbed pictures 1-3 below for comparisons.



Pictures 1-3 from left to right: Differences in seedbed between Level 1 (low to moderate salinity-sodicity on left), 2 (moderate to high salinity-sodicity in the middle) and 3 (very high salinity-sodicity on right) on May 31, 2024.

Differences in Germination

There was no germination in the AAC Synergy and ND Genesis plots due to a very poor seed germination issue not related to seedbed, salinity or sodicity issues in Level 1 and Level 2. In Level 3, all four barley plots/varieties were drowned out right after planting and there was standing water in those plots for days (Figure 2).

Figure 2. Level 1 (furthest), Level 2 (in the middle) and Level 3 (closest) north side plots, were planted with barley varieties on June 18, 2024. Level 3 barley plots drowned out right after planting (June 13, 2024) for days, which resulted in zero germination in all plots.

There was standing water in tire tracks between the plots with saturated soil in the plots in Level 1. Level 2 and 3 barley plots were drowned on the north side of the trial area (Figure 2). It took Level 3 drowned out plots days to dry versus Level 2 drowned out plots resulting in no germination in Level 3 barley plots regardless of the variety. Tradition and ND Treasure germinated well in Levels 1 and 2. In Level 1, barley and oats started germinating 9-10 days after planting, and sugarbeet started germination 11-12 days after planting. In Level 2, barley and oats took 11-12 days to start germinating and sugarbeets 14-15 days. In Level 3, oats started germinating 9-10 days after planting, and sugarbeets took 14-15 days.

This pattern of germination between the three levels of salinity and sodicity was very similar to 2022, meaning higher soil moisture will result in rapid germination even at moderately high and very high salinity and sodicity levels in the surface layers (0-6-inch depth). Higher moisture levels at a level when soils are saturated or drowned out for days actually is detrimental to germination.

Differences in Growth, Vigor, Stands and Maturity

Early in the growing-season, barley always looks better than oats, however, oats catch up with time. Sugarbeets also germinated slower compared to barley and oats but looked much better with time. Due to the very poor seed germination issues for AAC Synergy and ND Genesis barley varieties, plots of these two varieties in Level 1 and Level 2 had zero germination. All four barley varieties had zero germination as plots drowned out due to heavy rain on saturated soil right after planting in Level 3. Oat plots germinated and had good stands in all three levels. All six sugarbeet varieties also had good stands in all three levels. Excess moisture resulted in good germination and stands in Level 2 and 3, but too much moisture resulted in standing water and saturated soil conditions that negatively affected germination, slowed growth and resulted in slightly less vigor, especially early in the growing-season. Later in the season, when there was adequate soil moisture and weather warmed up, oat and sugarbeet plots looked very good in Level 2 and Level 3. The oat plots in Level 3 seemed more mature compared to the Level 1 and 2 oat plots on September 5, 2024. In the past, Level 3 and Level 2 always matured late compared to Level 1. See pictures 4-6 showing barley, oat and sugarbeet stands growing in Level 1, Level 2 and Level 3 on September 5, 2024.

Picture 4. Barley (left), oat (middle) and sugarbeet (right) varieties growing in Level 1 on September 5, 2024.

Picture 5. Barley (right), oat (middle) and sugarbeet (left) varieties growing in Level 2 on September 5, 2024.

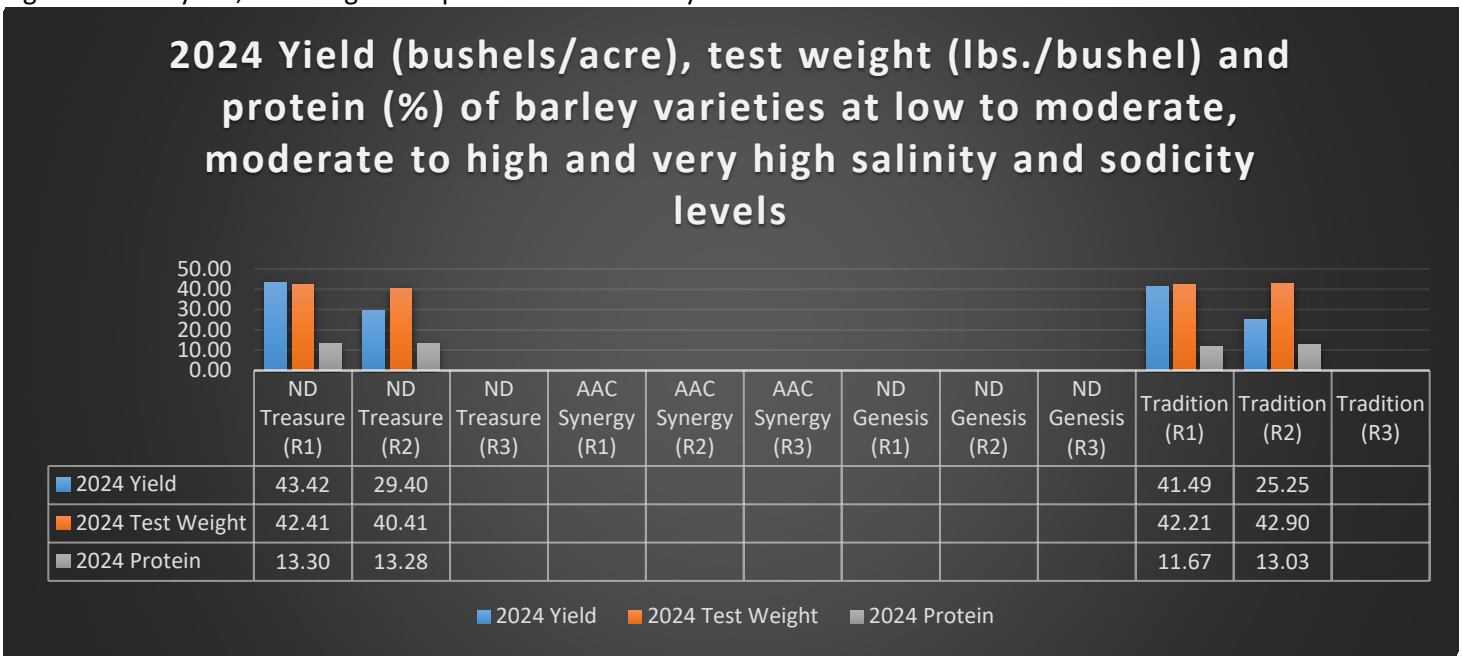
Picture 6. Barley (left), oat (middle) and sugarbeet (right) varieties growing in Level 3 on September 5, 2024.

Differences in Yield and Quality

Barley

The seed for AAC Synergy and ND Genesis varieties had zero germination, which was not known at the time of planting. No observations on these varieties were obtained at any level. In Level 3, ND Treasure and Tradition also had zero germination and zero yields. It was a low yielding year for barley in Level 1 and Level 2 despite high moisture levels during spring and growing-season, which was similar to 2022. The main difference between 2024 and 2022 was excess soil moisture instead of optimum soil moisture (26.38-inches versus 17.53-inches). That indicates increased soil moisture does help annual crops on saline and sodic areas. ND Treasure and Tradition yields in Level 2 were 32.28 and 39.14% lower compared to the yields of these two varieties in Level 1. These differences in yields between Level 1 versus Level 2 were better than 2020, 2021 and 2023 and were similar to 2022. Level 2 barley had slightly higher protein % than Level 1. Details are in Figure 3.

Figure 3. 2024 yield, test weight and protein of four barley varieties.

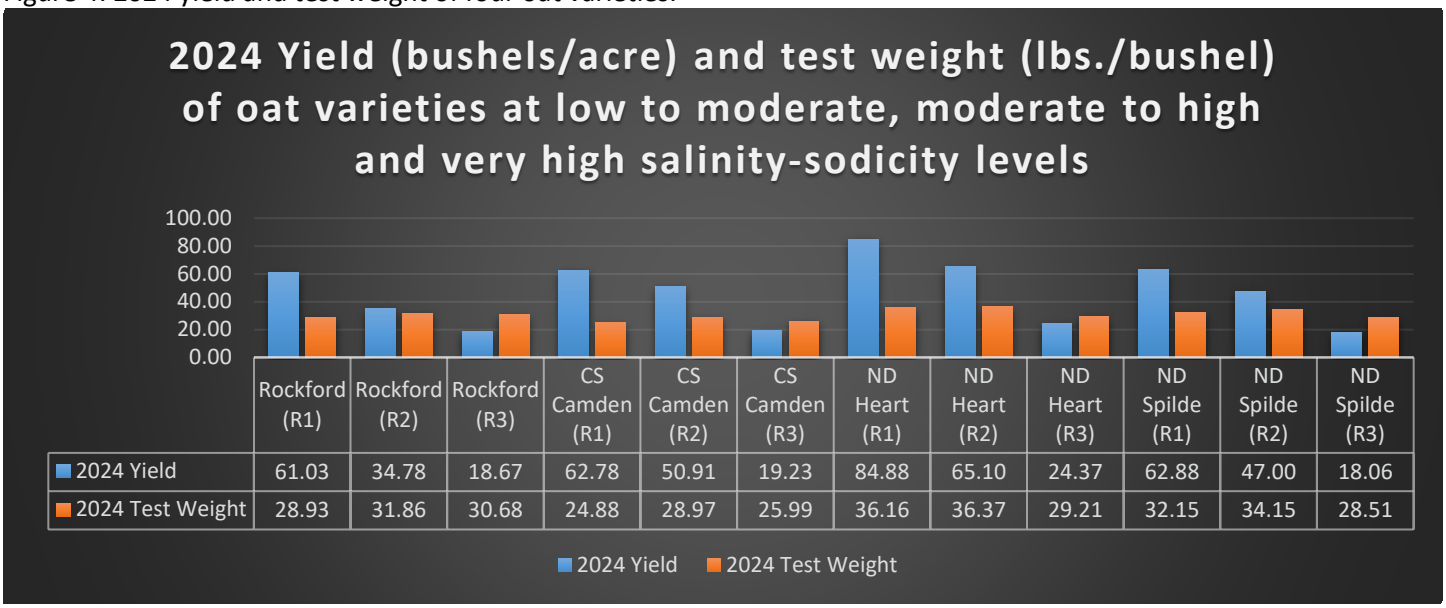


	ND Treasure (R1)	ND Treasure (R2)	ND Treasure (R3)	AAC Synergy (R1)	AAC Synergy (R2)	AAC Synergy (R3)	ND Genesis (R1)	ND Genesis (R2)	ND Genesis (R3)	Tradition (R1)	Tradition (R2)	Tradition (R3)
2024 Yield	43.42	29.40								41.49	25.25	
2024 Test Weight	42.41	40.41								42.21	42.90	
2024 Protein	13.30	13.28								11.67	13.03	

Oats

Yields of all oat varieties were lower than previous years, especially compared to 2022, which had increased but not excess soil moisture in the spring and early part of the growing-season. Increased soil moisture that does not lead to saturated soil conditions for longer periods of time results in improved germination and yield on saline and sodic soils. Overall, Level 2 yields were 18.90 to 43.01% lower compared to Level 1. Level 3 oat yields were 69.36 to 71.27% lower than the yields in Level 1. Level 3 oat yields were 46.31 to 62.56% lower than Level 2. Level 2 oats had the highest test weights compared to Level 1 and 3. Details are in Figure 4.

Figure 4. 2024 yield and test weight of four oat varieties.

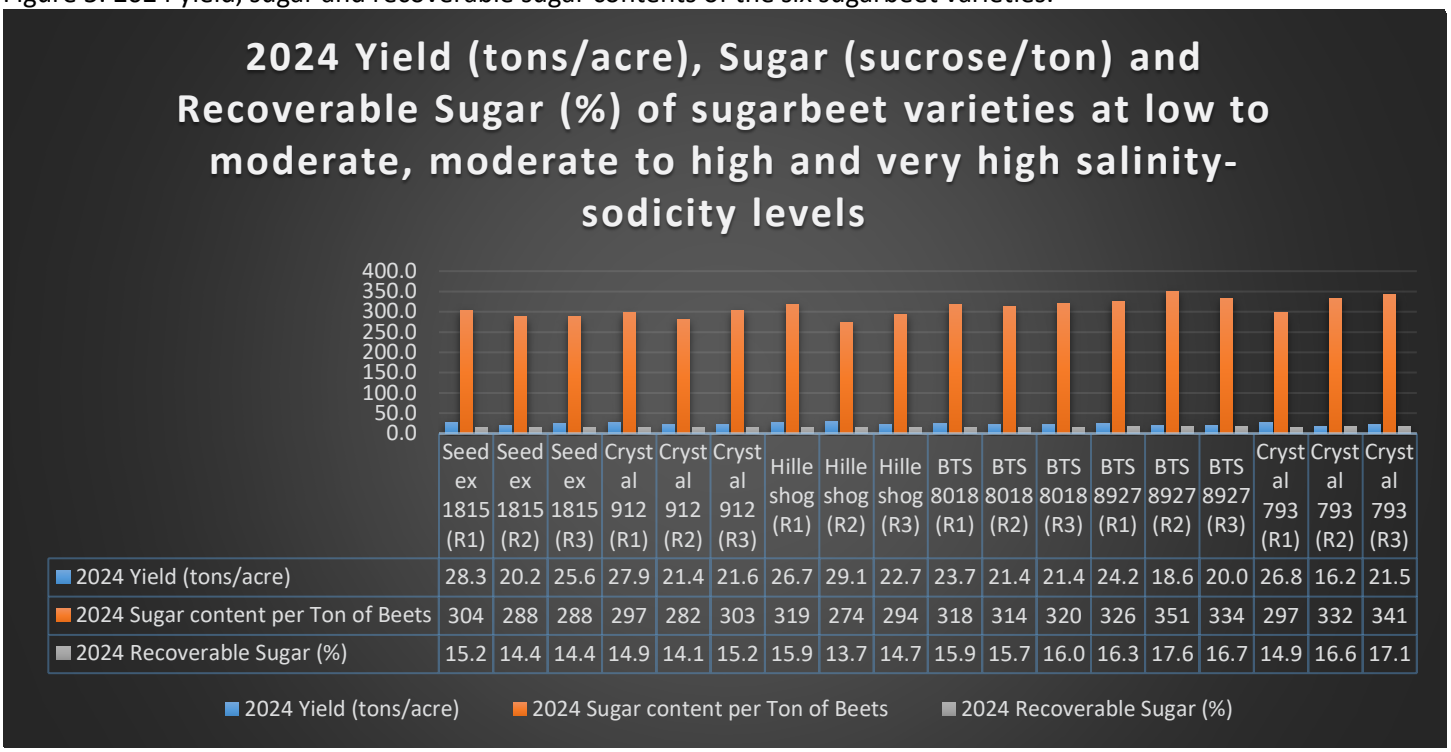


	Rockford (R1)	Rockford (R2)	Rockford (R3)	CS Camden (R1)	CS Camden (R2)	CS Camden (R3)	ND Heart (R1)	ND Heart (R2)	ND Heart (R3)	ND Spilde (R1)	ND Spilde (R2)	ND Spilde (R3)
2024 Yield	61.03	34.78	18.67	62.78	50.91	19.23	84.88	65.10	24.37	62.88	47.00	18.06
2024 Test Weight	28.93	31.86	30.68	24.88	28.97	25.99	36.16	36.37	29.21	32.15	34.15	28.51

Sugarbeet

All sugarbeet varieties performed well in all three levels of salinity and sodicity. Seedex 1815, Crystal 793, Crystal 912 and Hilleshog varieties were the highest yielding varieties out of the six sugarbeet varieties. All varieties produced roughly similar sugar contents per ton of beets and recoverable sugar percent. Details are in Figure 5.

Figure 5. 2024 yield, sugar and recoverable sugar contents of the six sugarbeet varieties.



	Seedex 1815 (R1)	Seedex 1815 (R2)	Seedex 1815 (R3)	Crystal 912 (R1)	Crystal 912 (R2)	Crystal 912 (R3)	Hilleshog (R1)	Hilleshog (R2)	Hilleshog (R3)	BTS 8018 (R1)	BTS 8018 (R2)	BTS 8018 (R3)	BTS 8927 (R1)	BTS 8927 (R2)	BTS 8927 (R3)	Crystal 793 (R1)	Crystal 793 (R2)	Crystal 793 (R3)
2024 Yield (tons/acre)	28.3	20.2	25.6	27.9	21.4	21.6	26.7	29.1	22.7	23.7	21.4	21.4	24.2	18.6	20.0	26.8	16.2	21.5
2024 Sugar content per Ton of Beets	304	288	288	297	282	303	319	274	294	318	314	320	326	351	334	297	332	341
2024 Recoverable Sugar (%)	15.2	14.4	14.4	14.9	14.1	15.2	15.9	13.7	14.7	15.9	15.7	16.0	16.3	17.6	16.7	14.9	16.6	17.1

Summary:

- Spring and early growing-season soil moisture levels have a significant impact on germination, growth, yield and quality even at moderately high and very high salinity and sodicity levels.
- Surface salinity and sodicity (0-6” depths) has more impact on germination, stand and yield than subsurface salinity and sodicity (6-24” depths).
- Excess soil moisture resulting in saturated soil conditions for extended periods of time negatively effects germination, stands and yield of salt-tolerant small grains such as barley and oats.
- Increased salinity results in delayed and uneven germination, poor growth and vigor, delayed maturity, yield and quality. An increase in sodicity results in poor seedbed, crusted surface layers, saturated soils and drowned out areas.
- Seed size and plant root structure matters when salinity and sodicity levels increase, especially in a dry growing-season. Bigger seed tends to germinate better through crusted soil surfaces and deeper tap roots help plants extract moisture from the deeper soil depths compared to shallow fibrous roots.
- All sugarbeet varieties have done very well at salinity and sodicity levels that are moderately high to very high in the 0-6-inch depths followed by sunflowers, oats and barley. Durum and canola can yield high at low to moderate levels of salinity and sodicity in the 0-6-inch soil depths, however, moderately high to very high levels negatively affect the yield and quality of these crops.

2024 Hessian Fly Pheromone Trapping Report

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Introduction:

Hessian fly, *Mayetiola destructor* (Say), is one of the most significant insect pests affecting wheat in ND. This insect pest was introduced into North America during the late 1770s in Long Island, New York by straw-bedding of Hessian soldiers during the American Revolution. Its populations have spread across the wheat-growing regions of the country. While wheat is the main preferable host, it also infests barley, rye and several species of grass as alternative hosts. Historically, Hessian fly has been a sporadic pest in ND, with notable outbreaks occurring in 1991, 2003 and 2015 (Knodel, 2015). A study conducted by Anderson et al. in 2012 utilized pheromone traps to monitor the distribution and spread of this insect in ND. However, this study is now a decade old, and in recent years we have seen an increase in Hessian fly outbreaks particularly in the northeast region of the state. To enhance our understanding of Hessian fly population distribution and peak emergence periods, a state-wide trapping program was initiated in ND using sex pheromone-baited sticky traps (Fig. 1).

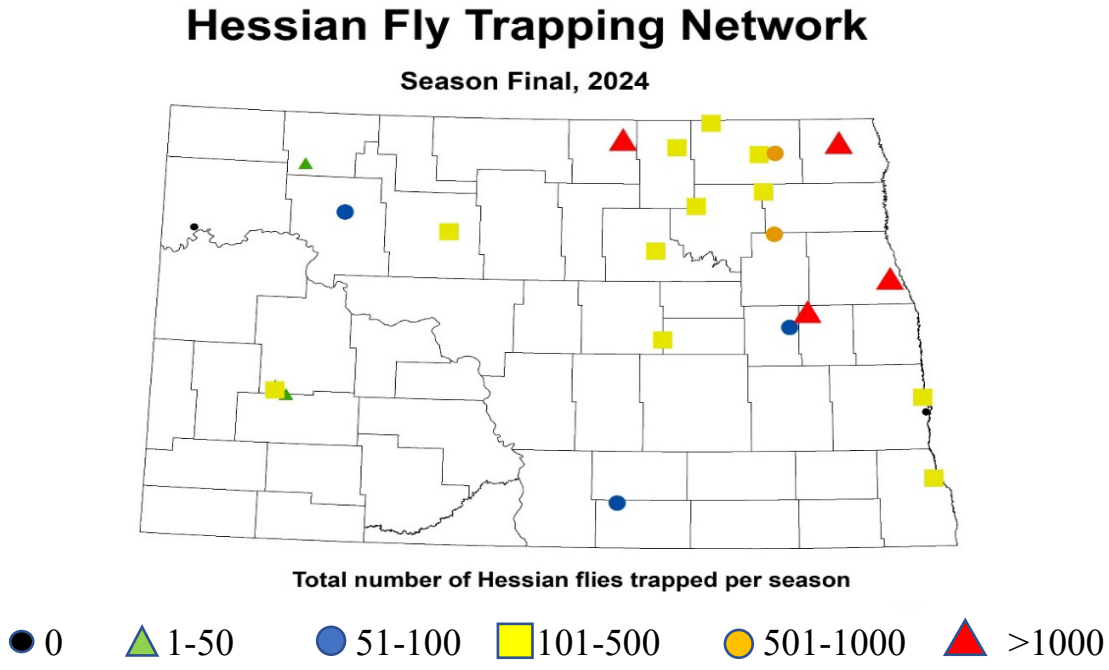

Figure 1: Season count of 2024 Hessian fly trapping network

Materials and Methods:

Sex pheromone lures were obtained from Pherobank, Netherlands. These lures were deployed in delta sticky traps positioned on poles at the edges of the wheat fields (Fig. 2). Trap liners were changed weekly and stored in Ziploc bags in the freezer until the number of flies could be counted (Fig. 3). The lures were replaced every four weeks. Traps were established at the beginning of the season, immediately following wheat emergence, and remained in place until harvest. Monitoring dates varied by trapping sites. A total of 26 traps were placed in 21 counties.

Figure 2: Hessian fly pheromone trap set in a wheat field. Photo: Anitha Chirumamilla.

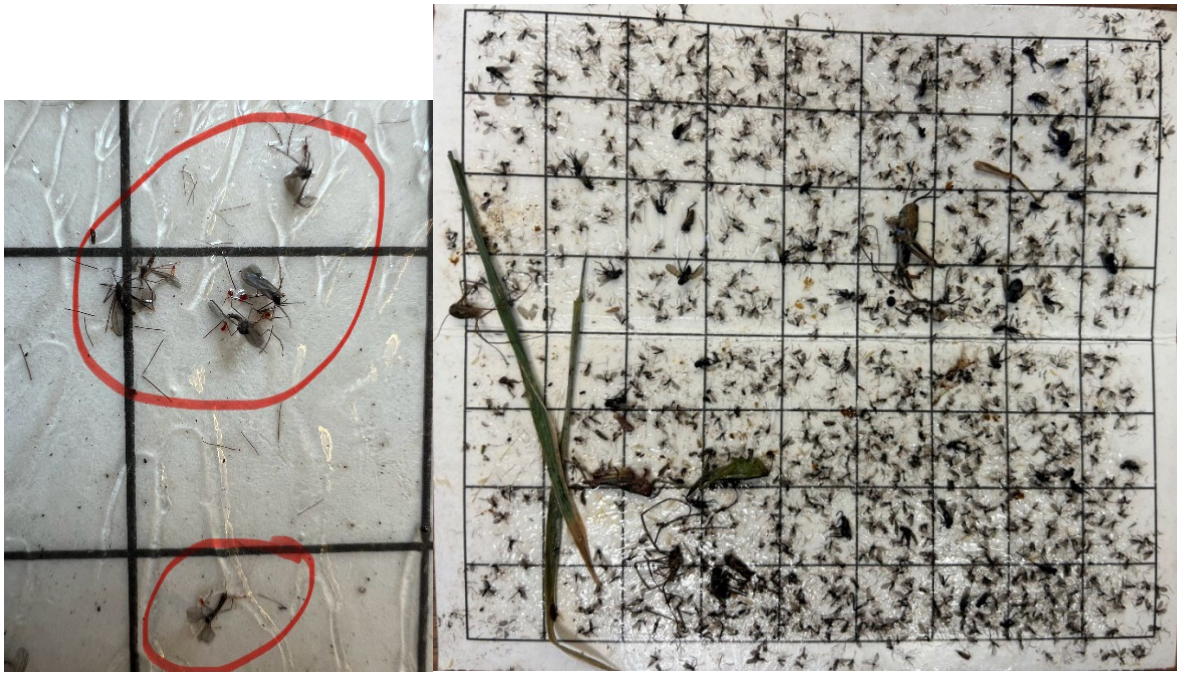

Figure 3: Pheromone trap sticky bottom with Hessian flies. Photo: Anitha Chirumamilla.

Results:

Distribution: Trapping results indicate a significant presence of Hessian fly across the state. In 2024, a total of 12,530 Hessian flies were captured on sticky traps monitored by IPM insect trappers from June to mid-August (Fig. 1 and Table 1). This marked a dramatic eight-fold increase compared to 2023, where only 1,527 Hessian flies were captured at 37 trapping sites.

The highest trap catches were found in the northeast and east central regions of North Dakota, where over 1,000 total Hessian flies per trap per season were reported in Pembina, Rolette, Grand Forks, and Steele counties, accounting for 4 of the 26 trap sites (about 15%). Additionally, 2 of the trap sites (approximately 7%) located in Cavalier and Nelson counties reported captures between 501 and 1,000 Hessian flies per trap per season. Eleven of the sites (around 42%) had captures ranging from 101 to 500 Hessian flies per trap per season, indicating a considerable presence of Hessian flies overall. Conversely, 8 of the sites (about 31%) recorded lower captures, ranging from 1 to 100 flies per trap per season, while only 2 sites (or 8%) in Williams and Cass counties had no Hessian flies (Table 1).

Table 1. Summary of Hessian fly trapping in North Dakota, 2024

County	Total No. of Hessian Fly
Dunn 2	0
Williams	0
Cass 1	1
Stark	3
Burke	37
McIntosh	51
Mountrail	63
Griggs	100
Benson	112
Grand Forks	155
Dunn 1	156
Cavalier-Hannah	164
Cavalier-LREC	169
Ward	183
Richland	231
Cass 2	252
Towner	278
Walsh	300
Foster	310
Ramsey	410
Nelson	764
Cavalier	777
Steele	1254
Grand Forks (K)	1552
Rolette	2403
Pembina	2805
Total	**12530**

Peak Emergence:

Hessian fly is reported to have two generations in ND, with first-generation flies emerging in early spring and the second-generation flies appearing in late summer, specifically in August and September (Anderson et al., 2012). To understand these emergence patterns, we analyzed data from northeast counties of ND, focusing on weekly fly counts during the trapping period (Fig.4).

The graph representing weekly counts indicates that first generation Hessian flies emerged from their overwintering pre-pupal stage in spring coinciding with the emergence of spring wheat. Overall, population numbers initially appeared low across all trapping sites. Notably, there was no clear distinction between first- and second-generation flies, as emergence occurred throughout the season. However, the highest trap catches were observed in several counties (Pembina, Rolette, Cavalier, Steele, Grand Forks, Nelson and Walsh) during early to mid-July. Given the time interval between the first trap catches, these peaks can likely be attributed to the second generation (Fig. 4).

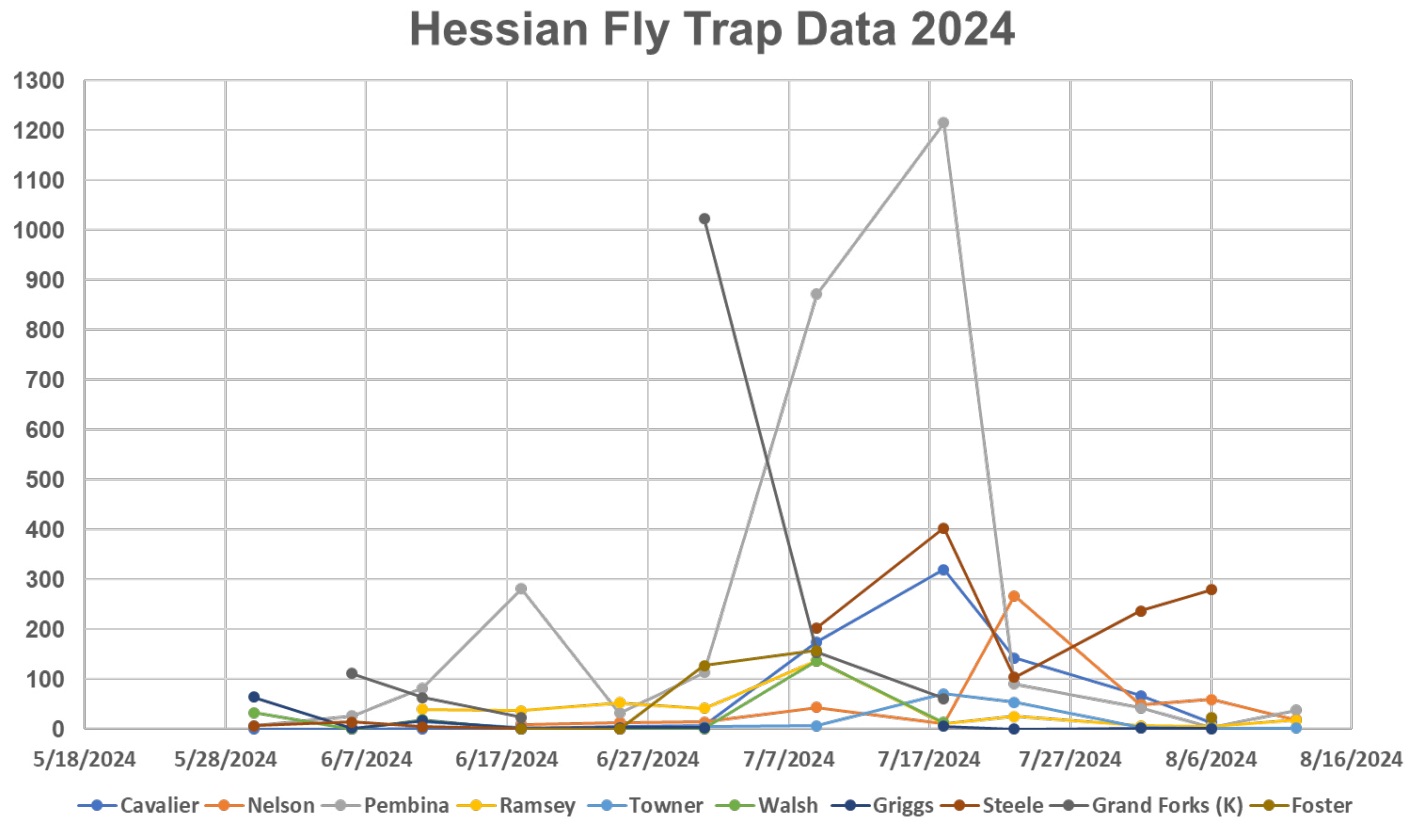

Figure 4: Weekly trap catch data of Hessian flies in northeastern counties of ND

Best Practices for Managing Hessian Fly Infestation

Pest management practices for control of Hessian fly should emphasize preventative management strategies to reduce reproduction and population levels rather than chemical control.

1. Destroying Volunteer Wheat and Grass Hosts

- Eliminate any volunteer wheat and grassy hosts at least two weeks before planting to reduce potential pest habitat through herbicides or tillage.

2. Selecting Non-Host Cover Crops
    - Choose cover crops that do not host Hessian fly to disrupt their life cycle. While oats are not preferred hosts, rye is favored for oviposition and larval development.

3. Time of Planting for Winter Wheat
    - Plant winter wheat, rye and barley cover crops after the "Hessian fly free planting dates":
        - Northern ND: After September 15
        - Southern ND: After September 30

    This timing helps to break the continuity of the pest life cycle. As flies emerge in late summer, there is no place for them to lay eggs. However, with the warmer and extended fall season that we are experiencing in North Dakota, the current fly free planting dates may become less effective due to the extended emergence of flies in the fall.

4. Utilizing Resistant/Tolerant Varieties
    - Planting resistant/tolerant varieties is the most cost-effective strategy for minimizing Hessian fly infestations and damage. Currently, no known resistance genes exist in varieties grown in ND. However, the spring wheat breeding program at NDSU is actively testing varieties with potential Hessian fly resistance genes, providing promising prospects for ND growers.

5. Chemical Control

    Insecticide control of Hessian fly is difficult due to their long fly emergence window, lack of a monitoring protocol and a threshold, and environmental factors impacting fly emergence and activity. Chemical control of Hessian fly was researched in winter wheat but there is no information available regarding Hessian fly control in spring wheat.
    - Insecticide seed treatments like thiamethoxam and imidacloprid can be used at the highest labeled rates in winter wheat. Insecticide residual is only effective for about 20 - 30 days after seeding, and Hessian fly may infest wheat well beyond that time. However, they provide little to no protection from spring infestations (Wilde et al. 2001).
    - Research in winter wheat indicates that applying a pyrethroid insecticide during the 2-3 leaf stage of wheat can be effective against Hessian flies, if the insecticide application and peak fly emergence coincide (Flanders et al. 2013).

    Historically, insecticides were not recommended in ND due to low Hessian fly populations. However, our 2024 trapping data revealed high numbers in the northeastern and east central areas of ND, with over 1,000 flies per trap per season, indicating a HIGH risk for Hessian fly infestation in wheat in 2025.

Acknowledgements

Thanks to the North Dakota Wheat Commission, the USDA NIFA CPPM EIP grant award 2021-70006-35330, and the North Dakota Department of Agriculture CAPS Program for support. Thanks to all the IPM trappers who helped us in 2023 and 2024.

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Final Report for NDSU
Seed Treatments for Flea Beetle Control in Spring Canola, 2024

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Table 1. Experimental and agronomic information.

	Langdon
Trial Latitude (LLC)	48.75539
Trial Longitude (LLC)	-98.34080
Canola Variety	DK400TL
Previous Crop	HRSW
Planting Date	May 22
Emergence Date	June 4
Plot Size	3.5 ft x 20 ft
Row Spacing	6 inches
Seeding Depth	0.75 inch
Seeding Rate	14 seeds/ft^2
Experimental Design	RCBD, 4 reps
Harvest Date	September 25

Materials and Methods

The trial was conducted at the Langdon Research Extension Center in Langdon, ND. See Table 1 for planting dates, trial design, seeding rates and other information.

Seed treatment efficacy was examined for control of crucifer and striped flea beetles in spring canola. Treatments, rates and active ingredients are listed in Table 2. Dekalb DK400TL canola seed was treated prior to planting. Two neonicotinoid seed treatments, Helix Vibrance (thiamethoxam) and Prosper Evergol (clothianidin) were tested alone and in combination with either Lumiderm or Fortenza (cyantraniliprole). Prosper Evergol also was tested in combination with two rates of Buteo Start (flupyradifurone), and in combination with the commercial rates of Lumiderm and Buteo Start. Lastly, we included two treatments using a second hybrid, InVigor L350, treated commercially with Helix Vibrance and Lumiderm. InVigor L350 was included because we had second-hand reports of this hybrid having less severe feeding injury compared to other hybrids with the same seed treatment package.

Table 2. Treatments, active ingredients and rates used in the trial.

Treatment No.	Treatment Name	Product Rate(s)	Active Ingredient(s)	AI Rate (s)
1	Fungicide Check			
2	Helix Vibrance	23 fl oz/cwt	Thiamethoxam	400 g/100 kg
3	Helix Vibrance Fortenza[1]	23 fl oz/cwt 10.2 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 400 g/100 kg
4	Prosper Evergol	21.5 fl oz/cwt	Clothianidin	400 g/100 kg
5	Prosper Evergol Lumiderm	21.5 fl oz/cwt 9.8 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 400 g/100 kg
6	Prosper Evergol Buteo Start[2]	21.5 fl oz/cwt 9.6 fl oz/cwt	Clothianidin Flupyradifurone	400 g/100 kg 300 g/100 kg
7	Prosper Evergol Buteo Start	21.5 fl oz/cwt 16 fl oz/cwt	Clothianidin Flupyradifurone	400 g/100 kg 500 g/100 kg
8	Prosper Evergol Lumiderm Buteo Start[2]	21.5 fl oz/cwt 9.8 fl oz/cwt 9.6 fl oz/cwt	Clothianidin Cyantraniliprole Flupyradifurone	400 g/100 kg 400 g/100 kg 300 g/100 kg
9	Hybrid L350 Helix Vibrance Lumiderm	23 fl oz/cwt 9.8 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 400 g/100 kg

[1]Fortenza substituted for Lumiderm, rate(s) adjusted to match commercial Lumiderm rate and cyantraniliprole concentration.
[2]Commercial Buteo Start rate when used in combination with a neonicotinoid.

Sampling activities, dates and crop stages are given in Table 3. Plots were rated for flea beetle feeding injury using the 0-6 scale developed by Dr. Janet Knodel, with 0 = no feeding and 6 = dead plant. Within each plot, 10 randomly selected seedlings were rated. For analysis, the 10 ratings were averaged for a single rating value per plot. We attempted to rate feeding injury at 3, 7, 10 and 14 days after emergence (DAE), but this was not possible for the last rating due to weather. Plant stand was measured after the last injury ratings were made by counting the number of live plants in three square feet at two locations within each plot, and calculating the number of plants per square foot. Plots were harvested at maturity by straight combining with a research plot combine. Grain weight and percent moisture content were collected with the Harvest Master weigh system on the combine. Yields were adjusted to 10% standard grain moisture. All data were analyzed using the GLIMMIX procedure in SAS version 9.4 statistical software. The Tukey HSD post-hoc test ($P<0.05$) was used to test for significance among treatment means.

Table 3. Sampling activities, sampling dates, and crop stages.

Activity	Date	DAE	Crop Stage
Injury Rating 1	June 7	3 DAE	Cotyledon
Injury Rating 2	June 11	7 DAE	2-leaf
Injury Rating 3	June 14	10 DAE	3-leaf
Injury Rating 4	June 19	15 DAE	4-leaf
Stand Counts	June 19	15 DAE	4-leaf

Results and Discussion

Flea beetle activity and seedling feeding was unusually light due to cold, wet conditions from mid-May through June. These conditions favored canola growth but not flea beetle activity. Flea beetles

are most active and destructive to canola seedlings when warm, dry conditions exist during the susceptible seedling stages from emergence through the 6-leaf stage. Consequently, seedling injury was relatively low regardless of the seed treatment package tested.

Treatment means are presented in Table 4. There were no significant differences among treatments for plant stand, yield, and feeding injury at 3, 7, and 10 DAE. Treatment 9, InVigor L350 with the commercial Helix Vibrance and Lumiderm seed treatment package, was not significantly different from Treatment 3 (DK400TL with the equivalent seed treatment package) for plant stand, yield, and feeding injury at 3, 7 and 10 DAE. However, Treatment 9 had significantly less feeding injury than all other treatments at 15 DAE. This may be due to better seedling vigor compared to DK400TL where InVigor L350 was able to grow through earlier feeding injury more quickly than DK400TL. While not statistically significant, Treatment 9 had the highest yield of all treatments, which seems to support a hybrid performance difference rather than a seed treatment efficacy difference. With the increased availability of many new straight-cut hybrids, hybrid performance using the most commonly available commercial seed treatments should be examined in more rigorous detail.

Table 4. Treatment means for seed treatments for flea beetle injury, plant stand, and grain yield at Langdon, 2024.

Trt. No.	Treatment	Injury 3 DAE	Injury 7 DAE	Injury 10 DAE	Injury 15 DAE	Plant Stand (plants/ft^2)	Grain Yield (lbs/acre)
1	Fungicide Check	2.4	3.7a	3.8a	2.7abc	7.2a	2,384.7a
2	Helix Vibrance @ 23	2.2	3.4a	3.9a	3.3a	9.5a	2,481.8a
3	Helix Vibrance @ 23 Fortenza @ 10.2	1.4	2.6a	3.3a	3.1ab	8.8a	2,566.0a
4	Prosper Evergol @ 21.5	1.7	2.9a	3.7a	2.9abc	9.3a	2,496.5a
5	Prosper Evergol @ 21.5 Lumiderm @ 9.8	1.1	2.3a	3.5a	2.9abc	7.9a	2,535.4a
6	Prosper Evergol @ 21.5 Buteo Start @ 9.6	1.0	2.9a	3.7a	2.8abc	8.3a	2,491.9a
7	Prosper Evergol @ 21.5 Buteo Start @ 16	1.3	2.9a	3.4a	2.4bc	8.1a	2,684.8a
8	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Buteo Start @ 9.6	0.8	2.1a	3.4a	2.4c	8.8a	2,652.5a
9	Hybrid L350 Helix Vibrance @ 23 Lumiderm @ 9.8	1.6	3.0a	3.2a	1.6d	7.8a	3,002.1a
	F-value	**1.94**	**1.17**	**1.08**	**12.03**	**0.92**	**2.01**
	P-value	**0.10**	**0.35**	**0.41**	**<0.0001**	**0.52**	**0.09**

Means within a column that share the same letter are not significantly different (Tukey's HSD at P<0.05).

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Langdon REC Foundation Seed Stocks Program

The Langdon REC supports a Foundation Seed Stocks program to help increase and distribute the newest NDSU varieties of HRSW, barley, soybean 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 2025 growing season are listed below:

HRSW – Faller, ND Thresher, MN-Rothsay, Prosper, Glenn, ND Stampede
Barley – Lacey, ND Treasure
Soybeans – ND17009GT, ND21008GT20
Flax – CDC Rowland

Growers who have grown seed for certification in one of the last four years who request seed prior to December 1 will be guaranteed an allocation. Any seed inventories available after December 1 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.

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