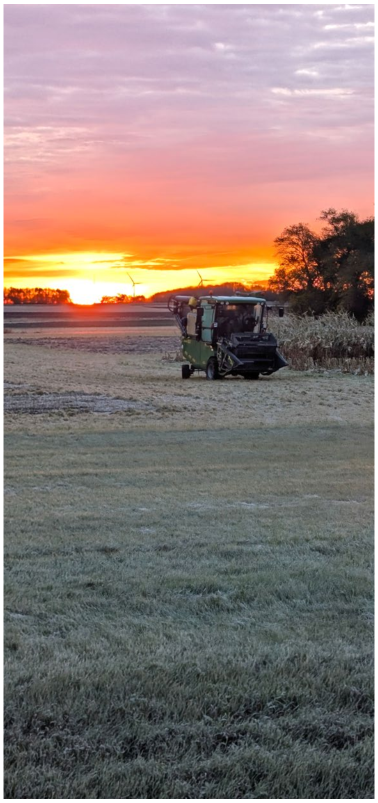

Langdon Research Extension Center

NORTH DAKOTA STATE UNIVERSITY

Annual Research Report No. 100

December 2025

NDSU NORTH DAKOTA STATE UNIVERSITY

NDSU Research and Extension Faculty and Staff Involved with the Langdon Research Extension Center

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Venkat Chapara, PhD	Plant Pathologist
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Naeem Kalwar	Extension Soil Health Specialist II
Sara Schuchard-McGregor, MBA	Administrative Assistant
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Amanda Arens	Research Specialist II/Plant Pathology
Travis Hakanson	Research Specialist II/Foundation Seed
Carmen Ewert	Research Technician/Foundation Seed
Richard Duerr	Research Specialist/Agronomy
Larissa Jennings	Research Specialist/Plant Pathology
Lahni Stachler	Cavalier County Extension Agent/ANR
Katie Henry	Cavalier County Extension Agent/FCW

2025 Seasonal/Temporary Employees

Morgan Titus	Mason Christianson	Kartheek Chapara	Neeraja Narra
Traci Murphy	Noah Foster	McKenna Schneider	
Kaleb Foster	Aiden Brown	Carleen Schill	

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NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

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NDSU | EXTENSION

Table of Contents

The 2025 annual research report is intended to provide producers with 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:

1. www.ag.ndsu.edu/varietytrials/ (old NDSU variety trial website)
2. 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 tolerance or 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 **trial mean** value shown in the trial table represents an average of 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. 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 90% confidence (LSD probability 10%) the higher-yielding variety has a significant yield advantage. When the difference between two varieties is less than the LSD value, no significant difference was found between those two varieties under those growing conditions. 'NS' is used to indicate no significant difference for that trait among any of the varieties at the 90% level of confidence. The **coefficient of variation (CV)** 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 2025. 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.

2025 Weather Summary

Fall recharge at Langdon from September through October 2024 was 5.93 inches, 2.56 inches above normal. Precipitation from November 2024 through March 2025 was 5.30 inches, 2.05 inches above normal. Precipitation from April to September was 12.85 inches, 1.54 inches below normal. Snowfall for 2024-2025 from October through April was 36.1 inches, 4.71 inches below normal. December and January received the most snow. December-February temperatures averaged 5.2ºF, 0.5ºF below normal. June was the 8th driest on record. Temperatures averaged 2.2º F above normal for the same time period. September was the 10th hottest on record. The 2025 growing season temperatures averaged 2.2ºF above normal and rainfall averaged 0.5 inches below normal across NE North Dakota from April-September according to the NDAWN stations.

Small grain yields were generally very good but pulse crops did not perform very well. Canola yields were good. Sunflowers were damaged by strong winds and rain just before harvest.

2025 Crop Management - Langdon					
Field Trial	**Previous Crop**	**Seeding Rate Unit/Acre**	**Planting Date**	**Harvest Date**	**Row Spacing**
Barley	soybean	1.0 million pls	May 23	Sept. 3	6
Canola	soybean	435,000 pls	May 30	Sept. 25	6
Corn	soybean	28,000 thinned	May 13	Oct. 13	30
Durum	soybean	1.50 million pls	May 23	Sept. 23	6
Dry Bean	soybean	75,000-90,000 pls	May 31	Sept. 26	30
Field Pea	wheat	325,000 pls	May 27	Sept. 9	6
Flax	soybean	2.8 million pls	May 30	Oct. 24	6
HRSW	soybean	1.50 million pls	May 23	Sept. 23	6
HRWW	soybean	1.2 million pls	Sept. 28, 2024	Aug. 14	6
Oat	soybean	1.0 million pls	May 15	Sept. 8	6
Rye	soybean	1.0 million pls	Sept. 28, 2024	Aug. 14	6
Soybean – RR	barley	200,000 pls	May 27	Oct. 3	6
Sunflower – Conf.	wheat	17,000 thinned	May 30	*	30
Sunflower – Oil	wheat	20,000 thinned	May 30	*	30

pls = pure live seed emergence

Langdon Soil Type: Svea-Barnes loam

* Sunflowers were not harvested due to wind and rain damage.

2025 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)	soybean	1.50 million pls	May 14	Aug. 28	7
Soybean (No-Till)	HRSW	200,000 pls	May 31	Oct. 9	7
Park River (Walsh County)					
HRSW	potatoes	1.50 million pls	May 9	Aug. 25	6
Soybean	wheat	200,000 pls	May 28	Oct. 10	6
Pekin (Nelson County)					
HRSW	soybean	1.50 million pls	May 29	Sept. 10	6
Soybean	barley	200,000 pls	May 29	Oct .10	6
Cando (Towner County)					
HRSW	canola	1.50 million pls	May 28	Sept. 10	6
Location	**Soil Type**				
Cavalier	Fargo silty clay				
Park River (HRSW)	Glyndon silt loam				
Park River (soybean)	Overly silty clay				
Pekin	Svea-Cresbard loam				
Cando	Egeland-Embden fine sandy loam				

pls = pure live seeds

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

Darin Weisz - Cando
Hayden Anderson - Towner County Extension Agent
Dave Hankey - Park River
Bailey Schroeder - Walsh County Extension Agent
Kent Schluchter - Cavalier
Alissa Sharp - Pembina County Extension Agent
Jarvis Stein - Pekin

Record of Climatological Observation
Langdon, ND

	Precipitation Normal*	2025	Dep. from Normal		Temperature Normal*	2025	Dep. from Normal
April	1.25	0.64	-0.61	April	37.9	38.5	+0.6
May	2.30	2.13	-0.17	May	51.6	55.7	+4.1
June	3.22	1.23	-1.99	June	61.1	62.7	+1.6
July	2.93	4.01	+1.08	July	66.3	65.6	-0.7
August	2.60	2.31	-0.29	August	64.5	64.5	0
September	2.10	2.53	+0.43	September	54.7	59.9	+5.2
Total	14.40	12.85	-1.55	Total	56.0	57.8	+1.8

*122 year average

Monthly Growing Degree Days and Normals-Langdon

	Wheat Growing Degree Days			Corn Growing Degree Days			Sunflower Growing Degree Days		
	2025	Normal	Deviation	2025	Normal	Deviation	2025	Normal	Deviation
April	284	244	+40	--	--	--	--	--	--
May	690	619	+71	326	209	+117	445	308	+137
June	888	890	-2	401	360	+41	558	534	+24
July	957	1027	-70	456	503	-47	630	689	-59
August	978	979	-1	459	472	-13	634	658	-24
September	816	704	+112	352	259	+93	495	372	+123
Total	4613	4463	+150	1994	1803	+191	2762	2561	+201

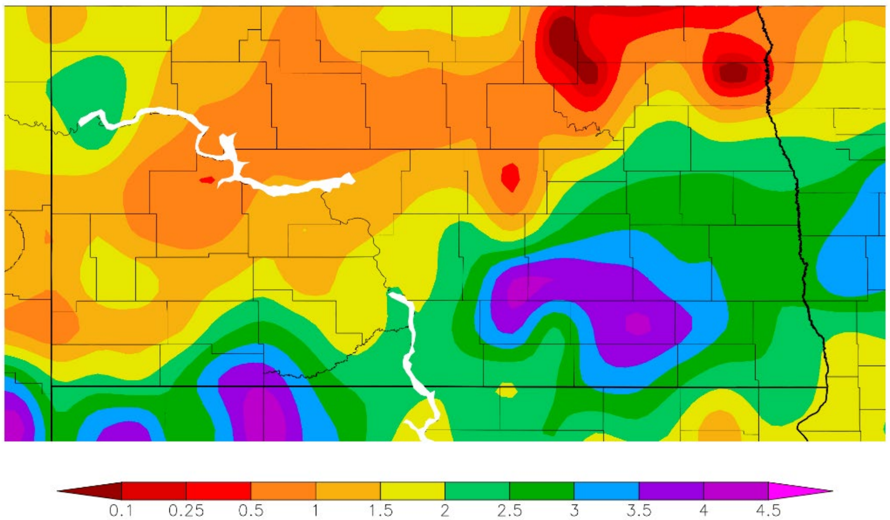
Frost Dates-Langdon and Selected Cities

	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
2025	17-May	29-Apr	7-Oct	7-Oct	143	161
Cavalier						
Normal	16-May	5-May	24-Sep	5-Oct	131	153
2025	29-Apr	29-Apr	13-Oct	14-Oct	167	168
Park River						
Normal	8-May	30-Apr	30-Sep	10-Oct	145	163
2025	29-Apr	29-Apr	7-Sep	23-Oct	131	177
Pekin						
Normal	18-May	3-May	22-Sep	30-Sep	127	150
2025	7-May	29-Apr	7-Sep	21-Oct	123	175

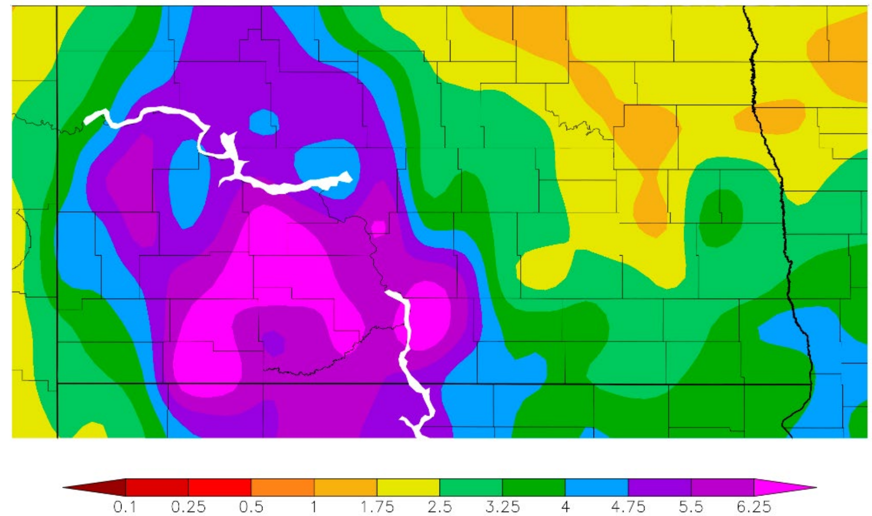
Normals are from the NWS. The 2025 frost dates are from the nearest reporting NDAWN station.

North Dakota 2025 Precipitation (inches) Maps

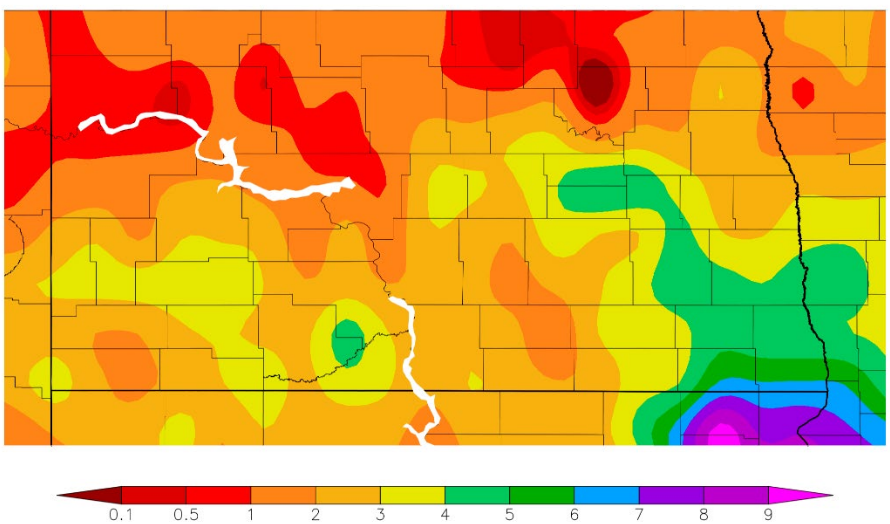
4/1/25 – 4/30/25



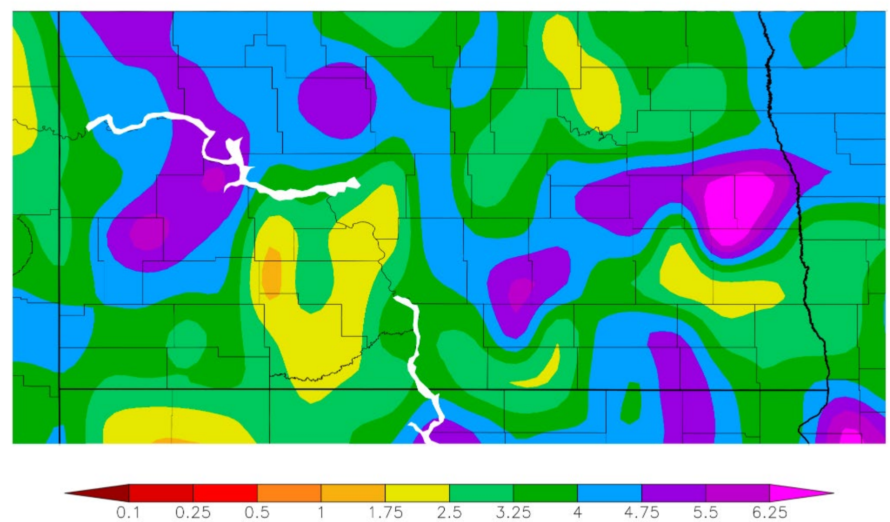
5/1/25 – 5/31/25



6/1/25 – 6/30/25

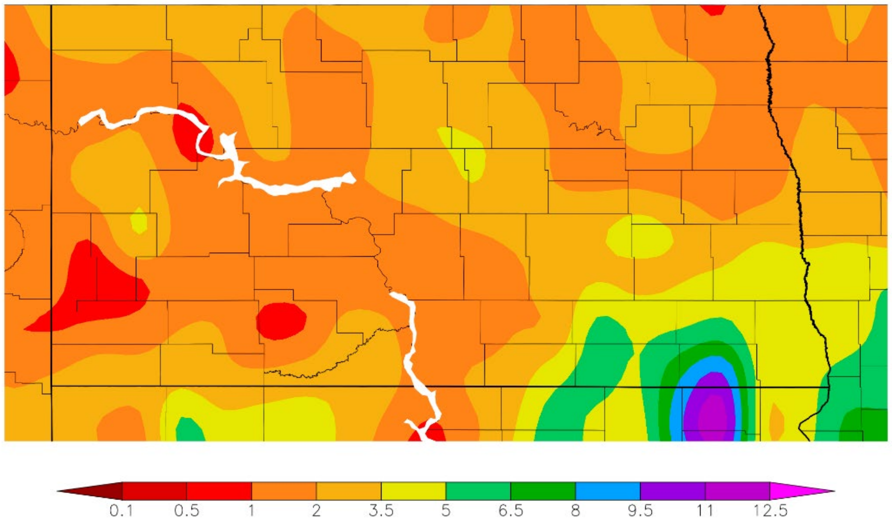


7/1/25 – 7/31/25

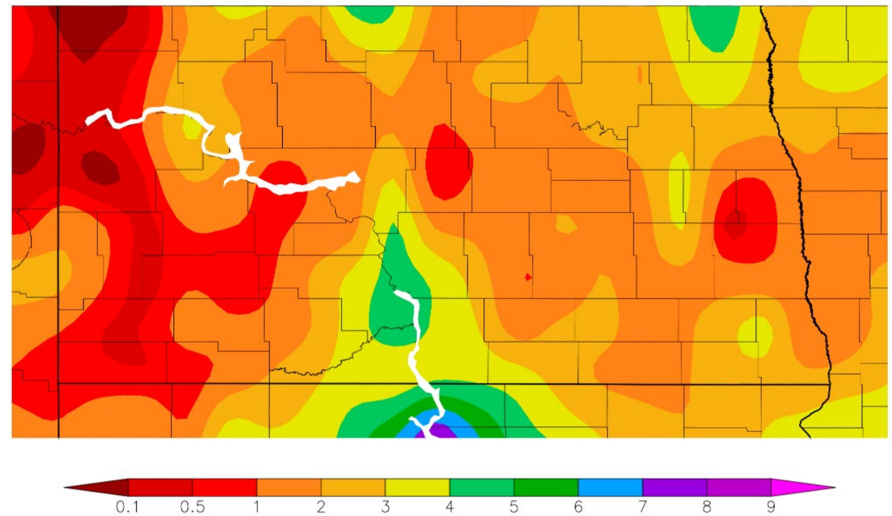


North Dakota 2025 Precipitation (inches) Maps Continued

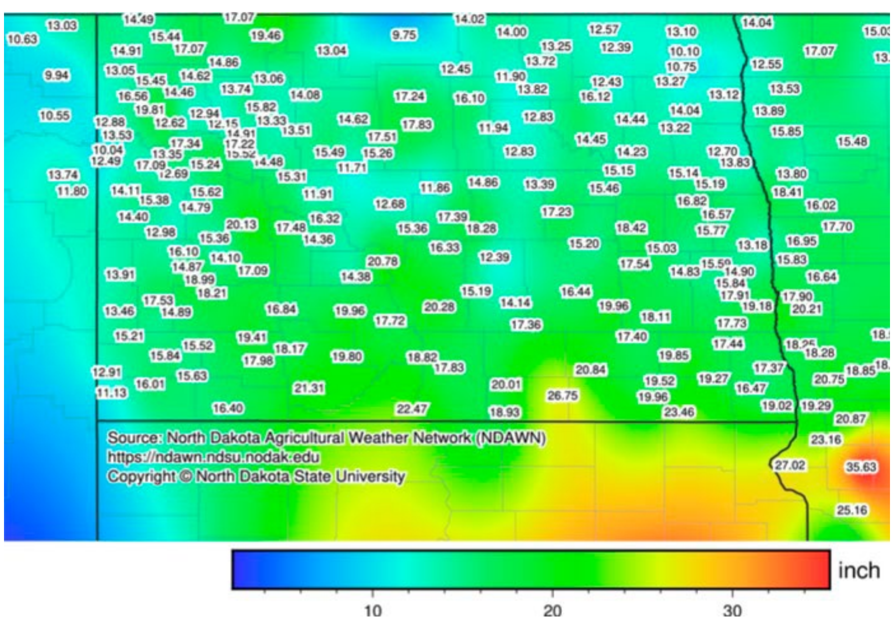
8/1/25 – 8/31/25



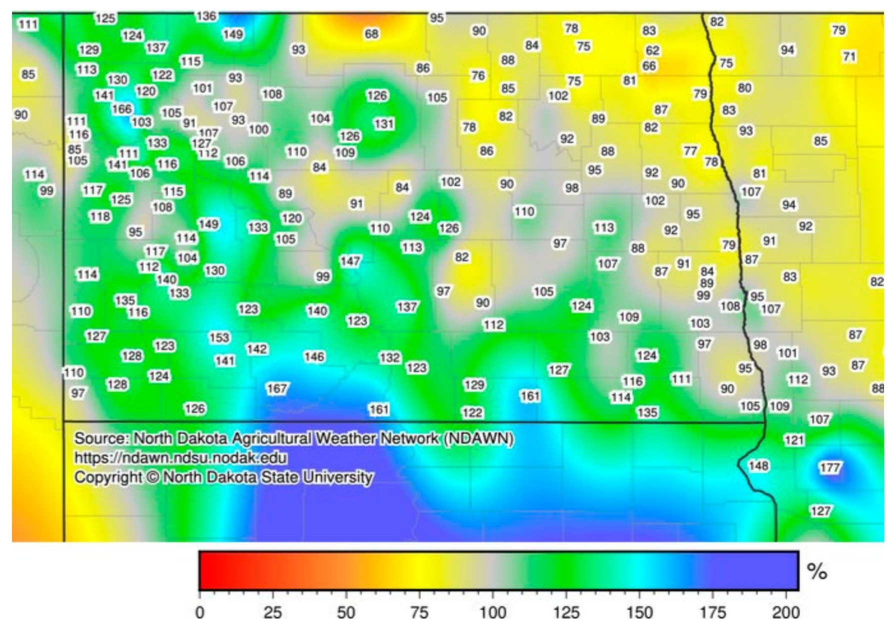
9/1/25 – 9/30/25

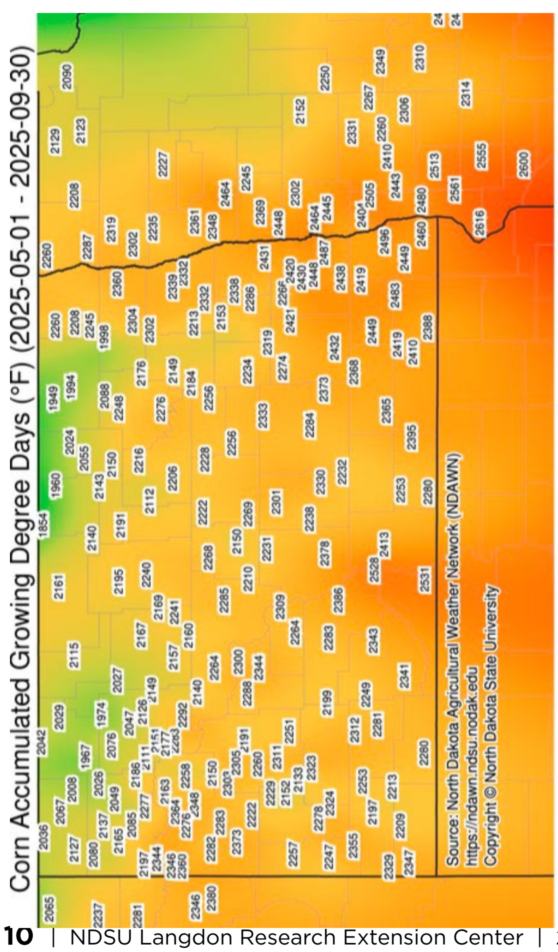


Growing Season 4/1/2025 – 9/30/2025



Percent of Normal Rainfall (%) (2025-04-01 – 2025-09-30)




Corn Accumulated Growing Degree Days (°F) (2025-05-01 - 2025-09-30)
Source: North Dakota Agricultural Weather Network (NDAWN)
https://ndawn.ndsu.nodak.edu
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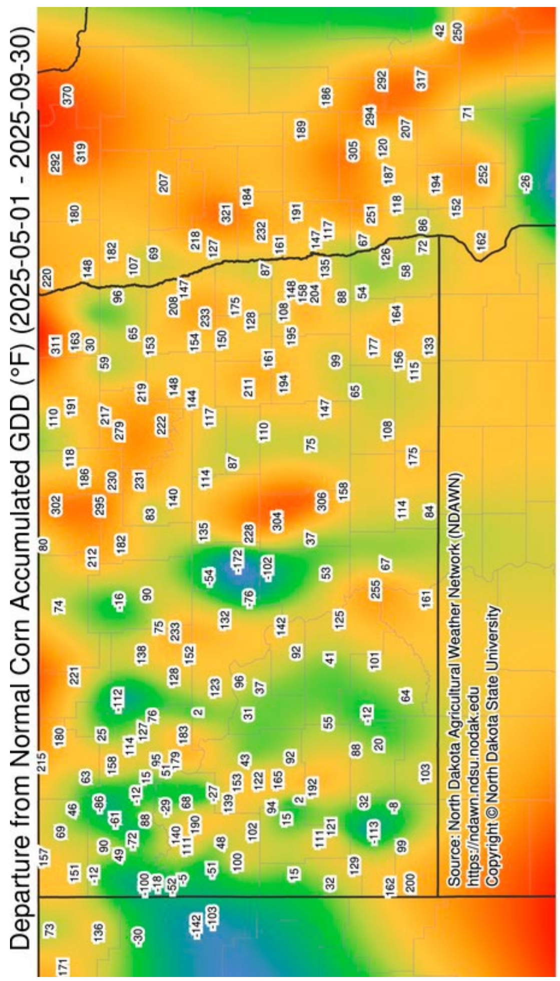
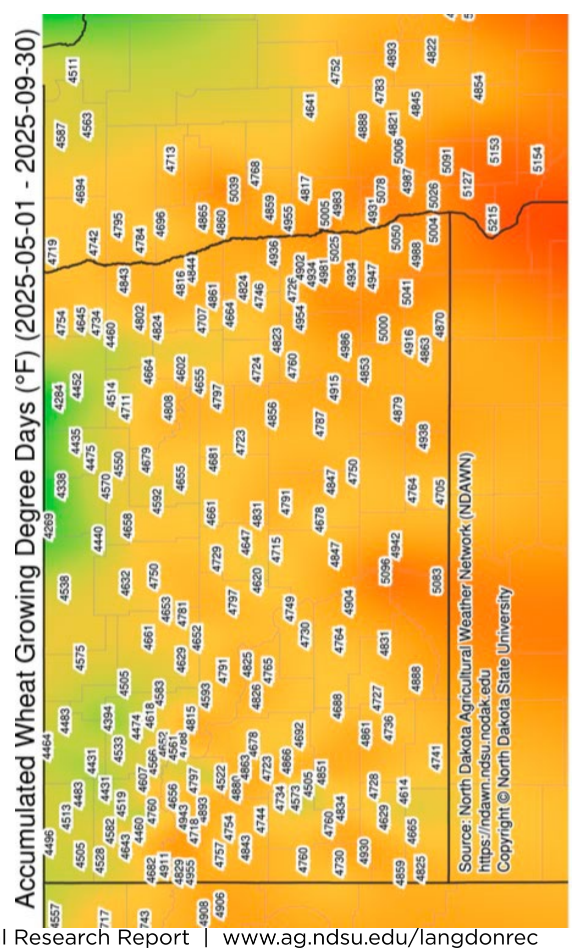
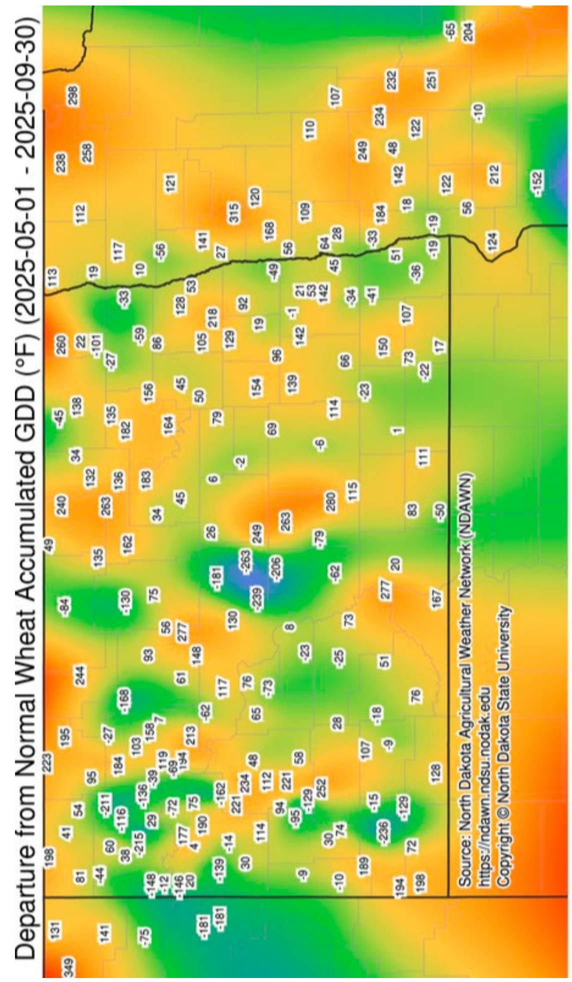
°F
1500
1750
2000
2250
2500
2750


Departure from Normal Corn Accumulated GDD (°F) (2025-05-01 - 2025-09-30)
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


Accumulated Wheat Growing Degree Days (°F) (2025-05-01 - 2025-09-30)
Source: North Dakota Agricultural Weather Network (NDAWN)
https://ndawn.ndsu.nodak.edu
Copyright © North Dakota State University
°F
3750
4000
4250
4500
4750
5000
5250


Departure from Normal Wheat Accumulated GDD (°F) (2025-05-01 - 2025-09-30)
Source: North Dakota Agricultural Weather Network (NDAWN)
https://ndawn.ndsu.nodak.edu
Copyright © North Dakota State University
°F
-250
0
250
500

Durum Summary, Langdon 2021-2025

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)					Height (in)					Days to Head				
Variety	21	22	23	24	25	5yr	21	22	23	24	25	5yr	17	20	24	25	4yr	22	23	24	25	4yr	22	23	24	25	4yr
Alkabo	49	78	63	83	74	69	59.5	60.6	62.0	62.4	52.9	59.5	1.3	0.1	1.3	1	0.9	37	39	43	40	40	53	53	58	50	54
Maier	40	68	62	80	73	65	59.4	59.8	61.8	61.9	51.5	58.9	4.8	2.6	1.4	2	2.7	37	37	41	41	39	54	56	58	50	55
Mountrail	49	86	74	86	70	73	59.3	60.5	61.8	61.1	50.6	58.7	5.0	3.8	1.7	2	3.1	37	39	44	39	40	54	56	59	50	55
AC Strongfield	46	71	64	72	68	64	58.8	58.7	61.3	61.5	48.0	57.7	4.5	5.5	3.5	1	3.6	34	38	43	38	38	53	55	59	50	54
Carpio	50	81	67	81	80	72	59.8	62.7	61.9	63.1	53.0	60.1	6.5	2.7	1.6	3	3.5	37	38	43	42	40	55	59	60	53	57
Joppa	44	86	68	82	78	72	60.2	61.1	62.5	61.2	53.2	59.6	6.8	3.5	1.4	2	3.4	38	37	45	43	41	53	56	59	51	55
Divide	51	75	63	80	77	69	59.7	61.1	61.3	62.0	51.3	59.1	6.3	2.9	1.4	2	3.2	40	39	42	42	41	56	60	59	52	57
ND Grano	50	84	67	89	73	72	61.0	61.9	62.1	62.6	51.3	59.8	5.0	1.9	2.2	1	2.5	37	39	43	39	39	53	58	60	50	55
ND Riveland	45	81	64	88	88	73	59.5	61.6	61.1	62.5	53.2	59.6	3.3	3.1	1.6	1	2.3	39	40	46	44	42	55	58	59	52	56
ND Stanley	50	86	68	84	80	73	60.4	62.7	62.7	63.5	53.7	60.6	4.0	2.6	2.0	1	2.4	36	38	43	42	40	54	57	60	51	56
AAC Schrader	--	--	--	--	82	--	--	--	--	--	51.9	--	--	--	--	1	--	--	--	--	41	--	--	--	--	51	--
AAC Spitfire	--	--	--	--	70	--	--	--	--	--	48.0	--	--	--	--	2	--	--	--	--	37	--	--	--	--	49	--
AAC Stronghold	--	--	--	--	71	--	--	--	--	--	50.8	--	--	--	--	1	--	--	--	--	40	--	--	--	--	50	--
CDC Defy	--	--	--	--	81	--	--	--	--	--	52.2	--	--	--	--	1	--	--	--	--	40	--	--	--	--	48	--
MT Blackbeard	--	--	--	--	72	--	--	--	--	--	50.7	--	--	--	--	3	--	--	--	--	46	--	--	--	--	53	--
TCG Ranger	--	--	--	--	85	--	--	--	--	--	52.7	--	--	--	--	1	--	--	--	--	40	--	--	--	--	48	--
Tioga	48	81	64	--	--	--	59.3	62.1	61.1	--	--	--	6.0	4.0	--	--	--	40	41	--	--	--	55	58	--	--	--
Rugby	41	69	--	--	--	--	59.8	61.1	--	--	--	--	8.0	7.0	--	--	--	40	--	--	--	--	53	--	--	--	--
TCG Webster	40	71	--	--	--	--	59.6	59.9	--	--	--	--	--	0.2	--	--	--	29	--	--	--	--	50	--	--	--	--
CDC Defy	--	82	--	--	--	--	--	60.8	--	--	--	--	--	--	--	--	--	38	--	--	--	--	52	--	--	--	--
CDC Vantta	--	58	--	--	--	--	--	56.1	--	--	--	--	--	--	--	--	--	34	--	--	--	--	58	--	--	--	--
AC Commander	42	--	--	--	--	--	58.7	--	--	--	--	--	1.8	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--
Ben	46	--	--	--	--	--	59.8	--	--	--	--	--	4.0	3.5	--	--	--	--	--	--	--	--	--	--	--	--	--
Grenora	49	--	--	--	--	--	59.1	--	--	--	--	--	5.8	4.3	--	--	--	--	--	--	--	--	--	--	--	--	--
Lebsock	45	--	--	--	--	--	60.0	--	--	--	--	--	3.8	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--
Pierce	45	--	--	--	--	--	59.7	--	--	--	--	--	5.3	3.7	--	--	--	--	--	--	--	--	--	--	--	--	--
Alzada	39	--	--	--	--	--	57.3	--	--	--	--	--	0.3	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--
CDC Verona	52	--	--	--	--	--	59.4	--	--	--	--	--	6.0	4.8	--	--	--	--	--	--	--	--	--	--	--	--	--
VT Peak	49	--	--	--	--	--	60.8	--	--	--	--	--	4.3	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--
Trial Mean	48	79	66	83	78		59.8	61.3	61.9	62.3	52.3		5.9	3.3	1.7	1.7		38	40	43	42		55	58	59	51	
C.V. %	7.1	6.4	5.4	5.4	6.1		0.5	1.6	0.7	0.9	1.5		31.8	52.6	--	--		4.0	5.1	4.1	4.4		1.5	2.3	1.1	2.3	
LSD 5%	3.1	7.1	6.3	--	--		0.2	1.4	0.6	--	--		2.6	2.4	--	--		2.1	2.8	--	--		1.1	1.9	--	--	
LSD 10%	2.6	5.9	--	5.2	5.6		0.2	1.2	0.5	0.7	0.9		2.2	2.0	--	0.9		1.8	2.4	2.1	2.2		0.9	1.6	0.8	1.4	

The 2025 lodging scale was 1-9.

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	**3[1]**	**5**	**4**	**4**	**5**	**12**	**5**	**5**	**4**	**4**	**5**	**14**	**5**	**5**	**4**	**4**	**5**	**14**	**5**	**4**	**4**	**5**	**13**	**5**	**4**	**4**	**5**	**12**	**1**	**1**	**2**	**4**	**6**
Variety	**21**	**22**	**23**	**24**	**25**	**3yr**	**21**	**22**	**23**	**24**	**25**	**3yr**	**21**	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**20**	**22**	**24**	**25**	**2yr**
SY Valda	59	72	83	82	77	81	59.7	59.9	61.0	60.5	60.6	60.7	14.7	14.0	13.8	13.3	14.3	13.8	30	29	33	29	30	46	45	53	47	49	0.5	2.0	1.2	2.4	1.8
LCS Trigger	65	72	85	83	84	84	59.2	60.4	59.7	60.6	60.3	60.2	13.0	12.6	11.9	11.3	12.1	11.8	34	34	37	34	35	52	51	59	54	55	3.7	1.8	1.7	2.9	2.3
AP Murdock	52	69	77	86	79	81	59.6	59.6	60.2	60.2	57.7	59.4	14.9	14.0	13.7	13.1	14.3	13.7	30	30	33	29	30	46	37	52	48	45	0.6	1.9	1.5	1.7	1.6
MN-Torgy	59	65	80	83	80	81	60.0	59.9	61.5	61.2	60.2	61.0	15.4	15.2	14.8	14.0	14.9	14.6	33	33	36	32	34	49	49	53	49	50	2.4	1.0	1.8	1.5	1.7
AP Smith	59	66	79	81	76	79	59.9	59.1	60.7	60.4	59.5	60.2	15.2	14.6	14.1	13.9	14.8	14.3	29	29	32	29	30	47	46	54	49	50	--	0.4	1.0	1.2	1.1
MS Cobra	58	59	78	85	77	80	59.7	58.9	61.4	61.2	59.5	60.7	15.5	14.8	14.4	13.8	14.9	14.4	30	30	33	29	31	45	44	52	47	48	--	2.2	1.1	2.0	1.6
ND Thresher	55	62	76	67	73	72	58.5	59.1	59.6	59.6	57.8	59.0	15.6	14.8	14.3	14.0	15.0	14.4	30	31	32	30	31	48	49	53	48	50	--	0.7	1.3	1.8	1.6
ND Roughrider	--	78	89	89	83	87	--	58.8	59.2	59.3	57.6	58.7	--	14.3	14.0	13.3	14.7	14.0	32	31	35	32	33	47	47	53	48	49	--	2.5	1.4	1.9	1.7
LCS Dual	--	60	81	79	73	78	--	60.1	61.2	60.9	60.2	60.8	--	14.0	13.3	13.2	13.8	13.4	31	30	34	31	32	45	43	52	46	47	--	0.1	1.0	1.5	1.3
MN-Rothsay	--	64	83	84	78	82	--	59.0	60.5	60.6	59.3	60.1	--	14.6	14.1	13.6	14.5	14.1	30	28	32	29	30	49	48	55	50	51	--	1.9	1.1	1.3	1.2
MS Charger	--	75	88	84	78	83	--	59.4	60.4	60.1	59.9	60.1	--	12.9	12.7	12.2	13.1	12.7	30	29	33	29	31	43	43	52	46	47	--	2.5	1.5	2.8	2.2
ND Heron	--	57	79	76	73	76	--	60.6	62.0	62.2	61.3	61.8	--	15.4	14.4	14.2	15.2	14.6	31	30	34	31	32	43	42	50	45	46	--	4.4	2.6	2.3	2.5
LCS Buster	61	--	89	87	89	88	57.7	--	58.5	59.0	58.1	58.5	13.0	--	11.9	11.7	12.4	12.0	--	34	38	35	35	--	50	58	49	52	2.7	--	1.8	2.8	2.3
ND Stampede	--	--	87	91	83	87	--	--	60.5	61.1	59.7	60.4	--	--	14.6	13.8	15.2	14.5	--	31	35	31	32	--	46	51	46	48	--	--	1.3	1.3	1.3
Ascend-SD	--	--	83	77	81	80	--	--	60.9	60.7	58.9	60.2	--	--	13.9	13.9	14.9	14.2	--	34	40	35	36	--	46	55	49	50	--	--	2.6	2.0	2.3
LCS Boom	--	--	78	84	76	80	--	--	61.8	61.6	61.4	61.6	--	--	14.3	13.6	14.6	14.2	--	28	33	29	30	--	40	50	45	45	--	--	1.1	1.8	1.5
LCS Hammer AX	--	--	79	79	67	75	--	--	60.4	60.5	57.0	59.3	--	--	13.8	13.5	15.0	14.1	--	29	34	30	31	--	44	51	47	47	--	--	1.1	1.5	1.3
WB9590	--	--	83	84	75	81	--	--	60.8	61.0	58.4	60.1	--	--	14.6	14.0	15.0	14.5	--	27	30	27	28	--	45	52	46	48	--	--	1.1	1.5	1.3
ND Horizon	--	--	--	82	80	--	--	--	--	61.2	59.6	--	--	--	--	14.2	15.2	--	--	--	34	30	--	--	--	52	47	--	--	--	1.0	1.6	1.3
AP Elevate	--	--	--	85	82	--	--	--	--	60.0	59.0	--	--	--	--	13.8	14.6	--	--	--	32	28	--	--	--	53	48	--	--	--	1.1	2.1	1.6
Brawn SD	--	--	--	83	79	--	--	--	--	62.0	62.1	--	--	--	--	13.0	13.4	--	--	--	37	32	--	--	--	52	47	--	--	--	3.4	2.2	2.8
MS Nova	--	--	--	75	73	--	--	--	--	60.2	59.1	--	--	--	--	13.9	14.6	--	--	--	33	29	--	--	--	51	46	--	--	--	1.0	1.3	1.2
TW Olympic	--	--	--	82	80	--	--	--	--	60.8	60.3	--	--	--	--	13.6	14.6	--	--	--	36	32	--	--	--	53	47	--	--	--	1.4	2.0	1.7
TW Trailfire	--	--	--	78	75	--	--	--	--	60.8	59.1	--	--	--	--	13.7	14.4	--	--	--	36	31	--	--	--	50	46	--	--	--	2.5	3.4	3.0
SY Ingmar	53	64	73	--	73	--	60.5	60.2	61.0	--	60.0	--	15.6	15.1	14.7	--	15.0	--	30	29	--	29	--	46	45	--	47	--	0.0	1.5	--	2.0	--
Faller	62	70	--	--	84	--	59.3	59.7	--	--	60.0	--	14.5	14.0	--	--	13.9	--	33	--	--	32	--	48	--	--	49	--	2.0	2.6	--	1.8	--
AP Dagr	--	--	--	--	72	--	--	--	--	--	56.8	--	--	--	--	--	13.7	--	--	--	--	28	--	--	--	--	49	--	--	--	--	2.3	--
AP Iconic	--	--	--	--	79	--	--	--	--	--	59.3	--	--	--	--	--	14.1	--	--	--	--	30	--	--	--	--	48	--	--	--	--	2.0	--
Enhance-SD	--	--	--	--	81	--	--	--	--	--	59.0	--	--	--	--	--	15.0	--	--	--	--	33	--	--	--	--	46	--	--	--	--	1.5	--
Ambush	58	71	85	82	--	--	60.8	58.8	62.2	61.7	--	--	15.5	14.3	14.2	14.4	--	--	32	32	33	--	--	47	45	51	--	--	0.2	2.4	1.4	--	--
Ballistic	66	63	96	86	--	--	58.9	60.1	60.2	60.7	--	--	14.7	15.1	13.5	13.0	--	--	30	33	36	--	--	45	47	53	--	--	1.9	2.0	2.5	--	--
Commander	54	63	80	84	--	--	60.2	59.5	61.1	60.6	--	--	15.0	14.5	14.1	13.7	--	--	31	31	35	--	--	44	43	51	--	--	0.0	1.0	1.1	--	--
LCS Cannon	54	63	80	80	--	--	61.0	60.6	61.7	61.5	--	--	14.9	14.4	14.0	13.6	--	--	29	28	32	--	--	42	40	49	--	--	0.0	0.0	1.0	--	--
LCS Ascent	--	67	84	83	--	--	--	59.9	61.8	61.5	--	--	--	13.7	13.3	12.8	--	--	30	29	34	--	--	43	42	51	--	--	--	4.4	1.9	--	--
CP3915	--	--	80	80	--	--	--	--	60.8	61.2	--	--	--	--	14.1	13.6	--	--	--	30	33	--	--	--	46	52	--	--	0.0	--	1.0	--	--
CP3119A	63	65	--	80	--	--	56.7	56.3	--	56.4	--	--	13.4	13.1	--	12.3	--	--	33	--	38	--	--	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	--	--
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	--	--
Rocker	--	--	--	79	--	--	--	--	--	60.3	--	--	--	--	--	14.1	--	--	--	--	35	--	--	--	--	55	--	--	--	--	1.5	--	--
TW Starlite	--	--	--	80	--	--	--	--	--	61.1	--	--	--	--	--	14.2	--	--	--	--	44	--	--	--	--	56	--	--	--	--	3.1	--	--
MS Ranchero	--	--	--	82	--	--	--	--	--	59.8	--	--	--	--	--	13.0	--	--	--	--	39	--	--	--	--	58	--	--	--	--	4.3	--	--
SY 611 CL2	58	67	80	--	--	--	60.4	60.0	61.7	--	--	--	15.5	14.6	14.6	--	--	--	29	29	--	--	--	46	45	--	--	--	0.2	1.3	--	--	--
TCG-Wildcat	60	67	79	--	--	--	60.5	60.2	61.2	--	--	--	15.5	15.0	14.6	--	--	--	31	30	--	--	--	47	45	--	--	--	0.2	0.9	--	--	--

[1]Langdon was excluded due to low yields caused by drought conditions. Shattering occurred at both Langdon and Nelson County.

HRSW Summary, Langdon 2022-2025 (Page 1 of 2)

	Yield (bu/a)					Test Weight (lbs/bu)					Protein (%)					Days to Head					Height (in)				
Variety	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**
Faller	86	81	89	98	89	61.4	59.0	61.7	59.6	60.1	13.6	12.8	12.8	13.7	13.1	51	48	57	49	51	34	34	38	36	36
SY Ingmar	75	71	74	85	77	61.5	59.8	61.2	59.3	60.1	15.0	13.3	14.2	14.8	14.1	50	44	57	46	49	31	28	32	32	31
SY Valda	86	79	87	89	85	60.8	59.5	60.7	60.5	60.2	14.1	12.5	13.2	14.2	13.3	50	44	55	47	49	32	28	34	33	32
LCS Trigger	94	80	88	97	89	61.4	59.0	61.8	60.3	60.4	12.1	11.6	11.1	11.9	11.5	55	53	62	54	56	35	35	39	37	37
SY 611 CL2	82	86	82	87	85	61.3	61.4	61.6	58.6	60.5	14.6	13.3	13.9	14.7	14.0	48	45	54	46	48	30	28	32	31	30
LCS Cannon	76	87	80	87	85	61.7	60.8	61.9	60.2	61.0	14.6	12.8	13.5	14.0	13.4	46	40	53	44	46	30	28	32	32	31
AP Murdock	93	73	86	94	84	61.7	58.4	60.1	56.2	58.2	13.7	12.8	12.9	14.0	13.2	50	45	54	47	49	31	29	33	32	31
MN-Torgy	82	75	82	95	84	61.5	60.6	61.7	58.6	60.3	14.7	13.9	14.3	14.5	14.2	51	51	56	48	52	34	34	38	34	36
ND Heron	68	81	74	85	80	62.1	61.1	62.4	59.5	61.0	15.1	12.7	14.1	15.0	13.9	47	41	52	45	46	32	30	36	34	33
MN-Rothsay	77	80	88	89	86	60.1	59.4	61.1	57.9	59.5	14.6	13.6	13.3	14.4	13.8	52	49	58	49	52	31	28	33	30	31
Driver	82	84	82	91	86	62.1	60.3	61.9	60.5	60.9	13.9	12.9	13.6	14.1	13.5	51	46	57	49	51	34	33	37	37	36
LCS Buster	86	80	94	107	93	59.1	56.6	60.1	57.9	58.2	12.5	11.5	11.1	11.9	11.5	54	51	61	48	53	35	35	39	38	37
ND Frohberg	77	75	75	81	77	61.8	60.0	61.6	59.2	60.3	14.2	13.2	13.5	14.5	13.7	49	45	55	47	49	34	32	38	37	36
TCG-Wildcat	79	81	83	86	83	61.9	59.9	61.5	59.0	60.1	15.2	13.2	14.4	15.1	14.2	50	44	56	48	49	31	29	35	35	33
AP Gunsmoke CL2	81	77	77	82	79	60.4	59.0	60.5	58.1	59.2	14.8	13.7	13.3	14.7	13.9	49	45	54	47	49	30	29	34	33	32
AP Smith	80	75	86	84	82	60.6	59.6	60.4	58.8	59.6	14.7	13.1	14.1	14.7	14.0	52	45	56	49	50	31	28	31	31	30
MS Cobra	68	78	83	91	84	60.2	60.7	61.2	57.8	59.9	15.0	13.1	13.8	14.8	13.9	49	44	55	47	49	31	30	35	32	32
WB9590	74	79	84	85	82	60.3	60.1	60.7	56.8	59.2	15.0	13.8	13.8	14.7	14.1	48	45	53	46	48	28	27	31	30	29
ND Thresher	76	73	75	96	82	60.7	58.3	60.4	55.7	58.1	14.8	13.6	14.0	14.8	14.1	51	48	55	48	50	31	30	34	35	33
Shelly	76	86	91	88	88	60.2	59.9	61.3	58.2	59.8	14.1	12.9	13.0	14.5	13.5	51	46	56	48	50	30	29	33	32	31
Ascend-SD	90	81	80	96	86	62.3	59.4	61.7	55.3	58.8	14.1	12.2	13.9	15.2	13.8	51	46	57	49	51	36	35	41	38	38
LCS Ascent	85	84	84	92	87	61.4	60.5	61.8	54.9	59.1	13.6	12.6	12.9	14.1	13.2	47	42	53	45	47	31	29	34	33	32
LCS Dual	73	80	81	90	83	61.4	60.2	61.6	60.7	60.8	13.9	12.2	13.0	13.8	13.0	48	44	54	46	48	32	30	36	36	34
LCS Hammer AX	80	79	83	80	81	61.0	59.5	61.1	54.3	58.3	14.4	12.8	13.4	15.2	13.8	49	44	53	47	48	31	29	33	34	32
MS Charger	90	85	87	93	88	60.2	59.4	60.5	59.3	59.7	12.5	12.1	12.0	12.6	12.2	48	43	54	46	48	31	28	34	33	31
Brawn-SD	80	84	85	90	86	62.7	61.2	62.1	61.6	61.6	13.1	12.2	12.6	13.3	12.7	49	45	55	47	49	34	33	38	37	36
ND Stampede	86	81	90	86	86	61.3	59.2	61.2	60.5	60.3	14.5	13.9	13.6	15.2	14.2	49	46	53	46	48	33	31	35	34	33
ND Roughrider	93	88	87	88	88	61.0	57.6	59.4	57.8	58.3	13.7	13.2	13.1	14.4	13.6	50	47	56	47	50	33	31	36	36	34
ND Horizon	--	81	85	89	85	--	60.2	61.7	56.9	59.6	--	12.9	14.2	15.6	14.2	--	45	54	47	49	--	30	34	33	32
LCS Boom	--	81	86	86	84	--	60.1	61.8	59.4	60.4	--	13.0	13.3	14.2	13.5	--	40	52	44	45	--	29	35	32	32
AP Elevate	--	--	89	90	--	--	--	60.3	58.4	--	--	--	13.8	14.4	--	--	--	55	47	--	--	--	32	31	--
CP3055	--	--	92	99	--	--	--	59.0	55.9	--	--	--	12.1	12.6	--	--	--	64	53	--	--	--	37	36	--
MS Nova	--	--	73	84	--	--	--	60.3	58.2	--	--	--	14.1	14.5	--	--	--	53	46	--	--	--	34	33	--
MT Carlson	--	--	84	75	--	--	--	61.0	52.3	--	--	--	13.3	14.1	--	--	--	54	47	--	--	--	35	33	--
PFS Rolls	--	--	90	86	--	--	--	61.4	56.4	--	--	--	13.1	14.6	--	--	--	57	49	--	--	--	37	35	--
TCG Badlands	--	--	78	83	--	--	--	60.5	55.3	--	--	--	13.4	14.3	--	--	--	56	47	--	--	--	36	33	--
TCG Zelda	--	--	88	90	--	--	--	61.2	57.5	--	--	--	13.5	14.2	--	--	--	53	46	--	--	--	32	30	--
TW Olympic	--	--	84	96	--	--	--	61.7	60.3	--	--	--	13.4	14.2	--	--	--	55	48	--	--	--	37	36	--
TW Trailfire	--	--	81	82	--	--	--	60.6	56.9	--	--	--	13.7	14.8	--	--	--	52	47	--	--	--	36	36	--
Lang-MN	--	78	--	87	--	--	61.2	--	60.5	--	--	13.4	--	15.2	--	--	50	--	49	--	--	35	--	36	--
AAC Hockley	--	--	--	81	--	--	--	--	59.8	--	--	--	--	14.1	--	--	--	--	47	--	--	--	--	33	--
AAC Hodge	--	--	--	87	--	--	--	--	58.6	--	--	--	--	15.2	--	--	--	--	46	--	--	--	--	38	--
AP Dagr	--	--	--	87	--	--	--	--	58.0	--	--	--	--	13.4	--	--	--	--	48	--	--	--	--	31	--
AP Iconic	--	--	--	90	--	--	--	--	58.9	--	--	--	--	14.0	--	--	--	--	47	--	--	--	--	34	--
CP3678	--	--	--	89	--	--	--	--	58.4	--	--	--	--	14.5	--	--	--	--	49	--	--	--	--	35	--
Dagmar	--	--	--	86	--	--	--	--	59.0	--	--	--	--	15.2	--	--	--	--	46	--	--	--	--	34	--
Enhance-SD	--	--	--	92	--	--	--	--	57.8	--	--	--	--	15.0	--	--	--	--	46	--	--	--	--	37	--
LCS Rimfire	--	--	--	90	--	--	--	--	55.7	--	--	--	--	14.6	--	--	--	--	45	--	--	--	--	30	--
PFS Muffins	--	--	--	96	--	--	--	--	56.3	--	--	--	--	14.3	--	--	--	--	47	--	--	--	--	32	--
PG Predator	--	--	--	88	--	--	--	--	58.2	--	--	--	--	14.7	--	--	--	--	47	--	--	--	--	31	--
TCG Arsenal	--	--	--	92	--	--	--	--	57.0	--	--	--	--	14.0	--	--	--	--	49	--	--	--	--	33	--

HRSW Summary, Langdon 2022-2025 (Page 2 of 2)

	Yield (bu/a)					Test Weight (lbs/bu)					Protein (%)					Days to Head					Height (in)				
Variety	22	23	24	25	3yr	22	23	24	25	3yr	22	23	24	25	3yr	22	23	24	25	3yr	22	23	24	25	3yr
Glenn	68	69	69	--	--	62.7	62.1	62.7	--	--	15.0	13.3	14.5	--	--	47	44	52	--	--	35	34	39	--	--
Bolles	71	74	77	--	--	60.4	59.3	61.1	--	--	15.8	14.4	14.4	--	--	52	48	57	--	--	33	33	35	--	--
ND VitPro	71	70	74	--	--	62.7	61.5	62.8	--	--	14.8	13.8	14.7	--	--	48	45	54	--	--	33	31	36	--	--
Ambush	78	81	83	--	--	59.5	61.6	61.7	--	--	14.4	12.6	14.4	--	--	51	44	53	--	--	33	31	34	--	--
Ballistic	76	95	90	--	--	61.5	58.7	61.0	--	--	15.0	12.5	13.0	--	--	48	47	55	--	--	32	33	37	--	--
Commander	75	76	82	--	--	60.3	59.9	60.7	--	--	14.2	13.0	13.6	--	--	48	43	53	--	--	32	30	35	--	--
SY Longmire	70	72	76	--	--	60.1	59.8	60.8	--	--	15.2	13.2	13.8	--	--	50	46	54	--	--	31	29	33	--	--
CP3915	84	75	82	--	--	61.4	59.5	61.7	--	--	14.5	13.5	13.8	--	--	50	45	55	--	--	32	29	34	--	--
Lanning	61	75	79	--	--	58.2	59.2	60.6	--	--	15.3	13.9	14.3	--	--	49	51	55	--	--	32	33	37	--	--
MS Ranchero	76	78	88	--	--	59.1	59.1	60.8	--	--	14.2	13.1	13.1	--	--	52	56	58	--	--	35	39	43	--	--
CAG Justify	93	81	84	--	--	60.0	55.7	59.4	--	--	13.1	12.4	12.6	--	--	52	48	56	--	--	34	32	38	--	--
CAG Reckless	82	85	85	--	--	61.5	60.6	61.7	--	--	14.3	12.4	13.8	--	--	49	45	55	--	--	35	34	38	--	--
CP3099A	82	77	79	--	--	58.9	53.8	56.6	--	--	12.5	11.0	10.5	--	--	54	49	59	--	--	35	35	40	--	--
CP3188	81	71	79	--	--	59.9	57.6	59.3	--	--	13.0	11.8	12.1	--	--	50	44	54	--	--	33	32	36	--	--
Allegiant 8175	75	79	80	--	--	61.7	59.7	62.0	--	--	14.0	12.6	13.2	--	--	50	45	55	--	--	32	31	34	--	--
AAC Starbuck VB	80	85	83	--	--	61.2	61.4	62.2	--	--	15.3	12.7	14.1	--	--	49	44	54	--	--	33	32	36	--	--
PFS Buns	--	80	94	--	--	--	57.0	59.4	--	--	--	12.8	11.7	--	--	--	55	67	--	--	--	32	34	--	--
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	--	--
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	--	--
CAG Ceres	--	--	80	--	--	--	--	61.0	--	--	--	--	13.7	--	--	--	--	54	--	--	--	--	33	--	--
CAG Recoil	--	--	90	--	--	--	--	60.8	--	--	--	--	13.2	--	--	--	--	62	--	--	--	--	36	--	--
CP3119A	--	--	86	--	--	--	--	57.8	--	--	--	--	12.2	--	--	--	--	65	--	--	--	--	38	--	--
CP3360AX	--	--	83	--	--	--	--	62.2	--	--	--	--	12.7	--	--	--	--	53	--	--	--	--	83	--	--
MT Dutton	--	--	81	--	--	--	--	60.0	--	--	--	--	13.6	--	--	--	--	54	--	--	--	--	37	--	--
MT Ubet	--	--	81	--	--	--	--	60.8	--	--	--	--	13.7	--	--	--	--	56	--	--	--	--	39	--	--
Rocker	--	--	78	--	--	--	--	60.3	--	--	--	--	14.0	--	--	--	--	56	--	--	--	--	37	--	--
TW Starlite	--	--	78	--	--	--	--	61.1	--	--	--	--	14.7	--	--	--	--	59	--	--	--	--	45	--	--
CP3530	87	80	--	--	--	61.0	59.4	--	--	--	14.7	12.8	--	--	--	52	47	--	--	--	36	35	--	--	--
TCG-Spitfire	83	79	--	--	--	60.0	59.0	--	--	--	13.6	12.9	--	--	--	52	48	--	--	--	32	30	--	--	--
SY McCloud	75	82	--	--	--	61.9	61.0	--	--	--	15.0	13.0	--	--	--	48	45	--	--	--	32	30	--	--	--
TCG-Heartland	68	75	--	--	--	61.0	60.4	--	--	--	15.4	14.0	--	--	--	48	43	--	--	--	30	27	--	--	--
Allegiant 822	81	73	--	--	--	62.2	61.2	--	--	--	13.8	13.5	--	--	--	49	45	--	--	--	30	28	--	--	--
Allegiant 8432	67	83	--	--	--	59.4	60.1	--	--	--	14.7	12.9	--	--	--	47	43	--	--	--	30	30	--	--	--
Elgin-ND	--	73	--	--	--	--	60.0	--	--	--	--	12.5	--	--	--	--	43	--	--	--	--	34	--	--	--
WB9606	--	81	--	--	--	--	59.9	--	--	--	--	12.2	--	--	--	--	46	--	--	--	--	33	--	--	--
LCS Rebel	77	--	--	--	--	62.3	--	--	--	--	14.6	--	--	--	--	48	--	--	--	--	33	--	--	--	--
MS Barracuda	73	--	--	--	--	60.6	--	--	--	--	15.0	--	--	--	--	46	--	--	--	--	29	--	--	--	--
MN-Washburn	80	--	--	--	--	61.1	--	--	--	--	14.1	--	--	--	--	53	--	--	--	--	32	--	--	--	--
Trial Mean	79	79	83	89		60.8	59.6	61.0	58.0		14.3	13.0	13.4	14.3		50	46	55	47		32	31	36	34	
C.V. %	7.7	8.2	4.3	4.0		1.1	1.3	0.7	0.8		2.8	4.9	2.7	2.2		1.6	2.3	1.9	1.6		3.2	4.0	3.4	3.4	
LSD 5%	8.4	9.0	--	--		0.9	1.1	--	--		0.6	0.9	--	--		1.1	1.5	--	--		1.4	1.7	--	--	
LSD 10%	7.1	7.5	4.1	4.2		0.8	0.9	0.5	0.5		0.5	0.8	0.4	0.4		1.0	1.2	1.2	0.9		1.2	1.4	1.4	1.4	

HRSW Summary, Nelson County 2022-2025

	Yield (bu/a)					Test Weight (lbs/bu)					Protein (%)					Lodging (1-9)			Shatter (1-9)[1]		
Variety	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**24**	**25**	**2yr**	**21**	**22**	**2yr**
SY Valda	69	85	88	84	85	58.3	61.2	60.7	58.3	60.1	13.6	14.1	14.0	15.0	14.4	1.2	2.5	1.9	1.7	0.8	1.3
LCS Trigger	55	84	91	81	85	58.9	59.9	60.6	57.6	59.4	12.9	12.2	11.5	13.2	12.3	1.0	4.7	2.9	1.7	2.5	2.1
AP Murdock	56	81	92	89	87	58.2	60.5	59.8	55.1	58.5	13.9	13.8	13.8	14.4	14.0	1.1	1.6	1.4	4.0	3.0	3.5
MN-Torgy	54	79	90	81	83	57.6	61.8	59.9	57.4	59.7	15.5	15.3	14.4	15.6	15.1	1.7	1.0	1.4	3.0	0.8	1.9
AP Smith	58	75	85	80	80	57.8	60.9	59.7	56.5	59.0	14.0	14.7	13.8	15.2	14.6	0.9	0.9	0.9	3.0	3.7	3.4
MS Cobra	52	84	94	79	86	58.8	61.4	60.5	56.7	59.5	14.4	14.6	14.0	15.3	14.6	1.1	2.9	2.0	4.3	2.6	3.5
LCS Dual	52	84	86	83	84	60.3	61.0	59.9	58.4	59.8	13.1	13.4	13.5	14.6	13.8	1.0	1.1	1.1	--	2.8	--
MN-Rothsay	50	84	89	82	85	58.6	60.7	59.5	54.7	58.3	14.2	14.4	14.1	14.7	14.4	1.1	1.1	1.1	--	3.8	--
MS Charger	76	90	94	92	92	58.9	60.6	59.3	57.3	59.1	12.2	12.8	12.7	13.7	13.1	1.3	4.3	2.8	--	0.4	--
ND Heron	52	82	87	81	83	59.9	62.2	61.2	59.9	61.1	14.3	14.8	14.4	15.6	14.9	2.3	2.0	2.2	--	1.4	--
ND Thresher	62	69	82	78	76	58.7	58.7	59.8	56.0	58.2	14.3	14.7	14.1	16.2	15.0	1.2	1.1	1.2	--	0.9	--
ND Roughrider	76	88	102	89	93	57.6	58.5	59.7	53.2	57.1	13.3	14.1	14.1	15.2	14.5	1.1	1.6	1.4	--	1.5	--
LCS Buster	--	88	93	76	86	--	59.2	58.7	54.8	57.6	--	12.1	12.3	13.3	12.6	0.8	6.1	3.5	3.0	--	--
Ascend-SD	--	82	82	86	84	--	60.9	60.3	57.6	59.6	--	14.3	14.8	15.5	14.9	2.9	1.1	2.0	--	--	--
LCS Boom	--	84	95	91	90	--	62.0	61.3	60.1	61.1	--	14.4	13.9	14.9	14.4	1.0	1.1	1.1	--	--	--
LCS Hammer AX	--	82	81	67	77	--	60.6	59.1	52.5	57.4	--	14.1	13.6	15.4	14.4	1.1	1.1	1.1	--	--	--
WB9590	--	82	94	85	87	--	60.2	60.4	56.4	59.0	--	15.0	13.9	15.2	14.7	1.0	1.1	1.1	--	--	--
ND Stampede	--	90	104	94	96	--	61.2	61.2	56.4	59.6	--	14.6	14.1	15.6	14.8	1.5	1.2	1.4	--	--	--
AP Elevate	--	--	91	91	--	--	--	59.5	56.2	--	--	--	14.0	14.8	--	1.1	1.2	1.2	--	--	--
Brawn-SD	--	--	87	89	--	--	--	61.0	59.7	--	--	--	14.3	14.2	--	4.7	1.6	3.2	--	--	--
ND Horizon	--	--	91	89	--	--	--	60.6	57.7	--	--	--	14.6	15.6	--	1.0	1.2	1.1	--	--	--
MS Nova	--	--	85	86	--	--	--	59.8	57.5	--	--	--	14.0	15.0	--	0.9	1.1	1.0	--	--	--
TW Olympic	--	--	84	82	--	--	--	60.2	56.6	--	--	--	14.2	15.4	--	1.0	2.0	1.5	--	--	--
TW Trailfire	--	--	90	79	--	--	--	60.8	57.4	--	--	--	14.1	14.5	--	1.6	5.4	3.5	--	--	--
AP Dagr	--	--	--	78	--	--	--	--	53.1	--	--	--	--	14.4	--	--	1.0	--	--	--	--
AP Iconic	--	--	--	84	--	--	--	--	56.2	--	--	--	--	14.6	--	--	1.1	--	--	--	--
Enhance-SD	--	--	--	85	--	--	--	--	56.0	--	--	--	--	15.8	--	--	1.0	--	--	--	--
Faller	--	--	--	88	--	--	--	--	57.7	--	--	--	--	14.7	--	--	1.3	--	--	--	--
SY Ingmar	--	--	--	77	--	--	--	--	57.7	--	--	--	--	15.4	--	--	1.1	--	--	--	--
TCG-Zelda	--	--	--	81	--	--	--	--	55.6	--	--	--	--	15.2	--	--	1.5	--	--	--	--
Ambush	68	85	95	--	--	57.6	62.2	61.6	--	--	14.1	15.0	14.7	--	--	1.1	--	--	2.0	1.9	2.0
Ballistic	59	95	92	--	--	59.8	60.6	59.9	--	--	14.6	13.9	13.3	--	--	2.5	--	--	3.3	2.4	2.9
Commander	56	83	93	--	--	59.1	61.0	60.0	--	--	14.0	14.6	13.7	--	--	0.9	--	--	6.7	3.8	5.3
LCS Cannon	61	82	94	--	--	60.6	61.4	61.0	--	--	14.1	14.1	13.8	--	--	0.9	--	--	1.3	1.1	1.2
LCS Ascent	61	88	87	--	--	59.0	62.2	60.5	--	--	13.8	13.6	12.7	--	--	2.2	--	--	--	3.2	--
CP3915	--	80	88	--	--	--	60.5	60.6	--	--	--	14.2	13.8	--	--	1.0	--	--	--	--	--
CP3119A	56	--	75	--	--	54.1	--	54.6	--	--	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	--
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	--	--	--	--	--
Rocker	--	--	82	--	--	--	--	59.4	--	--	--	--	14.4	--	--	1.0	--	--	--	--	--
TW Starlite	--	--	82	--	--	--	--	60.6	--	--	--	--	14.1	--	--	1.7	--	--	--	--	--
MS Ranchero	--	--	81	--	--	--	--	58.8	--	--	--	--	13.3	--	--	4.7	--	--	--	--	--
SY Ingmar	60	72	--	--	--	59.2	60.5	--	--	--	14.6	14.8	--	--	--	--	--	--	2.0	0.8	1.4
TCG-Spitfire	68	81	--	--	--	57.7	59.7	--	--	--	13.9	14.5	--	--	--	--	--	--	1.0	0.3	0.7
SY 611 CL2	61	80	--	--	--	59.2	60.5	--	--	--	13.8	14.8	--	--	--	--	--	--	0.7	1.2	1.0
TCG-Heartland	64	78	--	--	--	60.1	61.2	--	--	--	15.0	15.5	--	--	--	--	--	--	2.0	0.7	1.4
TCG-Wildcat	61	84	--	--	--	58.9	61.2	--	--	--	14.2	14.8	--	--	--	--	--	--	4.3	1.9	3.1
CP3530	71	82	--	--	--	58.8	60.0	--	--	--	14.4	14.4	--	--	--	--	--	--	1.0	0.4	0.7
TCG-Teddy	--	81	--	--	--	--	60.0	--	--	--	--	14.6	--	--	--	--	--	--	--	--	--
WB9719	--	79	--	--	--	--	62.7	--	--	--	--	14.4	--	--	--	--	--	--	--	--	--
CP3188	64	--	--	--	--	57.7	--	--	--	--	13.6	--	--	--	--	--	--	--	1.3	1.1	1.2
MN-Washburn	61	--	--	--	--	58.4	--	--	--	--	14.6	--	--	--	--	--	--	--	0.0	0.1	0.1
Faller	67	--	--	--	--	58.2	--	--	--	--	13.6	--	--	--	--	--	--	--	2.3	0.5	1.4
ND Frohberg	60	--	--	--	--	60.0	--	--	--	--	14.2	--	--	--	--	--	--	--	6.0	2.5	4.3
AP Gunsmoke CL2	74	--	--	--	--	58.5	--	--	--	--	14.3	--	--	--	--	--	--	--	0.7	0.8	0.8
Trial Mean	61	83	89	84		58.5	60.8	59.9	56.7		14.0	14.3	13.7	14.9		1.4	1.9		2.4	1.7	
C.V. %	5.7	3.7	5.4	2.8		0.4	0.6	1.0	1.2		1.4	1.5	2.6	1.5		--	--		35.5	38.9	
LSD 5%	3.0	4.3	--	--		0.2	0.6	--	--		0.2	0.3	--	--		--	--		1.4	0.6	
LSD 10%	2.5	3.5	5.6	2.7		0.2	0.5	0.7	0.8		0.1	0.3	0.4	0.3		--	1.2		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 2021-2025

	Yield (bu/a)					Test Weight (lbs/bu)					Lodging (1-9)	Protein (%)				
Variety	**21**	**22**	**24**	**25**	**3yr**	**21**	**22**	**24**	**25**	**3yr**	**2025**	**21**	**22**	**24**	**25**	**3yr**
SY Valda	48	65	57	68	64	57.8	58.6	60.1	61.4	60.0	3	12.8	14.3	12.3	13.5	13.4
LCS Trigger	59	65	65	81	70	57.6	58.4	59.0	61.2	59.5	2	11.2	12.8	10.6	11.0	11.5
AP Murdock	41	59	69	70	66	58.2	58.0	60.3	59.8	59.4	2	13.2	14.0	12.1	13.8	13.3
MN-Torgy	49	58	65	74	66	58.3	58.4	61.7	61.7	60.6	2	12.9	14.8	12.9	14.1	13.9
AP Smith	52	61	64	70	65	58.0	56.6	60.4	61.6	59.5	1	13.4	14.3	12.9	14.2	13.8
MS Cobra	52	47	65	70	61	58.2	55.4	61.6	61.7	59.6	2	13.6	15.2	12.9	14.0	14.0
ND Heron	47	48	56	64	56	59.5	58.0	63.3	62.5	61.3	3	13.6	15.2	13.1	14.2	14.2
LCS Dual	--	49	50	67	55	--	56.3	60.6	60.5	59.1	2	--	14.4	12.2	12.8	13.1
MN-Rothsay	--	57	67	78	67	--	56.1	60.7	62.1	59.6	1	--	14.5	12.9	14.2	13.9
MS Charger	--	65	58	63	62	--	57.3	60.4	60.0	59.2	3	--	13.3	11.3	12.4	12.3
ND Thresher	--	60	36	56	51	--	56.9	59.0	58.2	58.0	3	--	14.4	13.6	13.5	13.8
ND Roughrider	--	72	68	77	72	--	57.1	59.0	59.3	58.5	3	--	14.7	12.1	13.6	13.5
LCS Buster	51	--	73	90	--	55.8	--	58.4	60.0	--	1	11.5	--	10.8	11.3	--
ND Horizon	--	--	58	72	--	--	--	61.1	61.0	--	2	--	--	12.8	14.2	--
WB9590	--	--	58	60	--	--	--	61.2	59.1	--	2	--	--	13.2	14.6	--
AP Elevate	--	--	66	71	--	--	--	60.0	61.0	--	2	--	--	12.9	14.0	--
TW Olympic	--	--	61	72	--	--	--	60.7	61.7	--	2	--	--	12.5	13.8	--
Ascend-SD	--	--	53	69	--	--	--	60.3	60.1	--	3	--	--	12.1	13.6	--
Brawn-SD	--	--	63	66	--	--	--	62.7	62.8	--	3	--	--	11.3	12.4	--
LCS Boom	--	--	59	63	--	--	--	62.1	62.7	--	2	--	--	12.6	13.9	--
LCS Hammer AX	--	--	56	61	--	--	--	61.0	60.3	--	2	--	--	12.8	14.0	--
MS Nova	--	--	53	59	--	--	--	60.0	58.6	--	1	--	--	12.8	13.7	--
ND Stampede	--	--	66	72	--	--	--	61.2	62.1	--	1	--	--	12.4	14.9	--
TW Trailfire	--	--	56	63	--	--	--	61.2	60.1	--	3	--	--	12.6	13.6	--
Faller	50	64	--	71	--	57.9	58.1	--	61.3	--	2	12.5	13.6	--	12.6	--
AP Dagr	--	--	--	62	--	--	--	--	56.6	--	4	--	--	--	13.1	--
AP Iconic	--	--	--	68	--	--	--	--	60.7	--	3	--	--	--	13.5	--
Enhance-SD	--	--	--	72	--	--	--	--	60.3	--	2	--	--	--	14.1	--
SY Ingmar	--	--	--	62	--	--	--	--	60.7	--	3	--	--	--	14.3	--
TCG-Zelda	--	--	--	69	--	--	--	--	60.3	--	2	--	--	--	14.3	--
CP3119A	57	60	72	--	--	55.4	54.5	56.4	--	--	--	11.6	13.2	11.4	--	--
Ambush	47	66	56	--	--	59.8	56.6	62.2	--	--	--	13.8	13.5	13.2	--	--
Ballistic	58	50	65	--	--	58.2	57.2	61.2	--	--	--	13.0	15.3	12.1	--	--
Commander	47	60	61	--	--	58.8	56.9	60.9	--	--	--	13.1	14.4	13.0	--	--
LCS Cannon	46	52	56	--	--	59.6	58.2	61.8	--	--	--	12.5	14.4	12.5	--	--
CP3099A	--	66	77	--	--	--	57.1	58.4	--	--	--	--	12.9	11.1	--	--
LCS Ascent	--	58	64	--	--	--	58.0	62.4	--	--	--	--	14.0	12.3	--	--
CP3915	--	--	61	--	--	--	--	61.6	--	--	--	--	--	12.5	--	--
MS Ranchero	--	--	67	--	--	--	--	59.1	--	--	--	--	--	12.2	--	--
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	--	--
Rocker	--	--	65	--	--	--	--	60.7	--	--	--	--	--	13.3	--	--
TW Starlite	--	--	71	--	--	--	--	61.7	--	--	--	--	--	13.2	--	--
SY Ingmar	44	56	--	--	--	58.9	58.4	--	--	--	--	13.9	14.4	--	--	--
MN-Washburn	49	59	--	--	--	57.8	57.9	--	--	--	--	13.2	14.6	--	--	--
SY 611 CL2	58	60	--	--	--	59.1	57.6	--	--	--	--	13.4	14.8	--	--	--
TCG-Heartland	47	48	--	--	--	59.5	57.5	--	--	--	--	14.3	15.5	--	--	--
TCG-Spitfire	48	67	--	--	--	58.0	57.5	--	--	--	--	13.7	13.6	--	--	--
ND Frohberg	46	51	--	--	--	59.2	58.9	--	--	--	--	13.6	14.5	--	--	--
TCG-Wildcat	51	58	--	--	--	59.2	58.9	--	--	--	--	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	47	--	--	--	--	59.3	--	--	--	--	--	13.4	--	--	--	--
MS Barracuda	41	--	--	--	--	58.6	--	--	--	--	--	13.5	--	--	--	--
SY McCloud	52	--	--	--	--	59.6	--	--	--	--	--	13.8	--	--	--	--
Trial Mean	49	58	62	69		58.2	57.3	60.6	60.6		2.2	13.1	14.3	12.4	13.6	
C.V. %	6.4	7.8	5.9	4.4		0.6	0.9	0.9	0.8		--	2.5	1.5	2.2	1.4	
LSD 5%	3.3	6.4	--	--		0.3	0.7	--	--		--	0.5	0.3	--	--	
LSD 10%	2.8	5.3	4.2	3.5		0.2	0.6	0.7	0.5		0.6	0.4	0.3	0.3	0.2	

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

HRSW Summary, Towner County 2021-2025

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (1-9)
Variety	21	22	23	24	25	3yr	21	22	23	24	25	3yr	21	22	23	24	25	3yr	2024
SY Valda	72	71	79	94	71	81	59.2	61.0	61.2	60.6	62.2	61.3	14.4	15.3	14.2	13.7	14.9	14.3	1.1
LCS Trigger	69	75	81	86	80	82	57.9	61.4	58.7	60.9	62.5	60.7	12.9	13.2	12.1	11.8	12.5	12.1	2.4
AP Murdock	68	66	74	98	75	82	58.8	60.0	59.4	60.6	59.4	59.8	14.6	15.2	14.1	13.7	14.9	14.2	1.8
MN-Torgy	72	64	85	94	74	84	59.6	60.7	60.9	61.3	61.7	61.3	15.2	16.2	14.5	14.5	15.7	14.9	1.8
AP Smith	72	62	81	90	72	81	59.4	60.2	60.7	60.9	61.1	60.9	14.6	15.5	14.3	14.6	15.5	14.8	1.0
ND Thresher	67	50	80	75	63	73	57.8	59.1	59.8	59.3	60.0	59.7	15.5	16.2	14.1	14.3	16.1	14.8	1.4
MS Cobra	70	63	73	98	65	79	59.4	60.1	61.1	61.3	59.7	60.7	15.0	15.7	14.7	14.5	15.8	15.0	1.0
ND Heron	70	60	76	88	64	76	60.5	61.9	61.6	61.9	62.0	61.8	15.7	16.7	15.0	15.3	15.7	15.3	2.8
LCS Dual	--	66	76	99	66	80	--	61.4	60.8	61.3	61.2	61.1	--	15.3	13.7	14.1	14.5	14.1	1.0
MN-Rothsay	--	69	88	93	67	83	--	60.5	60.2	61.2	60.7	60.7	--	16.2	14.0	14.0	15.3	14.4	1.0
MS Charger	--	74	84	98	72	85	--	60.5	60.4	60.2	61.3	60.6	--	13.9	12.8	12.8	13.9	13.2	1.6
LCS Buster	69	--	89	88	77	85	56.2	--	57.7	58.8	60.2	58.9	12.7	--	11.8	12.5	13.5	12.6	2.8
ND Roughrider	--	--	89	97	81	89	--	--	58.5	58.9	59.2	58.9	--	--	13.8	13.9	15.7	14.5	1.6
Ascend-SD	--	--	83	94	73	84	--	--	60.7	60.6	61.9	61.1	--	--	13.9	14.7	15.8	14.8	2.2
LCS Boom	--	--	72	94	72	79	--	--	61.6	61.3	62.5	61.8	--	--	14.9	14.7	15.1	14.9	1.1
LCS Hammer AX	--	--	78	96	61	78	--	--	60.1	60.9	58.3	59.8	--	--	13.8	14.0	15.7	14.5	1.0
WB9590	--	--	79	98	71	83	--	--	60.8	61.5	59.4	60.6	--	--	14.9	15.1	15.5	15.2	1.1
ND Stampede	--	--	82	104	78	88	--	--	59.8	60.9	59.2	60.0	--	--	14.5	14.9	15.1	14.8	1.1
AP Elevate	--	--	--	95	74	--	--	--	--	60.2	60.3	--	--	--	--	14.5	15.4	--	1.1
Brawn-SD	--	--	--	95	76	--	--	--	--	62.1	64.0	--	--	--	--	13.6	14.3	--	2.0
ND Horizon	--	--	--	94	67	--	--	--	--	61.2	61.2	--	--	--	--	15.1	15.4	--	1.0
MS Nova	--	--	--	90	65	--	--	--	--	60.5	60.0	--	--	--	--	14.7	14.9	--	1.1
TW Olympic	--	--	--	99	71	--	--	--	--	60.7	61.8	--	--	--	--	14.4	15.0	--	1.7
TW Trailfire	--	--	--	85	71	--	--	--	--	60.5	59.9	--	--	--	--	14.5	14.8	--	3.3
SY Ingmar	66	63	73	--	68	--	59.9	60.8	61.5	--	61.5	--	15.2	16.4	15.0	--	15.5	--	--
Faller	76	67	--	--	78	--	58.8	60.4	--	--	60.9	--	14.4	15.4	--	--	14.6	--	--
AP Dagr	--	--	--	--	70	--	--	--	--	--	59.8	--	--	--	--	--	14.0	--	--
AP Iconic	--	--	--	--	74	--	--	--	--	--	61.1	--	--	--	--	--	14.8	--	--
Enhance-SD	--	--	--	--	76	--	--	--	--	--	60.2	--	--	--	--	--	15.4	--	--
TCG-Zelda	--	--	--	--	72	--	--	--	--	--	60.0	--	--	--	--	--	15.2	--	--
Commander	65	64	73	100	--	--	60.2	60.5	61.2	60.7	--	--	14.8	15.9	14.2	14.5	--	--	1.2
Ambush	74	72	82	95	--	--	61.1	59.9	61.7	61.4	--	--	15.1	15.6	14.2	15.2	--	--	1.7
Ballistic	80	67	92	98	--	--	57.7	61.1	59.6	60.8	--	--	14.1	16.4	13.3	13.7	--	--	2.4
LCS Cannon	67	58	74	91	--	--	60.4	61.6	61.6	61.4	--	--	14.7	15.4	14.5	14.5	--	--	1.1
LCS Ascent	--	63	87	95	--	--	--	61.1	61.5	61.4	--	--	--	14.4	13.5	13.4	--	--	1.6
CP3915	--	--	78	87	--	--	--	--	60.6	60.7	--	--	--	--	13.9	14.5	--	--	1.0
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	--	--	--	90	--	--	--	--	--	60.5	--	--	--	--	--	13.5	--	--	3.9
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
Rocker	--	--	--	92	--	--	--	--	--	60.8	--	--	--	--	--	14.8	--	--	2.0
TW Starlite	--	--	--	90	--	--	--	--	--	60.9	--	--	--	--	--	14.7	--	--	4.4
TCG-Spitfire	67	72	83	--	--	--	58.1	60.3	59.6	--	--	--	15.4	15.2	13.7	--	--	--	--
SY 611 CL2	65	70	77	--	--	--	59.6	61.0	61.9	--	--	--	15.3	15.4	14.8	--	--	--	--
TCG-Heartland	73	61	75	--	--	--	60.7	61.6	61.8	--	--	--	15.9	16.4	15.3	--	--	--	--
TCG-Wildcat	74	69	69	--	--	--	60.1	60.4	61.5	--	--	--	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	67	67	--	--	--	--	59.1	60.1	--	--	--	--	14.7	15.3	--	--	--	--	--
ND Frohberg	63	67	--	--	--	--	60.3	61.5	--	--	--	--	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	75	--	--	--	--	--	60.1	--	--	--	--	--	15.1	--	--	--	--	--	--
MS Barracuda	62	--	--	--	--	--	59.4	--	--	--	--	--	15.4	--	--	--	--	--	--
SY McCloud	66	--	--	--	--	--	60.9	--	--	--	--	--	16.1	--	--	--	--	--	--
Driver	77	--	--	--	--	--	59.8	--	--	--	--	--	14.6	--	--	--	--	--	--
Trial Mean	70	67	80	93	72		59.1	60.4	60.6	60.6	60.8		14.7	15.5	14.1	14.1	15.0		1.7
C.V. %	7.0	7.6	6.3	6.2	6.4		0.5	0.5	0.7	1.1	0.8		1.1	2.5	1.9	1.9	3.4		55.4
LSD 5%	4.2	7.3	7.1	--	--		0.3	0.5	0.6	--	--		0.1	0.5	0.4	--	--		--
LSD 10%	3.6	6.0	5.9	6.8	5.4		0.2	0.4	0.5	0.8	0.6		0.1	0.4	0.3	0.3	0.6		1.1

There was no lodging in the 2025 trial.

HRSW Summary, Walsh County 2020-2025

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Lodging (1-9)		
Variety	20	21	22	23	25	3yr	20	21	22	23	25	3yr	20	21	22	23	25	3yr	22	25	2yr
SY Ingmar	67	50	67	76	73	72	61.5	62.5	61.0	62.3	60.9	61.4	15.2	15.7	14.9	15.5	14.8	15.1	1.5	3	2.3
SY Valda	73	57	68	88	72	76	59.8	62.4	60.9	62.0	60.6	61.2	13.5	15.1	13.7	14.4	13.9	14.0	2.0	3	2.5
LCS Trigger	80	68	73	97	80	83	60.0	62.5	61.7	61.0	59.8	60.8	11.1	12.9	11.9	11.6	11.8	11.8	1.8	4	2.9
AP Murdock	76	48	72	80	68	73	61.1	61.9	60.0	62.4	58.2	60.2	13.4	14.8	13.1	14.1	14.4	13.9	1.9	2	2.0
MN-Torgy	77	54	66	81	78	75	60.5	62.1	61.3	62.6	61.4	61.8	14.5	15.8	14.6	15.5	14.7	14.9	1.0	2	1.5
AP Smith	67	54	69	84	74	76	59.2	61.9	60.5	61.5	59.4	60.5	14.7	15.8	14.5	14.4	14.3	14.4	0.4	2	1.2
MS Cobra	--	51	62	77	78	72	--	61.9	60.2	62.2	61.8	61.4	--	16.3	13.9	15.2	14.8	14.6	2.2	2	2.1
ND Heron	--	49	57	77	70	68	--	63.2	61.1	63.1	62.4	62.2	--	16.4	14.9	15.2	15.5	15.2	4.4	3	3.7
ND Thresher	--	50	62	82	71	71	--	60.9	59.9	61.6	59.1	60.2	--	15.9	14.3	14.8	14.6	14.6	0.7	2	1.4
LCS Dual	--	--	58	83	62	68	--	--	61.2	62.7	60.0	61.3	--	--	13.5	13.8	13.4	13.6	0.1	2	1.1
MN-Rothsay	--	--	67	82	74	74	--	--	59.7	61.8	60.9	60.8	--	--	13.6	14.3	14.1	14.0	1.9	2	2.0
MS Charger	--	--	71	91	68	77	--	--	60.1	61.3	61.4	60.9	--	--	12.8	13.1	13.0	13.0	2.5	2	2.3
ND Roughrider	--	--	70	95	79	81	--	--	59.0	60.8	58.3	59.4	--	--	13.6	14.5	14.4	14.2	2.5	2	2.3
ND Stampede	--	--	--	93	84	--	--	--	--	62.2	60.5	--	--	--	--	15.2	15.3	--	--	2	--
WB9590	--	--	--	93	72	--	--	--	--	62.2	60.2	--	--	--	--	14.8	15.2	--	--	2	--
Ascend-SD	--	--	--	86	79	--	--	--	--	62.6	59.8	--	--	--	--	15.3	14.5	--	--	3	--
LCS Boom	--	--	--	76	71	--	--	--	--	63.4	62.1	--	--	--	--	14.8	14.8	--	--	3	--
LCS Buster	--	--	--	98	94	--	--	--	--	60.5	57.8	--	--	--	--	12.0	11.9	--	--	3	--
LCS Hammer AX	--	--	--	74	65	--	--	--	--	61.5	59.7	--	--	--	--	14.6	14.6	--	--	2	--
Faller	80	60	65	--	82	--	60.3	62.2	60.6	--	60.5	--	14.0	15.2	13.6	--	13.8	--	2.6	3	2.8
AP Dagr	--	--	--	--	63	--	--	--	--	--	56.7	--	--	--	--	--	13.4	--	--	3	--
AP Elevate	--	--	--	--	83	--	--	--	--	--	59.0	--	--	--	--	--	14.4	--	--	4	--
AP Iconic	--	--	--	--	80	--	--	--	--	--	59.4	--	--	--	--	--	13.5	--	--	3	--
Brawn-SD	--	--	--	--	76	--	--	--	--	--	62.3	--	--	--	--	--	13.0	--	--	3	--
Enhance-SD	--	--	--	--	79	--	--	--	--	--	60.5	--	--	--	--	--	14.6	--	--	2	--
MS Nova	--	--	--	--	69	--	--	--	--	--	61.3	--	--	--	--	--	14.7	--	--	2	--
ND Horizon	--	--	--	--	83	--	--	--	--	--	61.1	--	--	--	--	--	15.1	--	--	2	--
TCG-Zelda	--	--	--	--	75	--	--	--	--	--	60.2	--	--	--	--	--	14.6	--	--	3	--
TW Olympic	--	--	--	--	81	--	--	--	--	--	61.0	--	--	--	--	--	14.4	--	--	3	--
TW Trailfire	--	--	--	--	79	--	--	--	--	--	61.1	--	--	--	--	--	14.5	--	--	3	--
SY 611 CL2	71	50	64	78	--	--	60.8	62.7	61.0	63.1	--	--	14.7	15.8	14.5	15.3	--	--	1.3	--	--
TCG-Spitfire	74	54	68	86	--	--	58.2	60.8	60.5	59.9	--	--	13.8	15.2	14.0	14.1	--	--	1.5	--	--
Ambush	70	51	72	91	--	--	61.3	62.7	60.6	63.1	--	--	15.1	15.6	13.9	14.9	--	--	2.4	--	--
Ballistic	74	60	61	103	--	--	59.9	61.5	61.1	61.8	--	--	14.8	15.7	14.1	14.2	--	--	2.0	--	--
Commander	74	51	61	87	--	--	60.6	62.5	60.7	62.3	--	--	14.3	15.7	14.2	14.5	--	--	1.0	--	--
LCS Cannon	73	48	67	78	--	--	62.9	63.4	61.1	63.0	--	--	14.0	15.6	13.7	14.4	--	--	0.0	--	--
TCG-Heartland	63	46	56	81	--	--	61.4	62.9	61.4	63.0	--	--	15.3	15.9	15.1	15.6	--	--	0.8	--	--
TCG-Wildcat	69	55	68	81	--	--	60.9	62.6	60.9	62.2	--	--	15.6	15.6	14.4	15.1	--	--	0.9	--	--
CP3530	--	59	68	88	--	--	--	61.1	60.6	62.3	--	--	--	15.0	14.5	15.0	--	--	2.5	--	--
LCS Ascent	--	--	68	76	--	--	--	--	60.1	63.0	--	--	--	--	12.9	13.4	--	--	4.4	--	--
CP3915	69	--	--	86	--	--	61.3	--	--	62.7	--	--	13.9	--	--	14.7	--	--	--	--	--
WB9719	--	--	--	84	--	--	--	--	--	63.1	--	--	--	--	--	14.2	--	--	--	--	--
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	65	52	63	--	--	--	60.5	61.8	60.3	--	--	--	13.9	15.7	14.2	--	--	--	0.0	--	--
CP3099A	--	--	76	--	--	--	--	--	60.5	--	--	--	--	--	12.8	--	--	--	0.9	--	--
LCS Rebel	66	52	--	--	--	--	61.0	63.1	--	--	--	--	14.8	16.5	--	--	--	--	--	--	--
MS Barracuda	69	47	--	--	--	--	60.9	61.8	--	--	--	--	14.6	15.8	--	--	--	--	--	--	--
SY McCloud	60	51	--	--	--	--	61.7	63.1	--	--	--	--	15.9	16.0	--	--	--	--	--	--	--
LCS Buster	82	62	--	--	--	--	58.4	61.2	--	--	--	--	11.5	13.5	--	--	--	--	--	--	--
Driver	--	50	--	--	--	--	--	62.7	--	--	--	--	--	15.4	--	--	--	--	--	--	--
Linkert	66	--	--	--	--	--	61.7	--	--	--	--	--	14.8	--	--	--	--	--	--	--	--
Bolles	61	--	--	--	--	--	58.5	--	--	--	--	--	16.3	--	--	--	--	--	--	--	--
Shelly	75	--	--	--	--	--	60.8	--	--	--	--	--	14.1	--	--	--	--	--	--	--	--
ND VitPro	66	--	--	--	--	--	62.0	--	--	--	--	--	15.2	--	--	--	--	--	--	--	--
Lang-MN	72	--	--	--	--	--	61.3	--	--	--	--	--	14.9	--	--	--	--	--	--	--	--
CP3055	76	--	--	--	--	--	57.4	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--
Velocity	64	--	--	--	--	---	61.9	--	--	--	--	---	15.8	--	--	--	--	---	--	--	--
MS Ranchero	75	--	--	--	--	--	59.5	--	--	--	--	--	13.3	--	--	--	--	--	--	--	--
Trial Mean	71	54	65	85	75		60.6	62.1	60.4	62.1	60.2		14.3	15.3	13.8	14.5	14.2		1.7	2.6	
C.V. %	6.9	4.0	6.1	4.7	6.4		1.2	0.5	0.5	0.7	0.8		3.1	1.9	2.2	2.0	1.4		65	--	
LSD 5%	6.9	1.8	3.6	5.6	--		1.0	0.2	0.3	0.6	--		0.6	0.2	0.3	0.4	--		0.9	--	
LSD 10%	5.7	1.5	3.0	4.7	5.7		0.8	0.2	0.2	0.5	0.6		0.5	0.2	0.2	0.3	0.2		0.8	0.5	

2024 trial results were too unreliable to publish.

HRWW Summary, Langdon 2022-2025

	Yield (bu/a)					Test Weight (lbs/bu)					Heading Date	Height (in)	Lodging (1-9)	Protein (%)				
Variety	**22**	**23**	**24**	**25**	**3yr**	**22**	**23**	**24**	**25**	**3yr**	**25**	**25**	**25**	**22**	**23**	**24**	**25**	**3yr**
AC Emerson	71	51	92	120	88	61.1	63.3	58.0	60.8	60.7	6/11	35.4	2.1	13.4	14.4	12.0	13.3	13.2
Jerry	81	63	80	100	81	60.8	62.8	56.1	58.8	59.2	6/10	41.9	5.9	12.8	13.3	12.1	13.2	12.9
Northern	62	69	88	126	94	57.9	63.8	53.9	58.5	58.7	6/11	33.5	4.3	13.3	13.6	12.1	12.8	12.8
SY Monument	61	60	81	124	88	56.4	62.7	53.3	59.2	58.4	6/8	32.4	4.1	12.8	12.6	12.2	12.6	12.5
ND Noreen	85	62	98	123	94	62.8	64.5	58.9	61.6	61.7	6/10	39.8	3.8	13.0	14.1	11.7	13.1	13.0
AAC Wildfire	70	66	87	119	91	57.4	63.8	55.1	60.9	59.9	6/15	37.5	3.8	13.5	12.4	11.8	12.9	12.4
AAC Vortex	91	61	104	127	98	61.6	63.3	58.3	60.6	60.7	6/8	34.6	2.9	13.0	14.0	12.4	13.3	13.2
MS Maverick	67	58	88	119	88	60.8	63.7	56.3	61.1	60.4	6/8	32.2	5.6	12.9	13.9	13.0	13.1	13.3
SD Andes	87	66	97	131	98	61.2	64.4	57.8	61.7	61.3	6/9	33.5	3.7	12.3	12.9	11.7	12.4	12.3
SD Midland	79	69	97	133	99	61.2	64.1	57.7	60.9	60.9	6/9	34.7	3.4	12.6	12.5	11.2	12.4	12.0
Winner	82	58	99	126	94	61.9	63.4	57.1	60.3	60.3	6/6	31.4	3.9	12.4	13.2	12.4	12.6	12.7
ND Allison	85	69	98	127	98	60.9	63.7	57.1	60.9	60.6	6/12	36.6	3.7	11.5	12.0	11.0	11.6	11.5
AAC Goldrush	--	66	85	120	90	--	63.4	57.0	60.2	60.2	6/12	34.2	2.5	--	13.4	12.0	13.1	12.8
SD Pheasant	--	69	79	120	89	--	63.9	55.0	59.7	59.5	6/10	34.6	5.2	--	14.1	11.6	12.9	12.9
AAC Overdrive	--	--	96	123	--	--	--	56.2	58.3	--	6/10	32.0	4.2	--	--	12.3	13.1	--
AAC Coldfront	--	--	101	137	--	--	--	57.7	62.2	--	6/9	34.9	1.0	--	--	11.2	11.9	--
WB4422	--	--	88	133	--	--	--	55.7	61.2	--	6/7	32.5	2.9	--	--	12.2	12.6	--
LCS Steel AX	--	--	89	134	--	--	--	54.1	60.8	--	6/7	35.4	3.3	--	--	11.1	11.8	--
CS Bridger CLP	--	--	--	127	--	--	--	--	58.8	--	6/8	30.4	3.8	--	--	--	12.3	--
WB4540	--	--	--	128	--	--	--	--	59.6	--	6/6	31.9	2.3	--	--	--	12.1	--
Keldin	62	71	95	--	--	58.4	64.0	56.1	--	--	--	--	--	13.0	12.9	12.1	--	--
WB4309	69	55	78	--	--	60.0	63.4	55.7	--	--	--	--	--	13.8	14.2	12.9	--	--
LCS Chrome	--	--	94	--	--	--	--	57.5	--	--	--	--	--	--	--	12.1	--	--
SY Wolverine	50	48	--	--	--	58.5	63.3	--	--	--	--	--	--	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	--	--	--	--
Trial Mean	69	61	91	125		59.7	63.5	56.2	60.1		6/9	34.5	3.6	12.9	13.3	12.0	12.7	
C.V. %	9.5	6.5	7.6	5.1		1.3	0.4	1.4	1.1		0.5	3.9	--	2.7	1.9	2.6	1.9	
LSD 10%	5.2	4.7	8.2	4.4		0.6	0.3	0.9	0.6		0.7	1.2	0.9	0.4	0.3	0.4	0.2	

No lodging in the 2022-2024 trials.
Winter survival was 100% for all varieties in 2025.
Overwinter leaf stage ranged from 1.5 to 2 leaf.
Fungicides were not used in any of the trials above.

Winter Rye, Langdon 2025

Variety	Heading Date	Plant Height (in)	Lodging (1-9)	Test Weight (lbs/bu)	Yield 2025	Yield 2 yr avg.	Yield 3 yr avg.
					---------------- bu/a----------------		
AC Hazlet	6/1	48	4.0	58.2	120.5	110.1	93.6
Aroostok	6/3	46	3.0	57.8	116.3	105.0	85.7
Danko	6/2	46	1.3	59.2	133.8	124.8	102.5
ND Dylan	5/30	51	4.5	57.4	96.6	101.2	87.4
ND Gardner	5/31	51	4.3	56.7	90.1	86.3	74.1
Spooner	6/4	52	2.3	57.7	101.8	93.7	79.3
SU Bebop	6/9	44	2.3	58.4	143.2	131.9	--
SU Cossani	6/5	42	1.0	58.2	155.7	142.6	--
SU Karlsson	6/7	40	2.0	58.5	166.8	153.6	--
SU Performer	6/8	43	1.5	58.7	163.4	150.6	--
SU Perspectiv	6/6	41	1.5	58.5	146.5	144.6	--
Trial Mean	6/4	47.4	1.9	53.0	124.4		
LSD 10%	0.6	3.3	--	0.8	6.0		
C.V. %	1.0	1.9	--	0.5	8.9		

Winter survival was 100% for all varieties.

Corn Grain, Langdon 2025

Brand	Hybrid	RM[1]	Hybrid Traits[1]	Insect Traits	Days to Silk	Harvest Moisture	Test Weight	Yield 2023	Yield 2024	Yield 2025	Yield 2yr Avg	Yield 3yr Avg
						(%)	(lbs/bu)	------------bu/a				------------
Channel	180-24VT2P	80	RR2	VT2Pro	78	28	54.3	147.5	216.5	224.9	220.7	196.3
Innvictis	A7883VT2PRIB	78	RR2	VT Double Pro	78	25	56.0	133.3	191.6	229.1	210.3	184.6
Integra	3009VT2	80	RR2	YGBT	76	29	53.4	137.2	185.6	195.1	190.4	172.6
Thunder	T6278 VT2P	78	RR2	VT2P	75	26	54.8	126.0	192.1	228.1	210.1	182.0
Thunder	T6977 VT2P	77	RR2	VT2P	74	26	54.9	137.5	195.1	233.6	214.4	188.7
Channel	169-09VT2P	69	RR2	VT2Pro	75	24	57.4	--	187.2	205.3	196.3	--
Legacy	LC261-24	76	RR2	VT2P	76	27	53.9	--	195.0	191.8	193.4	--
Allegiant	8037	81	RR2		78	26	53.5	--	--	229.9	--	--
Legacy	LC221-25	72	RR2	VT2P	75	26	56.6	--	--	198.1	--	--
Legacy	LC301-24	80	RR2	VT2P	80	30	53.9	--	--	234.6	--	--
Legacy	LC18-18	78	RR2	VT2P	76	25	54.5	--	--	206.3	--	--
Proseed	2676RR	76	RR2		77	28	54.5	--	--	228.9	--	--
Proseed	2181VT2P	81	RR2	BT	79	28	53.7	--	--	215.4	--	--
Proseed	2679VT2P	79	RR2	BT	76	25	55.1	--	--	221.3	--	--
Thunder	TEX24-76	76	RR2	VT2P	77	26	54.7	--	--	218.2	--	--
Thunder	T6181 VT2P	81	RR2	VT2P	79	27	53.9	--	--	211.4	--	--
Trial Mean					79	24	54.7	131.8	187.8	218.2		
C.V. %					1.2	7.8	1.5	6.9	7.3	7.5		
LSD 10%					1.3	2.6	1.1	13.0	18.9	22.6		

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

Yield reported at 15.5% moisture.

GDD from May 13 to October 13 were 1920. Normal is 1783.

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

Barley Summary, Langdon 2021-2025

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)			Plump (%)					
Variety	**21**	**22**	**23**	**24**	**25**	**3yr**	**21**	**22**	**23**	**24**	**25**	**3yr**	**19**	**20**	**2yr**	**21**	**22**	**23**	**24**	**25**	**3yr**
Tradition*	79	99	111	88	140	113	47.2	50.0	48.5	46.6	49.3	48.1	0.0	0.2	0.1	93	95	97	99	98	98
AAC Synergy	92	105	113	89	148	117	48.2	50.5	51.2	48.0	52.2	50.5	1.3	2.7	2.0	94	97	99	99	97	98
Explorer	80	106	102	88	128	106	48.2	48.9	49.9	46.7	49.8	48.8	0.0	0.1	0.1	96	95	99	100	95	98
ABI Cardinal	83	103	109	84	122	105	46.9	50.6	50.3	47.8	51.1	49.7	1.0	1.7	1.4	93	97	98	99	96	98
ND Treasure*	83	112	113	98	138	116	44.5	48.5	46.6	45.6	48.5	46.9	--	--	--	89	97	94	99	99	97
CDC Fraser	82	105	113	92	139	115	46.3	49.4	48.9	46.9	51.4	49.1	--	--	--	95	97	98	99	96	98
Firefoxx	--	--	125	79	122	108	--	--	48.4	44.0	47.5	46.6	--	--	--	--	--	99	99	96	98
ND Genesis	91	100	117	--	148	--	48.8	48.8	51.2	--	51.8	--	0.3	0.5	0.4	98	95	100	--	99	--
AAC Prairie	--	--	--	--	126	--	--	--	--	--	51.3	--	--	--	--	--	--	--	--	94	--
CDC Churchill	--	--	--	--	150	--	--	--	--	--	52.3	--	--	--	--	--	--	--	--	96	--
SY Stanza	--	--	--	--	139	--	--	--	--	--	48.6	--	--	--	--	--	--	--	--	98	--
AAC Connect	90	100	109	92	--	--	47.1	49.5	50.9	48.4	--	--	0.5	2.0	1.3	90	95	98	99	--	--
Lacey*	--	98	110	86	--	--	--	49.3	49.2	47.3	--	--	0.0	--	--	--	95	97	99	--	--
CDC Prairie	--	--	117	85	--	--	--	--	50.4	48.5	--	--	--	--	--	--	--	96	98	--	--
Winston	--	--	117	87	--	--	--	--	49.5	45.5	--	--	--	--	--	--	--	100	100	--	--
Pinnacle	84	99	109	--	--	--	50.2	51.6	51.7	--	--	--	0.0	0.1	0.1	99	97	100	--	--	--
Conlon	57	100	107	--	--	--	49.9	51.1	51.6	--	--	--	1.8	0.3	1.1	98	98	99	--	--	--
Brewski	91	109	108	--	--	--	48.3	50.1	50.6	--	--	--	--	1.1	--	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	85	107	112	87	138		47.7	49.5	49.8	46.8	50.1		0.5	0.5		96	96	98	99	98	
C.V. %	9.9	5.0	6.8	6.3	5.2		1.5	1.1	1.0	1.0	1.1		149	126		2.8	1.8	1.0	0.3	0.7	
LSD 5%	9.9	7.6	11.0	--	--		0.8	0.8	0.7	--	--		1.0	0.9		3.0	2.4	1.4	--	--	
LSD 10%	7.7	6.3	9.1	6.5	8.5		0.6	0.7	0.7	0.6	0.7		0.9	0.7		2.0	2.0	1.1	0.3	0.8	

*6-row

ND Genesis seed lot had a poor stand in 2024. Results are not published.

Barley Summary, Langdon 2021-2025

	Height (in)						Protein (%)						Days to Head					
Variety	**21**	**22**	**23**	**24**	**25**	**3yr**	**21**	**22**	**23**	**24**	**25**	**3yr**	**21**	**22**	**23**	**24**	**25**	**3yr**
Tradition*	24	32	33	31	30	31	13.5	10.9	12.0	10.8	13.7	12.2	57	50	46	54	47	49
AAC Synergy	26	30	33	31	29	31	13.6	10.4	12.9	10.4	12.3	11.9	62	54	51	55	47	51
Explorer	22	24	25	26	25	25	13.9	9.7	12.1	9.8	12.1	11.3	61	55	51	56	48	52
ABI Cardinal	22	29	30	31	29	30	14.2	10.3	12.2	10.5	13.4	12.0	61	57	52	57	50	53
ND Treasure*	22	27	31	29	27	29	12.7	10.3	11.7	10.6	13.5	11.9	59	51	45	54	47	49
CDC Fraser	25	29	30	31	30	30	13.7	10.3	13.2	10.9	12.1	12.1	62	57	53	58	50	54
Firefoxx	--	--	27	28	26	27	--	--	11.3	8.9	10.8	10.3	--	--	51	56	48	52
ND Genesis	26	33	34	--	29	--	12.5	9.7	11.3	--	10.9	--	61	54	51	--	47	--
AAC Prairie	--	--	--	--	30	--	--	--	--	--	12.5	--	--	--	--	--	49	--
CDC Churchill	--	--	--	--	29	--	--	--	--	--	12.0	--	--	--	--	--	48	--
SY Stanza	--	--	--	--	25	--	--	--	--	--	10.7	--	--	--	--	--	49	--
AAC Connect	24	28	32	29	--	--	14.5	10.3	12.8	10.9	--	--	62	54	52	56	--	--
Lacey*	--	30	34	30	--	--	--	11.0	12.4	11.7	--	--	--	50	44	52	--	--
CDC Prairie	--	--	33	30	--	--	--	--	13.1	10.7	--	--	--	--	51	56	--	--
Winston	--	--	26	28	--	--	--	--	11.5	10.1	--	--	--	--	54	58	--	--
Pinnacle	23	30	31	--	--	--	13.7	10.0	11.2	--	--	--	61	52	50	--	--	--
Conlon	25	29	31	--	--	--	14.1	10.5	12.6	--	--	--	58	51	42	--	--	--
Brewski	24	30	32	--	--	--	13.0	10.1	11.8	--	--	--	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	23	29	31	29	28		13.2	10.0	12.1	10.3	12.1		61	53	49	55	47	
C.V. %	7.3	5.4	5.4	5.6	7.7		3.7	4.6	4.9	4.2	4.7		2.2	2.1	2.9	1.4	1.7	
LSD 5%	2.0	2.2	2.4	--	--		0.6	0.7	0.9	--	--		2.0	1.6	2.0	--	--	
LSD 10%	2.0	1.9	2.0	2.0	2.6		0.4	0.6	0.7	0.5	0.7		1.0	1.4	1.7	1.0	1.0	

*6-row

ND Genesis seed lot had a poor stand in 2024. Results are not published.

Oat Summary, Langdon 2020-2025

	Yield (bu/a)						Test Weight (lbs/bu)						Days to Head						Height (in)						Lodging (1-9)[1]					Crown Rust (1-9)[2]
Variety	20	22	23	24	25	3yr	20	22	23	24	25	3yr	20	22	23	24	25	3yr	20	22	23	24	25	3yr	19	20	24	25	3yr	2024
Beach	185	160	119	153	162	145	39.9	43.2	40.9	41.2	40.2	40.8	47	50	48	56	50	51	42	43	42	48	41	44	0.2	2.5	4.5	5	4.0	1.3
HiFi	188	185	137	167	169	158	36.5	41.1	36.6	37.5	35.2	36.4	50	51	51	58	54	54	40	44	43	48	46	46	0.0	2.6	2.3	7	4.0	1.5
Otana	181	165	145	151	130	142	35.1	41.0	39.1	35.7	34.0	36.3	50	51	51	59	53	54	42	45	43	49	45	46	1.3	5.3	7.6	9	7.3	4.3
Rockford	170	182	127	160	155	147	37.7	42.8	37.5	38.7	36.9	37.7	50	52	50	60	53	54	44	45	42	51	43	45	0.2	2.4	2.4	8	4.3	2.7
Newburg	195	205	136	182	144	154	34.9	40.5	38.9	34.8	34.6	36.1	50	51	50	60	53	54	43	43	38	47	46	44	1.1	4.3	4.3	9	5.9	2.2
Leggett	193	186	140	173	180	164	36.6	41.5	38.3	37.9	36.5	37.6	49	50	48	58	52	53	40	42	42	45	42	43	0.2	2.5	3.7	4	3.4	1.2
Jury	191	183	140	184	171	165	35.4	40.8	36.8	36.3	34.0	35.7	49	50	51	56	53	53	45	47	49	52	50	50	0.7	4.8	8.2	8	7.0	2.3
Paul*	146	126	91	115	121	109	44.0	46.8	39.0	43.5	41.1	41.2	51	53	50	62	56	56	47	45	51	49	49	49	0.1	1.7	6.5	4	4.1	1.0
Deon	223	185	145	180	195	173	36.6	41.0	37.4	37.3	37.0	37.2	51	52	51	61	53	55	47	44	43	47	44	45	0.0	0.9	3.8	3	2.6	1.0
ND Heart	194	175	127	163	160	150	37.3	41.5	33.4	38.4	37.1	36.3	48	50	51	56	50	52	42	45	45	47	44	46	0.5	3.6	3.6	5	4.1	1.1
ND Carson	220	205	148	188	208	181	41.1	41.1	37.7	37.3	36.4	37.1	50	51	52	58	53	54	44	42	44	46	44	45	0.0	1.0	1.1	1	1.0	1.5
ND Spilde	209	187	148	178	199	175	39.8	39.8	38.5	36.7	36.4	37.2	49	50	53	57	53	54	43	43	47	49	43	46	0.1	3.3	4.8	4	4.0	1.0
ND Crema*	133	125	87	103	121	104	48.2	48.2	36.6	44.5	43.1	41.4	52	53	52	61	54	56	45	48	42	50	50	47	0.0	2.2	3.7	2	2.6	1.3
AAC Douglas	--	187	156	145	140	147	--	39.8	36.9	34.5	32.0	34.5	--	49	48	55	49	51	--	42	42	45	42	43	--	--	2.0	8	--	7.3
MN-Pearl	--	192	129	186	192	169	--	39.7	36.0	37.1	35.7	36.3	--	50	49	57	53	53	--	42	41	46	42	43	--	--	1.8	7	--	1.2
SD Buffalo	--	189	132	177	178	162	--	41.2	37.7	39.2	38.4	38.4	--	48	57	55	49	54	--	43	44	49	42	45	--	--	3.1	1	--	1.0
ND Miller	--	201	138	174	184	166	--	41.8	39.2	38.2	37.6	38.3	--	51	53	57	53	54	--	42	47	46	43	45	--	--	5.4	6	--	1.0
ND Williams	--	190	139	186	200	175	--	42.1	36.9	38.9	37.8	37.9	--	52	57	58	54	57	--	47	45	49	49	48	--	--	3.1	4	--	1.0
CDC Endure	--	--	153	177	182	171	--	--	35.7	36.2	34.0	35.3	--	--	51	57	53	54	--	--	43	46	43	44	--	--	1.1	5	--	2.3
SD Momentum	--	--	--	173	197	--	--	--	--	40.7	39.9	--	--	--	--	62	54	--	--	--	--	55	55	--	--	--	6.6	3	--	1.0
SD Titan	--	--	--	173	194	--	--	--	--	39.0	37.1	--	--	--	--	57	52	--	--	--	--	51	50	--	--	--	4.9	4	--	1.0
CS Camden	209	197	143	143	--	--	33.6	38.9	34.1	32.5	--	--	49	49	50	57	--	--	42	39	41	42	--	--	0.0	0.5	1.0	--	--	6.7
Killdeer	199	189	128	171	--	--	36.3	40.0	35.0	35.5	--	--	48	49	50	56	--	--	38	40	37	41	--	--	0.0	2.4	4.2	--	--	2.5
Ore Level 48	--	--	136	--	--	--	--	--	37.9	--	--	--	--	--	48	--	--	--	--	--	43	--	--	--	--	--	--	--	--	--
CDC Minstrel	199	189	--	--	--	--	34.5	40.2	--	--	--	--	49	50	--	--	--	--	42	42	--	--	--	--	0.1	0.2	--	--	--	--
Warrior	179	169	--	--	--	--	35.8	41.2	--	--	--	--	46	48	--	--	--	--	39	39	--	--	--	--	0.0	1.0	--	--	--	--
CDC Dancer	192	--	--	--	--	--	36.9	--	--	--	--	--	49	--	--	--	--	--	44	--	--	--	--	--	0.0	2.3	--	--	--	--
Hytest	181	--	--	--	--	--	38.9	--	--	--	--	--	47	--	--	--	--	--	44	--	--	--	--	--	0.8	1.6	--	--	--	--
Souris	186	--	--	--	--	--	36.7	--	--	--	--	--	48	--	--	--	--	--	39	--	--	--	--	--	0.1	0.0	--	--	--	--
Stallion	170	--	--	--	--	--	38.3	--	--	--	--	--	48	--	--	--	--	--	43	--	--	--	--	--	0.1	2.7	--	--	--	--
Hayden	181	--	--	--	--	--	38.0	--	--	--	--	--	48	--	--	--	--	--	41	--	--	--	--	--	0.1	2.3	--	--	--	--
Trial Mean	192	182	135	167	174		37.2	41.5	37.5	38.3	37.2		49	51	51	58	53		42	44	44	47	45		0.2	2.1	3.8	5		1.7
C.V. %	3.7	3.7	6.1	6.4	6.7		1.6	0.8	1.9	1.3	1.6		1.5	1.2	1.9	1.6	2.7		4.3	3.2	5.0	2.5	5.8		234	76	--	--		29.1
LSD 5%	11.7	9.4	11.5	--	--		1.0	0.5	1.0	--	--		1.2	0.8	1.4	--	--		3.0	2.0	3.0	--	--		0.8	2.6	--	--		--
LSD 10%	9.8	7.9	9.6	12.6	13.6		0.8	0.4	0.8	0.6	0.7		1.0	0.7	1.1	1.1	1.6		2.5	1.7	2.5	1.4	3.1		0.7	2.2	--	1.9		0.6

*Hull-less variety

The 2021 trial was not harvested.

[1] 2019 and 2020 scale is 0-9.

[2] 1=none, 9=severe

Flax Summary, Langdon 2021-2025

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)			Height (in)						Days to Flower						Oil (%)	
Variety	**21**	**22**	**23**	**24**	**25**	**3yr**	**21**	**22**	**23**	**24**	**25**	**3yr**	**22**	**25**	**2yr**	**21**	**22**	**23**	**24**	**25**	**3yr**	**21**	**22**	**23**	**24**	**25**	**3yr**	**24**	**25**
Carter*	21	57	35	35	31	34	53.1	53.7	51.5	51.9	47.1	50.2	0.4	1	0.7	21	28	30	26	29	28	52	48	47	53	45	48	45.9	40
CDC Glas	21	65	28	39	28	32	51.2	52.9	48.4	50.4	42.7	47.2	0.0	1	0.5	19	29	30	26	33	30	54	50	52	54	48	51	47.5	42
Omega*	21	50	31	34	24	30	53.2	53.8	51.8	52.2	44.4	49.5	1.9	3	2.5	19	27	31	25	32	29	54	50	45	54	45	48	45.6	40
Webster	23	59	31	39	28	33	52.6	54.0	50.4	52.0	45.6	49.3	0.0	2	1.0	21	30	30	27	33	30	52	51	49	53	48	50	46.3	40
York	20	63	35	40	31	35	52.3	53.6	51.2	51.9	46.7	49.9	0.0	2	1.0	20	31	33	28	31	31	53	48	51	53	46	50	46.3	40
Gold ND*	21	56	32	39	27	32	53.0	52.6	52.2	52.0	45.1	49.8	0.6	3	1.8	20	31	32	27	33	31	55	51	50	54	47	50	46.1	39
CDC Neela	22	59	35	38	31	34	52.1	53.7	51.3	52.0	47.0	50.1	0.5	2	1.3	20	29	33	27	32	31	53	50	50	54	47	50	46.2	40
ND Hammond	21	58	31	36	27	32	52.3	53.0	49.2	51.4	43.5	48.0	0.0	2	1.0	21	32	32	27	31	30	52	48	49	53	47	50	44.2	40
AAC Bright*	21	62	32	36	28	32	51.0	51.0	47.0	49.2	41.7	46.0	0.0	2	1.0	20	29	31	25	32	29	54	51	52	53	48	51	49.3	43
CDC Dorado*	18	55	30	32	25	29	51.8	53.9	47.2	50.4	44.4	47.3	0.1	2	1.1	19	29	29	23	28	27	51	49	44	51	44	46	47.0	42
AAC Marvelous	22	64	30	39	31	33	52.5	53.9	50.5	51.7	46.0	49.4	0.1	1	0.6	20	28	29	26	32	29	53	49	51	54	48	51	48.3	42
CDC Rowland	21	68	35	42	32	37	52.5	53.4	50.2	51.3	44.6	48.7	0.1	1	0.6	17	29	29	26	32	29	55	49	50	53	47	50	46.9	41
CDC Kernen	--	57	23	35	21	26	--	53.7	46.0	51.4	44.6	47.3	1.8	2	1.9	--	29	31	27	33	30	--	51	47	55	46	49	46.2	41
Trial Mean	21	58	31	37	28		52.6	53.5	50.7	51.8	47.7		0.6	2		20	30	31	27	31		53	50	50	54	47		46.5	40
C.V. %	5.0	5.0	8.3	8.5	14.6		0.3	0.7	2.1	0.5	1.9		131	--		4.0	3.3	5.6	3.9	5.5		0.7	1.5	2.6	2.1	1.4		1.9	1.4
LSD 5%	1.4	4.7	5.6	--	--		0.2	0.6	1.7	--	--		1.2	--		1.1	1.6	2.8	--	--		0.6	1.2	2.1	--	--		--	--
LSD 10%	1.2	4.0	--	3.7	4.9		0.2	0.5	1.5	0.3	1.1		1.0	1.3		0.9	1.3	2.4	1.2	2.1		0.5	1.0	1.7	1.3	0.8		1.1	0.7

*Yellow seed color.

Canola - Liberty Link, Langdon 2024-2025

Company/Brand	Variety	Type[1]	Oil Type	Blackleg Rating[2]	Clubroot Resistant[4]	Days to First Flower			Flower Duration (days)			Days to Mature			% Cover[3]		
						24	25	2yr	24	25	2yr	24	25	2yr	24	25	2yr
BASF	InVigor L345PC	LL	Trad	R	Yes	40	40	40	20	23	22	87	97	92	86	85	86
BASF	InVigor L340PC	LL	Trad	R	Yes	39	39	39	21	22	22	86	94	90	76	82	79
BASF	InVigor L350PC	LL	Trad	R	Yes	45	42	44	16	23	20	92	97	95	81	87	84
BASF	InVigor L343PC	LL	Trad	R	Yes	39	39	39	19	21	20	86	94	90	73	85	79
CROPLAN	CP7250LL	LL	HO	R	Yes	43	41	42	19	26	23	91	95	93	75	75	75
Dyna-Gro	DG 661 LCM	LL	Trad	R	Yes	39	39	39	21	26	24	88	95	92	83	80	82
Pioneer	P612L	LL	Trad	R	Yes	43	41	42	20	24	22	92	99	96	46	78	62
BASF	InVigor L333PC	LL	Trad	R	Yes	41	40	41	17	23	20	87	94	91	78	85	82
BrettYoung	BY7204LL	LL	Trad	R	Yes	42	38	40	19	28	24	91	96	94	64	83	74
CANTERRA SEEDS	CS4100 LL	LL	Trad	R	Yes	41	39	40	20	28	24	90	95	93	68	73	71
CROPLAN	CP7130LL	LL	HO	R	Yes	40	39	40	20	25	23	87	96	92	71	73	72
DEKALB	DK400TL	TFLL	Trad	R	Yes	37	36	37	20	24	22	87	94	91	84	77	81
BrettYoung	BY7202LL	LL	Trad	R	Yes	--	38	--	--	25	--	--	92	--	--	78	--
BrettYoung	BY7206LL	LL	Trad	R	Yes	--	41	--	--	26	--	--	96	--	--	80	--
CROPLAN	CP7500LL	LL	HO	N/A	N/A	--	40	--	--	23	--	--	97	--	--	83	--
DEKALB	DK401TL	TFLL	Trad	R	Yes	--	37	--	--	26	--	--	95	--	--	77	--
DEKALB	DK800LL	LL	Trad	R	Yes	--	38	--	--	25	--	--	94	--	--	80	--
DEKALB	DK801LL	LL	Trad	R	Yes	--	36	--	--	26	--	--	93	--	--	75	--
BASF	InVigor L330PC	LL	Trad	R	Yes	--	38	--	--	23	--	--	95	--	--	85	--
BASF	InVigor L355PC	LL	Trad	R	Yes	--	41	--	--	24	--	--	97	--	--	70	--
Pioneer	P520L	LL	Trad	R	Yes	--	41	--	--	24	--	--	95	--	--	75	--
BASF	InVigor LR344PC	TFLL	Trad	R	Yes	42	--	--	17	--	--	89	--	--	76	--	--
BASF	InVigor LR354PC	TFLL	Trad	R	Yes	44	--	--	17	--	--	92	--	--	71	--	--
CANTERRA SEEDS	CS4000 LL	LL	Trad	R	Yes	40	--	--	20	--	--	87	--	--	79	--	--
Pioneer	P516L	LL	Trad	R	Yes	41	--	--	21	--	--	90	--	--	73	--	--
Trial Mean						41	39		20	25		89	96		73	79	
C.V. %						1.7	2.3		5.5	5.1		1.3	1.5		10.4	8.1	
LSD 10%						0.8	1.1		1.3	1.5		1.4	1.7		8.9	7.5	

All varieties are 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 2022-2025

Company/Brand	Variety	Height (in)			Lodging (0-9)			Vigor[2]	Oil[1] (%)			Yield[1] (lbs/a)					
		24	25	2yr	20	22	2yr	1-5	24	25	2yr	2022	2023	2024	2025	2yr	3yr
BASF	InVigor L345PC	51	54	53	6.3	4.1	5.2	4	43.6	40.3	42.0	3734	2454	3391	3933	3662	3259
BASF	InVigor L340PC	50	52	51	5.3	4.2	4.8	4	43.0	40.9	42.0	3573	2644	3406	3630	3518	3227
BASF	InVigor L350PC	55	55	55	--	1.7	--	4	46.1	41.1	43.6	3615	2668	3140	3490	3315	3099
BASF	InVigor L343PC	50	53	52	--	3.8	--	4	43.4	41.3	42.4	3627	2541	3304	3791	3548	3212
CROPLAN	CP7250LL	52	49	51	--	--	--	4	44.7	40.6	42.7	--	2554	2432	2775	2604	2587
Dyna-Gro	DG 661 LCM	55	55	55	--	--	--	4	44.4	41.4	42.9	--	2243	2738	3110	2924	2697
Pioneer	P612L	55	53	54	--	--	--	3	45.0	41.8	43.4	--	2584	2607	3046	2827	2746
BASF	InVigor L333PC	52	53	53	--	--	--	4	43.7	40.1	41.9	--	--	3110	4003	3557	--
BrettYoung	BY7204LL	55	52	54	--	--	--	5	46.9	43.6	45.3	--	--	2805	3344	3075	--
CANTERRA SEEDS	CS4100 LL	53	54	54	--	--	--	3	46.6	43.1	44.9	--	--	2822	3495	3159	--
CROPLAN	CP7130LL	56	58	57	--	--	--	4	45.0	41.7	43.4	--	--	3149	3352	3251	--
DEKALB	DK400TL	50	50	50	--	--	--	4	46.2	42.5	44.4	--	--	3048	3098	3073	--
BrettYoung	BY7202LL	--	54	--	--	--	--	4	--	41.9	--	--	--	--	3197	--	--
BrettYoung	BY7206LL	--	53	--	--	--	--	4	--	43.1	--	--	--	--	3388	--	--
CROPLAN	CP7500LL	--	52	--	--	--	--	4	--	40.3	--	--	--	--	3387	--	--
DEKALB	DK401TL	--	50	--	--	--	--	4	--	42.5	--	--	--	--	3746	--	--
DEKALB	DK800LL	--	47	--	--	--	--	4	--	42.7	--	--	--	--	3381	--	--
DEKALB	DK801LL	--	49	--	--	--	--	4	--	42.8	--	--	--	--	3432	--	--
BASF	InVigor L330PC	--	52	--	--	--	--	4	--	40.4	--	--	--	--	3520	--	--
BASF	InVigor L355PC	--	53	--	--	--	--	4	--	43.3	--	--	--	--	3650	--	--
Pioneer	P520L	--	55	--	--	--	--	3	--	41.3	--	--	--	--	3137	--	--
BASF	InVigor LR344PC	55	--	--	--	--	--	--	44.1	--	--	--	--	3258	--	--	--
BASF	InVigor LR354PC	58	--	--	--	1.1	--	--	44.8	--	--	3351	2429	3186	--	--	--
CANTERRA SEEDS	CS4000 LL	54	--	--	--	4.0	--	--	45.3	--	--	3237	2907	2529	--	--	--
Pioneer	P516L	53	--	--	--	--	--	--	44.2	--	--	--	--	2733	--	--	--
Trial Mean		54	52		5.2	3.8		4.0	44.7	42.0		3261	2530	2912	3358		
C.V. %		3.6	5.4		18.4	12.9		10.0	1.2	1.8		3.9	9.9	9.5	10.1		
LSD 5%		--	--		1.3	0.5		--	--	--		122	360	--	--		
LSD 10%		2.3	3.4		1.1	0.4		0.5	0.6	0.9		102	299	326	399		

[1]8.5% moisture

[2]Vigor - Visual rating of early growth at 4 weeks after planting (5=best).

Canola - Roundup Ready, Langdon 2024-2025

Company	Variety	Height (in)			Oil[1] (%)			Yield[1] (lbs/a)			
		24	25	2yr	24	25	2yr	24	25	2yr	3yr
CROPLAN	CP9978TF	50	50	50	44.9	41.3	43.1	2933	2831	2882	2899
BASF InVigor	LR354PC	52	51	52	45.4	42.0	43.7	3076	3295	3186	2905
CROPLAN	CP9221TF	49	52	51	43.2	40.1	41.7	2446	2777	1244	2545
Dyna-Gro	DG 781 TCM	50	48	49	45.0	41.2	43.1	2753	3315	3034	2865
CANTERRA SEEDS	CS3200 TF	52	53	53	45.4	42.2	43.8	3051	3403	3227	--
CANTERRA SEEDS	CS3300 TF	51	51	51	45.1	42.6	43.9	2669	3141	2905	--
CROPLAN	CP9551TF	--	50	--	--	42.6	--	--	3399	--	--
Star	StarFlex	49	--	--	45.9	--	--	2871	--	--	--
Nuseed	NC527CR TF	50	--	--	45.0	--	--	2534	--	--	--
CANTERRA SEEDS	CS3100 TF	52	--	--	44.3	--	--	2457	--	--	--
Pioneer	P515G	48	--	--	46.0	--	--	2819	--	--	--
Proseed	TR 23127	50	--	--	44.9	--	--	2566	--	--	--
Dyna-Gro	DG 760 TM	51	--	--	44.5	--	--	2603	--	--	--
BASF InVigor	LR344PC	52	--	--	44.4	--	--	2919	--	--	--
BrettYoung	BY 6219TF	53	--	--	44.4	--	--	2819	--	--	--
Trial Mean		51	51		44.9	41.7		2727	3166		
C.V. %		2.8	10.7		1.4	2.1		11.3	8.6		
LSD 10%		1.7	6.6		0.8	1.1		366	336		

[1] 8.5% moisture

No lodging in the 2024 and 2025 trials.

Canola - Roundup Ready, Langdon 2024-2025

Company	Variety	Type[1]	Blackleg Rating[2]	Oil Type	Clubroot Resistant[4]	Days to First Flower			Flower Duration (days)			Days to Mature			% Cover[3]		
						24	25	2yr	24	25	2yr	24	25	2yr	24	25	2yr
CROPLAN	CP9978TF	TF	R	HO	No	39	36	38	22	27	25	90	93	92	83	78	81
BASF InVigor	LR354PC	TFLL	R	Trad	Yes	42	41	42	18	26	22	88	95	92	82	80	81
CROPLAN	CP9221TF	TF	R	HO	Yes	38	35	37	20	25	23	85	92	89	78	80	79
Dyna-Gro	DG 781 TCM	TF	R	Trad	Yes	39	36	38	21	27	24	88	95	92	80	85	83
CANTERRA SEEDS	CS3200 TF	TF	R	Trad	Yes	43	40	42	19	28	24	90	95	93	100	85	93
CANTERRA SEEDS	CS3300 TF	TF	R	Trad	Yes	38	36	37	24	25	25	88	92	90	63	78	71
CROPLAN	CP9551TF	TF	N/A	HO	N/A	--	36	--	--	25	--	--	93	--	--	78	--
Star	StarFlex	TF	R	Trad	No	38	--	--	22	--	--	87	--	--	81	--	--
Nuseed	NC527CR TF	TF	R	Trad	Yes	39	--	--	22	--	--	89	--	--	75	--	--
CANTERRA SEEDS	CS3100 TF	TF	R	Trad	Yes	44	--	--	22	--	--	93	--	--	66	--	--
Pioneer	P515G	OptG	R	Trad	Yes	39	--	--	22	--	--	87	--	--	78	--	--
Proseed	TR 23127	TF	R	Trad	Yes	41	--	--	21	--	--	87	--	--	68	--	--
Dyna-Gro	DG 760 TM	TF	R	Trad	No	39	--	--	20	--	--	86	--	--	77	--	--
BASF InVigor	LR344PC	TFLL	R	Trad	Yes	41	--	--	18	--	--	87	--	--	76	--	--
BrettYoung	BY 6219TF	TF	R	Trad	Yes	38	--	--	23	--	--	88	--	--	73	--	--
Trial Mean						41	37		21	26		89	94		75	80	
C.V. %						1.9	1.2		16.8	3.2		1.4	0.9		11.2	7.4	
LSD 10%						0.9	0.6		4.3	1.0		1.5	1.0		10.0	7.3	

[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 2022-2025

Variety	Market Class	Days to Maturity	Plant Height	2024 Lodging	100 Seed Weight	Yield 2022	Yield 2023	Yield 2024	Yield 2025	2 yr Avg.	3 yr Avg.	4 yr Avg.
			(in)	(1-9)	(g)	(lbs/a)						
Black Tails	Black Turtle	104	15	1.0	16.1	3463	3512	2698	2093	2395	2768	2941
Eclipse	Black Turtle	103	16	1.4	16.8	3132	2935	2726	2307	2516	2656	2775
ND Twilight	Black Turtle	103	15	2.6	18.3	2901	2458	2021	2266	2144	2248	2412
ND Galaxy	Black Turtle	103	16	--	15.0	--	--	--	1552	--	--	--
ND Pegasus	Great Northern	106	16	3.8	31.9	4098	3176	2570	2916	2743	2887	3190
Eiger	Great Northern	105	16	--	26.0	--	--	--	2263	--	--	--
Blizzard	Navy	104	18	1.2	17.4	3350	3210	1920	2601	2261	2577	2770
HMS Medalist	Navy	105	17	1.4	16.2	2847	3238	2268	3264	2766	2924	2904
ND Polar	Navy	105	15	1.7	15.5	3172	2994	2086	2121	2103	2400	2593
T9905	Navy	105	15	3.1	20.0	3326	3118	1994	2368	2181	2493	2701
ND Rosalind	Pink	104	13	3.4	26.5	--	--	2245	2240	2242	--	--
Coral	Pink	105	17	--	29.8	--	--	--	2089	--	--	--
Magnolia	Pink	103	15	--	32.4	--	--	--	2135	--	--	--
Cowboy	Pinto	103	20	4.4	27.1	3074	3246	2283	2161	2222	2563	2691
LaPaz	Pinto	103	14	4.1	23.6	3155	3496	2351	1308	1830	2385	2578
Monterrey	Pinto	103	16	2.9	23.5	3189	3254	2839	1578	2208	2557	2715
ND Falcon	Pinto	104	15	2.8	28.4	3278	2684	1957	1412	1684	2018	2333
ND Palomino	Pinto	104	15	3.7	31.7	2632	2557	2284	2117	2200	2319	2397
Torreon	Pinto	103	16	3.8	27.4	3558	2767	2242	1600	1921	2203	2542
Vibrant	Pinto	103	15	3.8	27.1	3626	3227	2857	2034	2445	2706	2936
Windbreaker	Pinto	103	14	4.1	29.3	2490	3109	2525	1907	2216	2514	2508
USDA Diamondback	Pinto	103	14	3.4	28.8	--	3050	2163	1663	1913	2292	--
ND Rodeo	Pinto	103	16	3.6	29.8	--	2868	2778	1955	2367	2534	--
USDA Rattler	Pinto	105	18	2.2	34.4	--	3546	2417	3256	2836	3073	--
Gleam	Pinto	103	16	--	23.9	--	--	--	1707	--	--	--
Merlot	Small Red	103	16	5.3	28.6	2875	2493	1952	1745	1849	2063	2266
Viper	Small Red	103	16	3.2	21.4	3626	--	2033	2289	2161	2649	--
Trial Mean		104	15.8	3.1	25.5	3160	3063	2225	2128			
C.V. %		0.9	14.4	--	5.6	8.9	7.0	12.0	18.1			
LSD 10%		1.3	3.1	--	2.0	336	--	552	530			

Days to mature (R9) at least 80% of pods showing yellow and mostly ripe.
Trials were direct harvested 2022-2025.

Field Pea, Langdon 2023-2025 (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 2023	Yield 2024	Yield 2025	Yield 2 yr Avg.	Yield 3 yr Avg.
			(days)	(in)	(1-9)	(g)		(lbs/bu)	(%)	bu/a				
Yellow Cotyledon Type														
CDC Inca	Meridian Seeds	48	94	21	6	194	2351	64.7	26.7	77.7	90.8	65.4	78.1	78.0
AAC Julius	Valesco Genetics	47	92	17	7	188	2430	64.2	26.6	86.6	70.3	43.6	56.9	66.8
ND Dawn	NDSU	45	89	14	8	193	2350	64.0	25.4	73.7	66.0	49.4	57.7	63.0
CDC Engage	Alliance Seed	53	98	19	7	199	2290	65.4	28.1	--	--	47.6	--	--
CP5222Y	Winfield/Croplan	43	91	20	6	220	2079	63.6	28.2	81.8	81.5	57.4	69.5	73.6
CP5411Y	Winfield/Croplan	49	92	17	7	187	2455	63.5	27.3	--	--	39.6	--	--
EG25001	Evolution Genetics	45	92	20	6	199	2291	64.1	29.9	--	--	64.1	--	--
Navigator	Evolution Genetics	48	92	17	7	189	2414	63.5	25.6	--	--	48.7	--	--
GTPR004	GeneTech	52	95	16	8	186	2444	64.5	26.6	--	74.3	40.6	57.4	--
GTPR005	GeneTech	51	96	17	7	191	2385	64.1	26.3	--	75.5	45.3	60.4	--
GTPR007	GeneTech	53	95	17	7	172	2658	64.7	27.1	--	--	42.9	--	--
AAC Beyond	Meridian Seeds	49	92	15	8	179	2561	64.0	26.7	87.8	70.5	62.0	66.2	73.4
AAC Carver	Meridian Seeds	45	92	22	5	195	2331	63.9	25.3	--	91.7	63.4	77.6	--
MS GrowPro	Meridian Seeds	46	93	22	6	254	1798	63.4	29.4	80.0	87.3	60.4	73.8	75.9
MS ProStar	Meridian Seeds	48	94	20	6	200	2301	64.1	27.0	78.0	82.0	55.4	68.7	71.8
21162	Peterson Farms Seed	50	98	22	6	207	2190	64.8	29.3	--	--	50.1	--	--
21163	Peterson Farms Seed	52	96	17	7	171	2660	65.9	29.3	46.4	73.7	34.5	54.1	51.5
Protin	Photosyntech	49	91	18	7	268	1695	63.5	29.0	81.5	93.6	63.0	78.3	79.4
PSTSPS54	Photosyntech	52	93	19	7	198	2293	63.6	26.5	--	84.7	46.7	65.7	--
PSTSPS55	Photosyntech	45	90	19	6	195	2348	63.8	27.5	--	88.8	47.3	68.1	--
PSTSPS59	Photosyntech	42	90	20	6	216	2109	63.7	28.3	--	--	45.8	--	--
PSTSPS60	Photosyntech	46	93	16	8	203	2243	64.1	26.6	--	--	37.4	--	--
CDC Dakota	Premier Genetics	51	95	14	8	170	2681	63.5	30.2	--	--	41.9	--	--
Orchestra	Premier Genetics	43	91	20	6	252	1803	64.0	28.3	82.1	85.4	65.9	75.6	77.8
PG Bank	Premier Genetics	46	92	17	7	188	2430	63.9	28.1	--	80.4	50.7	65.5	--
DS Admiral	Pulse USA	43	87	15	8	219	2076	62.7	25.9	82.1	66.3	59.4	62.9	69.3
PG Cash	Premier Genetics	45	89	14	8	225	2020	62.5	27.9	75.9	83.7	66.4	75.1	75.3
PG Prairie	Premier Genetics	49	96	21	6	193	2370	64.9	26.6	--	80.4	58.2	69.3	--
2822	Valesco Genetics	48	95	20	6	177	2574	64.0	27.9	--	72.8	44.6	58.7	--
25-84 (Thor)	Valesco Genetics	43	93	19	7	228	2010	63.5	29.0	--	--	62.2	--	--

Field Pea, Langdon 2023-2025 (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 2023	Yield 2024	Yield 2025	Yield 2 yr Avg.	Yield 3 yr Avg.
			(days)	(in)	(1-9)	(g)		(lbs/bu)	(%)	bu/a	bu/a	bu/a	bu/a	bu/a
Yellow Cotyledon Type														
AAC Chrome	Valesco Genetics	47	97	15	8	201	2266	64.6	26.9	84.5	72.3	58.5	65.4	71.8
AAC Harrison	Valesco Genetics	47	96	21	6	186	2452	65.2	27.8	--	--	59.4	--	--
AAC IronHorse	Valesco Genetics	48	96	23	6	189	2414	64.4	26.4	--	--	45.1	--	--
AAC McMurphy	Valesco Genetics	50	96	20	6	191	2404	64.2	27.9	--	78.0	44.7	61.3	--
Green Cotyledon Type														
ND Victory	NDSU	51	97	24	5	148	3078	65.2	26.6	72.4	68.3	39.8	54.1	60.2
Aragorn	Pulse USA	43	90	17	7	201	2266	62.6	26.1	67.6	61.5	40.3	50.9	56.5
Arcadia	Pulse USA	44	88	11	9	189	2418	62.7	25.5	70.2	67.0	51.3	59.2	62.8
PG Greenback	Premier Genetics	52	95	23	6	196	2332	64.4	26.3	--	85.4	45.6	65.5	--
PSTSPS49	Photosyntech	50	91	22	6	176	2584	64.7	26.5	82.0	81.9	51.8	66.8	71.9
PSTSPS57	Photosyntech	48	93	21	6	188	2417	64.6	25.4	--	88.1	59.6	73.9	--
PSTSPS61	Photosyntech	47	93	22	6	203	2245	64.2	26.2	--	--	49.7	--	--
Maple Cotyledon Type														
PSTSPS48	Photosyntech	48	91	16	7	221	2058	63.0	27.4	80.2	72.8	49.0	60.9	67.3
Trial Mean		48	93	18	7	196	2353	64.1	27.2	78.9	76.7	50.6		
C.V. %		2.0	2.0	16.0	13.0	8.0	9.0	1.2	3.6	7.4	11.4	14.7		
LSD 10%		1	2	3	1	18	246	0.9	1.1	7.9	10.2	8.7		

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

[2] 0% moisture basis

Soybean - RR2XF, Enlist E3, and GT, Langdon 2025

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity	Plant Height	Oil	Protein	Yield 2025	Yield 2-yr Avg.
				date[3]	(in)	(%)	(%)	----------bu/a----------	
Channel	00526RXF	RR2XF	00.5	09/18	36	15.6	33.4	53.4	--
Channel	00924RXF	RR2XF	00.9	09/24	36	14.9	33.6	58.4	57.5
Dyna-Gro	S009XF33	RR2XF	00.9	09/21	31	15.0	33.7	53.6	--
Dyna-Gro	S01XF25	RR2XF	0.1	09/24	39	15.1	33.3	55.1	58.3
Fortus	0084E	Enlist E3	00.9	09/29	32	15.2	34.9	56.7	62.7
Fortus	0086E	Enlist E3	0.8	09/28	34	16.1	32.8	59.7	--
Fortus	0165E	Enlist E3	0.1	09/28	34	15.2	35.0	56.9	60.8
Golden Harvest	GH00973E3	Enlist E3	00.9	09/26	31	15.1	35.0	56.8	63.0
Golden Harvest	GH0116E3	Enlist E3	0.1	09/26	36	15.3	34.7	57.6	--
Integra	XF0063	RR2XF	0.6	09/11	32	15.9	32.9	55.7	54.2
Integra	XF0115	RR2XF	0.1	09/25	40	14.7	34.7	58.9	--
Legacy	L00860E	Enlist E3	0.8	09/29	33	14.9	35.9	58.3	--
Legacy	L0160E	Enlist E3	0.1	09/30	33	15.4	34.3	58.2	--
Legacy	LS0098-23 XF	RR2XF	00.9	09/27	35	16.4	32.5	56.5	63.0
Legacy	LS014-23 XF	RR2XF	0.1	09/25	37	15.3	33.2	52.5	55.7
Legacy	LS024-25 XF	RR2XF	0.2	09/28	34	15.8	31.5	57.8	--
Legacy	LS034-24 XF	RR2XF	0.2	09/29	36	16.3	32.2	59.8	65.7
NDSU	ND17009GT	GT	00.9	09/24	38	16.7	34.9	46.8	47.6
Proseed	EL50-13N	Enlist E3	0.1	09/26	34	15.0	35.5	61.3	--
Proseed	EL60-083	Enlist E3	0.8	09/26	36	15.3	35.1	61.0	--
Proseed	XF30-092N	RR2XF	00.9	09/26	38	16.0	33.3	63.6	64.8
Proseed	XF60-082	RR2XF	0.8	09/24	39	15.5	33.3	57.8	--
Proseed	XF60-092	RR2XF	00.9	09/25	38	15.1	34.0	58.5	--
Thunder Seed	TE76007	Enlist E3	0.7	09/20	35	15.2	35.7	54.3	--
Thunder Seed	TE7601N	Enlist E3	0.1	09/27	36	15.8	34.2	56.8	--
Thunder Seed	TX8301	RR2XF	0.1	09/22	31	15.4	34.4	54.6	--
Thunder Seed	TX8402N	RR2XF	0.2	09/24	36	15.2	33.2	53.9	54.8
Thunder Seed	TX85008	RR2XF	0.8	09/25	38	15.2	34.3	57.7	59.9
Xitavo	XO 0094E	Enlist E3	0	09/29	35	15.0	35.4	60.2	62.9
Trial Mean				9/25	34.9	15.5	34.0	56.1	
C.V. %				1.8	11.6	1.2	1.4	6.6	
LSD 10%				2.5	4.8	0.2	0.6	4.3	

[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 2025

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Oil (%)	Protein (%)	Yield 2025	Yield 2 yr Avg.
								---------- bu/a----------	
Channel	0325RXF	RR2XF	0.3	09/22	36	15.0	36.9	52.3	55.3
Dyna-Gro	S01XF25	RR2XF	0.1	09/19	35	14.9	35.7	46.1	--
Dyna-Gro	S03XF36	RR2XF	0.3	09/20	37	15.1	37.3	53.9	--
Fortus	0084E	Enlist E3	00.9	09/22	33	14.1	37.8	50.0	49.2
Fortus	0086E	Enlist E3	00.8	09/19	31	14.6	37.2	50.1	--
Fortus	0165E	Enlist E3	0.1	09/19	32	14.5	38.0	46.0	46.3
Fortus	0324E	Enlist E3	0.3	09/21	35	14.7	36.9	51.7	51.2
Fortus	0544E	Enlist E3	0.5	09/24	31	14.5	37.2	45.3	47.3
Golden Harvest	GH0384XF	RR2XF	0.3	09/21	37	15.0	36.0	54.4	58.5
Golden Harvest	GH0446XF	RR2XF	0.4	09/23	34	15.4	35.1	59.7	--
Integra	XF0115	RR2XF	0.1	09/20	35	14.5	36.1	52.7	52.2
Integra	XF0493	RR2XF	0.4	09/24	35	14.9	37.0	51.7	48.9
Legacy	L0360E	Enlist E3	0.3	09/21	32	14.7	37.1	46.0	--
Legacy	L0380E	Enlist E3	0.3	09/23	23	14.2	38.5	45.0	--
Legacy	LS014-23 XF	RR2XF	0.1	09/20	33	14.8	35.9	44.7	--
Legacy	LS024-25 XF	RR2XF	0.2	09/22	29	14.6	36.3	49.4	--
Legacy	LS034-24 XF	RR2XF	0.2	09/21	37	15.2	36.4	52.9	57.3
NDSU	ND17009GT	GT	00.9	09/22	29	15.6	37.6	44.0	45.5
Proseed	EL50-13N	Enlist E3	0.1	09/18	31	14.2	38.1	45.9	--
Proseed	EL50-33N	Enlist E3	0.3	09/23	29	14.8	36.7	44.3	50.5
Proseed	EL60-33N	Enlist E3	0.3	09/24	24	14.2	38.4	44.4	--
Proseed	XF60-22N	RR2XF	0.2	09/21	33	14.4	35.8	53.4	--
Proseed	XF60-32N	RR2XF	0.3	09/21	33	14.7	35.9	47.8	--
Thunder Seed	TE7405N	Enlist E3	0.5	09/25	34	15.2	36.0	48.6	--
Thunder Seed	TE7603N	Enlist E3	0.3	09/23	31	14.1	37.5	50.4	--
Thunder Seed	TX8402N	RR2XF	0.2	09/20	38	15.1	35.1	46.6	--
Thunder Seed	TX8603N	RR2XF	0.3	09/21	36	14.7	37.3	55.9	--
Thunder Seed	TX8605N	RR2XF	0.5	09/24	35	15.0	36.2	53.7	--
Xitavo	XO 0094E	Enlist E3	0.0	09/22	33	14.3	38.0	50.1	50.5
Xitavo	XO 0234E	Enlist E3	0.2	09/21	34	14.6	37.8	47.4	54.1
Trial Mean				9/21	32.1	14.8	36.8	48.8	
C.V. %				1.2	8.6	1.3	1.0	7.8	
LSD 10%				1.6	3.3	0.2	0.4	4.5	

[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, Pembina County 2025

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Oil (%)	Protein (%)	Yield 2025	Yield 2 yr Avg.[4]
								----------bu/a----------	
Channel	00526RXF	RR2XF	00.5	09/19	37	15.5	33.8	52.1	--
Channel	00924RXF	RR2XF	00.9	09/20	41	15.4	33.0	57.8	--
Dyna-Gro	S009XF33	RR2XF	00.9	09/22	32	15.3	34.1	52.8	54.3
Dyna-Gro	S01XF25	RR2XF	0.1	09/22	42	15.5	33.6	54.6	--
Golden Harvest	GH00973E3	Enlist E3	00.9	09/22	34	15.2	35.0	54.3	56.1
Golden Harvest	GH0116E3	Enlist E3	0.1	09/24	37	15.2	35.8	55.1	--
Integra	XF0063	RR2XF	0.6	09/20	37	15.4	33.9	52.5	54.4
Legacy	L00860E	Enlist E3	0.8	09/24	35	15.7	34.3	50.5	--
Legacy	L0160E	Enlist E3	0.1	09/26	35	15.8	33.8	57.8	--
Legacy	LS0098-23 XF	RR2XF	00.9	09/24	36	16.2	33.0	49.5	55.4
Legacy	LS014-23 XF	RR2XF	0.1	09/23	40	14.9	34.8	49.3	55.3
Legacy	LS024-25 XF	RR2XF	0.2	09/23	40	15.6	33.7	58.8	--
Legacy	LS034-24 XF	RR2XF	0.2	09/24	39	16.0	33.6	57.2	--
NDSU	ND17009GT	GT	00.9	09/23	37	15.8	36.0	48.6	50.9
Proseed	EL50-13N	Enlist E3	0.1	09/24	37	15.5	34.5	54.3	--
Proseed	XF30-092N	RR2XF	00.9	09/22	38	16.6	33.0	54.7	58.7
Proseed	XF60-092	RR2XF	00.9	09/22	26	15.5	33.8	54.1	--
Proseed	XF60-22N	RR2XF	0.2	09/23	38	15.7	32.5	57.8	--
Thunder Seed	TE76007	Enlist E3	0.7	09/19	37	15.7	35.3	48.0	--
Thunder Seed	TE7601N	Enlist E3	0.1	09/24	40	15.7	35.4	56.1	--
Thunder Seed	TX8301	RR2XF	0.1	09/22	34	15.2	34.1	53.7	55.9
Thunder Seed	TX8402N	RR2XF	0.2	09/21	40	15.7	33.1	51.3	54.5
Thunder Seed	TX85008	RR2XF	0.8	09/21	36	15.6	34.1	52.9	--
Xitavo	XO 0094E	Enlist E3	0	09/25	35	16.3	33.5	57.7	58.3
Trial Mean				9/22	36	15.6	34.1	53.0	
C.V. %				1.2	8.0	1.8	1.5	7.7	
LSD 10%				1.7	3.4	0.4	0.7	4.8	

[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]The two year average is 2023 and 2025 data because the 2024 trial wasn't harvested.

Yield, oil and protein reported at 13% moisture.

Soybean - RR2XF, Enlist E3, and GT, Walsh County 2025

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity	Plant Height	Oil	Protein	Yield 2025	Yield 2 yr Avg.
				date[3]	(in)	(%)	(%)	bu/a	bu/a
Channel	00924RXF	RR2XF	00.9	09/18	32	15.8	33.8	54.9	58.1
Channel	0325RXF	RR2XF	0.3	09/21	32	16.4	34.4	60.4	65.9
Dyna-Gro	S01XF25	RR2XF	0.1	09/18	33	15.6	34.5	56.5	63.3
Dyna-Gro	S03XF36	RR2XF	0.3	09/21	31	16.2	34.6	61.5	--
Fortus	0084E	Enlist E3	00.9	09/20	30	15.6	35.7	55.7	61.6
Fortus	0086E	Enlist E3	00.8	09/19	29	16.5	34.6	47.5	--
Fortus	0165E	Enlist E3	0.1	09/19	31	16.3	35.4	60.7	64.9
Fortus	0324E	Enlist E3	0.3	09/22	30	16.0	34.2	58.1	59.7
Fortus	0544E	Enlist E3	0.5	09/25	32	16.6	33.3	61.6	63.1
Golden Harvest	GH0225XF	RR2XF	0.2	09/20	30	16.1	34.6	56.1	57.9
Golden Harvest	GH0384XF	RR2XF	0.3	09/22	33	16.2	34.5	56.7	56.4
Integra	XF0115	RR2XF	0.1	09/19	34	15.9	34.4	55.4	61.4
Integra	XF0493	RR2XF	0.4	09/22	32	16.0	34.6	54.9	60.7
Legacy	L0360E	Enlist E3	0.3	09/23	29	16.2	34.6	54.4	--
Legacy	L0380E	Enlist E3	0.3	09/22	33	16.6	34.3	57.5	--
Legacy	LS014-23 XF	RR2XF	0.1	09/19	32	15.8	34.4	52.6	60.8
Legacy	LS024-25XF	RR2XF	0.2	09/20	32	16.2	33.8	56.2	--
Legacy	LS034-24 XF	RR2XF	0.2	09/20	32	16.6	34.2	57.1	66.7
NDSU	ND17009GT	GT	00.9	09/19	33	16.2	37.1	50.4	56.4
Proseed	EL 50-13N	Enlist E3	0.1	09/19	29	15.4	35.8	48.9	59.5
Proseed	EL 50-33N	Enlist E3	0.3	09/23	31	16.1	34.1	53.9	58.7
Proseed	EL60-33N	Enlist E3	0.3	09/22	34	16.5	34.6	56.7	--
Proseed	XF 40-12	RR2XF	0.1	09/20	31	15.7	34.5	54.1	61.1
Proseed	XF60-22N	RR2XF	0.2	09/19	31	15.9	33.8	59.3	--
Thunder Seed	TE7405N	Enlist E3	0.5	09/25	34	16.8	33.4	60.1	--
Thunder Seed	TE7603N	Enlist E3	0.3	09/23	29	15.3	34.8	57.1	--
Thunder Seed	TX8402N	RR2XF	0.2	09/19	32	15.9	34.1	57.9	--
Thunder Seed	TX8603N	RR2XF	0.3	09/21	30	16.6	34.6	55.5	--
Thunder Seed	TX8605N	RR2XF	0.5	09/21	34	16.8	33.0	61.2	--
Trial Mean				9/21	31.3	16.1	34.5	55.2	
C.V. %				1.1	6.4	1.7	1.4	6.8	
LSD 10%				1.5	2.4	0.5	0.8	4.4	

[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 - Conventional, Walsh County 2025

Brand	Variety	Maturity Group[1]	Maturity	Plant Height	Oil	Protein	Yield 2024	Yield 2025	Yield 2 yr Avg.
Conventional:			date[2]	(in)	(%)	(%)	---------bu/a--------		
NDSU	ND Rolette	00.9	9/19	32	16.2	34.7	62.0	66.3	64.1
Richland IFC	MK009	00.9	9/20	31	15.1	34.2	51.7	46.3	49.0
Richland IFC	MK0249	0.2	9/22	26	15.7	33.7	52.1	45.3	48.7
Trial Mean			9/20	29.6	15.8	34.9	59.7	48.9	
C.V. %			5.3	2.0	2.1	1.5	7.8	17.8	
LSD 10%			1.3	6.4	0.4	0.6	5.6	10.6	

[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).

Yield, oil and protein reported at 13% moisture.

Management of Fusarium Head Blight in Barley

Venkat Chapara, Amanda Arens, Larissa Jennings, and Andrew Friskop

This field study was planted on May 14, 2025, at the Langdon Research Extension Center. The experimental trial was designed in a randomized complete block with four replications. Plots were arranged in six 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 canola. 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 the boot stage (Feekes 9-10) at a rate of 300 g per 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. All fungicides were applied at the recommended stage, Feekes 10.51 (10% flowering), on July 5th, with a wind speed of 12 MPH and a temperature of 71°F at 12:30 pm. The initial treatment, consisting of Prosaro Pro, was followed by a second application of Proline four days later, on July 9th, under similar environmental conditions (wind speed: 12 MPH, 76°F at 12:30 pm).

Percent FHB incidence 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 on the heads was rated using a 0-100% scale from the same 50 heads. FHB index was calculated using the formula: Index=(SEV*INC)/100. Plots were harvested on September 2 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: Fusarium Head Blight was significantly lower in fungicide-treated plots compared to the non-treated check. However, no significant differences were observed among the fungicides applied alone at Feekes 10.51 and the Prosaro Pro treatment at Feekes 10.51, followed by Proline applied four days later. Additionally, yield, test weight, and plumpness percentage were significantly higher in fungicide-treated plots than in the non-treated check (Table 1).

Table 1: Efficacy of fungicides at various application timings to manage Fusarium Head Blight on barley.

Treatments	Rate (Oz/A)	% Incidence	Fusarium Head Blight % Severity	INDEX	DON	Plump (%)	Yield lbs/A	Test Weight lbs/bu
Non-Treated Check	Check	92	22	20	14	97	83	45
Prosaro Pro	10.3	25	3	0.8	2	98	100	47
Prosaro Pro	13.6	20	2	0.4	3	98	96	47
Miravis Ace	13.7	22	2	0.4	5	99	94	47
Sphaerex	7.3	25	2	0.7	2	98	91	46
Prosaro Pro fb Proline	10.30 + 5	22	2	0.5	3	99	95	47
	Mean	**34**	**5**	**4**	**5**	**98**	**93**	**46**
	CV%	**28**	**34**	**45**	**53**	**1**	**5**	**2**
	LSD	**14**	**3**	**3**	**4**	**1**	**7**	**1**
	P-Value (0.05)	**0.00001***	**0.00001***	**0.00001***	**0.00001***	**0.0450***	**0.0041***	**0.0052***

Note: All treatments of fungicide were mixed with an adjuvant; Induce @ 0.125% v/v.

Acknowledgements: Funding from NIFA (USWBSI), and a special thanks to Noah Foster, Kaleb Foster, Aiden Brown, and Carleen Schill.

Efficacy of Fungicides to Manage Fusarium Head Blight in Hard Red Spring Wheat

Venkat Chapara, Amanda Arens, and Larissa Jennings

A field study was planted on May 23, 2025, at the Langdon Research Extension Center. The experimental design was a randomized complete block with four replications. Plots consisted of six rows, spaced six inches apart, with a row length of 20 feet. These were trimmed to 15 feet for harvest. The variety 'WB 9590' HRSW was seeded at a rate of 1.2 million pure live seeds per acre. A non-treated border plot was planted between treated plots to minimize spray drift interference. The previous crop was canola. No pre-emergent herbicide was applied. A post-emergent herbicide application included Huskie FX (18 fl oz/a), Axial Bold (15 fl oz/a), and Prowl (2.5 pt/a) was applied on June 11, 2025.

Corn spawn inoculum was distributed across the plots at the boot stage (Feekes 9-10) at a rate of 300 g per plot. To promote Fusarium Head Blight (FHB) development, supplemental moisture was applied daily for 1 hour from head emergence to the soft dough stage (Feekes 10.5 to 11.25). Fungicides were subsequently administered using a CO_2 backpack sprayer with a three-nozzle boom (XR8001) at 40 psi and a water volume of 15 GPA. The initial fungicide application occurred at Feekes 10.51 (10% flowering) on July 10 (wind speed 11 MPH, 80°F at 11:30 am). The second application, 4 days after the first (4 DAF), involved Prosaro Pro, Sphaerex, and Tebuconazole for treatments 9, 10, and 11, respectively, which had previously received Miravis Ace at the 10.51 stage. Treatment 12 was sprayed with Sphaerex at 4 DAF. All 4 DAF applications were conducted on July 14, 2025 (wind speed 9 MPH, 72°F at 2:30 pm).

Percent FHB incidence was calculated by counting the number of heads showing FHB symptoms out of 50 randomly selected heads. The two outer rows in the plot were excluded. FHB severity was rated on a 0-100% scale based on those same heads. FHB index was calculated using the formula: Index=(SEV*INC)/100. Plots were harvested on August 29th with a plot combine. Yield and test weight were determined. Statistical analysis was carried out using Genovix Generation II software. Fisher's least significant difference (LSD) was used to compare means at p (α = 0.05).

Results

Compared with the non-treated check, all the fungicides evaluated were effective in managing percent incidence, severity, index, and DON of Fusarium Head Blight (FHB), except for the low and high rates of the fungicide, 'Badge'. The treatment with Miravis Ace followed by Prosaro Pro resulted in the lowest FHB incidence. This was closely followed by Miravis Ace followed by Sphaerex when sprayed at the respective application stages (Table 1). These treatments each have received two sprays during the flowering season. FHB severity, index, DON, yield, and test weight in the remaining treatments also showed significant differences from the non-treated check. This validates the effectiveness of the treatments. The treatment 'experimental compound' led to the highest yields, highlighting its potential practical implications. In contrast, the lowest yield was recorded in the low and high rates of 'Badge', which was even lower than that of 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.

		Fusarium Head Blight				Yield	Test Weight
Treatments	**Rate (Oz/A)**	**% Incidence**	**% Severity**	**INDEX**	**DON (ppm)**	**(bu/A)**	**(lbs/bu)**
Non-Treated Check	0	62	7	4	7	52	58
Prosaro	8.2	14	1	0.2	1	59	60
Experimental	8.59	15	1	0.2	1	64	59
Miravis Ace	13.7	18	2	0.3	2	60	60
Prosaro Pro	10.3	11	1	0.1	1	58	59
Sphaerex	7.3	14	1	0.1	1	58	59
Badge SC Low rate	19.2	53	5	2	5	42	57
Badge SC High rate	29	61	5	3	5	42	57
Miravis Ace fb Prosaro Pro	13.7+10.3	9	1	0.1	1	59	59
Miravis Ace fb Sphaerex	13.7+7.3	10	1	0.1	1	62	59
Miravis Ace fb Tebuconazole	13.7+4	15	1	0.2	1	62	60
Sphaerex (4 DAF)	7.3	21	2	0.6	2	59	60
	Mean	**25**	**2**	**1**	**2**	**56**	**59**
	CV %	**40**	**49**	**82**	**49**	**7**	**2**
	LSD	**14**	**2**	**1.2**	**2**	**6**	**1**
	P-Value (0.05)	**0.00001***	**0.00001***	**0.00001***	**0.00001***	**0.00001***	**0.00001***

Note: All treatments were applied with non-ionic surfactant (NIS) @ 0.125 v/v.
*Indicates significant difference
4 DAF: 4 Days after first spray

Acknowledgements: Funding from NIFA (USWBSI), and a special thanks to Noah Foster, Kaleb Foster, Aiden Brown, and Carleen Schill.

Evaluation of Foliar Fungicide Treatments to Manage Blackleg on Canola

Venkat Chapara, Amanda Arens, and Larissa Jennings

Objective: To evaluate foliar fungicide treatments on two varieties of canola to manage blackleg.

Materials and Methods:

The objective of this research trial, conducted at the Langdon Research Extension Center, was to evaluate and compare the effectiveness of seven foliar fungicide treatments (Table 2) in managing blackleg disease on two canola cultivars, 'InVigor L340PC' and 'P612L', when sprayed at the 4-6 leaf stage. These cultivars have variable resistance to blackleg. The trial began on May 28, 2025, and utilized a randomized complete block design with a factorial arrangement (varieties as main plots; fungicides as subplots), replicated four times. State-recommended land preparation, fertilization, seeding rate, weed and insect control practices were followed. Plots measured 5 ft. wide by 16 ft. long and were inoculated twice with blackleg ascospores at the 2-4 leaf stage. Disease incidence and severity (on a 0-100 scale) were recorded after swathing on September 3, using ratings from twenty-five canola stubbles per plot. The data were analyzed using analysis of variance in a complete-block, balanced, orthogonal design via Genovix version II software. Plant vigor (0 - dead and 10 – most vigorous) was rated a week after the foliar sprays of the fungicides.

Table 1: Response of two canola varieties to receiving foliar fungicide treatments on mean blackleg (disease) incidence, severity, plant vigor, yield, and test weight.

Variety	Blackleg % Incidence	Blackleg % Severity	Plant Vigor (0-10)	Yield (lbs/A)	Test Weight (lbs/bu)
L340PC	16	3	9	2687	51.03
P612L	13	3	10	2386	51.28
Mean	**15**	**3**	**9**	**2537**	51
CV %	**56**	**84**	**9**	**10**	1
LSD	**NS**	**NS**	**0.8**	**256**	**0.21**
P-Value (0.05)	**NS**	**NS**	**0.0055***	**0.00001***	**0.024***

Table 2: Efficacy of foliar fungicide treatments on mean blackleg (disease) incidence, severity, vigor, phytotoxicity, yield, and test weights.

Treatments	Rate Oz/A	Blackleg % Incidence	Blackleg % Severity	Plant Vigor (0-10)	Yield (lbs/A)	Test Weight (lbs/bu)
Revytek	15	19	6	9	2607	51
Propulse	18	14	2	9	2515	51
Priaxor	8	18	4	9	2444	51
Miravis Neo	13.7	13	2	9	2519	51
Quadris	15.5	11	2	9	2469	51
Headline	12	19	5	8	2458	51
Proline	5.7	11	2	9	2718	51
Non-treated	0	14	3	9	2563	51
	Mean	**15**	**3**	**9**	**2537**	**51**
	CV %	**56**	**84**	**9**	**10**	**0.8**
	LSD	**NS**	**1**	**NS**	**NS**	**NS**
	P-Value (0.05)	**NS**	**0.024***	**NS**	**NS**	**NS**

NS indicates no significant differences were observed statistically
*Statistical differences were observed among the treatments

Results: The research results show that canola foliar fungicide treatments have practical implications for reducing the severity of blackleg. However, the varieties tested as the main plot treatments showed no statistically significant differences in the parameters tested, except for vigor, yield, and test weight. InVigor L340PC yielded higher than the variety P612L (Table 1). Likewise, the fungicide subplot treatments showed no significant differences in the parameters tested, except for blackleg severity (Table 2). No statistically significant interactions between varieties and foliar fungicide treatments were observed for any of the parameters tested. These results provide crucial insights into foliar fungicides as a blackleg management tool, and the research has to be repeated to provide recommendations to the growers.

Acknowledgements: Funding from the NCGA (Northern Canola Growers Association), and a special thanks to Noah Foster, Kaleb Foster, Aiden Brown, and Carleen Schill.

Canola Disease Survey in North Dakota – 2025

Venkat Chapara, Amanda Arens, and Larissa Jennings

In 2025, canola was grown in 48 counties of North Dakota. Of these, 21 major canola-producing counties were surveyed following swathing or direct harvest, with 94 fields scouted. During this process, the project team monitored the incidence of five diseases: Verticillium stripe, white mold, blackleg, clubroot, and powdery mildew. In addition to the disease monitoring, purple stem, a stress response exhibited by canola plants to biotic or abiotic factors, was also assessed.

Results:

Table 1: Percentage of canola fields exhibiting disease during the annual assessment across canola-growing counties in North Dakota.

County	Verticillium Stripe	White Mold	Blackleg	Clubroot	Powdery Mildew	Purple Stem
Benson	100	80	100	0	0	0
Bottineau	100	80	40	0	20	20
Bowman	100	100	100	0	100	100
Burke	100	100	100	0	0	0
Cavalier	100	71	76	35	0	0
Grand Forks	100	100	80	0	0	0
McHenry	100	100	80	0	0	0
McLean	100	100	60	0	20	20
Mountrail	100	100	100	0	0	0
Nelson	100	100	80	0	0	0
Pembina	80	20	40	0	0	0
Pierce	100	100	100	0	0	20
Ramsey	67	0	50	0	0	0
Renville	100	100	25	0	25	25
Rolette	100	100	67	0	0	0
Steel	100	100	100	0	0	0
Towner	100	100	50	0	17	17
Walsh	100	0	80	0	0	0
Ward	100	100	20	0	0	0
Wells	100	100	50	0	0	0
Average	**92**	**83**	**66**	**2**	**9**	**10**

In summary, major canola diseases were observed in a large number of fields in North Dakota; however, the incidence levels were low. When elaborated, Verticillium stripe appeared in 92% of surveyed canola fields, with an average disease incidence rate of 12% in each field visited. White mold was found in 83% of fields (6% incidence), blackleg in 66% (5% incidence), powdery mildew in 9% (4% incidence), and purple stem in 10% (3% incidence) of fields surveyed. Clubroot was present only in Cavalier County, detected in 35% of the fields surveyed (with an average incidence of 41%) (Tables 1 & 2).

Table 2: Incidence percentages of canola diseases observed in each field visited during the annual survey conducted in North Dakota.

County	Verticillium Stripe	White Mold	Blackleg	Clubroot	Powdery Mildew	Purple Stem
Benson	13	12	5	0	0	0
Bottineau	7	6	2	0	6	6
Bowman	2	2	2	0	40	30
Burke	12	7	3	0	0	0
Cavalier	23	6	19	41	0	0
Grand Forks	12	8	5	0	0	0
McHenry	9	8	3	0	5	0
McLean	14	8	2	0	0	0
Mountrail	14	10	2	0	0	0
Nelson	17	11	3	0	0	0
Pembina	31	8	16	0	0	0
Pierce	10	6	4	0	0	3
Ramsey	10	0	13	0	0	0
Renville	15	9	1	0	7	4
Rolette	13	5	3	0	3	3
Slope	8	2	2	0	20	10
Steel	2	6	6	0	0	0
Towner	13	5	2	0	2	2
Walsh	14	0	13	0	0	0
Ward	13	6	0	0	10	0
Wells	6	5	2	0	0	0
Average	**12**	**6**	**5**	**3**	**4**	**3**

Monitoring for Resistance Breakdown in the Clubroot Resistant Cultivars of Canola

Venkat Chapara

In the ongoing annual clubroot survey in canola fields, a crucial research initiative was conducted in 21 counties of North Dakota. The survey revealed a breakdown of first-generation resistance to clubroot in resistant canola cultivars in Cavalier County for the second consecutive year (Table 1). The breakdown of cultivar resistance to clubroot is a significant threat to the canola crop. However, with the proper measures, such as practicing longer crop rotations (one in four years) in acidic soils, using multi-gene clubroot-resistant canola cultivars, and maintaining proper equipment sanitation in endemic areas, growers can play a crucial role in preventing the spread of clubroot. 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		
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 roots was observed in the clubroot resistant varieties of canola.

Figure 2: Patch of clubroot infections in a canola field planted with a clubroot resistant variety.

Evaluation of Seed Treatments to Manage Verticillium Stripe on Canola

Venkat Chapara, Amanda Arens, and Larissa Jennings

A research trial was conducted at the Langdon Research Extension Center to evaluate the effectiveness of seed treatments for managing Verticillium in canola. The trial began on May 28, 2025, using the canola cultivar ‘InVigor L233P’ and a range of seed treatments, which were compared to non-treated seed. The experimental design was a randomized complete block structure with four replications. State-recommended protocols were followed for land preparation, fertilization, seeding rate, and weed control. Each plot measured 5 feet in width by 16 feet in length. Verticillium inoculum was produced by culturing isolates on wheat spawn in the laboratory in March 2025 and was applied at planting. After swathing, twenty-five canola stubbles per plot were evaluated for Verticillium incidence and severity by observing infection levels on the cross-sections of stems selected for rating (Figure 1). Disease severity was assessed on a 0-100% scale, where 0 indicated no visible disease tissue in the cross-section and 100% indicated dead or fully diseased tissue. The Verticillium mean disease severity index was calculated by multiplying the mean incidence by the percent severity and dividing the product by 100. Data were analyzed using analysis of variance with complete-block and balanced-orthogonal designs generated by Genovix Generation II software.

Table 1: Efficacy of seed treatments on Verticillium stripe incidence, severity, index, plant stand, yield and test weight on canola.

	Verticillium Stripe				Yield	Test Weight
Treatments	**% Incidence**	**% Severity**	**Index**	**Plant Stand/A**	**(lbs/a)**	**(lbs/bu)**
Trunemco	21	8	2	127,015	2214	51
Saltro	23	8	2	138,803	2184	51
Evergol Energy	20	5	1	123,874	2185	51
Intego Solo	25	7	3	125,462	2257	51
Rancona Summit	14	4	1	127,686	2358	51
Trilex	19	5	1	141,979	2298	51
Mertect	20	5	1	124,192	2209	51
Non-Treated	45	20	9	123,556	2106	52
Mean	**23**	**8**	**2**	**129,071**	**2226**	**51**
CV %	**44**	**45**	**75**	**18**	**7**	**0.9**
LSD	**15**	**5**	**3**	**NS**	**NS**	**NS**
P-Value (0.05%)	**0.0147***	**0.0001***	**0.0001***	**NS**	**NS**	**NS**

Results: The evaluated seed treatments resulted in significant differences in Verticillium stripe incidence, severity, and index, suggesting that the seed treatments may effectively manage Verticillium stripe. Notably, the Rancona Summit treatment produced the highest yield, while the non-treated control exhibited the lowest yield (Table 1). There were no significant differences detected for plant stand, yield, or test weight.

Figure 1: Verticillium stripe incidence and severity ratings were recorded by making the cross section of the canola stems at the collar region.

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 to evaluate the performance of fungicides to manage white mold in canola. The trial was planted on May 27, 2025, with the Roundup Ready canola variety 'Dekalb 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 for 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 conducted 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 branches 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 the 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.

Treatments & their rate	White Mold % Incidence	% MDS	Yield lbs/A	Test Weight lbs/bu
Non-treated Check	73	56	1647	52
Miravis Neo @ 13.7 fl oz/a	6	3	1651	51
ProPulse @ 13.6 fl oz/a	0	0	1864	52
Priaxor @ 4 fl oz/a	25	9	1789	52
Topsin 70WP @ 2 lb/a	10	4	1775	52
Endura @ 6 oz/a	19	10	1833	52
MEAN	**22**	**14**	**1760**	**52**
CV%	**32**	**30**	**10**	**0.8**
LSD	**11**	**6**	**NS**	**NS**
P-Value (0.05)	**0.00001***	**0.00001***	**NS**	**NS**

Note: Non-Ionic Surfactant was added to each treatment of fungicide at the rate of 0.25% v/v
*Significant differences among the treatments at P-value < 0.05.
NS: Non-Significant differences among the treatments at P-value < 0.05.

Results: There were significant differences observed in white mold incidence and mean disease severity (MDS) among the treatments tested. The fungicide ProPulse® followed by Miravis Neo® 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. ProPulse® yielded the highest among the treatments tested.

Acknowledgements: Special thanks to Noah Foster, Kaleb Foster, Aiden Brown, and Carleen Schill.

Clubroot Survey: Monitoring the Clubroot Spread in the Major Canola Growing Counties

Principle Investigator: Venkat Chapara
Collaborators: Zhaohui Liu, Luis del Rio, Neeraja Narra, Dante Marino, 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.

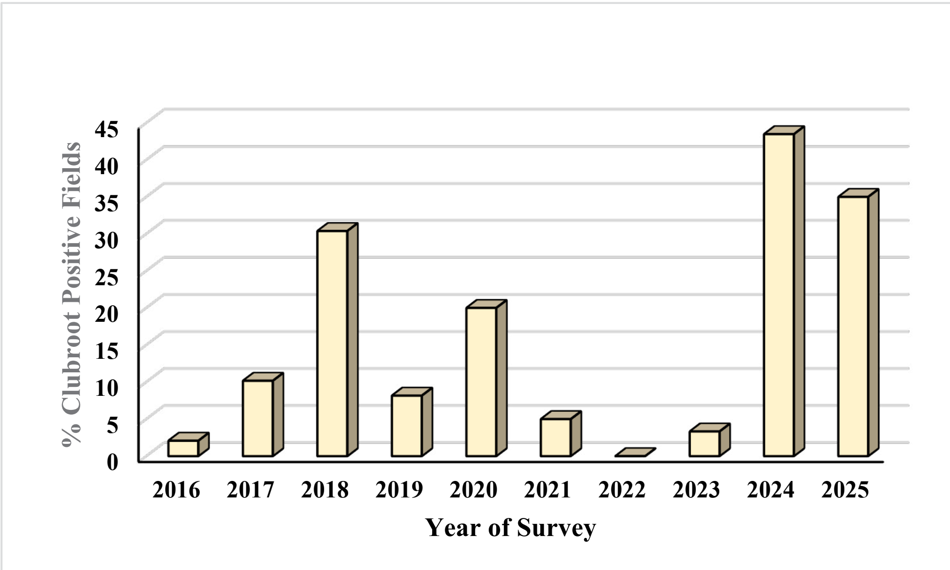
1st Phase: At flowering (10% of flowering onwards)

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, and 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 from AARD indicated that the probability of finding clubroot was higher if scouted at the field entrances. Hence, the survey was initiated 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 (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 AgVise© Soil Testing Laboratory for pH determination.

Results: The results of the clubroot survey in North Dakota indicate that 7 of the 94 fields surveyed had canola roots with galls infected by the clubroot pathogen. All the clubroot positives were found in Cavalier County, with a sudden increase in clubroot observed in 2024, rising to 48% of clubroot-infected canola fields, and this trend continued in 2025 with a 35% incidence (Figure 1). These clubroot-positive findings represent the highest incidence since the 2018 endemic. The rise in clubroot could be attributed to the breakdown of clubroot resistance in first-generation clubroot-resistant cultivars released by different companies. A drastic change in crop production practices by growers, such as crop rotation every 4 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 ten 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 the 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 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 in the survey (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%). The lowest percentage obtained was in Nelson County (25%). The highest number of resting spores (1,500,000) per gram of soil was obtained in a field in Cavalier County, while the lowest (11,000) per gram of soil was in Rolette and Towner Counties. Visible gall symptoms on roots were observed 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, the percentage of positive fields obtained with resting spores in various counties, and the range of pH of the soil obtained in each county in our survey.

		Percent Fields with Clubroot	pH	
County	CR Resting spore Range	Positives	Low	High
Bottineau	3/5 (546000-1500000)	60	5.4	7.4
Cavalier	22/30 (17000-807000)	73	4.9	7.9
Grand Forks	2/5 (60000-154000)	40	6.9	8.2
McLean	2/5 (550000-1450000)	40	5.1	7.8
Nelson	1/4 (35000)	25	7.1	8.1
Pembina	3/6 (62000-546000)	50	5.6	8.2
Ramsey	2/5 (306000-318000)	40	6.3	7.5
Renville	2/4 (141000-197000)	50	5.7	8.1
Rolette	2/5 (11000-37000)	16	6.8	7.7
Towner	4/6 (11000-62000)	67	5.2	7.9
Walsh	3/4 (18000-65000)	75	7.4	8.1
Ward	2/4 (110000-173000)	50	4.9	6.1

Obtained pH of Soil Samples in Various Counties: The range of pH obtained in soil samples across various counties collected from canola-grown fields in our survey was 4.9 - 8.2 (Table 1). Of these, 65% are of basic (≥7) pH, 30% are of acidic (< 6.6), and 5% are 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 present.

Screening of Canola Cultivars for Tolerance to Verticillium Stripe

Venkat Chapara, Amanda Arens, and Larissa Jennings

Canola cultivars/varieties: Seventeen commercial canola cultivars with unknown tolerance to Verticillium stripe were planted to monitor the level of tolerance against the pathogen *Verticillium longisporum* (Table 1). The trial was planted on May 28, 2025, 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	Seed Source
P612L	Pioneer
P617SL	Pioneer
P520L	Pioneer
P1540L	Pioneer
CP9551TF	Croplan Genetics
CP9978TF	Croplan Genetics
CP7130LL	Croplan Genetics
CP9221TF	Croplan Genetics
CP7250LL	Croplan Genetics
BY7204L	BrettYoung
InVigor L343PC	BASF
InVigor L340PC	BASF
InVigor L233P	BASF
InVigor LR354PC	BASF
InVigor L345PC	BASF
InVigor L350PC	BASF
DKTFLL21SC	Dekalb

Percent incidence and severity of Verticillium stripe was evaluated on August 29, 2025, by cross-section clipping of canola stems a half inch below ground level. Percent incidence was determined by the percentage of infected stems, and percent severity was determined by the percentage 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 demonstrated significant differences in Verticillium stripe incidence at P-Value < 0.05, with a least significant difference (LSD) of 13. The cultivars 'P1540L' and 'InVigor L350PC' exhibited the lowest Verticillium stripe disease incidence (8%), whereas the 'InVigor L233P' cultivar showed the highest incidence (35%) of Verticillium stripe (Figure 1). In addition, statistically significant differences in yield were observed at P-Value < 0.05, with an LSD of 259 (Figure 2), and the mean yield was 2,510 lbs/a. The InVigor L340PC cultivar achieved the highest yield, 2,832 lbs/a, supporting the robustness of these results and providing a basis for future decisions on choosing a cultivar with better tolerance to Verticillium stripe.

Figure 1: Percent Verticillium stripe incidence obtained on various commercial cultivars of canola tested in 2025 under field conditions.

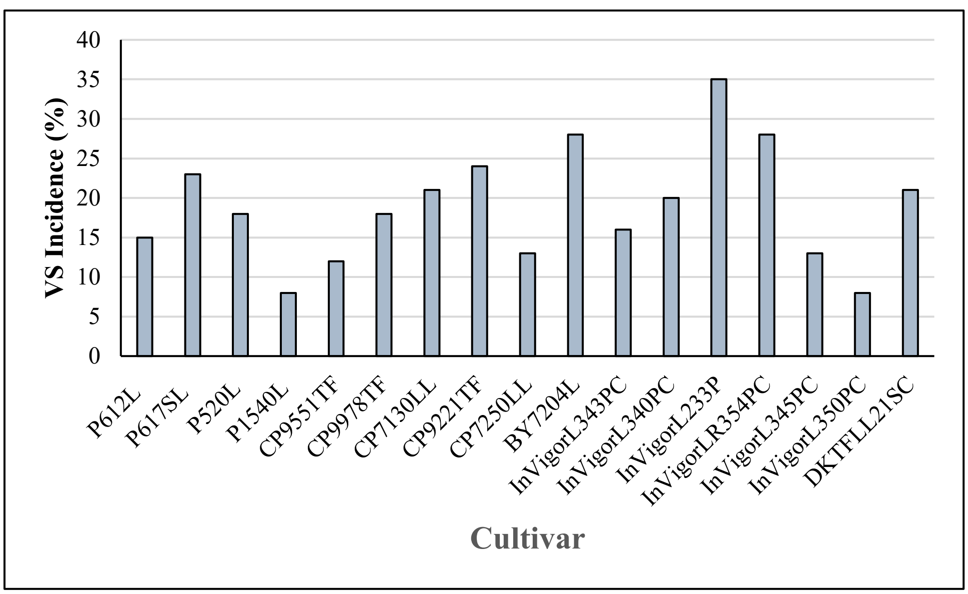


Figure 2: The average yield obtained on various commercial cultivars of canola tested in 2025 under the Verticillium stripe infection in field conditions.

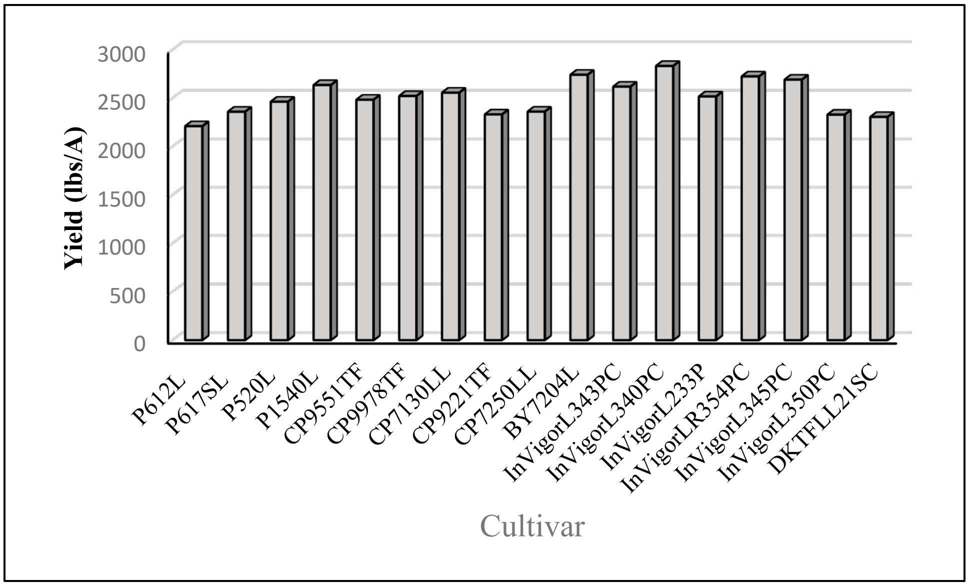


Figure 3: The picture below depicts Verticillium stripe disease on the cross-section of canola stubble.

Acknowledgements: Northern Canola Growers Association and a special thanks to Noah Foster, Kaleb Foster, Aiden Brown, and Carleen Schill.

Evaluation of Seed Treatments to Manage Purple Stem Caused by Root Rot Complex of Canola in Field Conditions

Venkat Chapara, Amanda Arens, and Larissa Jennings

Purple Stem: Purpling in canola, commonly regarded as a clear indicator of phosphorus deficiency, actually reflects a complex response to multiple stresses, particularly those caused by nutrient imbalances (e.g., sulfur or boron deficiency), herbicide carryover injury, or root rot pathogens. In affected areas, chlorophyll production is inhibited, which reveals the underlying purple pigment. Plants frequently exhibit constriction at the soil surface, with stems appearing scabbed due to damage. In some cases, purple plants are severed near the soil surface, leaving only the stems protruding. Recently, the adoption of shorter canola cropping rotations in North Dakota has increased both the intensity and incidence of purpling.

Objective: This study aims to evaluate the effectiveness of seed treatments and soil amendments in managing purple stem disease in canola caused by fungal pathogens.

Methodology: A research trial was conducted at the Langdon Research Extension Center to evaluate the effectiveness of seed treatments for managing root-rot and soil-borne disease complexes in canola. The trial was planted on May 29, 2025, with most seed treatments (Table 1) applied to the canola cultivar 'InVigor L233P' one week prior to planting. Beet lime was incorporated immediately prior to planting, and boron was administered as a foliar spray at the 4-leaf stage. Efficacy was determined by comparing treated seeds with non-treated controls. A randomized complete block design with four replications was used to ensure experimental rigor. The trial adhered to state-recommended protocols for land preparation, fertilization, seeding rate, and weed and insect management. Each plot measured 5 feet in width and 16 feet in length. Incidence and severity of the root rot complex were recorded 15 days after planting. To evaluate late infections of soil-borne diseases, twenty-five canola stubbles per plot were rated on a 0-100 scale after swathing on August 5. Data were analyzed using analysis of variance with complete block, balanced orthogonal designs generated by Genovix version II software.

Results: In our trial, purpling (purple discoloration on stems, see Figure 1) was observed due to the presence of major pathogens, including *Fusarium* spp. (the fungus responsible for root rot) and the second by *Verticillium longisporum (a fungus that causes Verticillium stripe disease*), as confirmed by morphological observations during the late infection stage. The evaluated seed treatments had no significant differences in managing purple stem incidence. Likewise, no significant differences were detected in plant stand, vigor, yield, or test weight between the treatments and the non-treated check (Table 1). The treatments Rancona summit, followed by Boron foliar treatment, produced the highest yield, while Intego Solo exhibited the lowest.

Table 1: Effects of fungicide seed treatments on purple stem incidence, plant stand, plant vigor, yield, and test weight.

Treatments	Purple Stem % Incidence	Plant Stand/A	Plant Vigor	Yield (lbs/A)	Test Weight (lbs/bu)
Trifloxystrobin	15	144,827	9	2217	51
Saltro	15	163,184	8	2176	52
Boron	12	143,183	8	2318	52
Evergol Energy	11	151,829	8	2197	52
Myclobutalinil	21	149,541	8	2258	51
Trunemco	13	126,766	8	2261	52
Ilevo	19	123,453	8	2228	51
Intego Solo	13	131,949	8	2156	52
Rancona summit	18	138,425	8	2324	51
Beet lime	18	139,927	8	2206	51
Non-Treated	20	146,076	8	2199	51
Mean	**16**	**141,742**	**8**	**2231**	**51**
CV %	**53**	**12**	**12**	**7**	**1**
LSD	**NS**	**NS**	**NS**	**NS**	**NS**
P-Value (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**

NS: Non-significant differences were observed at P-Value < 0.05.

Figure 1: Incidence of purple stem in the research trial at the Langdon Research Extension Center

Management of Interveinal Chlorosis in Soybeans

Venkat Chapara, Amanda Arens, and Larissa Jennings

Accurate diagnosis of plant diseases and identification of their causative pathogens are essential for developing effective preventive measures. Evaluating seed treatments enables the identification of optimal management strategies before disease outbreaks become unmanageable, as demonstrated in the case of interveinal chlorosis and soybean cyst nematode (SCN) infection in North Dakota. To identify the pathogen responsible for interveinal chlorosis, symptomatic soybean plants (Figure 1) were collected throughout the trial period, and pathogens were isolated from various sections of the lower stems. Confirmation of the pathogen responsible for Brown Stem Rot (BSR) involved placing stem and pith slices on potato dextrose agar (PDA) and purifying on lima bean agar. To evaluate seed treatment chemicals for managing interveinal chlorosis, ILeVO, Saltro, Trunemco, Dynasty, Intego Solo, Trilex, and Rancona Summit were rigorously tested for their efficacy in suppressing both SCN and interveinal chlorosis, as well as leaf necrosis, under field conditions. The soybean variety 'ND21008GT20' was used in the study at the Langdon Research Extension Center (LREC) in Langdon, ND, in a field with a pH of 6.4 and an organic matter content of 1.6%. The previous crop was soybean, which was vertically tilled prior to planting, and the field had a documented history of interveinal chlorosis and SCN.

Figure 1: Leaves of soybean plants exhibiting interveinal chlorosis in the treatment plots.

Results

Morphological analysis revealed that ninety percent of the cultures matched *Phialophora gregata*, the causal agent of BSR (Figure 2). Concurrently, soil samples were randomly collected from the research area and analyzed at the AGVISE laboratory in Benson, MN, revealing an SCN population of 9,650 eggs per 100 cc of soil. Among the seed treatments, Trunemco, Dynasty, ILeVO, Rancona Summit, Intego Solo, and Saltro exhibited the lowest Normalized Disease Index, calculated based on interveinal chlorosis symptoms and severity obtained in the treatments. These results were statistically significantly different from those of the Trilex and untreated control treatments, highlighting their effectiveness in disease management and providing a foundation for further research and application (Table 1). Dissemination of these findings to growers and stakeholders will be facilitated through outreach activities across North Dakota.

Figure 2: Cultures obtained from infected soybean samples exhibiting interveinal chlorosis in the treatment plots.

Table 1: The seed treatments tested, their rates, and influence on the variables tested (Plant Stand, Plant Vigor, NDI, Yield, and Test Weight).

Treatments	Plant Stand/A	Plant Vigor	NDI**	Yield (bu/A)	Test Weight (lbs/bu)
Ilevo	119,184	7	11	43	57
Saltro	127,028	8	14	38	57
Trunemco	121,799	6	13	40	57
Evergol Enegy	120,274	7	6	47	57
Non-Treated	123,760	8	43	40	57
Intego Solo	128,554	8	19	45	57
Rancona Summit	138,577	8	19	44	57
Trilex	118,313	7	11	43	57
Mean	**124,686**	**7**	**17**	**42**	**57**
CV %	**11**	**11**	**51**	**22**	**0.8**
LSD	**NS**	**1**	**13**	**NS**	**NS**
P-Value (0.5)	**NS**	**0.0105***	**0.0003***	**NS**	**NS**

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

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

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

Acknowledgements: Funding from North Dakota Soybean Council. Special thanks to Noah Foster, Kaleb Foster, Aiden Brown, and Carleen Schill.

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

Naeem Kalwar (Extension Soil Health Specialist)
Travis Hakanson (Research Specialist II/Foundation Seed)
Carmen Ewert (Research Technician/Foundation Seed)

Figure 1. The Langdon Research Extension Center conventional-till versus no-till demonstration sites on September 29, 2025.

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. In northeast North Dakota, most producers continue to till their soils in fall and spring. The primary reason is to dry the top four to six inches of soil, allowing for earlier planting. This practice is especially important because the region has a slightly shorter growing season than other areas of the state. According to the North Dakota Agricultural Weather Network (NDAWN), the Langdon area records the lowest accumulated growing degree days for crops such as canola, wheat, sunflower, and soybeans compared to NDAWN stations in Carrington, Dickinson, Fargo, Hettinger, Minot, and Williston.

Since 1993, a persistent wet weather cycle has made the transition to no-till farming in northeast North Dakota particularly challenging. Producers have become cautious about adopting no-till due to concerns over wet spring field conditions, which often delay planting. In a region with a short growing season, late planting can significantly reduce yields and complicate harvest, especially when compounded by wet falls or early frosts. Depending upon the soil type, landscape, and agronomic practices, it may take several years of no-till practices to improve soil structure, water infiltration and the challenges posed by a wet spring or fall. Many producers in the region have attempted no-till, but frequent issues like muddy and saturated fields, cooler soil temperatures and poor seedbeds have led to disappointing results. Additionally, muddy, or snowy conditions during fall harvests have further discouraged adoption. As a result, most producers reverted to conventional tillage after only one or two years, making it even more difficult for future adopters to successfully transition to no-till.

Objectives

Short-term objectives are to compare planting dates and document differences in input cost, germination, plant stand, yields, profits, and losses. Long-term objectives focus on evaluation of soil health, including salinity, sodicity, pH, structure, pore space, and water infiltration.

Site Details

A 35-acre field was divided into two rectangular sections oriented north to south: a 13.74-acre no-till site and a 20.67-acre conventional-till site, separated by a 15-foot border. Both sections include productive, marginal, and unproductive areas to accurately represent typical farm conditions. This project is a demonstration, not a replicated research trial.

Field Work Details

This report summarizes all activities conducted on the conventional-till and no-till sites since the demonstration began in fall of 2021, providing a comprehensive overview for readers.

Conventional-till

Fall-2021

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

Spring and Summer of 2022

- A uniform application of 125 pounds of urea nitrogen per acre was applied on May 29 followed by a single pass with a cultivator for incorporation.
- Fargo and Treflan (PPI) were applied on June 6 followed by two cultivator passes.
- Prosper (HRSW) was seeded 1.7 bushels per acre using a Concord 40-foot air seeder on June 7.

Fall-2022

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

Spring and Summer of 2023

- The site was cultivated and harrowed once. ND21008GT20 soybeans were then planted at seeding rate of 60 pounds/acre (174960 seeds/acre) on May 26, 2023.
- Roundup PowerMax 3 was applied at 30 ounces/acre + Kicker at 2.5 gallons/100 gallons of water at the rate of 10 gallons/acre on June 16.
- Roundup PowerMax 3 was applied at 30 ounces/acre + Kicker at 2.5 gallons/100 gallons of water at the rate of 10 gallons/acre on July 10th.

Fall-2023

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

Spring and Summer of 2024

- Site was cultivated once on April 25.
- On May 18, 80 pounds of nitrogen and 60 pounds of P2O5 were applied using urea and monoammonium phosphate (MAP). The fertilizer was then incorporated into the soil with a single pass of the cultivar.

- The site was planted with foundation grade Faller HRSW with an air seeder at the rate of 100 pounds of wheat seed per acre on May 19.
- An herbicide blend of Everest 3.0, Husky FX, Starane Ultra and Cue adjuvant was sprayed on June 26.
- Prosaro Pro 400 SC fungicide was sprayed on July 16.

Fall-2024

- Site was straight combined September 26.
- Site was chiseled on October 1 and again on October 3.

Spring and Summer of 2025

- Site was cultivated once on May 28.
- On May 30, 148 pounds of nitrogen and 60 pounds of P2O5 were applied using urea and monoammonium phosphate (MAP). The fertilizer was then incorporated into the soil with a single pass of the cultivator.
- The site was planted with foundation grade Faller HRSW with air seeder at the rate of 114 pounds of wheat seed per acre on May 30.
- An herbicide mix of Tolvera, Vigil, IronGate and Cue adjuvant was sprayed on June 27.

Fall-2025

- Site was straight combined September 30.
- Site was chiseled on October 13 and again on October 25.

No-till

Spring and Summer of 2022

- On June 13, the no-till site was planted with Prosper (HRSW) using a John Deere 1895 no-till disk drill. Seeding rate was 1.7 bushels per acre. Due to equipment limitations, the drill could not apply high rates of fertilizer during planting, therefore, only 62.5 pounds per acre of N (136 pounds of urea per acre) was applied initially. To ensure the total nitrogen application matched the conventional-till site, the remaining 62.5 pounds of N per acre was top dressed.
- No-till field 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.

Fall-2022

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

Spring and Summer of 2023

- The conventional-till site was planted on May 26, 2023, with ND21008GT20 (soybeans) at the seeding rate of 60 pounds/acre (174960 seeds/acre). Both the conventional and no-till fields were ready to plant the same day, but the no-till field planting was delayed until May 30, 2023 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 a 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

- On October 13, approximately 70% of the no-till site (10 out of 14 acres) was straight combined. The remaining 30% (4 acres) could not be harvested due to extremely high weed pressure primarily kochia, green foxtail and volunteer spring wheat. This area was cleaned up using a combine to evenly distribute the remaining crop and weed residue.

- On October 22, Roundup PowerMax 3 at 30 ounces/acre mixed 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. Due to equipment limitations, only half of the fertilizer could be 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 a rate of 100 pounds per acre.
- A mix of Everest 3.0 + Husky FX + Starane Ultra + Cue adjuvant was sprayed on June 21.

Fall-2024

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

Spring and Summer of 2025

- Site was sprayed with a mix of Paraquat 3SL at 2 pints/acre, Sharpen at 3 fluid oz/acre, MSO (1 quart/a) and AMS (8.5 lbs./100 gallons of spray) on May 9.
- Due to a delay in planting because of rain and another flush of weeds emerged, site was resprayed with another round of Paraquat 3SL at 2 pints/a, Sharpen at 3 fluid oz/acre, MSO (1 quart/a) and AMS (8.5 lbs./100 gallons of spray) on May 30.
- 164 pounds of nitrogen and 20 pounds of P2O5 as monoammonium phosphate (MAP) and urea was applied, on May 30. Half of the fertilizer was broadcasted, and the other half was banded with the no-till drill.
- On May 30, the site was planted with foundation grade Faller HRSW using a John Deere no-till drill at a seeding rate of 114 pounds of wheat seed per acre.
- On June 3, the site was reseeded due to some skips caused by the John Deere no-till drill at a rate of 60 pounds.
- An herbicide mix of Tolvera, Vigil, IronGate and, Cue adjuvant was sprayed on June 27.

Fall-2025

- Site was straight combined on September 30.
- An herbicide mix of Glyphosate 0.75 lb. ae/acre + 2,4-D Ester 1.0 lb. ae/acre + Fierce EZ 9.0 fluid ounces/acre + HSMOC 1.5 pint/acre + AMS 17.0 lbs./100 gallons of water at 20 gallons/acre was sprayed on November 5, 2025.

Soil Sampling and Analysis

In the fall 2021-2024, the following 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 four locations: 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). In the fall-2021, these soil samples were analyzed for textural and chemical analysis. In subsequent years (fall-2022-2024), only chemical analysis was performed.
- 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 2021-2025.

Soil Chemical Analysis Results

Between 2021 and 2024, soil EC (salinity) and SAR (sodicity) measurements revealed distinct difference between tillage practices and site productivity in the 0–12-inch soil depths. The conventional-till productive ground had very low to no salinity and sodicity issues. The conventional-till unproductive ground had low to high levels of salinity with moderate to high levels of sodicity. The no-till productive ground had low to moderately high salinity and low levels of sodicity while the no-till unproductive ground had high to very high levels of salinity and sodicity. Details are in Table 1.

Table 1. The 2021-2024 soil EC and SAR results for the conventional-till and no-till productive and unproductive sites at the 0-12, 12-24, 24-36 and 36-48-inch depths.

Site	Depth (inches)	2021	2022	2023	2024	2021	2022	2023	2024
		EC (dS/M)				SAR			
Conventional-till PG	0-12	2.44	0.95	0.86	1.11	2.06	1.46	1.35	4.70
	12-24	4.90	0.67	2.23	2.57	3.99	3.58	1.53	10.86
	24-36	5.25	1.08	1.95	2.77	5.89	4.19	2.43	12.02
	36-48	2.09	1.17	1.44	2.36	7.67	5.53	4.58	11.60
Conventional-till UG	0-12	10.43	14.11	4.81	6.94	10.88	18.78	14.41	9.44
	12-24	11.28	12.12	5.11	8.66	11.27	17.15	14.05	9.08
	24-36	10.39	8.05	4.16	7.97	11.36	16.05	11.11	9.33
	36-48	8.47	6.42	2.84	7.14	10.19	11.13	10.80	11.49
No-till PG	0-12	4.18	3.06	2.54	2.52	4.45	5.09	6.58	4.62
	12-24	7.10	7.31	3.84	6.49	10.74	13.94	12.88	9.51
	24-36	8.16	9.69	2.91	8.36	18.11	21.80	18.48	10.77
	36-48	8.19	9.01	3.07	8.80	17.47	19.32	19.14	11.82
No-till UG	0-12	13.52	17.83	8.57	14.62	24.15	24.21	23.01	16.25
	12-24	13.34	12.84	5.98	10.20	23.02	17.64	16.67	10.84
	24-36	11.82	11.45	5.43	10.22	23.50	15.96	16.69	10.05
	36-48	10.86	9.61	3.85	9.23	18.14	17.19	15.50	9.55

Soil Bulk Density Analysis Results

Table 2. The 2021-2025 soil bulk density results for the conventional-till and no-till productive and unproductive sites for the 0-5, 5-10-inch depths.

	Soil Bulk Density (grams/cm^3)					
Site	Depth (inches)	2021	2022	2023	2024	2025
Conventional-till PG	0-5	1.36	1.34	1.23	1.14	1.41
	5-10	1.26	1.44	1.39	1.51	1.39
Conventional-till UG	0-5	1.45	1.36	1.17	1.47	1.28
	5-10	1.22	1.37	1.27	1.39	1.36
No-till PG	0-5	1.44	1.32	1.35	1.33	1.47
	5-10	1.25	1.36	1.35	1.51	1.36
No-till UG	0-5	1.50	1.36	1.33	1.55	1.52
	5-10	1.34	1.47	1.34	1.57	1.37

Soil bulk density levels were relatively stable from 2021-2022, reached their lowest point in 2023, and peaked in 2025. Generally, the 0–5-inch soil layer had lower bulk density than the 5–10-inch level. However, in the no-till unproductive ground during 2021 and 2025, the 0–5-inch bulk density was higher than the 5–10-inch layer. Over time, no-till sites showed a trend of increasing bulk density compared to conventional-till sites, except in 2022. Additionally, unproductive ground consistently exhibited slightly higher bulk density than productive ground, likely due to elevated soil sodicity. Details are in Table 2.

Measurement of Soil Water Infiltration

Soil water infiltration rates were measured using a six-inch diameter ring, which was inserted into the surface soil. To simulate rainfall, 444 ml of deionized water was poured into the ring, representing one inch of rain. After the water fully infiltrated and no standing water remained, a second inch of rain was simulated by adding another 444 ml of deionized water. The time taken for each inch to be absorbed was recorded to assess infiltration rates. These measurements help evaluate differences in soil water absorption between conventional-till and no-till practices. Detailed annual infiltration rates for each site are presented in Table 3.

Table 3. The 2021-2025 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 51.46 seconds

Note:

1. 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.
2. 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.
3. 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.
4. 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.

5. 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.		
2025		
Site	**Time for infiltrating First-inch**	**Time for infiltrating Second-inch**
Conventionally-Tilled Productive Ground (CT-PG)	12.86 seconds	1 minute and 11.15 seconds
Conventionally-Tilled Un-productive Ground (CT-UG)	39.14 seconds	11 minutes and 47.24 seconds
No-Tilled Productive Ground (NT-PG)	11 minutes and 0.3 seconds	17 minutes and 32.85 seconds
No-Tilled Un-productive Ground (NT-UG) Site-A	117 hours, 57 minutes and 23.43 seconds	NA
No-Tilled Un-productive Ground (NT-UG) Site-B	3 hours, 9 minutes and 45.57 seconds	26 hours, 50 minutes and 5.26 seconds

Note:

1. All sites were moist or wet in 2025, especially NT-UG. However, infiltration rates were measured as weather was changing quickly.
2. CT-PG, CT-UG and NT-PG site infiltration rates were measured on November 5, 2025, whereas, NT-UG Site-A first-inch infiltration was started on the same day at 11:00 a.m.
3. The first-inch infiltration was started on NT-UG Site-A on November 5, 2025, however it was stopped on November 10, 2025 at 8:58 a.m. after 117 hours, 57 minutes and 23.43 seconds while there was still roughly half of the water in the ring that froze.
4. The NT-UG Site-B first-inch infiltration was started in the afternoon on November 10 slightly after 1:00 p.m. as topsoil was frozen in the morning.
5. NT-UG Site-B was barren and unproductive, however, it was selected to measure water infiltration as it was the driest looking spot in the NT-UG.
6. In addition, during the night of November 11 water in the infiltration ring was partially frozen and thawed on the afternoon of November 11, 2025.
7. At the time of recording the final-time for the NT-UG Site-B second-inch, there was still little bit of water around the edges of the ring.

There have been a few key observations regarding soil water infiltration rates:

- In 2021-2025, 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 an effect of higher sodicity level that causes soil dispersion resulting in dense soil layers and poor water infiltration.
- In 2023-2025, the no-till unproductive ground infiltration rates were much slower compared to 2021-2022.
- From fall of 2023 to 2025, soil water infiltration rates were measured at two unproductive no-till ground sites: Site-A and Site-B. Measurements at Site-A showed much slower infiltration rates compared to 2021-2022, with water sometimes failing to infiltrate at all in 2025. To confirm these findings, additional measurements were taken at Site-B. While Site-B's infiltration was still slower than those recorded in 2021-2022, they were somewhat faster than Site-A's. For 2024, only results from Site-B are included in this report.

Growing-Season Observations

2022

The conventional-till side was planted six days earlier than the no-till side. However, the no-till side exhibited better germination, and more uniform plant stands. The conventional-till side had saturated soil a few inches below the soil surface and slightly poorer germination in the tire tracks. Plant stands were thin and remained 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. Equipment differences may also have contributed to these outcomes; the conventional-tilled side used a 40-foot air seeder, while the no-till side used a John Deere 30-foot no-till drill. Despite being planted later, the no-till side was harvested at the same time as the conventional-till side and yielded three bushels per acre more.

2023

Both the productive and unproductive areas under no-till management experienced severe weed infestations throughout the growing season of 2023. The primary weeds included herbicide-resistant kochia, volunteer wheat, green foxtail and horseweed. These issues persisted until fall and were expected to worsen in 2024 due to a larger seed bank in the no-till field compared to the conventional-till. A significant contributing factor was the southerly winds in fall 2022, which dispersed kochia seeds across both no-till and conventional-till fields, with some plants even accumulating in shelterbelt trees to the north. In spring, the conventional-till field was cultivated and harrowed, effectively eliminating most weeds. In contrast, the no-till field retained high populations of kochia and foxtail. While a pre-plant incorporated (PPI) herbicide might have improved weed control, its effectiveness depends on soil incorporation which is not an option on no-till. Several pre-emergence herbicides are suitable for no-till soybeans but also require rain for activation. The dry spring of 2023 likely reduced the efficacy of these treatments. The no-till field suffered from severe kochia contamination despite three herbicide applications compared to only two sprays and much lower weed pressure in the conventional-till field.

2024

In 2024, the no-till plots experienced extensive areas of poor and slow wheat germination, primarily due to heavy rains immediately after planting. These conditions resulted in saturated, cooler soils that led to drowned-out sections, especially when compared to the conventional-till field. The conventional-till field showed better germination, growth, and vigor, except in areas affected by excess moisture. As a result, the no-till field was at a disadvantage from the outset. Furthermore, regions within the no-till field that exhibited poor or no crop growth also faced higher weed pressure, whereas areas with successful wheat establishment had lower weed infestations. Overall, weed pressure in the no-till system was reduced in 2024 compared to 2023. The conventional-till field benefited from a stronger start, which ultimately contributed to higher yields.

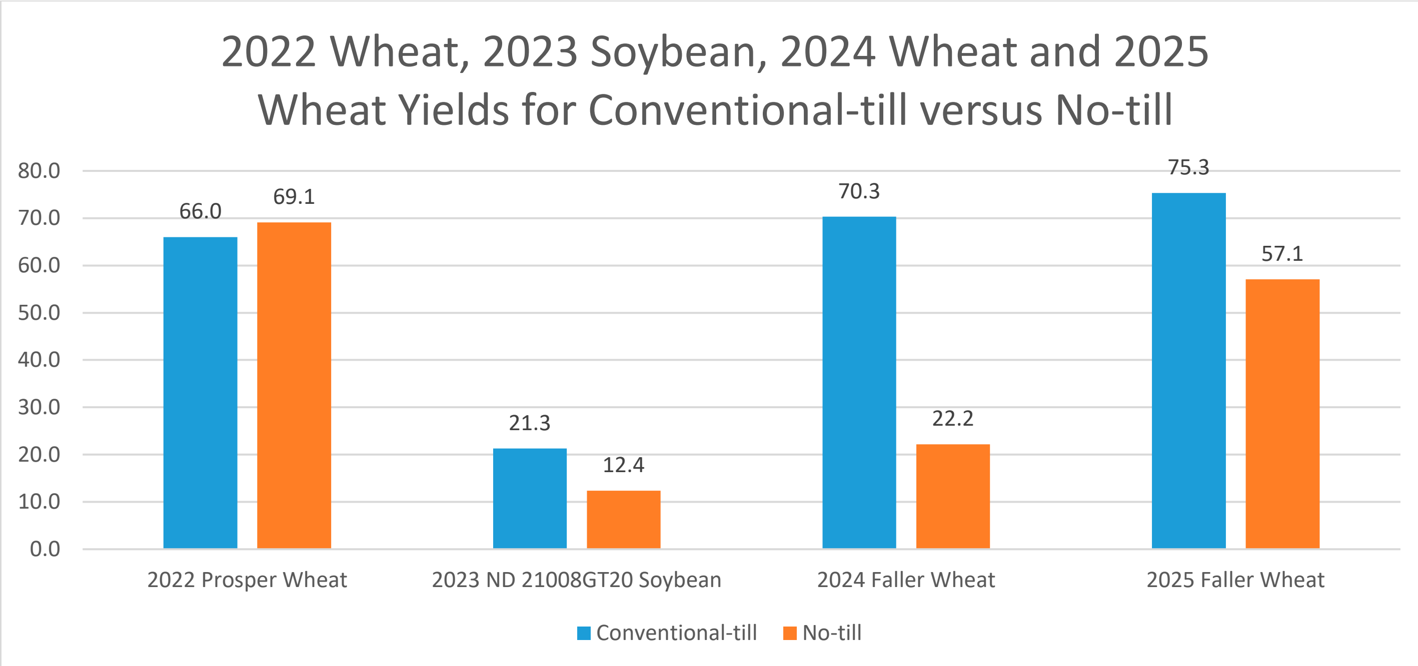
2025

In 2025, the Langdon area received slightly less rainfall than the average growing-season total (16.27 inches compared to 17.96 inches, as recorded by the Langdon NDAWN Station). Although total rainfall was lower, rain events occurred more frequently, often disrupting field operations such as seedbed preparation, planting, spraying, swathing, combining and fall work. On the positive side, these light rains provided crops with needed moisture, preventing extended dry periods followed by heavy downpours. Both the conventional-till and no-till fields were planted on the same day (May 30). However, the no-till drill, which is older and prone to issues, left skips that required replanting, increasing production cost for the no-till system. Despite these challenges, no-till germination and early crop establishment appeared as good if not better than conventional-till. Nevertheless, no-till yields in 2025 were unexpectedly lower. Grain quality was also poor at harvest for both systems, as delayed combining led to sprouting and low falling numbers, despite crops reaching physiological maturity. These results suggest that equipment reliability and timely field operations are critical for optimizing no-till performance, and that frequent, light rains can both benefit and hinder crop production depending on timing and field conditions.

Yield Differences in 2021-2025

Since 2023, conventional-till consistently produced higher yield than the no-till. In 2023, lower no-till yield was a result of 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 resulted in saturated, cooler soils and drowned out areas. These conditions caused poor germination and weak stands in large areas of the no-till field. In 2025, equipment issues with the no-till drill resulted in planting skips which contributed to slightly better conventional-till stands. Additionally, wheat lodging was more prevalent in the no-till field than in the conventional-till field. For detailed comparisons see Figure 2.

Figure 2. The Langdon Research Extension Center conventional-till versus no-till demonstration 2022-2025 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. Cost 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	**+ $146.00**
No-till		69.0	$483.0 (at $7.00 per bushel)	$246.21	**+ $237.00**

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.

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	**+ $99.40**
No-till		12.4	$158.0 (at $12.74 per bushel)	$256.18	**- $98.10**

High weed pressure significantly impacted the no-till site resulting in 30% of the no-till site not being harvested. The entire no-till area was included in the yield calculations (170 bushels/13.7 acres = 12.4 bushels/acre). Both conventional-till and no-till soybeans were sold to the local elevator in Langdon (CHS) for $12.74/bushel. High weed pressure also affects crop quality. Conventional-till soybeans had dockage of 0.5%. The no-till soybeans had 1.0% dockage. These dockages were factored into profit calculations in Table 5.

2024

The conventional-till field yielded 48.1 bushels per acre more than the no-till field due to improved germination, less weed pressure and good plant stands. In contrast, the effect of the wet weather conditions on the no-till field resulted in saturated, cooler and drowned-out areas, which significantly reduced its yield compared to the conventional-till field.

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	**+ $117.90**
No-till		22.2	$128.0 (at $5.77 per bushel)	$334.93	**- $206.90**

2025

Table 7. 2025 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	2025	75.32	$419.53 (at $5.57 per bushel)	$320.81	**+ $98.72**
No-till		57.05	$317.76 (at $5.57 per bushel)	$459.53	**- $141.77**

Note:

- The $5.57 per bushel price was approximate as wheat was not sold prior to writing this report.
- Wheat quality of both no-till and conventional-till was poor due to sprouting and falling numbers. This was a result of excessive rainfall and very poor drying conditions for 2-3 weeks prior to harvest.

Summary Based on Four-Years

Differences in Planting Dates:

2022: In year-one of transitioning to no-till, the conventional-till site was planted six days earlier than the no-till site.
2023: Both systems appeared ready for planting the same day, However, equipment issues delayed planting on the no-till site by four days.
2024: Conventional-till was planted on May 19 while no-till was planted two days later, on May 21. Although the soil in the no-till field was still somewhat wet, planting advanced to avoid forecasted heavy rain.
2025: Both conventional-till and no-till sites were planted on the same day (May 30).

Differences in Costs and Profitability:

Over the four-year period (2022-2025), the profitability of the no-till versus conventional-till systems varied significantly.
2022: The no-till site was slightly more profitable than the conventional-till site.
2023: No-till resulted in a revenue loss, primarily due to substantially higher herbicide costs, reduced yields from weed contamination, and increased dockage at the elevator. In contrast, the conventional-till system remained profitable. This highlights the necessity of a proactive and effective weed control program during the transition to no-till, as inadequate management can jeopardize the system's success.
2024: No-till again experienced a loss in revenue, largely attributed to very wet weather during planting and early growth stages, as well as higher herbicide expenses compared to convention-till.
2025: The no-till system continued to incur losses, this time due to planting skips caused by equipment issues (which required replanting), elevated herbicide costs, and lower yields. Notably, despite similar or better early crop stands in no-till, yields were unexpectedly lower than those in the conventional-till system.

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, 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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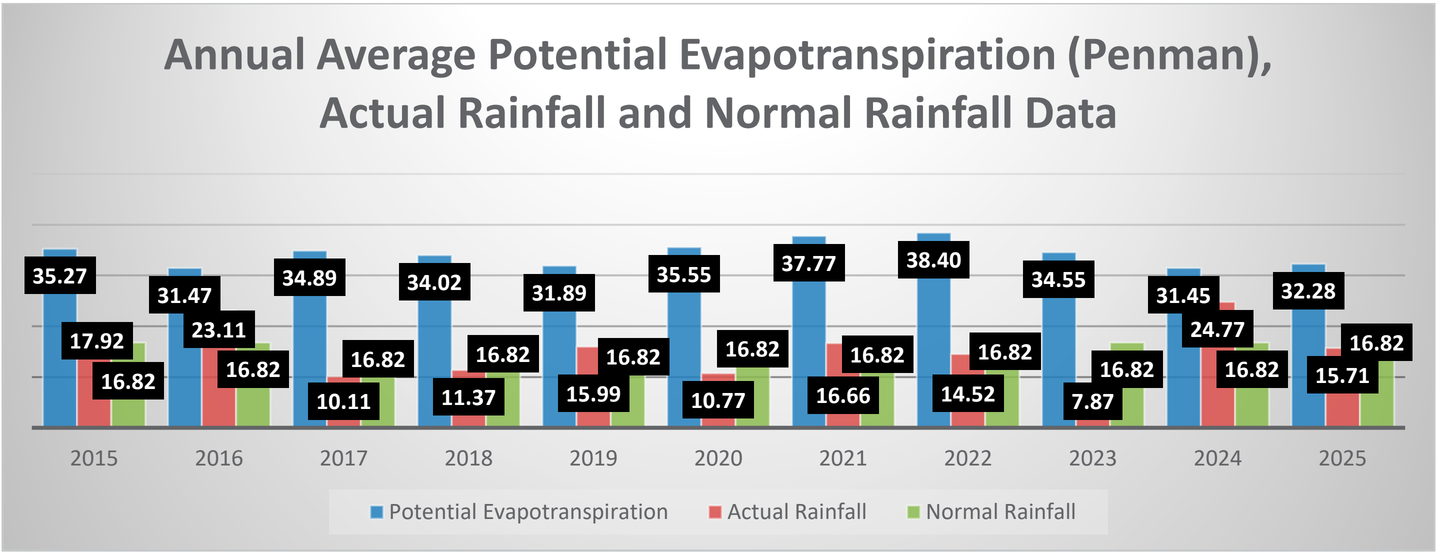
RESULTS AND DISCUSSION

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 2016-2025 results of three replications for the zero to four-foot soil depths. The treatment means of soil bulk density represent 2015-2025 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 potential evapotranspiration (Penman) and actual rainfall versus normal rain 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.

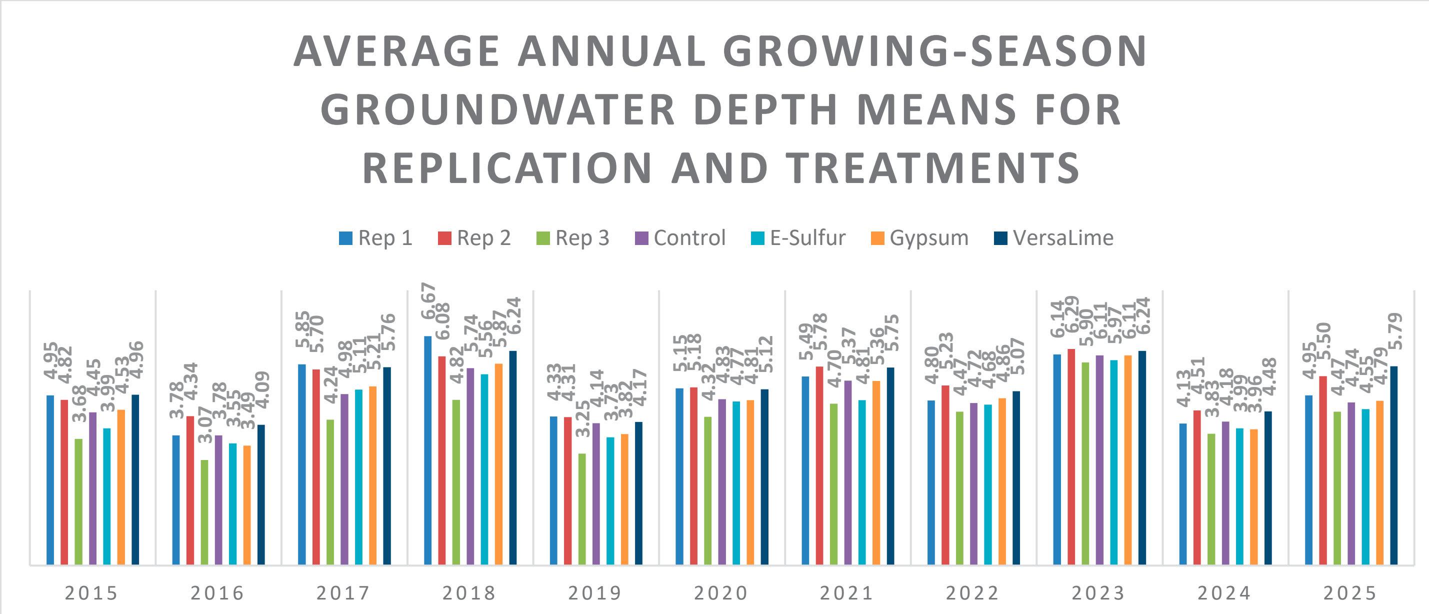


Note: The normal rainfall for 2015-2025 for May 1 to October 31 was 16.82-inches.

Increased evapotranspiration versus lower rainfall generally results 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.

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.

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.

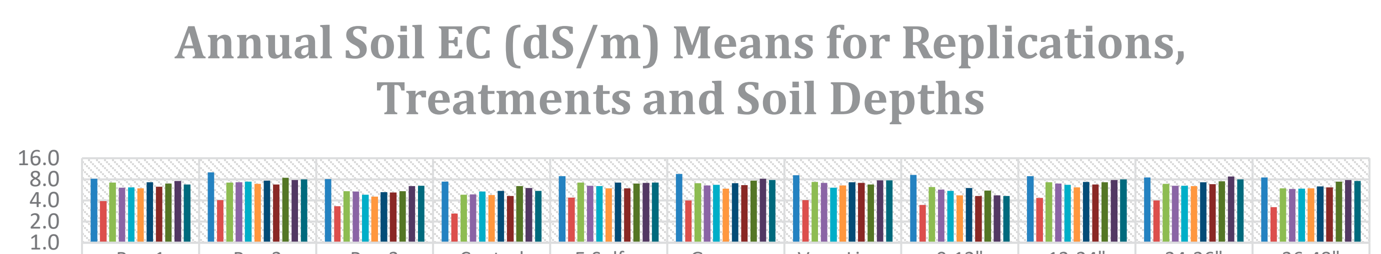


Note: In 2015, groundwater depths were only measured from mid-June to the end of October.

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	8.2	10.1	8.1	7.4	8.9	9.6	9.2	9.3	8.8	8.5	8.5
2016	3.9	4.0	3.3	2.6	4.4	4.0	4.0	3.4	4.4	4.0	3.2
2017	7.2	7.2	5.4	4.8	7.2	7.0	7.4	6.2	7.3	6.9	5.9
2018	6.1	7.3	5.3	4.9	6.5	6.5	7.1	5.7	7.0	6.5	5.8
2019	6.2	7.5	4.8	5.4	6.4	6.7	6.1	5.5	6.7	6.5	5.9
2020	6.0	6.9	4.6	4.8	6.0	5.9	6.5	4.7	6.1	6.4	5.9
2021	7.3	7.7	5.3	5.5	7.2	7.1	7.2	6.0	7.3	7.3	6.3
2022	6.3	6.8	5.2	4.6	5.9	6.6	7.1	4.6	6.8	6.8	6.1
2023	7.0	8.4	5.4	6.4	7.0	7.7	6.8	5.5	7.3	7.5	7.4
2024	7.6	7.9	6.4	6.0	7.1	8.2	7.7	4.7	7.8	8.7	7.8
2025	6.7	8.0	6.5	5.5	7.2	7.9	7.8	4.6	8.0	8.0	7.6

2014 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

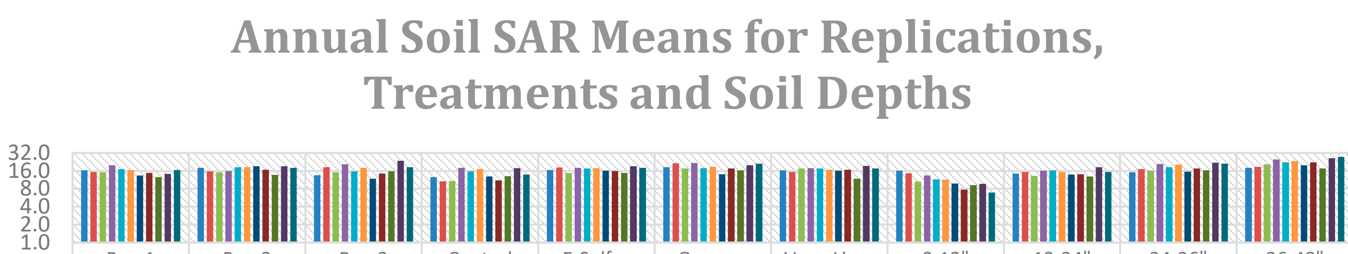
Soil EC levels in 2016, were significantly lower versus 2014 (at the time of tiling) despite shallow average annual growing-season groundwater depths due to excess rainfall and improved drainage under tiling. EC levels increased in 2017 due to dry weather resulting in increased capillary rise of groundwater and that trend continued in 2018-2025 despite the fact that land has been tiled and the average annual growing-season groundwater depths mostly had been deeper than the depth of the tiles (four-feet). 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 rise of capillary soil water (groundwater) and water-soluble salts.

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 changes in the SAR levels were in 2022 and 2025 in the 0-12-inch depth that were significantly lower compared to 2014-2021, in 2023 and in 2024. The SAR levels in the 0-12-inch depth has been decreasing numerically since 2014 (at the time of tiling), especially since 2021, however, increased slightly again in 2023-2024. 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	16.3	18.0	13.6	12.6	16.6	18.4	16.3	16.2	14.5	15.1	18.1
2016	15.3	15.7	18.4	10.7	18.3	21.5	15.3	14.6	15.3	17.1	18.8
2017	15.1	15.2	15.2	10.8	14.7	17.7	17.5	10.6	13.3	16.1	20.7
2018	19.9	15.9	20.7	18.0	18.0	21.6	17.8	13.4	16.1	20.9	25.0
2019	17.2	18.4	15.8	15.6	17.5	17.9	17.5	11.6	16.3	18.4	22.3
2020	16.4	18.4	18.0	17.1	17.8	18.8	16.8	11.4	15.4	20.5	23.3
2021	13.3	19.1	11.9	12.8	16.0	14.0	16.2	9.8	13.9	15.5	19.9
2022	14.8	16.8	14.5	11.1	16.0	17.7	16.7	7.7	14.1	17.5	22.1
2023	12.6	13.8	15.6	13.1	14.8	16.4	11.8	9.2	12.9	16.2	17.7
2024	14.3	19.3	23.7	17.8	19.1	19.9	19.4	9.7	18.4	22.0	26.2
2025	16.5	18.0	18.5	14.0	18.0	21.1	17.7	6.9	15.4	21.2	27.5

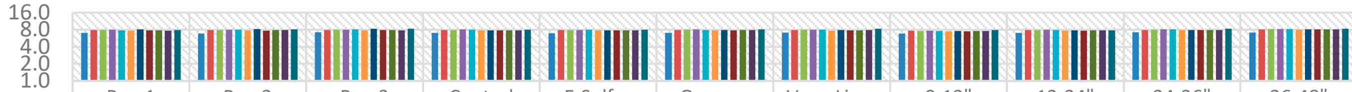
2014 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

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). Details of soil pH levels are shown in Figure 6.

Overall, soil pH levels remained the highest in 2021 followed by 2025, 2018, 2019, 2017, 2016, 2023, 2022, 2024, 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.

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

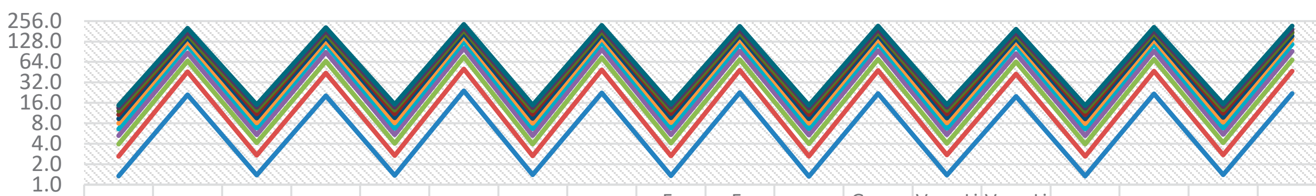


	Rep 1	Rep 2	Rep 3	Control	E-Sulfur	Gypsum	VersaLime	0-12"	12-24"	24-36"	36-48"
2014	7.1	6.9	7.2	7.1	6.9	7.1	7.1	6.9	7.0	7.2	7.1
2016	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.7	7.9	7.9	8.1
2017	7.9	7.9	8.0	7.9	7.9	8.0	8.0	7.6	7.9	8.0	8.2
2018	8.0	8.0	8.0	8.1	7.9	8.1	8.0	7.7	8.0	8.1	8.2
2019	7.8	8.0	8.1	8.0	8.0	7.9	8.0	7.6	7.9	8.1	8.3
2020	7.7	7.8	7.8	7.8	7.8	7.8	7.7	7.5	7.7	7.9	8.0
2021	8.1	8.2	8.3	7.8	7.8	7.9	7.9	7.6	7.8	7.9	8.1
2022	7.8	7.7	7.9	7.8	7.8	7.8	7.8	7.5	7.7	7.9	8.1
2023	7.8	7.9	7.9	7.8	7.8	7.9	7.8	7.6	7.8	7.9	8.1
2024	7.7	7.9	7.8	7.8	7.8	7.9	7.9	7.6	7.8	7.9	8.1
2025	7.9	8.1	8.3	8.0	8.0	8.1	8.3	7.9	7.8	8.4	8.3

2014 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

Differences in Soil Bulk Density Levels

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)
2025	1.3	22.5	1.3	20.9	1.3	23.7	1.4	23.2	1.3	22.9	1.3	23.0	1.3	20.3	1.3	21.3	1.4	23.4
2024	1.3	17.5	1.4	17.2	1.3	17.2	1.3	18.0	1.4	18.4	1.3	16.4	1.4	16.3	1.3	16.1	1.4	18.5
2023	1.4		1.5		1.4		1.4		1.5		1.4		1.4		1.4		1.5	
2022	1.4	15.4	1.4	18.4	1.4	19.6	1.4	18.7	1.4	17.3	1.4	19.1	1.4	16.0	1.4	16.8	1.5	18.8
2021	1.4	17.8	1.4	16.4	1.5	17.9	1.4	18.1	1.5	16.9	1.4	18.8	1.4	15.7	1.4	17.7	1.5	17.1
2020	1.4	16.9	1.4	18.3	1.4	22.7	1.4	20.6	1.4	20.6	1.4	19.0	1.4	16.9	1.3	17.5	1.4	21.1
2019	1.4	24.3	1.3	24.8	1.4	26.4	1.4	24.6	1.4	25.4	1.3	26.1	1.4	24.4	1.3	25.1	1.4	25.2
2018	1.3	20.9	1.3	23.3	1.4	25.5	1.3	24.5	1.3	23.6	1.3	23.3	1.4	21.5	1.3	23.1	1.3	23.4
2017	1.3	20.3	1.4	21.6	1.4	25.7	1.3	24.8	1.4	21.3	1.4	22.7	1.3	21.3	1.3	22.9	1.4	22.2
2016	1.3	25.1	1.3	23.8	1.3	26.5	1.3	26.4	1.3	25.6	1.3	25.7	1.4	22.8	1.3	25.5	1.3	24.8
2015	1.3	21.1	1.4	20.3	1.4	24.1	1.4	22.4	1.4	22.7	1.3	22.1	1.4	20.0	1.3	21.7	1.4	21.9

2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

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

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 whereas the 2016 bulk density levels have been one of the lowest under wet weather. Details of soil bulk density and gravimetric soil water levels are shown 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 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 2017-2021 and in 2023 resulted in increased salinity levels compared to 2016 levels. The lack of rain water fails to produce excess 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 proves salinity can occur or increase after lowered even 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 after a heavy rain or 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, tile-drained water can increase salinity and sodicity of the surface water resources. Based on the average 2015-2024 water quality analysis results, tile-drained water added conductivity, total dissolved solids, sodium adsorption ratio (SAR), calcium carbonate (CaCO3), calcium (Ca), magnesium (Mg), sodium (Na), sulfates (SO4), chloride (Cl), bicarbonates (HCO3), total Nitrogen (N), copper (Cu), zinc (Zn), selenium (Se) and bromide (Br) to the surface water-ditch or the surface water resource. That means over time depending upon the site-specific soil chemistry, tile drainage water can add salts and sodicity to the surface water resources.

SALT AND SODICITY TOLERANCE OF BARLEY, OAT AND SPRING WHEAT

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Barley and oats are among the most salt and sodicity tolerant annual crops producers can profitably grow in North Dakota. However, at elevated levels of salinity and sodicity levels, even barley and oats can result in significant yield losses, especially in the top six inches of the soils. To establish 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 2025 at three different levels of soil salinity and sodicity. This trial demonstration was a continuation of studies conducted from 2020 to 2024. Additionally, four Hard Red Spring Wheat (HRSW) varieties were added in 2025 to compare salinity and sodicity tolerances of spring wheat versus barley and oat crops.

Soil Analysis Results

Composite soil samples, each two feet deep and divided into 0-6-inch and 6–24-inch depths, were collected from every salinity and sodicity level on May 2, 2025. Three cores were taken for each sample at each level. Level 1 exhibited low to moderate salinity and sodicity; Level 2 showed moderate to high levels; and Level 3 contained very high salinity and sodicity—determined according to soil EC and SAR readings from the 0–6-inch depth. These classifications reflect the tolerances of annual crops such as barley and oats, rather than more sensitive crops like soybeans. To analyze soil EC and SAR, the saturated paste extract method was used (see Table 1).

Table 1. The 2020-2025 soil EC and SAR results of the three levels for the 0-6- and 6-24-inch depths.

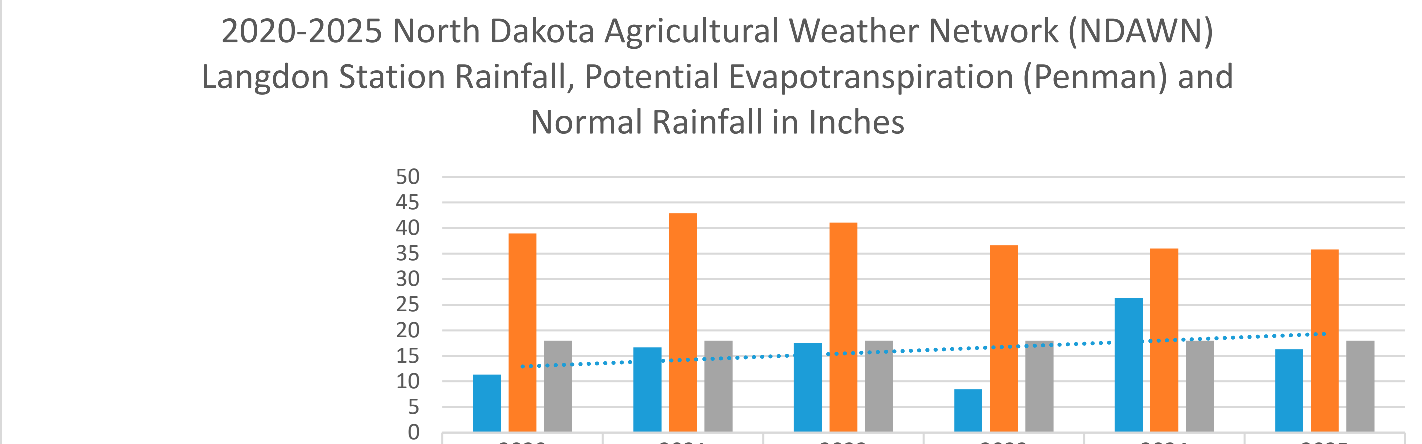
		EC (dS/m)						SAR					
Site	**Depth (in.)**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Level 1	0-6	3.99	4.63	1.64	5.44	3.90	3.66	7.12	6.20	4.95	6.68	4.37	2.90
	6-24	7.32	7.49	6.70	8.02	6.57	5.88	15.05	14.72	15.50	12.52	16.05	7.69
Level 2	0-6	7.80	13.20	7.92	10.30	7.40	7.78	18.13	22.88	16.28	17.07	18.18	9.41
	6-24	10.39	12.29	11.03	12.27	10.21	11.75	20.92	21.14	39.54	19.12	28.93	17.16
Level 3	0-6	10.50	14.90	11.21	11.99	9.37	8.78	27.30	32.74	30.00	22.06	28.87	14.04
	6-24	9.86	12.98	11.10	11.44	12.32	15.20	32.87	32.04	31.83	22.32	37.91	25.67

The main difference between the three levels was Level 1 soils had low to moderate salinity and sodicity in the top 0-6 inches, while Levels 2 and 3 showed higher levels at both 0-6- and 6-24-inch depths. The 6-24-inch depth of Level 1 had moderate to high salinity and sodicity levels. Results from 2020-2025 suggest that surface salinity and sodicity (0-6 inches) have a greater impact on germination, stands, yields, and quality than those in deeper layers.

Soil EC levels in Level 1 in 2020-21 and 2023-25 remained fairly consistent, moderately high in the 0-6-inch depths except in 2022. Dry conditions in 2023 led to the highest EC readings in this layer, but increased rainfall during 2024 brought a slight drop compared to 2023. In both 2022 and 2024, lower EC paired with higher moisture early in the season, as well as frequent showers during 2025, improved germination, plant stands, and yields—even where salinity and sodicity were higher—compared to 2020, 2021, and 2023. The 6–24-inch soil depth EC levels in Level 1 remained high across crops from 2020-25. Soil sodicity levels in the Level 1 0–6-inch soil depth remained low most years, while the 6–24-inch sodicity levels in Level 1 remained high in most years except 2025. Level 2 0–6-inch salinity and sodicity levels remained high and 6-24 inch levels of salinity and sodicity were very high in most years. Level 3 salinity and sodicity levels were very high in the 0–6-inch depth, while 6-24-inch salinity levels were high and sodicity levels were very high through most years.

Annual snowfall, spring-melt and rainfall during spring and the early growing season influenced salinity and sodicity levels particularly in the top 0-6 inch of the soil. Weather patterns in 2020 were dry for the Langdon area, 2021 was normal (spring and early growing-season), 2022 was normal with frequent rains during spring and early growing-season, 2023 reverted to dry conditions, 2024 was very wet and 2025 resembled 2022 with rain amounts close to normal with increased frequency during the growing season. Details of rain versus normal and potential evapotranspiration are given in Figure 1.

Figure 1. Annual 2020-2025 North Dakota Agricultural Weather Network (NDAWN) Langdon station rainfall, evapotranspiration (Penman) and normal rainfall for the periods of April 1 to October 31.



	2020	2021	2022	2023	2024	2025
Rain (inches)	11.37	16.66	17.53	8.45	26.38	16.27
Potential Evapotranspiration (inches)	38.91	42.89	41.07	36.63	35.99	35.79
Normal Rain (inches)	17.96	17.96	17.96	17.96	17.96	17.96

It's crucial to distinguish between timely rain that creates ideal soil moisture and excessive rainfall that leads to saturated, cool soils and flooded areas, especially during germination and other critical growth periods. In 2022, frequent light showers produced optimal soil conditions, whereas in 2024, infrequent but heavy rainfall resulted in saturated, cooler soils and some drowned-out patches. The weather in 2025 was more like 2022, with similar frequent light showers, although total rainfall during the growing season was a bit lower than normal.

Plot Sizes, Planting and Harvesting Details

Table 2. 2025 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
2025 Planting Details						
Barley	AAC Synergy (2-row)	May 31, 2025	1.2 million	1 to 1.5	Based on soil fertility results, a uniform rate of 130 pounds of N per acre (282 pounds of Urea per acre) was applied to all three levels.	All barley, oat and wheat plots in level 1, 2 and 3 were straight combined on September 24, 2025.
	Firefoxx (2-row)					
	ND Treasure (6-row)					
	Tradition (6-row)					
Oat	Newburg					
	Hifi					
	Rockford					
	ND Spilde					
Wheat	Faller					
	ND Stampede					
	ND Horizon					
	ND Heron					

Plot sizes were 4.5 X 22 feet. Harvested plot sizes were slightly smaller as they were trimmed during the growing-season. Planting and harvest details are in Table 2.

Results and Discussion

Similar to 2020-2024, the three levels showed variations between seedbed, germination, plant growth and vigor, maturity, yield, and quality in 2025.

Differences in Seedbed

As in previous years, the seedbed was rough and cloddy in areas with higher soil sodicity (Levels 2 and 3) compared to areas with low sodicity (Level 1) in the surface layers. This effect has been decreasing every year due to continuous tillage, but was still noticeable in 2025. An increase in soil sodicity results in wet, saturated and drowned out areas after light to heavy rains that effects readiness for tillage and planting. On May 29, 2025 the low to moderate sodicity areas were fully ready for field work, while moderate to very high levels stayed wet and cloddy. See seedbed pictures 1–3 for comparison.



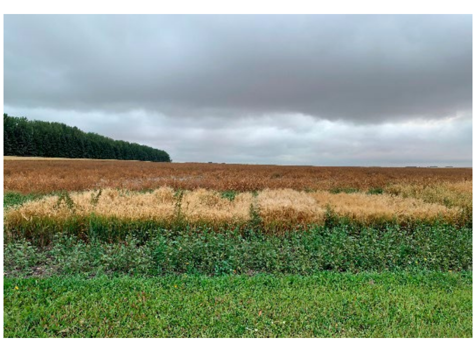
Pictures 1-3 from left to right: Differences in seedbed between Level 1 (low to moderate salinity-sodicity on the left), 2 (moderate to high salinity-sodicity in the middle) and 3 (very high salinity-sodicity on the right) on May 29, 2025.

Differences in Germination

Level 1 and 2 plots germinated in 7–8 days, while Level 3 took 2–3 days more. In 2025, frequent light rains provided optimal soil moisture, speeding up germination across all salinity levels compared to dry years. Barley germinated first, then oats, and finally wheat, each separated by one or two days.

Differences in Growth, Vigor, Stands and Maturity

Barley initially outperformed oats, but oats eventually matched its growth. Spring wheat lagged slightly behind barley. All three crops had very good germination and vigor in Level 1. In Level 2, barley and oats remained vigorous, but less than in Level 1, while wheat was weaker. In Level 3, barley plot still looked decent, oat looked better than wheat, while wheat had very poor growth and vigor in Level 3. Barley and oat plots had minor lodging in Level 1 while Level 2 and Level 3 plots had none. See pictures 4-12 showing barley, oat and wheat crop stands growing in Level 1, Level 2 and Level 3 on September 2, 2025.



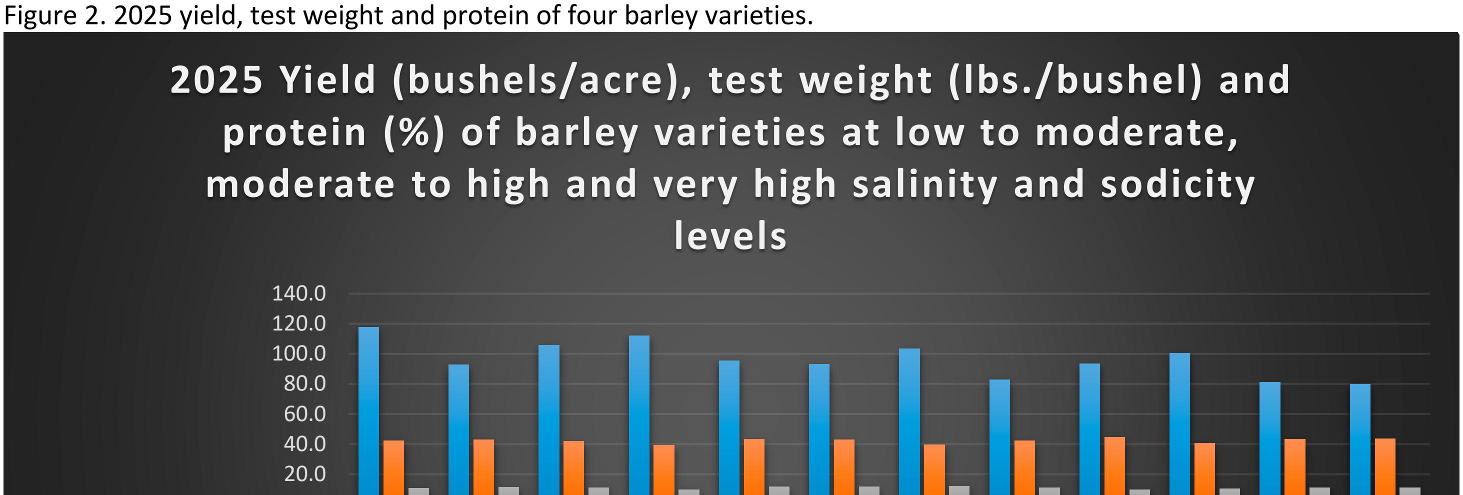
Picture 4-6. Barley (left), oat (middle) and spring wheat (right) varieties growing in Level 1 on September 2, 2025.

Picture 7-9. Barley (left), oat (middle) and spring wheat (right) varieties growing in Level 2 on September 2, 2025.

Picture 10-12. Barley (left), oat (middle) and spring wheat (right) varieties growing in Level 3 on September 2, 2025.

In 2025, all four barley varieties produced high yields in Level 1 (100.6 to 117.8 bushels/acre). Yields in Level 2 barley varieties were also very good compared to Level 1 (81.1 to 95.5 bushels/acre) with an average yield reduction of 18.9%, from Level 1, an improvement over previous years. Level 3 barley yields were also very high compared to past years with an average reduction in yield of 14.3% compared to Level 1. ND Treasure and Firefoxx varieties performed better in Level 3 versus Level 2 (13.6%), whereas AAC Synergy and Tradition had a slight decrease in yield in Level 3 compared to Level 2 (1.8%). Details are in Figure 2.

Figure 2. 2025 yield, test weight and protein of four barley varieties.



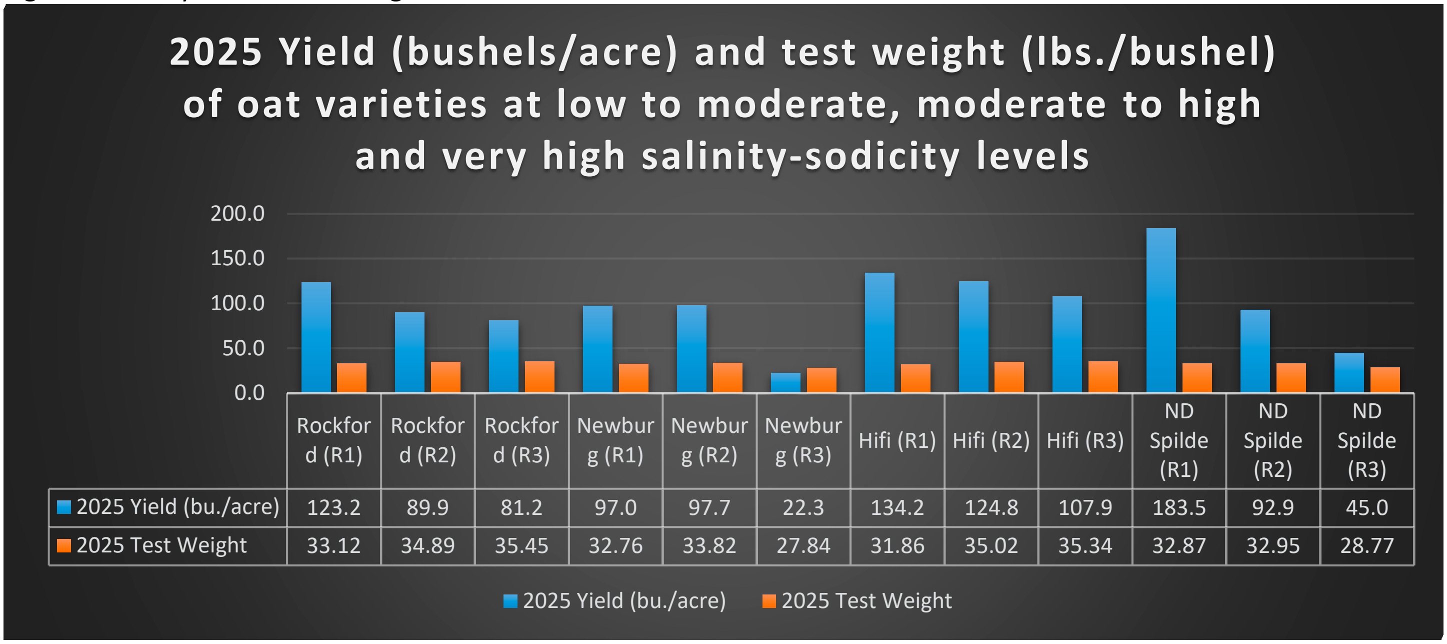
	ND Treasure (R1)	ND Treasure (R2)	ND Treasure (R3)	AAC Synergy (R1)	AAC Synergy (R2)	AAC Synergy (R3)	Firefoxx (R1)	Firefoxx (R2)	Firefoxx (R3)	Tradition (R1)	Tradition (R2)	Tradition (R3)
2025 Yield (bu./acre)	117.8	92.8	105.8	112.2	95.5	93.3	103.6	82.8	93.6	100.5	81.1	80.0
2025 Test Weight (lbs./bu.)	42.24	43.00	41.86	39.29	43.11	42.87	39.55	42.23	44.71	40.75	43.15	43.65
2025 Protein (%)	10.58	11.18	10.85	9.77	11.75	11.56	11.92	10.93	9.83	10.31	10.85	11.05

2025 Yield (bu./acre) 2025 Test Weight (lbs./bu.) 2025 Protein (%)

Oats

Level 1 oat yields were high, ranging from 97 to 183 bushels/acre. Level 2 yields were good (89.9–124.7 bushels/acre), with Rockford, Hifi, and ND Spilde averaging 27.3% lower than Level 1, while Newburg was up by 0.7%. Level 3 yields dropped by 51.5% compared to Level 1 and by 38% versus Level 2. See Figure 3 for details.

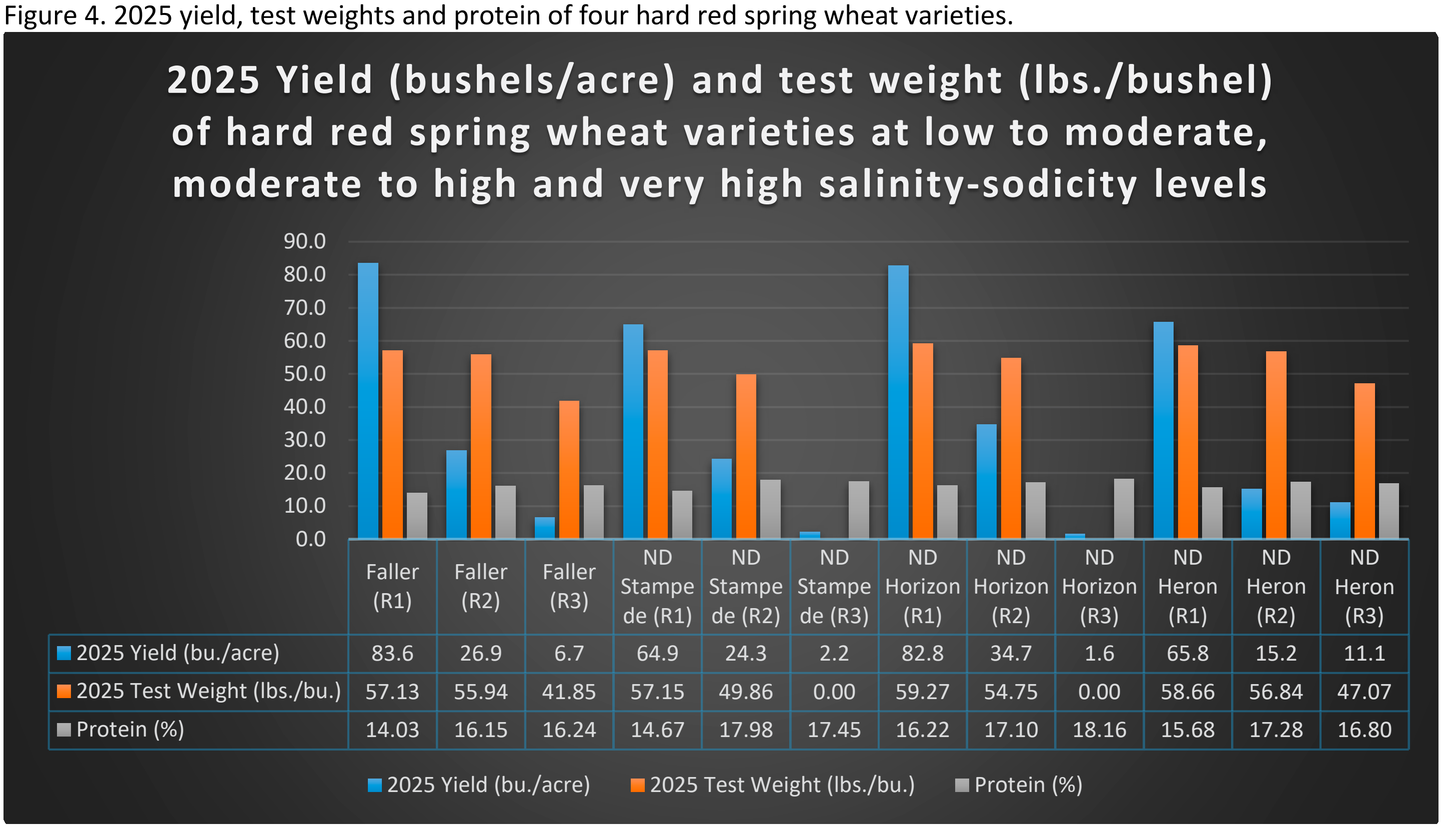
Figure 3. 2025 yield and test weight of four oat varieties.



	Rockford (R1)	Rockford (R2)	Rockford (R3)	Newburg (R1)	Newburg (R2)	Newburg (R3)	Hifi (R1)	Hifi (R2)	Hifi (R3)	ND Spilde (R1)	ND Spilde (R2)	ND Spilde (R3)
2025 Yield (bu./acre)	123.2	89.9	81.2	97.0	97.7	22.3	134.2	124.8	107.9	183.5	92.9	45.0
2025 Test Weight	33.12	34.89	35.45	32.76	33.82	27.84	31.86	35.02	35.34	32.87	32.95	28.77

Spring Wheat

Figure 4. 2025 yield, test weights and protein of four hard red spring wheat varieties.



	Faller (R1)	Faller (R2)	Faller (R3)	ND Stampede (R1)	ND Stampede (R2)	ND Stampede (R3)	ND Horizon (R1)	ND Horizon (R2)	ND Horizon (R3)	ND Heron (R1)	ND Heron (R2)	ND Heron (R3)
2025 Yield (bu./acre)	83.6	26.9	6.7	64.9	24.3	2.2	82.8	34.7	1.6	65.8	15.2	11.1
2025 Test Weight (lbs./bu.)	57.13	55.94	41.85	57.15	49.86	0.00	59.27	54.75	0.00	58.66	56.84	47.07
Protein (%)	14.03	16.15	16.24	14.67	17.98	17.45	16.22	17.10	18.16	15.68	17.28	16.80

Faller, ND Horizon and ND Heron wheat varieties performed well in Level 1 (65.8 to 83.6 bushels/acre) except ND Stampede, which yielded slightly lower compared local averages. Level 2 yielded lower, an average of 66.4% versus Level

1, while Level 3 yielded an average of 92.5% lower compared to Level 1. Across all varieties, Level 3 averaged 72.0% of Level 2 yields. See Figure 4 for details.

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-inch depths) has more impact on germination, stand and yield than subsurface salinity and sodicity (6-24-inch depths).
- Prolonged saturated soil harms germination, plant growth, and yield in salt-tolerant grains like barley and oats.
- Consistent, light rainfall that does not lead to soil saturation or plant damage has generally promoted enhanced germination, growth, vigor, yield, and crop quality, as observed in the years 2022 and 2025.
- 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. Larger 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.
- In 2025, barley and oat crops outyielded all spring wheat varieties with the increase in salinity and sodicity.
- Based on results from 2020 to 2025, sugar beet and sunflower have shown the highest tolerance to salinity and sodicity, followed by oats and barley. Durum, wheat, and canola appear to have similar tolerance levels, handling low to moderate salinity and sodicity in the surface soil layers (0–6 inches deep).

WHAT IS THE WORTH OF AN INCH OF TOPSOIL

Naeem Kalwar (Extension Soil Health Specialist)

Topsoil, also known as the A-horizon, is the most fertile and biologically active layer of the soil. This is the layer where farmers plant seeds, and it supports the crops that feed the world. Soils are typically composed of layers, known as horizons. O-horizon is the layer that has undecomposed organic material; mostly found in forest soils, A-horizon is known as topsoil and is rich in dark organic matter and nutrients, E-horizon is called the zone of leaching (rarely found in cultivated soils and mostly found in older well-developed soils of woodland) and is lighter in color compared to A-horizon, B-horizon is the subsoil layer that is very light in color and has low fertility and microbial activity compared to A-horizon, C-horizon (parent material) is the transitioning layer between B and C-horizons and R-horizon is the bedrock that releases material to the C-horizon after weathering (Figure 1). It is important to note that not all soils contain all these layers. Depending upon the location and soil type, a typically cultivated agriculture soil most probably will have A, B, C and R horizons.

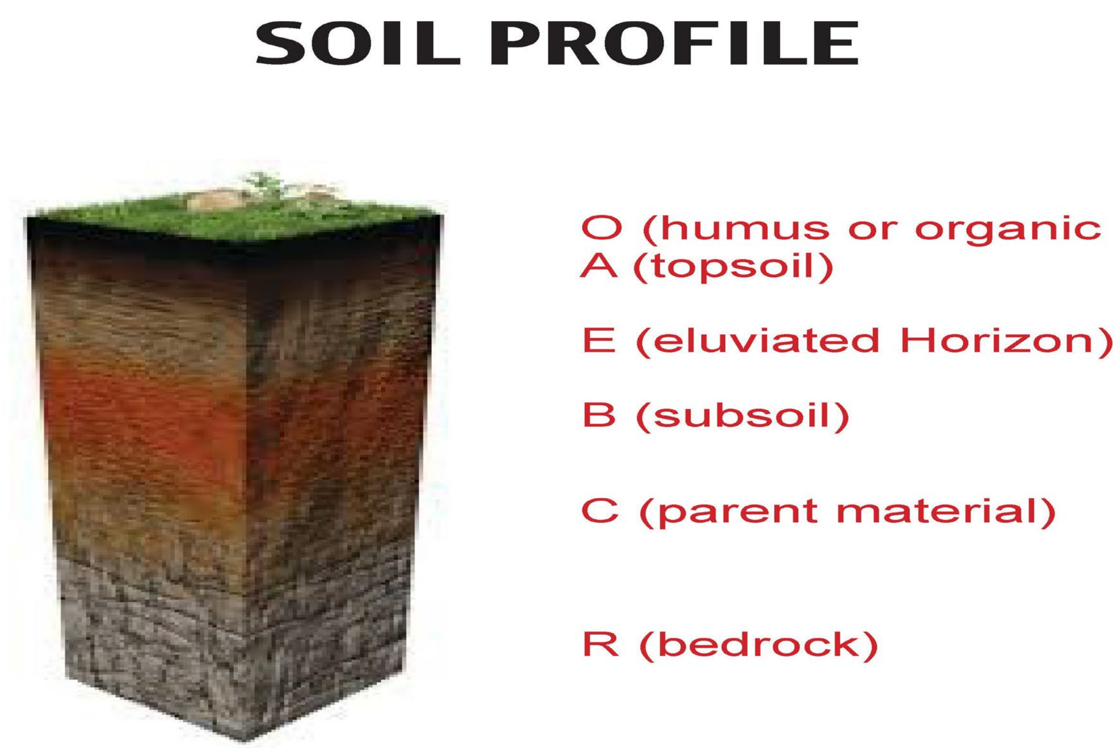


Figure 1. A soil profile showing typical soil layers or horizons that may or may not be present in all soils.

Topsoil is the most valuable soil layer, and it must be protected from erosion. Soil erosion (loss of soil material and nutrients) can happen due to the actions of wind, water, and tillage operations. Tillage can not only cause erosion, but it can enhance the extent of wind and water related erosion as it loosens the soil. Soil erosion not only occurs during the growing-season (Figure 2 and 3) but it can also happen in the winter (Figure 4).

Figure 2. Topsoil blowing a mile east of Langdon along Highway-5, ND on March 25, 2024.


Figure 3. Topsoil blowing a mile and a quarter southeast of Langdon on April 25, 2024.

When topsoil remains on agricultural land, it supports optimal crop and forage production. However, erosion can cause topsoil to accumulate in roadside ditches, leading to water pollution for both humans and livestock consumption. This loss also results in additional costs for farmers, ranchers, and land owners, who must invest in nutrient replacement. This erosion is frequently observed in road-side ditches adjacent to fields tilled in the fall.

Figure 4. A roadside ditch full of topsoil from the adjoining field that was tilled in the fall. Picture taken on December 19, 2021 5-6 miles west of Grand Forks, ND along Highway-2.

This raises an important question: What is the value of losing an inch of topsoil based on replacing the lost crop nutrients and organic matter? Assigning a dollar value to the qualitative benefits of topsoil, such as microbial activity is very difficult. However, we can estimate the financial cost of replacing nutrients and organic matter lost through erosion using available data.

To study this issue, Grand Forks County Agriculture and Natural Resource (ANR) Extension agent Isaac Cuchna collected a 0–6-inch deep sample of eroded topsoil from a roadside ditch adjoining a tilled field in the winter of 2024-25 between Crookston, MN and Grand Forks, ND. This soil sample was sent to a Soil Testing Laboratory for comprehensive fertility analysis and results are presented in Table 1. Results of the sample collected from the lost topsoil showed appreciable quantities of essential plant nutrients and significant amounts of soil organic matter. It is particularly important to note that nutrients can be replaced by applying commercial fertilizers, but increasing or rebuilding soil organic matter may take a long time despite adopting best management practices.

The estimated cost to replace the nitrogen (NO_3-N and NH_4-N), phosphorus (P), potash (K), sulphate-sulfur and iron present in the lost six-inches of soil through commercial fertilizers, came to $2541.22 or $423.54 per inch of lost topsoil. Replacement options for other nutrients were not available from the local Langdon supplier.

Soil Properties and Units	Level of Soil Properties
pH	7.4
CEC (meq/100 g of soil)	34.3
NO3-N (ppm)	70
NH4-N (ppm)	11.4
P (ppm)	35
K (ppm)	525
Ca (ppm)	193.2
Mg (ppm)	44.95
Sulfate-Sulfur (ppm)	36.11
Chloride (ppm)	84.78
Copper (ppm)	1.8
Iron (ppm)	11
Manganese (ppm)	9
Organic Matter (%)	5.7

Table 1: Soil analysis results of the 0-6-inch deep lost topsoil for key soil properties and levels.

For calculating the cost of soil organic matter for nutrient losses, a reference from the Building Soils for Better Crops, Ecological Management for Healthy Soils, Fourth Edition, SARE Handbook 10 by Fred Magdoff and Harold Van Es was used. According to this source, each one percent of soil organic matter contains 1000 pounds of nitrogen, 100 pounds of phosphorus, 100 pounds of potash and 100 pounds of sulfate-sulfur. Based on the 5.7% organic matter level of the lost 0-6-inch topsoil in the roadside ditch, it will cost $4141.73 to replace the lost referenced nutrients through commercial fertilizers. That will be $690.28 for every inch of topsoil. **When combining the cost of direct nutrient loss and nutrient loss due to organic matter loss, the total replacement cost is $1113.82 for every inch of lost topsoil or $6682.95 for the 0-6-inch layer of lost topsoil (Table 2).**

Nutrient Loss Type	For 0-6-inch Depth ($)	For Every Inch ($)
Direct Nutrient Loss	2541.22	423.53
Nutrient Loss due to losing Organic Matter	4141.73	690.28
Total	**6682.95**	**1113.81**

Table 2. The dollar amounts for replacing direct nutrient loss and by losing soil organic matter for 0-6-inch soil depth and for every inch of topsoil.

According to a long-term study by the NDSU Carrington Research Extension Center, consistent applications of livestock manure resulted in a one-percent increase in soil organic matter over 27 years. **Since livestock manure is the best and quickest way to increase soil organic matter, it means that despite best management practices, it will take 153.9 years to replace the lost 5.7% soil organic matter.** Based on the 2025 life expectancy of 77.6 years for an average North Dakotan, **it will roughly take two lifetimes (1.98 exactly) to rebuild 5.7% organic matter.**

2025 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 North Dakota. 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. (2012) used pheromone traps to monitor the distribution and spread of this insect in the state, but the study is now over a decade old. In recent years, renewed Hessian fly activity, especially in northeast ND has renewed concern among growers. To improve our understanding of Hessian fly population dynamics, including spatial distribution and peak adult emergence, a statewide trapping program using sex pheromone–baited sticky traps was initiated in 2023 (Fig. 1). **This year marks the third year of the project.**

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 28 traps were placed in 25 counties.

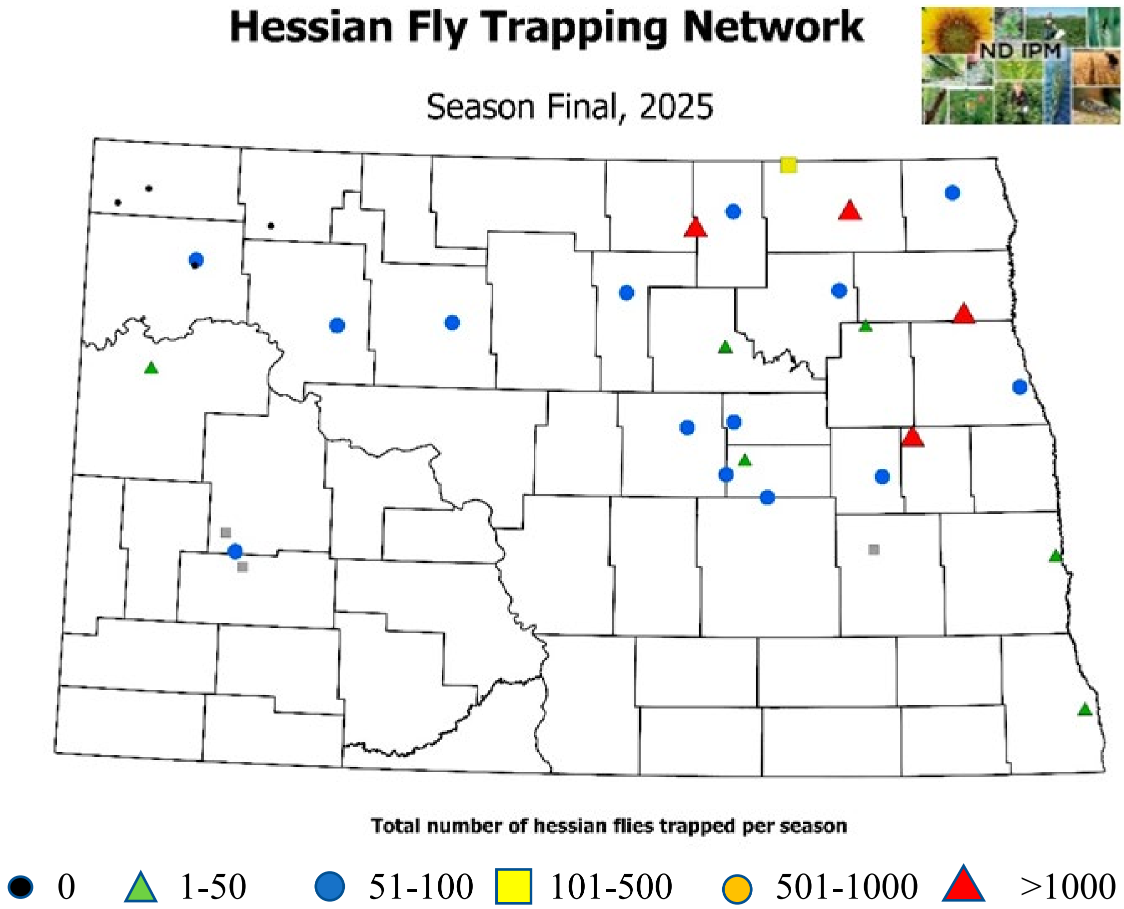

Figure 1: Season count of 2025 Hessian fly trapping network.

Results:

Distribution

Third-year trapping results indicate a substantial and growing presence of Hessian fly across the state. In 2025, a total of **16,357** Hessian flies were captured on sticky traps monitored by IPM insect trappers from early June through early September (Fig. 1 and Table 1). This total represents a **31% increase** over 2024, when **12,530** flies were captured at 26 traps placed across 21 counties. For comparison, in 2023 only **1,527** Hessian flies were recorded at 37 trapping sites, underscoring the rapid rise in population levels over the past three years.

In 2025, trap catches of Hessian flies were highest in the northeast region of North Dakota, with more than 1,000 Hessian flies per trap recorded at sites in Walsh, Rolette, Cavalier, and Steele counties. These four sites accounted for approximately 14% of the 28 trap locations statewide. This pattern closely resembled the distribution observed in 2024.

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

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

However, notable shift in Hessian fly population dynamics were observed across Walsh, Pembina, and Cavalier counties. In Pembina County, total trap counts dropped sharply from 2,805 in 2024 to just 291 in 2025. In contrast, Walsh County experienced a substantial increase, with counts rising from 300 to 1,261 flies over the same period. Cavalier County also showed significant growth: the Cavalier County LREC site increased from 169 flies in 2024 to 2,900 in 2025, while the second Cavalier County trap site rose from 164 to 904 flies. Across the remaining 23 trap sites, counts remained lower, with fewer than 500 flies recorded (Table 1).

Table 1. Summary of Hessian fly trapping in North Dakota, 2024 and 2025

	County	Total No. of Hessian fly 2024	Total No. of Hessian fly 2025
1	Stark	3	4
2	Dunn 2	0	14
3	Barnes	-	14
4	McKenzie	-	53
5	Richland	231	59
6	Foster CREC	310	74
7	Benson	112	76
8	Nelson	764	76
9	Cass	252	79
10	Griggs	100	116
11	Ward	183	117
12	Dunn 1	156	126
13	Pierce	-	130
14	Foster	-	141
15	Williams	0	149
16	Wells	-	226
17	Mountrail	63	243
18	Towner	278	260
19	Grand Forks	155	262
20	Pembina	2805	291
21	Eddy	-	297
22	Ramsey	410	324
23	Stutsman	-	386
24	Cavalier	164	904
25	Walsh	300	1261
26	Steele	1254	1360
27	Cavalier LREC	169	2900
28	Rolette	2403	6415
	Total	**12530**	**16357**

Peak Emergence:

Hessian fly has two generations in ND. The first-generation flies emerge in early spring and the second-generation flies appear in late summer, particularly in August and September (Anderson et al., 2012). To better understand these emergence patterns, we analyzed weekly fly-count data from both eastern and western counties of ND during the trapping period (Figs. 4 and 5).

The Weekly trap count data indicate that first-generation Hessian flies emerged from their overwintering pre-pupal stage in spring, coinciding with the emergence of spring wheat. Population levels were initially low across all trapping sites. Notably, there was no clear separation between first- and second-generation adults, as fly emergence continued throughout the season. The highest trap catches in ND occurred during July and August in both eastern and western regions. Based on the interval between the initial trap captures and these peaks, the increased fly counts during midsummer likely reflect the emergence of the second generation (Figures 4 and 5).

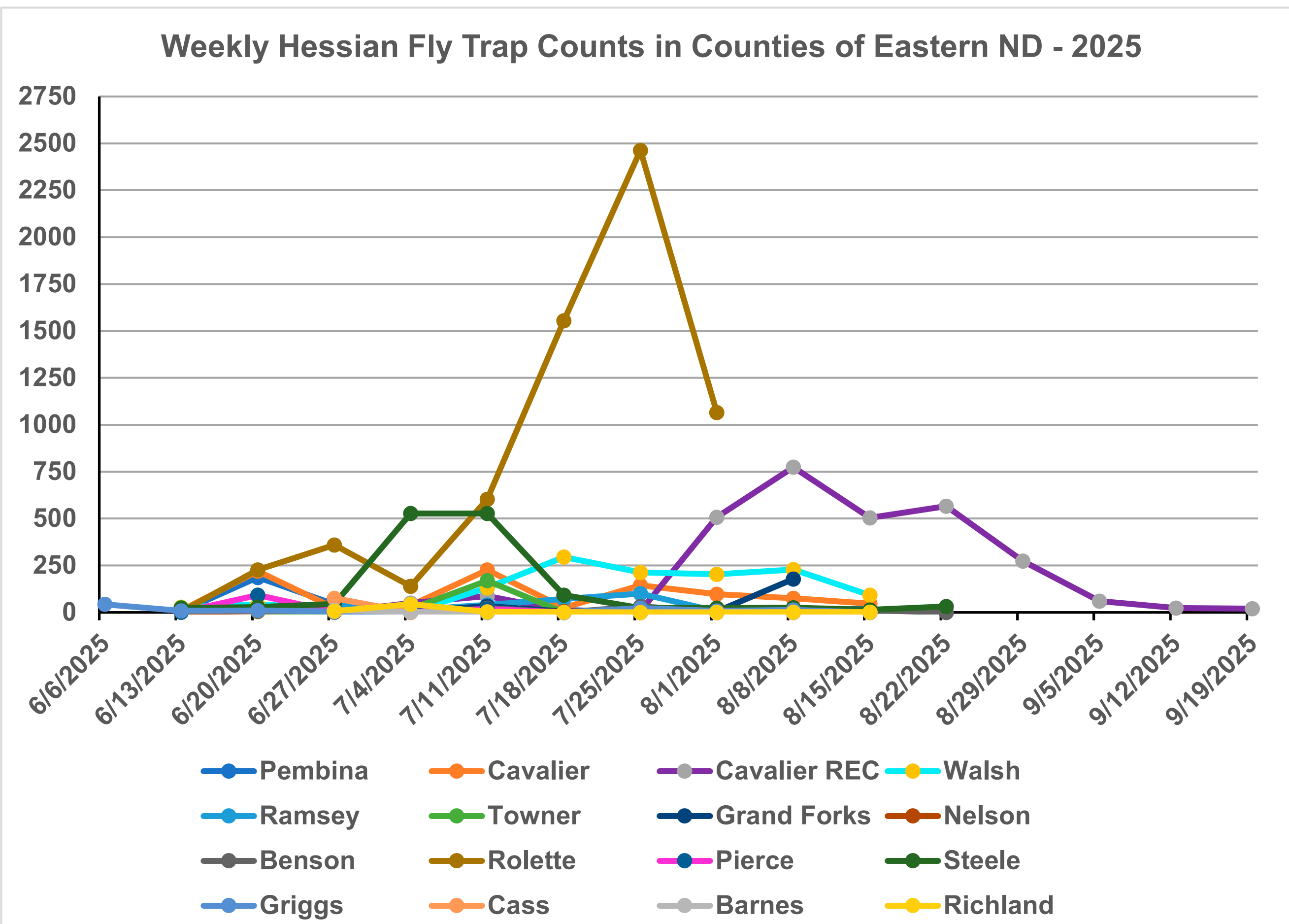

Figure 4: Weekly trap catch data of Hessian flies in eastern counties of ND.

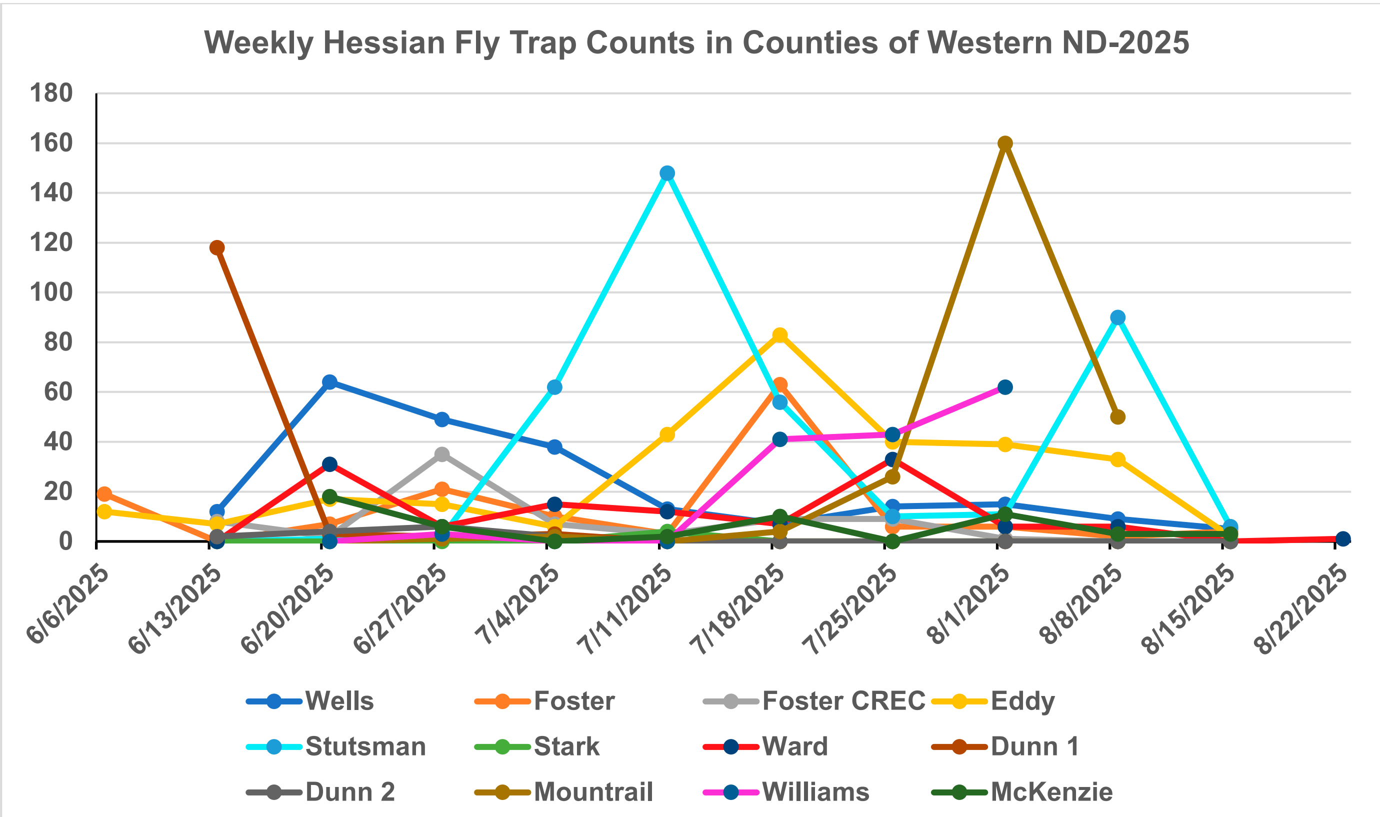

Figure 5: Weekly trap catch data of Hessian flies in western counties of ND.

Best Practices for Managing Hessian fly Infestation:

Effective Hessian fly management should focus on preventative strategies rather than chemical control. Key practices include destroying volunteer wheat and grassy hosts at least two weeks before planting, and selecting non-host cover crops to interrupt the pest's life cycle. Planting winter wheat and other small grains after the recommended "fly-free dates" (Sept. 15 in northern ND; Sept. 30 in southern ND) helps limit fall infestations, although warming autumn conditions may reduce the effectiveness of these dates.

Using resistant or tolerant varieties is the most economical control method. However, no resistant varieties are currently available, ongoing breeding programs at NDSU may provide new options in the future. Chemical control remains limited due to prolonged fly emergence, lack of monitoring tools, and short residual activity of insecticides. Seed treatments can provide early-season protection in winter wheat but offer minimal defense against spring infestations, while foliar pyrethroid applications are only effective when precisely timed with peak fly emergence.

Historically, insecticide use in ND was not advised because Hessian fly populations remained low. Recent data from the 2025 trapping season, however, reveal dramatic increase in fly numbers, particularly in the northeastern region, with over 1,000 flies captured per trap. These elevated numbers signal a high risk of Hessian fly infestation in wheat for 2026.

Acknowledgements

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Seed Treatments for Flea Beetle Control in Spring Canola, 2025

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Table 1. Location, experiment and agronomic information.

	Fargo	Langdon	Roseau
Trial Latitude (LLC)	46.901150	48.756286	48.847457
Trial Longitude (LLC)	-96.819222	-98.339257	-95.791617
Canola Variety	DK401TL	DK401TL	DK401TL
Previous Crop	HRSW	HRSW	HRSW
Planting Date	May 5	May 30	May 8
Emergence Date	May 12	June 6	May 20
Plot Size	4 ft x 20 ft	4 ft x 20 ft	5 ft x 25 ft
Row Spacing	6 inches	6 inches	7.5 inches
Seeding Depth	0.75 inch	0.75 inch	0.75 inch
Seeding Rate	14 seeds/ft^2	14 seeds/ft^2	14 seeds/ft^2
Experimental Design	RCBD, 4 reps	RCBD, 4 reps	RCBD, 4 reps
Harvest Date	September 3	September 26	September 10

Materials and Methods

The trials were conducted at the NDSU Campus Agronomy farm in Fargo, the Langdon REC in Langdon, and near Roseau, MN. See Table 1 for planting dates, trial design, seeding rates and other information.

The efficacy of various seed treatments was evaluated for controlling crucifer and striped flea beetles in spring canola. Dekalb DK401TL 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 three rates of 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. Additionally, foliar applications of Brigade 2EC were used alone and in combination with insecticidal seed treatments. Treatments, rates and active ingredients are listed in Table 2. Seed for Treatments 1, 2 and 12 were treated with a custom fungicide mix that equated with the active ingredients and rates found in the fungicide portion of Helix Vibrance.

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 7, 10 and 14 days after emergence (DAE), but this was not possible at each location due to weather and other field research commitments. The Roseau trial experienced extremely uneven emergence, which delayed injury rating timing and made injury ratings difficult. Plant stand was measured 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.

Foliar applications of Brigade 2EC (bifenthrin) were made to Treatments 2, 5, 8, 11 and 12 at Fargo and Langdon immediately following the second injury and defoliation ratings (May 27 and June 17), respectively. At Roseau, the first injury and defoliation ratings could not be completed before the foliar insecticide application. Instead, foliar applications were conducted on May 28, three days prior to the first rating. The second Brigade 2EC application was made to Treatment 12 one week after the first at all locations. All foliar applications were made with a backpack CO_2 sprayer using TeeJet 80015 flat fan nozzles at 40 PSI and a spray volume of 20 GPA.

Plots were harvested at maturity by straight combining with research plot combines, except at Langdon, where they were swathed prior to harvest. Grain weight, percent moisture content, and test weight were collected via the onboard weigh systems on the plot combines used at each location. Yields were adjusted to 8.5% standard grain moisture. All data were analyzed using the GLM procedure in SAS version 9.4 statistical software. The Fisher's LSD post-hoc test ($P<0.05$) was used to test for significance among treatment means when the main effect F-test was significant ($P<0.05$).

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

Treatment No.	Treatment Name	Product Rate(s)	Active Ingredient(s)	AI Rate (s) Metric
1	Fungicide Check			
2	Brigade 2EC	2.6 fl oz/a	Bifenthrin	0.04 lb/a
3	Helix Vibrance	23 fl oz/cwt	Thiamethoxam	400 g/100 kg
4	Helix Vibrance Fortenza[1]	23 fl oz/cwt 10.2 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 400 g/100 kg
5	Helix Vibrance Fortenza[1] Brigade 2EC	23 fl oz/cwt 10.2 fl oz/cwt 2.6 fl oz/a	Thiamethoxam Cyantraniliprole Bifenthrin	400 g/100 kg 400 g/100 kg 0.04 lb/a
6	Prosper Evergol	21.5 fl oz/cwt	Clothianidin	400 g/100 kg
7	Prosper Evergol Lumiderm	21.5 fl oz/cwt 9.8 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 400 g/100 kg
8	Prosper Evergol Lumiderm Brigade 2EC	21.5 fl oz/cwt 9.8 fl oz/cwt 2.6 fl oz/a	Clothianidin Cyantraniliprole Bifenthrin	400 g/100 kg 400 g/100 kg 0.04 lb/a
9	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
10	Prosper Evergol Buteo Start	21.5 fl oz/cwt 16 fl oz/cwt	Clothianidin Flupyradifurone	400 g/100 kg 500 g/100 kg
11	Prosper Evergol Buteo Start[2] Brigade 2EC	21.5 fl oz/cwt 9.6 fl oz/cwt 2.6 fl oz/a	Clothianidin Flupyradifurone Bifenthrin	400 g/100 kg 300 g/100 kg 0.04 lb/a
12	Brigade 2EC (2 apps)	2.6 fl oz/a	Bifenthrin	0.04 lb/a
13	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

[1]Fortenza substituted for Lumiderm, product rate adjusted to match commercial Lumiderm active ingredient rate.

[2]Commercial Buteo Start rate when used in combination with a neonicotinoid.

Table 3. Sampling activities, sampling dates (DAE = days after emergence), and crop stages.

	Fargo			Langdon			Roseau		
Activity	Date	DAE	Crop Stage	Date	DAE	Crop Stage	Date	DAE	Crop Stage
Stand Count	May 27	15	2-leaf	June 9 June 17	3	Cotyledon 2-leaf	June 5	16	Cotyledon-2-leaf
Injury Rating 1 Defoliation 1	May 19	7	Cotyledon	June 9	3	Cotyledon	May 31	11	Cotyledon-2-leaf
Injury Rating 2 Defoliation 2	May 27	15	2-leaf	June 17	11	2-leaf	June 5	16	Cotyledon-4-leaf
Injury Rating 3 Defoliation 3	June 5	24	4-leaf	June 24	18	4-leaf	---	---	---

Results and Discussion

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

At Fargo, flea beetle numbers were very low and no feeding activity was noted at the first rating date (7 DAE). At the second rating date (15 DAE), there were significant differences among treatments for flea beetle injury, but not for percent defoliation. Injury ratings were very low and injury was mainly on the cotyledons. Injury progressed by the third rating date (24 DAE), and although there were significant differences among treatments for injury and defoliation, the values were again low. In general, all treatments that received a foliar bifenthrin application had less feeding injury and less defoliation at 24 DAE compared to insecticidal seed treatments only. There were no significant differences among treatments for established plant stand and grain yield. Treatment means for Fargo are presented in Table 4.

At Langdon, there were no significant differences among treatments for feeding injury or defoliation for the first rating date at 3 DAE. Flea beetle activity had just begun in the trial. At the second rating date (11 DAE), there were pronounced and significant differences among treatments for feeding injury and defoliation. In general, Treatment 1, Treatments 3 and 6 (neonicotinoids only), Treatments 2 and 12 (bifenthrin only), Treatments 4 and 7 (neonicotinoids + cyantraniliprole), and Treatments 5 and 8 (neonicotinoids + cyantraniliprole + bifenthrin) had greater feeding injury and defoliation compared to Treatments 9, 10, 11 and 13, all of which contained flupyradifurone. The same trend was demonstrated at the third rating date (18 DAE), although treatments that received a foliar bifenthrin application showed some improvement. By 18 DAE, seedlings were at the 4-leaf stage and flea beetle pressure was winding down. The same trend was observed for grain yield, where treatments that included flupyradifurone had higher yields compared to neonicotinoids alone and in combination with cyantraniliprole. There were no significant differences among treatments for established plant stand at either the first or second sampling date (only the second plant stand results are presented). Treatment means for Langdon are presented in Table 5.

Roseau experienced very uneven emergence, which complicated the timing of ratings and foliar bifenthrin applications. There were no significant differences among treatments for established plant stand, although stands were thin due to soil crusting during emergence. Significant treatment differences were observed for both rating dates (11 and 16 DAE) for feeding injury and defoliation. The same trend among treatments that was observed at Langdon also was observed at Roseau. Despite this, there were no significant differences among treatments for grain yield. Treatment means for Roseau are presented in Table 6.

Table 4. Treatment means for flea beetle injury, percent defoliation, plant stand, and grain yield at Fargo, 2025.

Trt. No.	Treatment	Injury 7 DAE	% Defoliation 7 DAE	Injury 15 DAE	% Defoliation 15 DAE	Injury 24 DAE	% Defoliation 24 DAE	Plant Stand (plants/ft^2)	Grain Yield (lbs/acre)
1	Fungicide Check	0	0	1.7 a	0.5 a	2.3 ab	13.4 ab	14.5 a	2,696.0 a
2	Brigade 2EC	0	0	1.2 ab	0.5 a	2.1 bc	7.5 cde	14.3 a	3,087.0 a
3	Helix Vibrance	0	0	0.8 bc	0.2 a	2.4 ab	11.6 abc	14.1 a	3,258.9 a
4	Helix Vibrance Fortenza[1]	0	0	0.8 bc	0.3 a	2.3 ab	12.2 abc	15.0 a	3,084.2 a
5	Helix Vibrance Fortenza[1] Brigade 2EC	0	0	0.9 bc	0.2 a	2.1 bc	10.0 bcd	12.3 a	3,193.2 a
6	Prosper Evergol	0	0	0.7 c	0.0 a	2.2 abc	10.6 abc	14.2 a	2,993.6 a
7	Prosper Evergol Lumiderm	0	0	0.7 c	0.6 a	2.2 abc	12.2 abc	12.9 a	2,764.1 a
8	Prosper Evergol Lumiderm Brigade 2EC	0	0	0.7 c	0.4 a	2.1 bc	9.1 bcd	12.5 a	3,247.1 a
9	Prosper Evergol Buteo Start[2]	0	0	0.7 c	0.1 a	2.6 a	14.1 a	12.2 a	3,264.5 a
10	Prosper Evergol Buteo Start	0	0	0.6 c	0.3 a	2.2 abc	9.1 bcd	13.4 a	3,538.8 a
11	Prosper Evergol Buteo Start[2] Brigade 2EC	0	0	0.7 c	0.3 a	1.8 c	3.8 e	11.5 a	2,927.0 a
12	Brigade 2EC (2 apps)	0	0	0.7 c	0.3 a	1.8 c	4.4 de	13.4 a	2,952.3 a
13	Prosper Evergol Lumiderm Buteo Start[2]	0	0	1.1 bc	0.1 a	2.6 a	11.9 abc	13.2 a	2,878.2 a
	F-value	**---**	**---**	**3.25**	**0.72**	**3.03**	**3.60**	**0.98**	**1.22**
	P-value	**---**	**---**	**0.0031**	**0.7193**	**0.0049**	**0.0014**	**0.4834**	**0.3105**
	LSD	**---**	**---**	**0.48**	**NS**	**0.41**	**4.84**	**NS**	**NS**

Means within a column that share the same letter are not significantly different (P<0.05).

[1]Fortenza substituted for Lumiderm, product rate adjusted to match commercial Lumiderm active ingredient rate.

[2]Commercial Buteo Start rate when used in combination with a neonicotinoid.

Table 5. Treatment means for flea beetle injury, percent defoliation, plant stand, and grain yield at Langdon, 2025.

Trt. No.	Treatment	Injury 3 DAE	% Defoliation 3 DAE	Injury 11 DAE	% Defoliation 11 DAE	Injury 18 DAE	% Defoliation 18 DAE	Plant Stand (plants/ft^2)	Grain Yield (lbs/acre)
1	Fungicide Check	0.2 a	0.1 a	3.4 a	30.9 a	3.5 a	28.4 ab	13.5 a	2,978.4 de
2	Brigade 2EC	0.4 a	0.8 a	3.5 a	32.5 a	3.3 ab	26.6 abc	12.0 a	3,123.2 de
3	Helix Vibrance	0.2 a	0.5 a	3.3 a	32.5 a	3.0 abc	27.2 abc	13.0 a	2,889.9 e
4	Helix Vibrance Fortenza[1]	0.3 a	0.3 a	2.5 c	17.0 bc	2.4 cde	16.5 cd	12.5 a	3,228.4 de
5	Helix Vibrance Fortenza[1] Brigade 2EC	0.2 a	0.3 a	2.7 bc	27.3 ab	2.4 de	17.3 cd	12.7 a	3,365.7 b-e
6	Prosper Evergol	0.3 a	0.3 a	3.2 ab	30.6 a	3.2 ab	30.7 a	12.3 a	3,091.2 de
7	Prosper Evergol Lumiderm	0.2 a	0.4 a	3.3 a	29.7 a	3.4 a	30.6 a	12.3 a	3,290.6 cde
8	Prosper Evergol Lumiderm Brigade 2EC	0.1 a	0.3 a	3.4 a	32.8 a	3.2 ab	26.6 abc	11.6 a	3,187.2 de
9	Prosper Evergol Buteo Start[2]	0.2 a	0.4 a	2.3 cd	13.1 c	2.3 de	15.4 d	12.2 a	3,820.2 ab
10	Prosper Evergol Buteo Start	0.1 a	0.2 a	1.3 e	5.3 c	1.7 f	8.3 d	12.3 a	3,906.8 a
11	Prosper Evergol Buteo Start[2] Brigade 2EC	0.3 a	0.6 a	1.8 de	12.1 c	2.0 ef	7.7 d	11.6 a	3,771.8 abc
12	Brigade 2EC (2 apps)	0.4 a	0.5 a	3.2 ab	28.1 ab	2.8 bcd	17.9 bcd	12.8 a	3,450.4 a-d
13	Prosper Evergol Lumiderm Buteo Start[2]	0.3 a	0.3 a	2.2 cd	13.0 c	2.1 ef	12.9 d	12.3 a	3,266.0 de
	F-value	**0.98**	**0.58**	**13.29**	**5.32**	**8.24**	**4.90**	**0.44**	**3.55**
	P-value	**0.4870**	**0.8406**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.9367**	**0.0016**
	LSD	**NS**	**NS**	**0.57**	**12.17**	**0.61**	**10.69**	**NS**	**488.91**

Means within a column that share the same letter are not significantly different ($P<0.05$).

[1]Fortenza substituted for Lumiderm, product rate adjusted to match commercial Lumiderm active ingredient rate.

[2]Commercial Buteo Start rate when used in combination with a neonicotinoid.

Table 6. Treatment means for flea beetle injury, percent defoliation, plant stand, and grain yield at Roseau, 2025.

Trt. No.	Treatment	Injury 11 DAE	% Defoliation 11 DAE	Injury 16 DAE	% Defoliation 16 DAE	Plant Stand (plants/ft^2)	Grain Yield (lbs/acre)
1	Fungicide Check	3.4 a	28.8 a	3.5 a	32.5 a	6.5 a	2,963.7 a
2	Brigade 2EC	3.4 a	24.7 abc	3.1 ab	27.5 ab	6.0 a	2,883.2 a
3	Helix Vibrance	3.0 a	19.7 bcd	3.3 a	23.8 b	5.8 a	3,017.2 a
4	Helix Vibrance Fortenza[1]	2.1 bc	12.8 def	2.5 bcd	15.6 cd	6.1 a	2,900.8 a
5	Helix Vibrance Fortenza[1] Brigade 2EC	1.7 cd	17.5 cd	1.8 de	14.4 d	7.6 a	2,993.9 a
6	Prosper Evergol	3.3 a	26.6 ab	3.0 ab	25.6 ab	6.1 a	2,935.6 a
7	Prosper Evergol Lumiderm	1.5 cd	14.1 de	2.4 bcd	23.8 b	6.8 a	3,060.5 a
8	Prosper Evergol Lumiderm Brigade 2EC	2.4 b	17.8 cd	2.1 cde	14.1 de	6.5 a	2,980.3 a
9	Prosper Evergol Buteo Start[2]	1.2 de	6.3 efg	1.5 ef	13.1 de	6.3 a	2,888.4 a
10	Prosper Evergol Buteo Start	0.8 e	3.4 g	1.6 ef	10.9 de	6.0 a	2,960.5 a
11	Prosper Evergol Buteo Start[2] Brigade 2EC	0.8 e	4.1 g	1.1 f	6.6 e	6.0 a	2,933.3 a
12	Brigade 2EC (2 apps)	3.1 a	23.8 abc	2.5 bc	23.1 bc	5.4 a	2,819.1 a
13	Prosper Evergol Lumiderm Buteo Start[2]	0.8 e	5.9 fg	1.8 de	12.2 de	5.5 a	2,984.2 a
	F-value	**26.28**	**10.37**	**9.29**	**8.58**	**0.77**	**0.70**
	P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.6802**	**0.7447**
	LSD	**0.59**	**7.88**	**0.70**	**7.57**	**NS**	**NS**

Means within a column that share the same letter are not significantly different ($P<0.05$).

[1]Fortenza substituted for Lumiderm, product rate adjusted to match commercial Lumiderm active ingredient rate.

[2]Commercial Buteo Start rate when used in combination with a neonicotinoid.

Acknowledgements: We would like to thank the Northern Canola Growers Association for financial support and our Agronomy crew, Lawrence Henry and Rick Duerr in planting and harvesting the trial.

Efficacy of insecticide seed treatments on Hessian fly in spring wheat

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Introduction

Hessian fly, *Mayetiola destructor* (Say), is one of the most significant insect pests affecting wheat in North Dakota. It was introduced into North America during the late 1770s in Long Island, New York, primarily through straw-bedding of Hessian soldiers during the American Revolution (Schmid et al. 2018). Since then, its populations have spread across the wheat-growing regions of the country. Although wheat is the preferred host, it also infests barley, rye and several grass species as alternative hosts. Hessian fly causes injury in two main ways: 1) Larvae feeding at the base of the plants at early growth stages leads to stunting, seedling or tiller death and 2) Larvae feeding on stems, at the nodes in later growth stages weakens the stems, reduces grain filling or causes stem lodging.

Historically, Hessian fly has been a serious pest in winter wheat in southern states and a sporadic pest in ND, with notable outbreaks occurring in 1991, 2003 and 2015 (Knodel, 2015). However, in recent years, significant lodging and yield losses due to Hessian Fly have been observed in spring wheat fields in Cavalier County (Anitha Chirumamilla personal survey). These observations prompted a research study, funded by the North Dakota Wheat Commission, conducted in 2023 and 2024 to monitor the distribution, population density and emergence patterns of Hessian fly in ND using sex pheromone trapping. Results from this study indicated a significant presence of Hessian fly across the state. In 2024, IPM insect trappers captured a total of 12,530 Hessian flies on sticky traps at 27 sites from June to mid-August, an eight-fold increase, compared to 2023 when only 1,527 flies were captured at 37 sites. The highest trap catches were found in the northeast and east-central regions of North Dakota, where 500 to >1500 Hessian flies were captured per trap per season in Pembina, Rolette, Grand Forks, Steele, Cavalier and Nelson counties.

With the increasing Hessian fly numbers and associated yield losses in ND, spring wheat growers are seeking effective management options for this pest. Historically, Hessian fly management has focused on strategies developed for winter wheat systems, which include use of resistant varieties, fly-free planting dates, and insecticides (seed treatments and foliar insecticides). Seed treatments at higher doses have been shown to reduce Hessian fly infestations in winter wheat (Howell et al. 2017, Buntin et al. 2025). However, these studies were not specifically focused on managing Hessian fly in spring wheat, and there is currently no published data on the effectiveness of insecticide seed treatments for spring wheat.

The objective of this study is to evaluate the efficacy of several registered insecticide seed treatments for spring wheat in controlling Hessian fly populations in North Dakota. This insect produces two generations per season, infesting spring wheat during both the early seedling stage and later developmental stages. Although insecticide seed treatments typically provide protection only against the first generation, reducing early-season infestations may suppress overall population levels enough to diminish the impact of the second generation.

Materials & Methods

In 2025, field experiments were conducted at two sites in northeastern ND: the Langdon Research Extension Center in Langdon and at a farmer's field located 8 miles from Grand Forks where high numbers of Hessian flies have been observed in the past. However, no Hessian fly infestations occurred at the Grand Forks site during the trial period, resulting in no usable data. Consequently, this location is omitted from further analysis and discussion in this report.

At Langdon REC location, spring wheat was planted on May 27th due to unusually wet conditions early in the season. Individual research plots were 3.5 feet wide and 16 feet long, consisting of seven rows spaced 6 inches apart, using an Almaco planter at a seeding rate of 1.5 million live seeds per acre. Standard fertilizer was applied to target a yield of 60 bushels per acre, and weeds were controlled using appropriate herbicides.

A total of five insecticide seed treatments were evaluated, rather than the seven originally planned, due to the unavailability of insecticide, Foothold Extra. The treatments included in the study are listed in Table 1.

Table 1: List of insecticide treatments

Treatment number	Treatment	Rate (fl oz/cwt)	Active Ingredient	IRAC MOA
1	Untreated Check	-	-	-
2	Gaucho 600	0.13	Imidacloprid	4A
3	Gaucho 600	2.4	Imidacloprid	4A
4	Cruiser	0.75	Thiamethoxam	4A
5	Cruiser	1.33	Thiamethoxam	4A
6	Lumivia CPL	0.75	Chlorantraniliprole	28

The experiment was arranged in a randomized complete block design with four replications. Plant stand was measured by counting all plants within two 3-feet sections of row in each plot. Hessian fly populations were assessed by collecting 20 random tillers or stems from the outer rows of each plot and dissecting them in the laboratory to determine the number of larvae or pupae per stem. An exception was made at the tillering stage, when entire plants were removed instead, as individual tillers are difficult to separate at this early growth stage. During this stage, Hessian fly larvae and pupae are typically located near the crown region close to the soil surface.

Hessian fly sampling was conducted at the tillering, boot, milk, and late-dough growth stages; the corresponding sampling dates are provided in Table 2. Plots were harvested using a small-plot combine. Harvest was delayed due to rainfall. Plot weight, grain moisture, and test weight were recorded using the combine's onboard weighing system. Plot weights were adjusted to the standard grain moisture (13.5%) and converted to pounds per acre and bushels per acre.

All data were analyzed using analysis of variance for a complete-block, balanced, orthogonal design using Genovix Version II software. Treatment means were separated using Fisher's least significant difference (LSD) test.

Table 2. Sampling activities, sampling dates, and crop stages

Activity	Date	Crop Stage
Stand Count	June 11	2-leaf stage
Population count 1	June 20	Tillering
Population count 2	July 10	Boot stage
Population count 3	July 30	Milk stage
Population count 4	August 22	Dough stage

Results and Discussion:

Larval/Pupal Counts

Hessian fly larvae or pupae were not detected in the first two evaluations conducted at the tillering and boot stages. Two factors may explain the absence of counts at these early growth stages:

1. **Delayed adult emergence**, occurring from late June to early July, as indicated by consistently low adult fly captures in pheromone traps across all locations in North Dakota in 2025 (Figure 1);
2. **Early-stage infestations occur at the crown region** of wheat seedlings, where sampling requires pulling plants from the soil, which may dislodge larvae or pupae and lead to underestimation of infestations.

Hessian fly larvae were first observed during the third sampling event and pupae during the fourth, corresponding to the milk and dough stages of wheat development, respectively. These findings indicate that fly activity began late in the season—around the early boot stage—and continued through flowering. Treatment means for larval and pupal counts are presented in Figure 2 and Table 3, with yield data also summarized in Table 3.

No significant differences among treatments were found for plant stand, larval counts at the milk stage, or pupal counts at the dough stage. Mean larval counts at the milk stage ranged from 2.25 larvae per 20 stems in the untreated check to 7.5 larvae per 20 stems in the Lumivia treatment. Interestingly, the untreated check had the lowest number of larvae and pupae compared with all insecticide seed treatments. **At this time, the most plausible explanation is that the efficacy of the seed treatments had diminished by the time flies were active and ovipositing.**

At the dough stage, pupal counts increased across all treatments, although differences among treatments remained statistically insignificant. The lowest mean pupal numbers were recorded in **Gaucho 0.13 fl oz**, followed by **Cruiser 1.33 fl oz** and **Lumivia 0.75 fl oz**. These three treatments also showed the smallest increases in pupal counts from the milk to dough stages. In contrast, the untreated check, **Gaucho 2.4 fl oz**, and **Cruiser 0.75 fl oz** exhibited higher pupal counts and larger increases between growth stages (Figure 2).

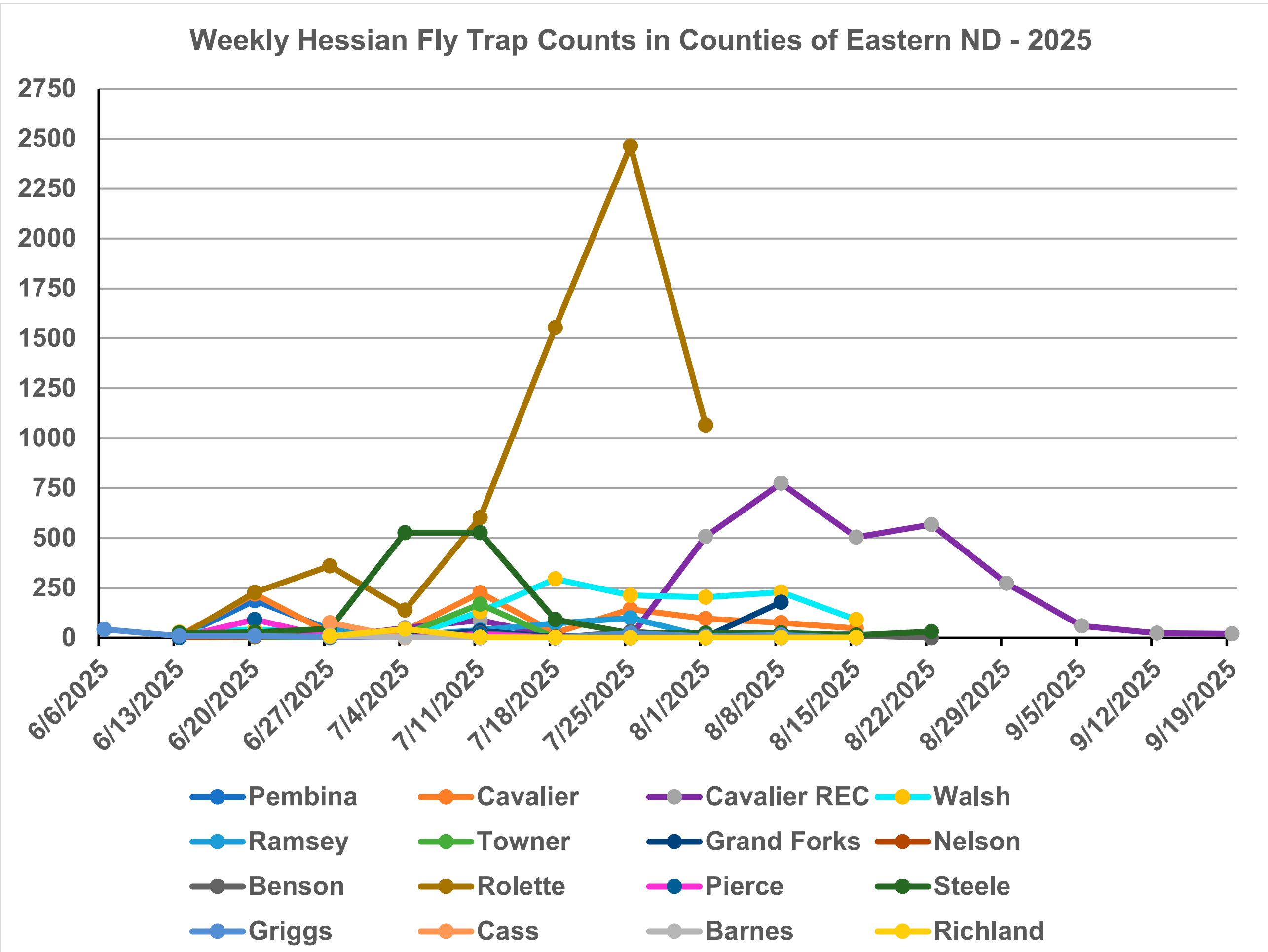

Figure 1: Weekly trap catch data of Hessian flies in eastern counties of ND.

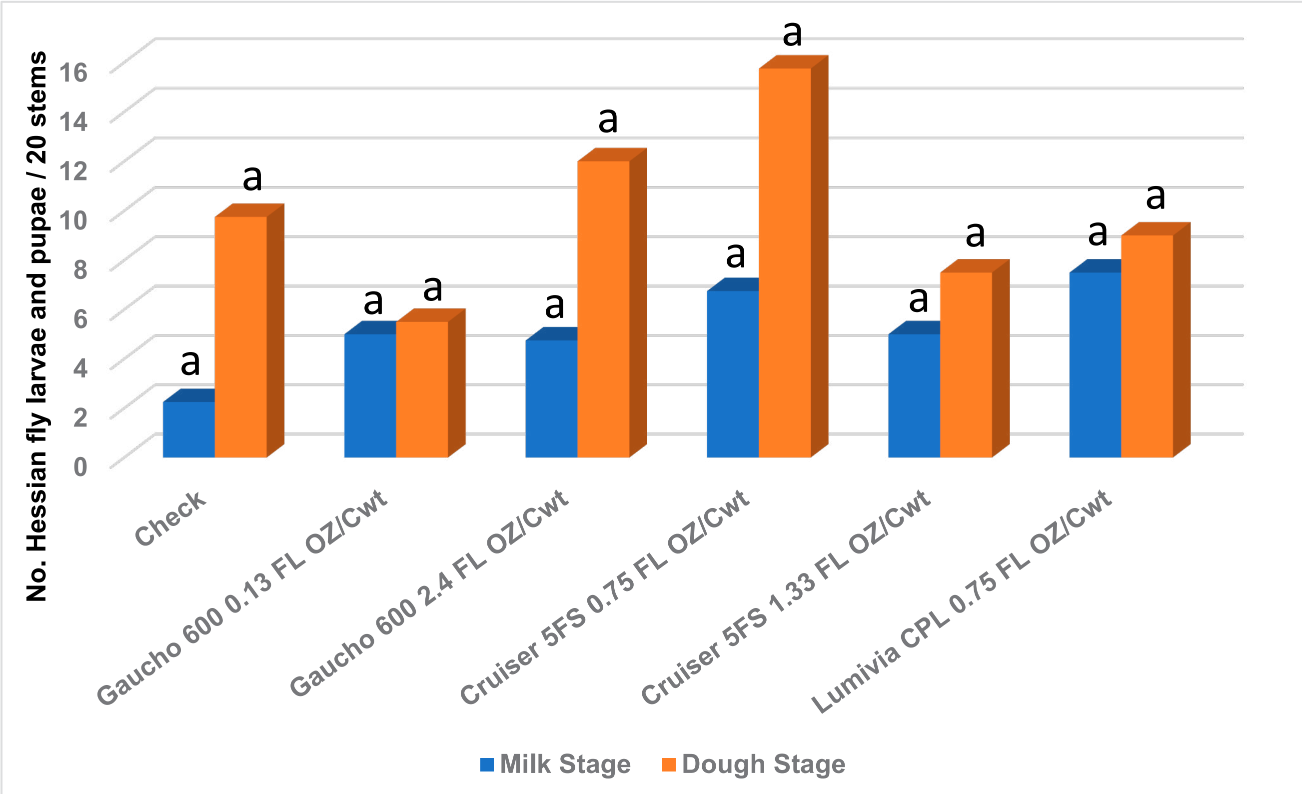

Figure 2: Mean number of Hessian fly pupae for insecticide seed treatments at milk and dough stages.
Bars of the same color that share the same letter are not significantly different (P<0.05).

Yield

Average yields across treatments ranged from 57.15 to 62.3 bu/ac. In contrast to the larval and pupal counts, **significant differences were observed among treatments for yield**. The higher rate of Gaucho (2.4 fl oz) produced the greatest yield (62.3 bu/ac), which was significantly higher than both the lower rate of Gaucho (0.13 fl oz) and the Cruiser 0.75 fl oz treatment (Table 3).

Although not statistically significant, a similar pattern was observed within the Cruiser treatments: the lower rate yielded 59.38 bu/ac compared with 61.8 bu/ac for the higher rate. The untreated check and the Lumivia treatment performed comparably to treatments 3, 5, and 6, with all producing yields exceeding 60 bu/ac (Table 3).

Table 3: Mean number of Hessian fly pupae for insecticide seed treatments at milk and dough stages and Yield.

	Treatment	Mean No. of Larvae or Pupae/20 stems		Plant Stand (Plants/ft2)	Yield (bu/ac)
		Milk Stage	Dough Stage		
1	Check	2.25 a	9.75 a	27 a	60 ab
2	Gaucho 600 0.13 FL OZ/Cwt	5.0 a	5.5 a	27 a	57.15 c
3	Gaucho 600 2.4 FL OZ/Cwt	4.75 a	12.0 a	24 a	62.3 a
4	Cruiser 5FS 0.75 FL OZ/Cwt	6.75 a	15.75 a	25 a	59.38 bc
5	Cruiser 5FS 1.33 FL OZ/Cwt	5.0 a	7.5 a	26 a	61.8 ab
6	Lumivia CPL 0.75 FL OZ/Cwt	7.5 a	9.0 a	25 a	60.23 ab
	Mean	**5.2**	**9.92**	**26**	**60.15**
	CV %	**98.5**	**52.2**	**12.6**	**2.8**
	LSD	**7.73**	**7.8**	**4.9**	**2.53**
	P-value (0.05)	**NS**	**NS**	**NS**	**0.008**

Means within a column that share the same letter are not significantly different (P<0.05).

Because no treatment differences were detected in larval or pupal counts, and because the yield of the untreated check was similar to that of four of the five seed treatments, **the observed yield differences cannot be attributed to seed treatment efficacy against Hessian fly.**

Conclusion

These results indicate that insecticide seed treatments alone may not effectively suppress Hessian fly populations in spring wheat in North Dakota. The late-season emergence of adult flies suggests that infestations occurred after the residual activity of seed treatments had diminished.

However, the presence of larvae at the milk stage and pupae at the dough stage highlights the potential value of integrating foliar insecticide applications at the boot and flowering stages with seed treatments. **Additional research combining seed treatments and timely foliar sprays may provide improved management of Hessian fly under North Dakota conditions.**

Acknowledgements

We would like to thank the North Dakota Wheat Commission for financial support and our field crew, Lawrence Henry and Rick Duerr in planting and harvesting the trial.

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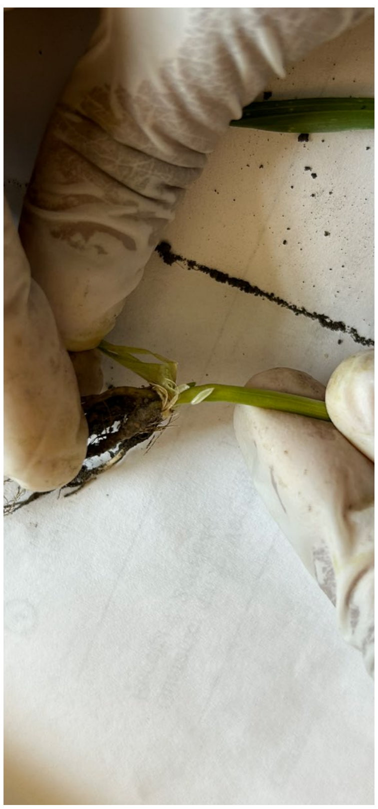
Langdon REC Foundation Seed Stocks Program

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 2026 growing season are listed below:

HRSW – Faller, Prosper, ND Stampede, ND Horizon
Barley – ND Treasure
Soybeans – 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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