Langdon
Research Extension Center

ANNUAL RESEARCH REPORT NO. 98

December 2023

NDSU NORTH DAKOTA STATE UNIVERSITY

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Table of Contents

The 2023 annual research report is intended to provide producers information to aid in selecting varieties and/or hybrids. Variety information and research reports on crop disease and production can also be found on our website www.ag.ndsu.edu/langdonrec. Variety trial results from all NDSU Research Extension Centers and the Main Station at Fargo can be accessed at www.ag.ndsu.edu/varietytrials/ (old NDSU variety trial website) and https://vt.ag.ndsu.edu/ (new NDSU variety trial website). For NDSU crop publications and additional crop information visit: www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/crops.

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

The agronomic data presented in this publication are from replicated research plots using experimental designs that enable the use of statistical analysis. The trials are designed so that "real" yield and agronomic differences can be statistically separated from differences that occur by chance. The least significant difference (LSD) values given in the report are used for this purpose. If the difference between two varieties exceeds the LSD value, it means that with 95% or 90% confidence (LSD probability 5 or 10%) the higher-yielding variety has a significant yield advantage. When the difference between two varieties is less than the LSD value, no significant difference was found between those two varieties under those growing conditions. The trial mean shown in the tables represent all named varieties and experimental lines tested in the trial. Experimental line data is not shown. Statistical analysis includes all varieties and experimental lines in the trial.

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

The NDSU Langdon Research Extension Center, in addition to its on-station research program, conducted variety research trials at several locations in 2023. 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.

2023 Weather Summary

Fall recharge at Langdon from September through October 2022 was 2.05 inches, 1.19 inches below normal. Precipitation from November 2022 through March 2023 was 3.60 inches, 0.35 inches above normal. Snowfall for 2022-2023 from November through April was 64.9 inches, 36.8 inches above normal. December and April received the most snow. December-February temperatures averaged 5.3°F, 0.1°F above normal. December was the 6th snowiest on record while April had the 2nd most snowfall for that month. March was the 4th coldest on record and April the 7th coldest. May was the 6th driest and 3rd hottest on record with only 0.42 of precipitation and temperatures in the 70s and 80s starting on May 11. Rainfall patterns throughout the summer were very sporadic. The 2023 growing season precipitation ranged from 32-85 percent of normal across NE North Dakota from May-August with most areas ranging from 35-45 percent of normal. Early season lack of rainfall resulted in delayed emergence in parts of some fields. June was the 3rd hottest on record while July was the 3rd driest. Despite the drier and warmer than normal conditions, producers were generally satisfied with the yield levels, except for soybeans. Very little disease or lodging of crops aided in the better than expected yields.

2023 Crop Management - Langdon					
Field Trial	**Previous Crop**	**Seeding Rate Unit/Acre**	**Planting Date**	**Harvest Date**	**Row Spacing**
Barley	soybean	1.0 million pls	May 22	Aug. 29	6
Buckwheat	soybean	50 lbs pls	May 31	Oct. 20	6
Canola	soybean	435,000 pls	June 1	Sept. 19	6
Crambe	soybean	20 lbs	May 31	Sept. 18	6
Corn	soybean	28,000 thinned	May 16	Oct. 15	30
Durum	soybean	1.50 million pls	May 19	Sept. 8	6
Dry Bean	soybean	75,000-90,000 pls	May 30	Oct. 12	30
Faba Bean	wheat	192,000 pls	May 19	Sept. 19	6
Field Pea	wheat	325,000 pls	May 19	Aug. 28	6
Flax	soybean	2.8 million pls	May 31	Oct. 5	6
HRSW	soybean	1.50 million pls	May 19	Sept. 9	6
HRWW	soybean	1.2 million pls	Sept. 20, 2022	Aug. 9	6
Oat	soybean	1.0 million pls	May 22	Sept. 7	6
Rye	soybean	1.0 million pls	Sept. 20, 2022	Aug. 9	6
Soybean – Conv.	wheat	200,000 pls	May 22	Oct. 12	6
Soybean – RR	wheat	200,000 pls	May 22	Oct. 12	6
Sunflower – Conf.	wheat	17,000 thinned	May 23	Oct. 17	30
Sunflower – Oil	wheat	20,000 thinned	May 23	Oct. 17	30

pls=pure live seed emergence

2023 Crop Management – Off-Station					
Location (County/Field Trial)	**Previous Crop**	**Seeding Rate Unit/Acre**	**Planting Date**	**Harvest Date**	**Row Spacing**
Cavalier (Pembina County)					
HRSW	HRWW	1.50 million pls	May 25	*	6
Soybean	HRWW	200,000 pls	May 25	Oct. 18	6
Park River (Walsh County)					
HRSW	fallow	1.50 million pls	May 24	Aug. 31	6
Soybean	wheat	200,000 pls	May 31	Oct. 16	6
Pekin (Nelson County)					
HRSW	soybean	1.50 million pls	May 26	Sept. 1	6
Soybean	wheat	200,000 pls	May 26	Oct. 13	6
Cando (Towner County)					
HRSW	soybean	1.50 million pls	May 12	Aug. 30	6
Location	**Soil Type**				
Cavalier	Fargo silty clay				
Park River	Glyndon silt loam				
Pekin	Lankin loam				
Cando	Great Bend, overly silty loam				

pls = pure live seeds
* Poor stands, did not harvest.

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

Darin Weisz - Cando
Lindy Berg - Towner County Extension Agent
Dave Hankey - Park River
Katie Thompson - Walsh County Extension Agent
Kent Schluchter – Cavalier
Madeleine Smith – Pembina County Extension Agent
Jarvis Stein - Pekin

Record of Climatological Observation
Langdon, ND

	Precipitation		Dep. from		Temperature		Dep. from
	Normal*	2023	Normal		Normal*	2023	Normal
April	1.25	1.57	+0.32	April	37.9	29.2	-8.7
May	2.26	0.42	-1.84	May	51.6	59.0	+7.4
June	3.22	2.44	-0.8	June	61.1	68.5	+7.4
July	2.92	0.65	-2.27	July	66.2	64.6	-1.6
August	2.59	1.66	-0.93	August	64.5	65.1	+0.6
September	2.07	2.50	+0.43	September	54.6	60.6	+6.0
Total	14.31	9.24	-5.07	Total	56.0	57.8	+1.8

*120 year average

Monthly Growing Degree Days and Normals-Langdon

	Wheat Growing Degree Days			Corn Growing Degree Days			Sunflower Growing Degree Days		
	2023	Normal	Deviation	2023	Normal	Deviation	2023	Normal	Deviation
April	100	244	-144	--	--	--	--	--	--
May	814	619	+195	371	209	+162	503	308	+195
June	1008	890	+118	538	360	+178	725	534	+191
July	941	1027	-86	438	503	-65	605	689	-84
August	980	979	+1	484	472	+12	660	658	+2
September	800	704	+96	343	259	+84	494	372	+122
Total	4643	4463	+180	2174	1803	+371	2987	2561	+426

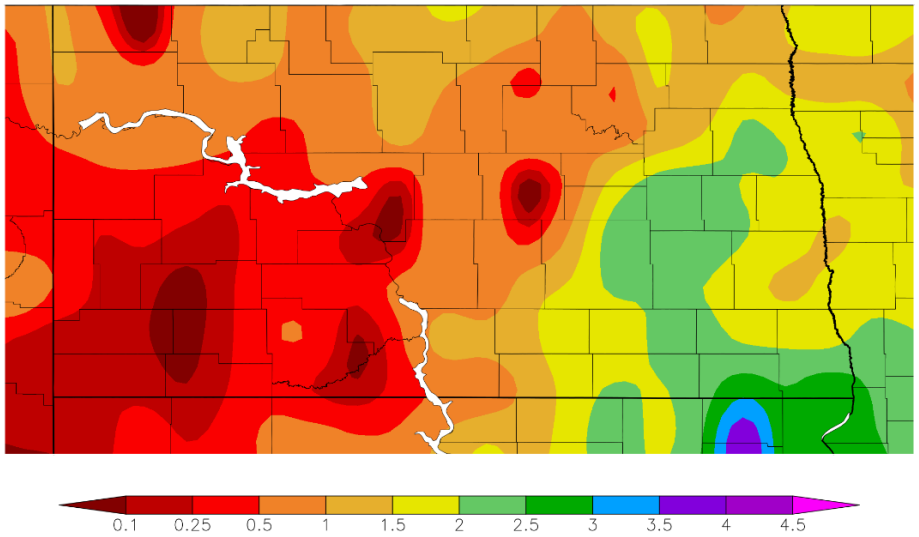
Frost Dates-Langdon and Selected Cities

	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
2023	2-May	25-Apr	7-Oct	24-Oct	158	182
Cavalier						
Normal	16-May	5-May	24-Sep	5-Oct	131	153
2023	26-Apr	25-Apr	7-Oct	10-Oct	164	168
Park River						
Normal	8-May	30-Apr	30-Sep	10-Oct	145	163
2023	2-May	25-Apr	8-Oct	10-Oct	159	168
Pekin						
Normal	18-May	3-May	22-Sep	30-Sep	127	150
2023	2-May	25-Apr	7-Oct	7-Oct	158	165

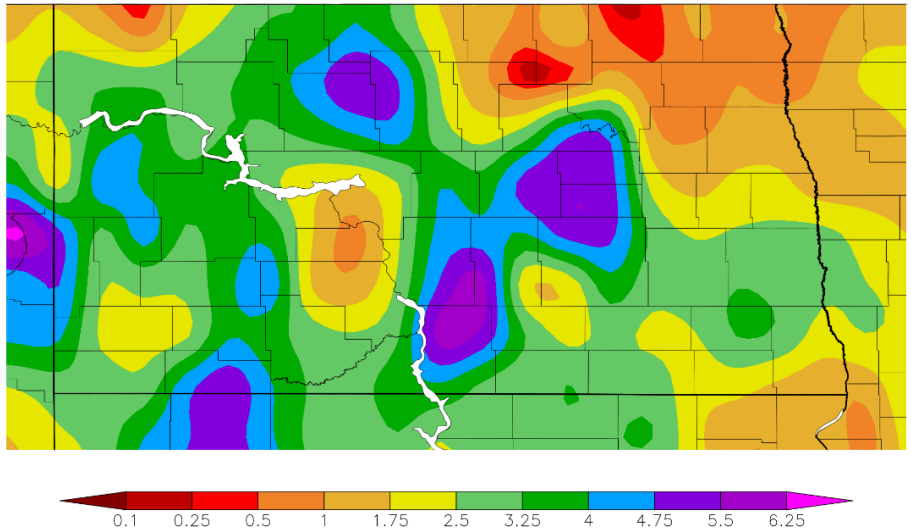
Normals are from the NWS. The 2023 frost dates are from the nearest reporting NDAWN station.

North Dakota 2023 Precipitation (inches) Maps

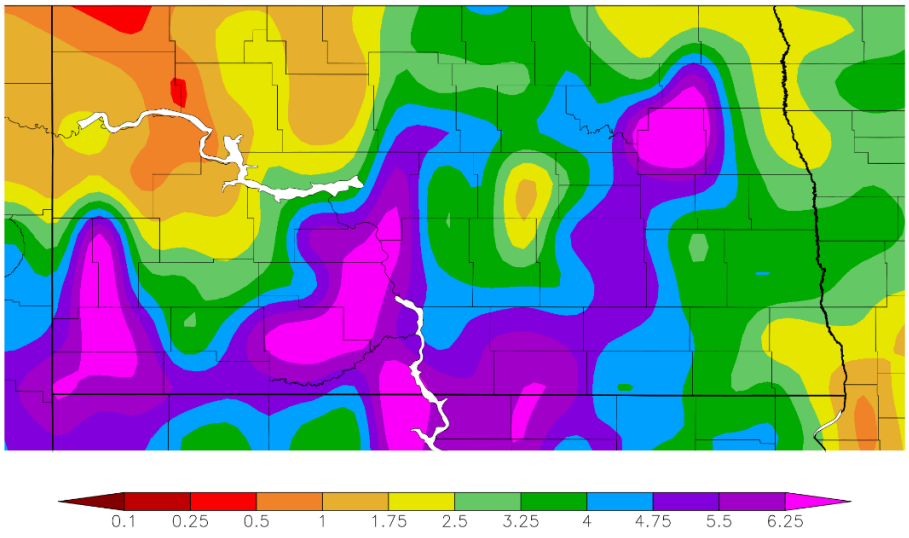
4/1/23 – 4/30/23



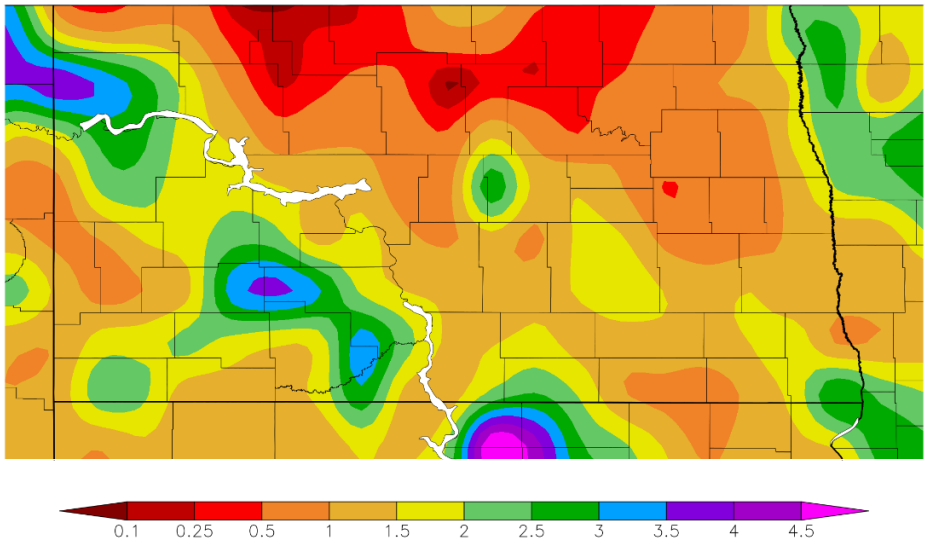
5/1/23 – 5/31/23



6/1/23 – 6/30/23

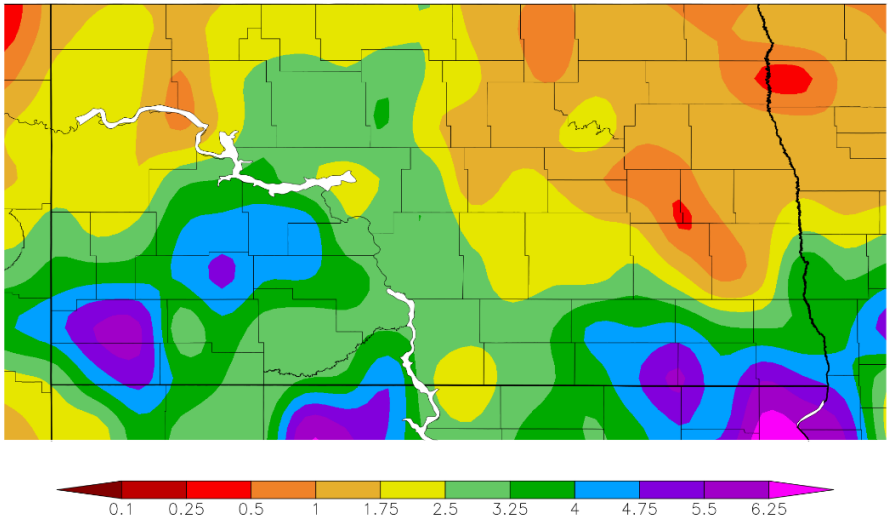


7/1/23 – 7/31/23

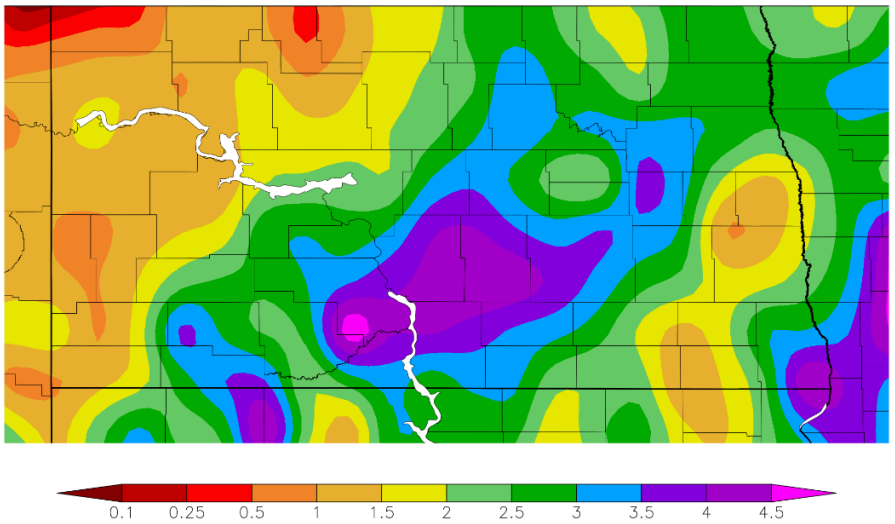


North Dakota 2023 Precipitation (inches) Maps Continued

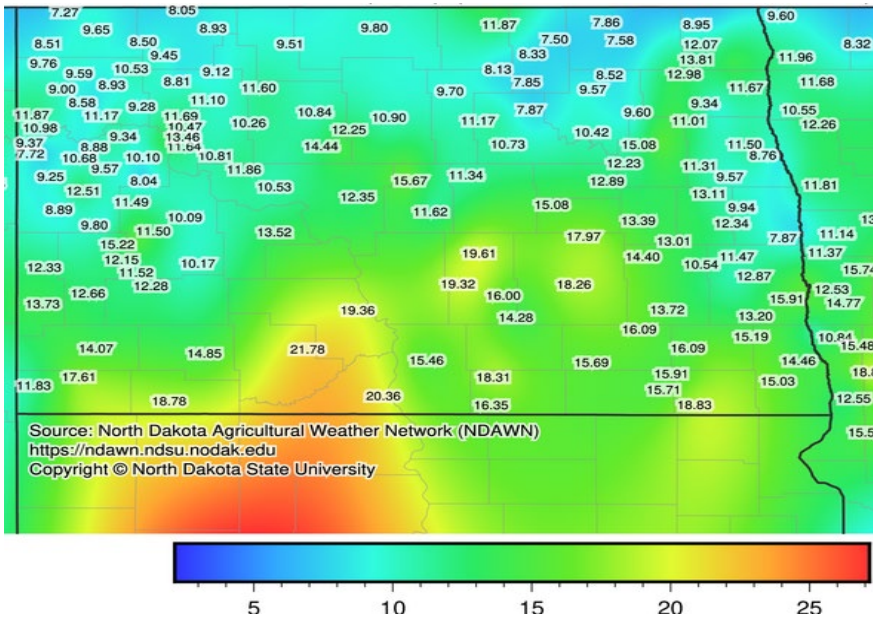
8/1/23 – 8/31/23



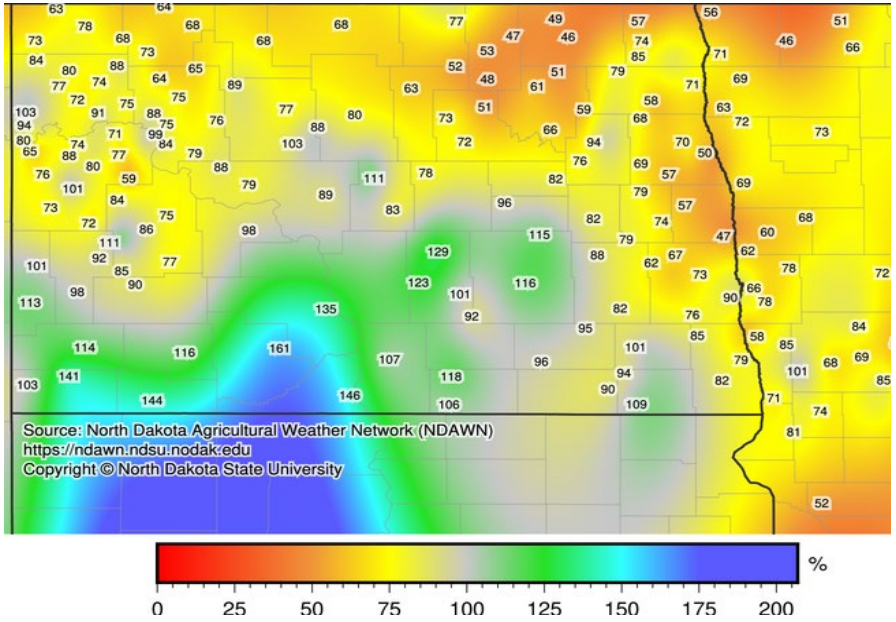
9/1/23 – 9/30/23



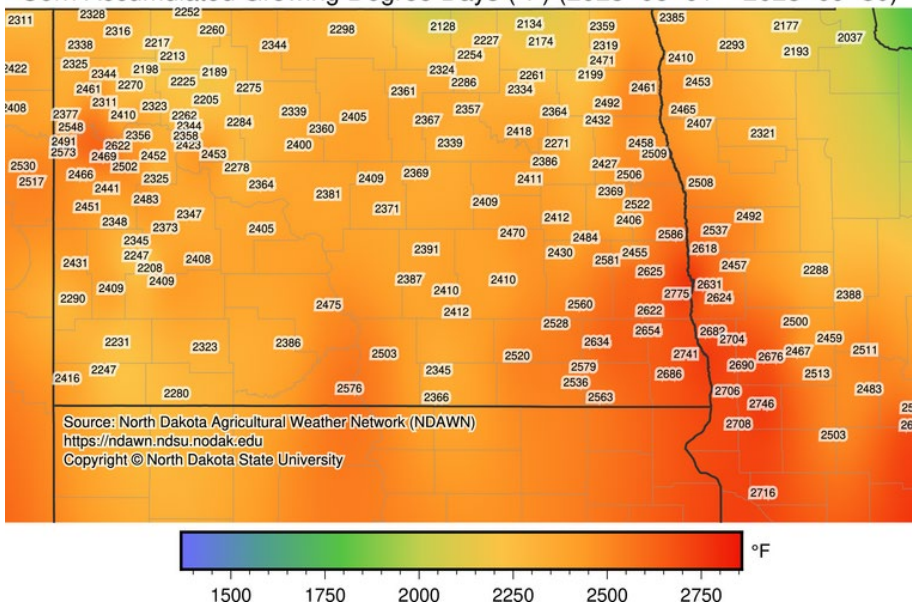
Growing Season 4/1/2023 – 9/30/2023



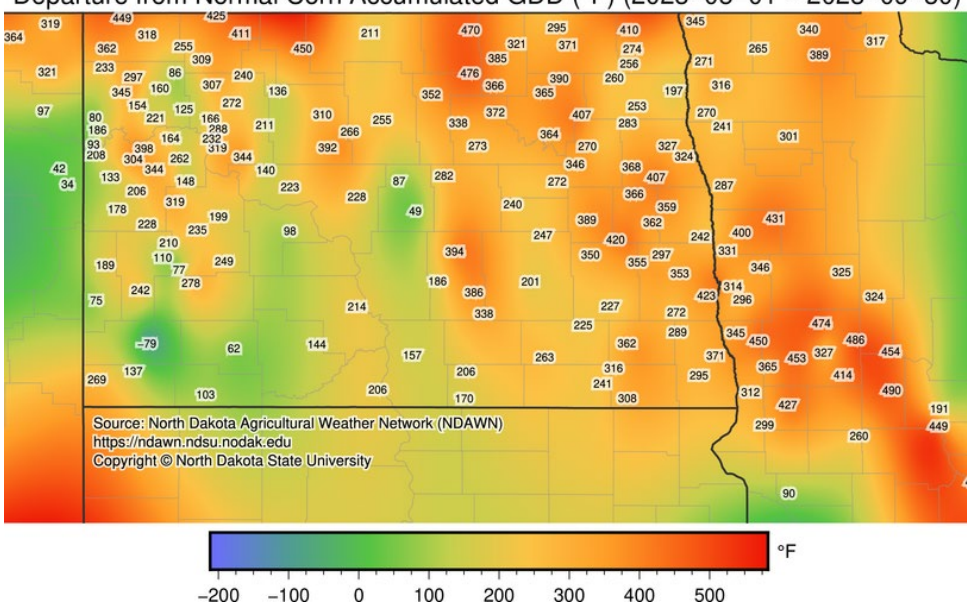
Percent of Normal Rainfall (%) (2023-04-01 – 2023-09-30)



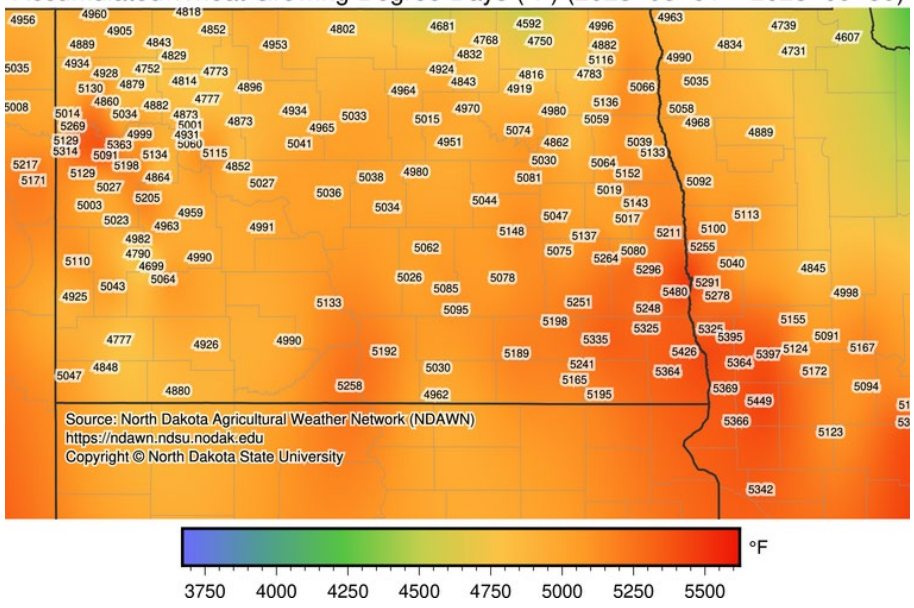
Corn Accumulated Growing Degree Days (°F) (2023–05–01 – 2023–09–30)



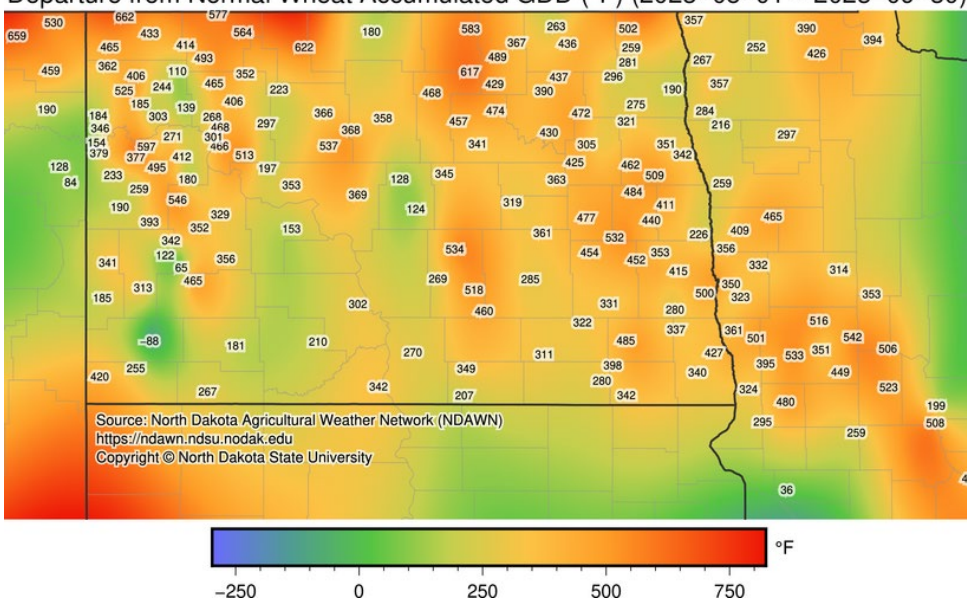
Departure from Normal Corn Accumulated GDD (°F) (2023–05–01 – 2023–09–30)



Accumulated Wheat Growing Degree Days (°F) (2023–05–01 – 2023–09–30)



Departure from Normal Wheat Accumulated GDD (°F) (2023–05–01 – 2023–09–30)



Durum Summary, Langdon 2019-2023

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)					Height (in)					Days to Head				
Variety	**19**	**20**	**21**	**22**	**23**	**5yr**	**19**	**20**	**21**	**22**	**23**	**5yr**	**15**	**16**	**17**	**20**	**4yr**	**20**	**21**	**22**	**23**	**4yr**	**20**	**21**	**22**	**23**	**4yr**
Alkabo	67	80	49	78	63	67	60.2	59.8	59.5	60.6	62.0	60.4	0.5	5.8	1.3	0.1	1.9	37	29	37	39	36	49	62	53	53	54
Maier	69	62	40	68	62	60	60.9	56.0	59.4	59.8	61.8	59.6	0.5	5.0	4.8	2.6	3.2	38	27	37	37	35	49	61	54	56	55
Mountrail	68	70	49	86	74	69	58.5	57.4	59.3	60.5	61.8	59.5	2.0	7.2	5.0	3.8	4.5	36	29	37	39	35	49	61	54	56	55
Strongfield	64	62	46	71	64	61	60.1	56.2	58.8	58.7	61.3	59.0	3.8	6.4	4.5	5.5	5.1	35	30	34	38	34	50	62	53	55	55
Tioga	69	77	48	81	64	68	60.5	58.4	59.3	62.1	61.1	60.3	0.3	6.4	6.0	4.0	4.2	39	33	40	41	38	50	61	55	58	56
Carpio	70	77	50	81	67	69	61.1	59.5	59.8	62.7	61.9	61.0	1.0	7.6	6.5	2.7	4.5	38	31	37	38	36	52	63	55	59	57
Joppa	75	76	44	86	68	70	60.9	58.3	60.2	61.1	62.5	60.6	0.5	6.9	6.8	3.5	4.4	39	32	38	37	37	49	63	53	56	55
Divide	68	78	51	75	63	67	59.9	58.6	59.7	61.1	61.3	60.1	1.8	6.9	6.3	2.9	4.5	38	32	40	39	37	51	62	56	60	57
ND Grano	70	75	50	84	67	69	60.7	58.2	61.0	61.9	62.1	60.8	0.8	6.4	5.0	1.9	3.5	39	29	37	39	36	50	64	53	58	56
ND Riveland	71	79	45	81	64	68	60.3	58.7	59.5	61.6	61.1	60.2	1.8	5.9	3.3	3.1	3.5	40	32	39	40	38	50	63	55	58	57
ND Stanley	66	82	50	86	68	70	60.7	60.0	60.4	62.7	62.7	61.3	--	--	4.0	2.6	--	38	30	36	38	36	50	63	54	57	56
Rugby	63	63	41	69	--	--	60.3	57.1	59.8	61.1	--	--	4.0	7.0	8.0	7.0	6.5	38	31	40	--	--	49	61	53	--	--
TCG Webster	71	55	40	71	--	--	59.8	57.7	59.6	59.9	--	--	--	--	--	0.2	--	31	24	29	--	--	47	59	50	--	--
CDC Defy	--	--	--	82	--	--	--	--	--	60.8	--	--	--	--	--	--	--	--	--	38	--	--	--	--	52	--	--
CDC Vantta	--	--	--	58	--	--	--	--	--	56.1	--	--	--	--	--	--	--	--	--	34	--	--	--	--	58	--	--
AC Commander	65	59	42	--	--	--	58.8	54.7	58.7	--	--	--	1.0	3.8	1.8	0.4	1.8	30	25	--	--	--	49	58	--	--	--
Ben	68	75	46	--	--	--	60.7	59.5	59.8	--	--	--	2.3	6.2	4.0	3.5	4.0	37	33	--	--	--	49	60	--	--	--
Grenora	70	84	49	--	--	--	59.1	58.4	59.1	--	--	--	0.8	6.7	5.8	4.3	4.4	35	29	--	--	--	48	61	--	--	--
Lebsock	70	75	45	--	--	--	61.1	60.4	60.0	--	--	--	3.8	5.7	3.8	2.0	3.8	35	29	--	--	--	48	61	--	--	--
Pierce	70	76	45	--	--	--	60.9	59.1	59.7	--	--	--	3.0	6.6	5.3	3.7	4.7	36	29	--	--	--	49	61	--	--	--
Alzada	59	48	39	--	--	--	58.7	54.1	57.3	--	--	--	0.0	3.0	0.3	0.4	0.9	31	26	--	--	--	48	59	--	--	--
CDC Verona	67	61	52	--	--	--	60.2	54.9	59.4	--	--	--	0.8	5.7	6.0	4.8	4.3	35	30	--	--	--	50	62	--	--	--
VT Peak	72	80	49	--	--	--	61.7	59.6	60.8	--	--	--	0.5	4.3	4.3	0.8	2.5	38	31	--	--	--	50	61	--	--	--
Trial Mean	70	74	48	79	66		60.5	58.3	59.8	61.3	61.9		1.7	6.1	5.9	3.3		37	30	38	40		50	62	55	58	
C.V. %	5.6	8.6	7.1	6.4	5.4		0.8	1.8	0.5	1.6	0.7		114	14.9	31.8	52.6		4.2	1.9	4.0	5.1		1.3	1.9	1.5	2.3	
LSD 5%	5.5	8.8	3.1	7.1	6.3		0.7	1.5	0.2	1.4	0.6		NS	1.3	2.6	2.4		2.2	1.0	2.1	2.8		0.9	1.0	1.1	1.9	
LSD 10%	4.6	7.4	2.6	5.9	--		0.6	1.3	0.2	1.2	0.5		2.2	1.1	2.2	2.0		1.8	0.9	1.8	2.4		0.7	0.9	0.9	1.6	

Average Data by Crop and Year Across Sites

HRSW	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)						Height (in)					Days to Head					Lodging (0-9)			
No. Sites	**5**	**5**	**3[1]**	**5**	**4**	**12**	**5**	**5**	**5**	**5**	**4**	**14**	**5**	**5**	**5**	**5**	**4**	**14**	**5**	**4**	**5**	**4**	**13**	**5**	**3**	**5**	**4**	**12**	**4**	**1**	**1**	**6**
Variety	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**20**	**21**	**22**	**23**	**3yr**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**22**	**3yr**
SY Ingmar	78	65	53	64	73	64	60.2	60.0	60.5	60.2	61.0	60.6	14.4	15.4	15.6	15.1	14.7	15.1	29	24	30	29	28	47	56	46	45	49	0.1	0.0	1.5	0.1
SY Valda	80	71	59	72	83	71	59.5	59.6	59.7	59.9	61.0	60.2	13.5	14.3	14.7	14.0	13.8	14.2	29	25	30	29	28	47	57	46	45	50	1.6	0.5	2.0	1.1
LCS Trigger	89	75	65	72	85	74	59.8	59.9	59.2	60.4	59.7	59.8	12.1	12.3	13.0	12.6	11.9	12.5	33	26	34	34	31	53	61	52	51	55	1.4	3.7	1.8	2.6
TCG-Spitfire	79	69	56	71	82	70	58.9	58.7	58.9	59.2	59.6	59.2	13.8	14.1	15.3	14.1	13.8	14.4	30	27	32	31	30	50	58	49	49	52	0.0	0.3	1.5	0.2
SY 611 CL2	79	66	58	67	80	69	60.7	59.8	60.4	60.0	61.7	60.7	14.0	15.1	15.5	14.6	14.6	14.9	28	23	29	29	27	47	55	46	45	49	0.2	0.2	1.3	0.2
TCG-Heartland	73	59	55	60	77	64	60.6	59.5	60.9	60.3	61.6	60.9	15.0	15.7	16.1	15.5	15.1	15.6	28	24	28	29	27	46	55	45	44	48	0.0	0.0	0.8	0.0
AP Murdock	80	73	52	69	77	66	58.8	59.7	59.6	59.6	60.2	59.8	14.0	14.3	14.9	14.0	13.7	14.2	29	25	30	30	28	48	56	46	37	46	1.1	0.6	1.9	0.9
Ambush	75	64	58	71	85	71	60.0	59.9	60.8	58.8	62.2	60.6	15.0	15.6	15.5	14.3	14.2	14.7	30	25	32	32	30	47	56	47	45	49	0.5	0.2	2.4	0.4
Ballistic	88	66	66	63	96	75	59.3	57.6	58.9	60.1	60.2	59.7	13.9	14.9	14.7	15.1	13.5	14.4	32	27	30	33	30	48	58	45	47	50	1.4	1.9	2.0	1.7
Commander	81	66	54	63	80	66	59.9	59.3	60.2	59.5	61.1	60.3	14.0	14.6	15.0	14.5	14.1	14.5	30	25	31	31	29	46	55	44	43	47	0.2	0.0	1.0	0.1
LCS Cannon	80	66	54	63	80	66	60.0	60.1	61.0	60.6	61.7	61.1	14.0	14.6	14.9	14.4	14.0	14.4	29	23	29	28	27	44	53	42	40	45	0.6	0.0	0.0	0.3
MN-Torgy	--	68	59	65	80	68	--	59.4	60.0	59.9	61.5	60.5	--	15.5	15.4	15.2	14.8	15.1	31	26	33	33	31	50	58	49	49	52	--	2.4	1.0	--
TCG-Wildcat	--	66	60	67	79	69	--	60.2	60.5	60.2	61.2	60.6	--	15.4	15.5	15.0	14.6	15.0	30	24	31	30	28	47	56	47	45	49	--	0.2	0.9	--
AP Smith	--	65	59	66	79	68	--	59.0	59.9	59.1	60.7	59.9	--	14.9	15.2	14.6	14.1	14.6	28	23	29	29	27	47	57	47	46	50	--	--	0.4	--
CP3530	78	--	62	69	82	71	59.3	--	59.0	59.7	60.3	59.7	14.9	--	14.8	14.9	14.1	14.6	--	26	33	34	31	--	60	48	47	51	1.9	--	2.5	--
MS Cobra	--	--	58	59	78	65	--	--	59.7	58.9	61.4	60.0	--	--	15.5	14.8	14.4	14.9	--	24	30	30	28	--	55	45	44	48	--	--	2.2	--
ND Thresher	--	--	55	62	76	64	--	--	58.5	59.1	59.6	59.1	--	--	15.6	14.8	14.3	14.9	--	25	30	31	28	--	58	48	49	51	--	--	0.7	--
LCS Ascent	--	--	--	67	84	--	--	--	--	59.9	61.8	--	--	--	--	13.7	13.3	--	--	--	30	29	--	--	--	43	42	--	--	--	4.4	--
LCS Dual	--	--	--	60	81	--	--	--	--	60.1	61.2	--	--	--	--	14.0	13.3	--	--	--	31	30	--	--	--	45	43	--	--	--	0.1	--
MN-Rothsay	--	--	--	64	83	--	--	--	--	59.0	60.5	--	--	--	--	14.6	14.1	--	--	--	30	28	--	--	--	49	48	--	--	--	1.9	--
MS Charger	--	--	--	75	88	--	--	--	--	59.4	60.4	--	--	--	--	12.9	12.7	--	--	--	30	29	--	--	--	43	43	--	--	--	2.5	--
ND Heron	--	--	--	57	79	--	--	--	--	60.6	62.0	--	--	--	--	15.4	14.4	--	--	--	31	30	--	--	--	43	42	--	--	--	4.4	--
LCS Buster	--	72	61	--	89	--	--	57.6	57.7	--	58.5	--	--	12.5	13.0	--	11.9	--	33	26	--	34	--	53	59	--	50	--	--	2.7	--	--
Ascend-SD	--	--	--	--	83	--	--	--	--	--	60.9	--	--	--	--	--	13.9	--	--	--	--	34	--	--	--	--	46	--	--	--	--	--
LCS Boom	--	--	--	--	78	--	--	--	--	--	61.8	--	--	--	--	--	14.3	--	--	--	--	28	--	--	--	--	40	--	--	--	--	--
LCS Hammer AX	--	--	--	--	79	--	--	--	--	--	60.4	--	--	--	--	--	13.8	--	--	--	--	29	--	--	--	--	44	--	--	--	--	--
TCG-Teddy	--	--	--	--	79	--	--	--	--	--	59.9	--	--	--	--	--	14.3	--	--	--	--	27	--	--	--	--	46	--	--	--	--	--
WB 9590	--	--	--	--	83	--	--	--	--	--	60.8	--	--	--	--	--	14.6	--	--	--	--	27	--	--	--	--	45	--	--	--	--	--
WB 9719	--	--	--	--	81	--	--	--	--	--	62.5	--	--	--	--	--	13.8	--	--	--	--	29	--	--	--	--	47	--	--	--	--	--
CP3915	--	67	--	--	80	--	--	60.2	--	--	60.8	--	--	14.6	--	--	14.1	--	30	--	--	30	--	46	--	--	46	--	--	0.0	--	--
Faller	85	69	62	70	--	--	59.5	58.6	59.3	59.7	--	--	13.9	14.4	14.5	14.0	--	--	32	27	33	--	--	49	58	48	--	--	2.2	2.0	2.6	2.1
MN-Washburn	73	63	56	66	--	--	59.6	59.2	59.5	59.6	--	--	14.5	14.7	15.2	14.6	--	--	29	25	30	--	--	49	57	49	--	--	0.1	0.0	0.0	0.1
ND Frohberg	--	64	54	63	--	--	--	60.3	60.4	60.6	--	--	--	15.1	15.6	14.6	--	--	32	26	33	--	--	46	56	46	--	--	--	1.2	0.9	--
AP Gunsmoke CL2	--	--	58	69	--	--	--	--	59.3	59.1	--	--	--	--	15.5	14.9	--	--	--	25	30	--	--	--	56	45	--	--	--	--	2.5	--
CP3119A	--	--	63	65	--	--	--	--	56.7	56.3	--	--	--	--	13.4	13.1	--	--	--	28	33	--	--	--	61	52	--	--	--	--	0.8	--
CP3188	--	--	53	66	--	--	--	--	57.8	58.7	--	--	--	--	13.4	13.4	--	--	--	25	31	--	--	--	57	46	--	--	--	--	2.8	--
CP3099A	--	--	--	72	--	--	--	--	--	58.5	--	--	--	--	--	13.0	--	--	--	--	34	--	--	--	--	50	--	--	--	--	0.9	--
LCS Rebel	79	67	58	--	--	--	60.7	60.9	60.4	--	--	--	14.6	15.3	15.7	--	--	--	32	26	--	--	--	45	54	--	--	--	2.2	5.4	--	--
MS Barracuda	81	61	50	--	--	--	59.6	58.6	59.5	--	--	--	14.4	15.6	15.7	--	--	--	28	23	--	--	--	45	53	--	--	--	0.6	0.1	--	--
SY McCloud	77	63	56	--	--	--	60.8	60.4	61.1	--	--	--	14.8	15.5	16.0	--	--	--	31	24	--	--	--	48	56	--	--	--	0.3	0.0	--	--
Driver	--	--	58	--	--	--	--	--	60.3	--	--	--	--	--	14.8	--	--	--	--	27	--	--	--	--	58	--	--	--	--	--	--	--
Linkert	69	60	--	--	--	--	59.4	59.6	--	--	--	--	15.3	15.5	--	--	--	--	28	--	--	--	--	48	--	--	--	--	0.0	0.1	--	--
Bolles	73	55	--	--	--	--	59.2	57.3	--	--	--	--	15.9	16.7	--	--	--	--	32	--	--	--	--	50	--	--	--	--	0.9	0.6	--	--
Shelly	79	62	--	--	--	--	59.5	57.7	--	--	--	--	14.0	15.2	--	--	--	--	29	--	--	--	--	48	--	--	--	--	0.9	0.1	--	--
ND VitPro	75	63	--	--	--	--	61.7	61.1	--	--	--	--	15.2	15.5	--	--	--	--	31	--	--	--	--	47	--	--	--	--	1.1	0.7	--	--

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

HRSW Summary, Langdon 2019-2023

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)					
Variety	**19**	**20**	**21**	**22**	**23**	**3yr[1]**	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**
Faller	84	81	28	86	81	82	60.4	59.7	58.6	61.4	59.0	59.7	13.7	14.1	15.3	13.6	12.8	13.9
Glenn	75	74	27	68	69	70	63.2	62.5	61.3	62.7	62.1	62.0	15.0	15.2	17.1	15.0	13.3	15.1
Bolles	73	68	15	71	74	71	60.3	58.8	59.4	60.4	59.3	59.7	15.3	16.6	18.5	15.8	14.4	16.2
SY Ingmar	81	77	21	75	71	75	61.5	60.6	60.9	61.5	59.8	60.7	14.2	15.2	17.1	15.0	13.3	15.1
SY Valda	80	79	28	86	79	81	60.6	59.9	60.4	60.8	59.5	60.2	13.0	14.2	16.4	14.1	12.5	14.3
CP3530	78	83	32	87	80	83	60.1	60.1	59.8	61.0	59.4	60.1	14.2	15.3	16.5	14.7	12.8	14.7
TCG-Spitfire	79	80	25	83	79	80	60.2	60.1	59.2	60.0	59.0	59.4	13.6	14.0	16.5	13.6	12.9	14.3
ND VitPro	73	76	21	71	70	72	63.0	62.2	60.7	62.7	61.5	61.6	14.8	15.1	17.4	14.8	13.8	15.3
LCS Trigger	87	81	23	94	80	85	60.5	60.2	59.5	61.4	59.0	60.0	11.9	12.6	14.3	12.1	11.6	12.7
Ambush	76	68	17	78	81	76	61.5	59.6	60.1	59.5	61.6	60.4	14.9	15.6	17.3	14.4	12.6	14.8
SY McCloud	78	76	23	75	82	78	61.8	61.2	61.1	61.9	61.0	61.3	14.7	15.1	18.0	15.0	13.0	15.3
SY 611 CL2	83	78	23	82	86	82	62.3	60.4	60.7	61.3	61.4	61.1	13.6	14.9	17.5	14.6	13.3	15.1
LCS Cannon	81	73	23	76	87	79	61.8	59.8	60.8	61.7	60.8	61.1	13.8	14.8	16.5	14.6	12.8	14.6
Ballistic	90	73	24	76	95	81	60.7	56.7	58.8	61.5	58.7	59.7	13.5	15.1	16.0	15.0	12.5	14.5
Commander	80	74	17	75	76	75	61.2	59.2	59.7	60.3	59.9	60.0	13.7	14.7	16.5	14.2	13.0	14.6
TCG-Heartland	75	67	23	68	75	70	61.9	59.8	60.9	61.0	60.4	60.8	14.7	15.7	17.7	15.4	14.0	15.7
SY Longmire	79	78	26	70	72	73	61.5	59.4	60.9	60.1	59.8	60.3	14.0	15.2	17.4	15.2	13.2	15.3
AP Murdock	82	87	21	93	73	84	60.5	59.7	59.6	61.7	58.4	59.9	14.1	14.0	16.8	13.7	12.8	14.4
MN-Torgy	84	70	28	82	75	76	61.2	59.1	60.2	61.5	60.6	60.8	14.6	15.5	16.8	14.7	13.9	15.1
CP3915	78	80	29	84	75	80	61.7	61.1	60.5	61.4	59.5	60.5	14.3	14.9	16.6	14.5	13.5	14.9
ND Heron	80	65	24	68	81	71	62.1	59.9	60.4	62.1	61.1	61.2	14.5	15.7	17.1	15.1	12.7	15.0
MN Rothsay	--	63	21	77	80	73	--	58.2	60.3	60.1	59.4	59.9	--	15.3	16.7	14.6	13.6	15.0
Allegiant 822	--	72	28	81	73	75	--	61.4	61.2	62.2	61.2	61.5	--	14.4	17.1	13.8	13.5	14.8
Allegiant 8432	--	74	22	67	83	75	--	58.8	60.6	59.4	60.1	60.0	--	15.2	17.2	14.7	12.9	14.9
Driver	--	73	29	82	84	80	--	60.0	60.6	62.1	60.3	61.0	--	14.5	15.9	13.9	12.9	14.2
Lanning	--	57	28	61	75	64	--	55.1	58.6	58.2	59.2	58.7	--	16.6	17.4	15.3	13.9	15.5
LCS Buster	--	73	22	86	80	80	--	57.0	57.8	59.1	56.6	57.8	--	12.8	13.9	12.5	11.5	12.6
MS Ranchero	--	62	33	76	78	72	--	54.6	58.9	59.1	59.1	59.0	--	15.4	15.1	14.2	13.1	14.1
ND Frohberg	--	73	14	77	75	75	--	61.0	59.9	61.8	60.0	60.6	--	14.7	17.2	14.2	13.2	14.9
TCG-Wildcat	--	74	23	79	81	78	--	60.5	60.4	61.9	59.9	60.7	--	15.2	17.0	15.2	13.2	15.1
AP Gunsmoke CL2	--	77	24	81	77	78	--	58.0	59.4	60.4	59.0	59.6	--	15.5	17.4	14.8	13.7	15.3
AP Smith	--	76	24	80	75	77	--	59.6	60.9	60.6	59.6	60.4	--	14.9	16.6	14.7	13.1	14.8
CAG Justify	--	--	23	93	81	87	--	--	57.9	60.0	55.7	57.9	--	--	15.2	13.1	12.4	13.6
CAG Reckless	--	--	24	82	85	83	--	--	59.9	61.5	60.6	60.7	--	--	16.7	14.3	12.4	14.5
CP3099A	--	--	31	82	77	80	--	--	59.2	58.9	53.8	57.3	--	--	13.9	12.5	11.0	12.5
CP3188	--	--	27	81	71	76	--	--	58.2	59.9	57.6	58.6	--	--	14.2	13.0	11.8	13.0
MS Cobra	--	--	20	68	78	73	--	--	59.9	60.2	60.7	60.3	--	--	16.9	15.0	13.1	15.0
Allegiant 8175	--	--	21	75	79	77	--	--	60.0	61.7	59.7	60.5	--	--	17.0	14.0	12.6	14.5
WB9590	--	--	22	74	79	77	--	--	59.3	60.3	60.1	59.9	--	--	17.8	15.0	13.8	15.5
Shelly	82	58	--	76	86	--	61.1	55.5	--	60.2	59.9	--	13.5	16.1	--	14.1	12.9	--
AAC Starbuck VB	--	--	--	80	85	--	--	--	--	61.2	61.4	--	--	--	--	15.3	12.7	--
Ascend-SD	--	--	--	90	81	--	--	--	--	62.3	59.4	--	--	--	--	14.1	12.2	--
LCS Ascent	--	--	--	85	84	--	--	--	--	61.4	60.5	--	--	--	--	13.6	12.6	--
LCS Dual	--	--	--	73	80	--	--	--	--	61.4	60.2	--	--	--	--	13.9	12.2	--
LCS Hammer AX	--	--	--	80	79	--	--	--	--	61.0	59.5	--	--	--	--	14.4	12.8	--
MS Charger	--	--	--	90	85	--	--	--	--	60.2	59.4	--	--	--	--	12.5	12.1	--
ND Thresher	--	--	--	76	73	--	--	--	--	60.7	58.3	--	--	--	--	14.8	13.6	--
Lang-MN	77	73	26	--	78	--	61.4	59.8	60.3	--	61.2	--	15.0	15.6	16.5	--	13.4	--
PFS-Buns	--	--	33	--	80	--	--	--	57.4	--	57.0	--	--	--	15.0	--	12.8	--
Elgin-ND	81	66	--	--	73	--	60.7	59.1	--	--	60.0	--	13.9	14.7	--	--	12.5	--
WB9719	--	--	--	--	79	--	--	--	--	--	61.2	--	--	--	--	--	12.6	--
Brawn-SD	--	--	--	--	84	--	--	--	--	--	61.2	--	--	--	--	--	12.2	--
CDC Landmark VB	--	--	--	--	81	--	--	--	--	--	61.3	--	--	--	--	--	13.0	--
CP3322	--	--	--	--	80	--	--	--	--	--	58.1	--	--	--	--	--	12.5	--
LCS Boom	--	--	--	--	81	--	--	--	--	--	60.1	--	--	--	--	--	13.0	--
TCG-Teddy	--	--	--	--	75	--	--	--	--	--	57.9	--	--	--	--	--	13.6	--
WB9606	--	--	--	--	81	--	--	--	--	--	59.9	--	--	--	--	--	12.2	--
LCS Rebel	81	76	22	77	--	--	61.7	61.5	59.6	62.3	--	--	14.4	15.4	17.4	14.6	--	--
MS Barracuda	83	66	15	73	--	--	61.3	57.9	58.4	60.6	--	--	14.3	14.8	17.4	15.0	--	--
MN-Washburn	76	78	22	80	--	--	60.7	60.0	59.6	61.1	--	--	14.3	14.4	16.8	14.1	--	--
Trial Mean	79	71	24	79	79		61.2	59.1	59.7	60.8	59.6		14.2	15.1	16.6	14.3	13.0	
C.V. %	4.7	8.1	9.3	7.7	8.2		0.8	1.8	0.5	1.1	1.3		2.4	3.0	1.1	2.8	4.9	
LSD 5%	5.2	8.1	2.0	8.4	9.0		0.7	1.5	0.3	0.9	1.1		0.5	0.6	0.2	0.6	0.9	
LSD 10%	4.4	6.8	1.7	7.1	7.5		0.6	1.2	0.2	0.8	0.9		0.4	0.5	0.1	0.5	0.8	

[1]Average of 2020, 2022 and 2023. 2021 was excluded due to low yields caused by drought conditions. In addition, shattering occurred due to uneven emergence resulting in uneven maturity, delayed harvest, and high winds prior to harvest.

HRSW Summary, Langdon 2019-2023

	Days to Head						Height (in)						Shatter (0-9)[1]	Lodging (0-9)
Variety	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**2021**	**2020**
Faller	57	48	63	51	48	54	31	34	24	34	34	31	1.3	2.0
Glenn	55	45	59	47	44	50	33	35	21	35	34	30	1.6	1.3
Bolles	58	50	62	52	48	54	30	33	23	33	33	30	4.1	0.6
SY Ingmar	56	47	59	50	44	51	28	31	20	31	28	26	0.9	0.0
SY Valda	56	47	62	50	44	52	27	32	21	32	28	27	1.5	0.5
CP3530	57	48	63	52	47	54	33	36	22	36	35	31	0.9	1.2
TCG-Spitfire	59	50	62	52	48	54	30	33	22	32	30	28	1.3	0.3
ND VitPro	55	46	59	48	45	51	31	34	21	33	31	28	0.5	0.7
LCS Trigger	61	53	64	55	53	57	32	35	20	35	35	30	0.0	3.7
Ambush	54	46	61	51	44	52	30	32	21	33	31	28	2.2	0.2
SY McCloud	55	47	60	48	45	51	29	33	20	32	30	27	0.2	0.0
SY 611 CL2	55	47	61	48	45	51	28	30	18	30	28	25	0.0	0.2
LCS Cannon	53	43	58	46	40	48	29	30	20	30	28	26	1.4	0.0
Ballistic	56	47	63	48	47	53	31	34	24	32	33	30	2.7	1.9
Commander	55	46	59	48	43	50	30	31	21	32	30	28	2.1	0.0
TCG-Heartland	54	46	60	48	43	50	28	31	20	30	27	26	1.3	0.0
SY Longmire	56	46	60	50	46	52	29	31	21	31	29	27	1.2	0.0
AP Murdock	56	47	61	50	45	52	28	31	21	31	29	27	2.1	0.6
MN-Torgy	56	49	64	51	51	55	30	34	21	34	34	30	0.9	2.4
CP3915	55	46	61	50	45	52	29	32	21	32	29	27	0.1	0.0
ND Heron	54	45	59	47	41	49	30	34	21	32	30	28	0.3	2.7
MN Rothsay	--	50	64	52	49	55	--	30	21	31	28	27	3.3	0.1
Allegiant 822	--	46	61	49	45	52	--	31	19	30	28	26	0.4	0.5
Allegiant 8432	--	45	59	47	43	50	--	32	21	30	30	27	3.7	0.0
Driver	--	48	62	51	46	53	--	34	22	34	33	30	1.3	0.6
Lanning	--	49	62	49	51	54	--	32	21	32	33	29	0.4	0.2
LCS Buster	--	53	63	54	51	56	--	35	22	35	35	31	3.4	2.7
MS Ranchero	--	51	63	52	56	57	--	34	21	35	39	32	0.3	5.8
ND Frohberg	--	47	60	49	45	51	--	35	21	34	32	29	4.8	1.2
TCG-Wildcat	--	47	59	50	44	51	--	32	18	31	29	26	2.0	0.2
AP Gunsmoke CL2	--	46	61	49	45	52	--	33	19	30	29	26	2.0	2.0
AP Smith	--	48	60	52	45	52	--	30	18	31	28	26	1.7	0.0
CAG Justify	--	--	62	52	48	54	--	--	22	34	32	29	2.4	--
CAG Reckless	--	--	61	49	45	52	--	--	20	35	34	30	3.6	--
CP3099A	--	--	63	54	49	55	--	--	22	35	35	31	0.3	--
CP3188	--	--	61	50	44	52	--	--	20	33	32	28	1.2	--
MS Cobra	--	--	60	49	44	51	--	--	20	31	30	27	1.5	--
Allegiant 8175	--	--	60	50	45	52	--	--	22	32	31	28	0.6	--
WB9590	--	--	60	48	45	51	--	--	19	28	27	25	1.6	--
Shelly	58	48	--	51	46	--	28	31	--	30	29	--	--	0.1
AAC Starbuck VB	--	--	--	49	44	--	--	--	--	33	32	--	--	--
Ascend-SD	--	--	--	51	46	--	--	--	--	36	35	--	--	--
LCS Ascent	--	--	--	47	42	--	--	--	--	31	29	--	--	--
LCS Dual	--	--	--	48	44	--	--	--	--	32	30	--	--	--
LCS Hammer AX	--	--	--	49	44	--	--	--	--	31	29	--	--	--
MS Charger	--	--	--	48	43	--	--	--	--	31	28	--	--	--
ND Thresher	--	--	--	51	48	--	--	--	--	31	30	--	0.5	--
Lang-MN	58	50	63	--	50	--	33	35	22	--	35	--	0.9	2.5
PFS-Buns	--	--	66	--	55	--	--	--	21	--	32	--	1.6	--
Elgin-ND	55	45	--	--	43	--	33	36	--	--	34	--	--	2.8
WB9719	--	--	--	--	46	--	--	--	--	--	30	--	--	--
Brawn-SD	--	--	--	--	45	--	--	--	--	--	33	--	--	--
CDC Landmark VB	--	--	--	--	45	--	--	--	--	--	33	--	--	--
CP3322	--	--	--	--	52	--	--	--	--	--	34	--	--	--
LCS Boom	--	--	--	--	40	--	--	--	--	--	29	--	--	--
TCG-Teddy	--	--	--	--	45	--	--	--	--	--	26	--	--	--
WB9606	--	--	--	--	46	--	--	--	--	--	33	--	--	--
LCS Rebel	55	45	58	48	--	--	31	35	22	33	--	--	0.9	5.4
MS Barracuda	54	44	58	46	--	--	28	29	19	29	--	--	1.2	0.1
MN-Washburn	57	49	62	53	--	--	29	31	21	32	--	--	0.6	0.0
Trial Mean	56	47	61	50	46		30	33	21	32	31		1.4	1.1
C.V. %	1.4	1.2	0.9	1.6	2.3		3.9	3.3	6.7	3.2	4.0		56.1	88
LSD 5%	1.1	0.8	0.4	1.1	1.5		1.7	1.5	1.2	1.4	1.7		0.7	1.4
LSD 10%	0.9	0.7	0.4	1.0	1.2		1.4	1.3	1.0	1.2	1.4		0.6	1.1

[1]Relative Rating 0-9

There was significant negative correlation between yield and shatter of -0.47.

HRSW Summary, Nelson County 2019-2023

	Yield (bu/a)					Test Weight (lbs/bu)					Protein (%)					Lodging (0-9)	Shatter (0-9)[2]		
Variety	**20**	**21**	**22**	**23**	**3yr[1]**	**20**	**21**	**22**	**23**	**3yr**	**20**	**21**	**22**	**23**	**3yr**	**19**	**21**	**22**	**2yr**
SY Ingmar	57	45	60	72	63	58.5	60.2	59.2	60.5	60.0	15.6	16.0	14.6	14.8	15.1	0.0	2.0	0.8	1.4
SY Valda	65	53	69	85	73	58.7	58.8	58.3	61.2	59.4	14.6	14.8	13.6	14.1	14.2	3.2	1.7	0.8	1.3
LCS Trigger	71	61	55	84	70	58.3	58.6	58.9	59.9	59.1	12.2	13.7	12.9	12.2	12.9	3.5	1.7	2.5	2.1
TCG-Spitfire	59	50	68	81	69	57.3	58.5	57.7	59.7	58.6	14.3	15.8	13.9	14.5	14.7	0.0	1.0	0.3	0.7
SY 611 CL2	54	57	61	80	65	57.4	59.7	59.2	60.5	59.8	15.9	15.6	13.8	14.8	14.7	0.5	0.7	1.2	1.0
Ambush	53	41	68	85	68	58.6	60.2	57.6	62.2	60.0	15.6	15.9	14.1	15.0	15.0	0.3	2.0	1.9	2.0
Ballistic	46	49	59	95	67	54.4	58.2	59.8	60.6	59.5	15.0	14.8	14.6	13.9	14.4	4.0	3.3	2.4	2.9
Commander	55	27	56	83	64	57.8	59.6	59.1	61.0	59.9	15.0	15.0	14.0	14.6	14.5	0.0	6.7	3.8	5.3
LCS Cannon	50	58	61	82	64	56.8	60.6	60.6	61.4	60.9	14.9	15.4	14.1	14.1	14.5	1.5	1.3	1.1	1.2
TCG-Heartland	50	54	64	78	64	56.3	60.5	60.1	61.2	60.6	15.8	16.8	15.0	15.5	15.8	0.0	2.0	0.7	1.4
AP Murdock	69	37	56	81	69	58.6	59.4	58.2	60.5	59.4	14.5	15.3	13.9	13.8	14.3	2.5	4.0	3.0	3.5
MN-Torgy	56	55	54	79	63	57.4	59.6	57.6	61.8	59.7	16.1	16.1	15.5	15.3	15.6	--	3.0	0.8	1.9
TCG-Wildcat	65	44	61	84	70	59.0	60.0	58.9	61.2	60.0	14.9	15.9	14.2	14.8	15.0	--	4.3	1.9	3.1
AP Smith	57	48	58	75	63	57.4	59.1	57.8	60.9	59.3	15.2	15.4	14.0	14.7	14.7	--	3.0	3.7	3.4
CP3530	--	54	71	82	77	--	58.9	58.8	60.0	59.2	--	15.4	14.4	14.4	14.7	4.0	1.0	0.4	0.7
MS Cobra	--	41	52	84	68	--	59.1	58.8	61.4	59.8	--	15.7	14.4	14.6	14.9	--	4.3	2.6	3.5
LCS Ascent	--	--	61	88	--	--	--	59.0	62.2	--	--	--	13.8	13.6	--	--	--	3.2	--
LCS Dual	--	--	52	84	--	--	--	60.3	61.0	--	--	--	13.1	13.4	--	--	--	2.8	--
MN-Rothsay	--	--	50	84	--	--	--	58.6	60.7	--	--	--	14.2	14.4	--	--	--	3.8	--
MS Charger	--	--	76	90	--	--	--	58.9	60.6	--	--	--	12.2	12.8	--	--	--	0.4	--
ND Heron	--	--	52	82	--	--	--	59.9	62.2	--	--	--	14.8	14.8	--	--	--	1.4	--
LCS Buster	60	40	--	88	--	54.9	57.3	--	59.2	--	12.9	13.6	--	12.1	--	--	3.0	--	--
CP3915	51	--	--	80	--	56.8	--	--	60.5	--	14.8	--	--	14.2	--	--	--	--	--
Ascend-SD	--	--	--	82	--	--	--	--	60.9	--	--	--	--	14.3	--	--	--	--	--
LCS Boom	--	--	--	84	--	--	--	--	62.0	--	--	--	--	14.4	--	--	--	--	--
LCS Hammer AX	--	--	--	82	--	--	--	--	60.6	--	--	--	--	14.1	--	--	--	--	--
ND Thresher	--	--	--	69	--	--	--	--	58.7	--	--	--	--	14.7	--	--	--	--	--
TCG-Teddy	--	--	--	81	--	--	--	--	60.0	--	--	--	--	14.6	--	--	--	--	--
WB9590	--	--	--	82	--	--	--	--	60.2	--	--	--	--	15.0	--	--	--	--	--
WB9719	--	--	--	79	--	--	--	--	62.7	--	--	--	--	14.4	--	--	--	--	--
MN-Washburn	49	56	61	--	--	57.6	59.1	58.4	--	--	15.4	15.4	14.6	--	--	0.0	0.0	0.1	0.1
Faller	51	44	67	--	--	55.3	59.0	58.2	--	--	15.0	14.9	13.6	--	--	5.2	2.3	0.5	1.4
ND Frohberg	53	20	60	--	--	58.8	59.8	60.0	--	--	15.3	16.0	14.2	--	--	--	6.0	2.5	4.3
AP Gunsmoke CL2	--	59	74	--	--	--	57.9	58.5	--	--	--	15.6	14.3	--	--	--	0.7	0.8	0.8
CP3119A	--	47	56	--	--	--	55.8	54.1	--	--	--	14.4	13.5	--	--	--	2.7	1.0	1.9
CP3188	--	50	64	--	--	--	56.7	57.7	--	--	--	13.9	13.6	--	--	--	1.3	1.1	1.2
CP3099A	--	--	59	--	--	--	--	57.3	--	--	--	--	13.3	--	--	--	--	1.2	--
LCS Rebel	64	48	--	--	--	60.3	59.8	--	--	--	15.4	16.1	--	--	--	5.0	2.3	--	--
MS Barracuda	42	39	--	--	--	55.1	59.2	--	--	--	16.3	16.5	--	--	--	2.0	2.7	--	--
SY McCloud	53	51	--	--	--	59.4	60.7	--	--	--	15.5	16.3	--	--	--	0.0	2.3	--	--
Driver	--	57	--	--	--	--	59.6	--	--	--	--	15.2	--	--	--	--	2.0	--	--
Linkert	52	--	--	--	--	57.7	--	--	--	--	15.8	--	--	--	--	0.0	0.0	--	--
Bolles	49	--	--	--	--	56.5	--	--	--	--	16.9	--	--	--	--	3.3	--	--	--
Shelly	46	--	--	--	--	53.9	--	--	--	--	16.1	--	--	--	--	2.8	--	--	--
ND VitPro	52	--	--	--	--	59.3	--	--	--	--	15.7	--	--	--	--	2.2	--	--	--
Lang-MN	54	--	--	--	--	58.5	--	--	--	--	15.6	--	--	--	--	6.3	--	--	--
CP3055	42	--	--	--	--	49.5	--	--	--	--	14.9	--	--	--	--	--	--	--	--
Velocity	51	--	--	--	--	58.0	--	--	--	--	16.5	--	--	--	--	--	--	--	--
MS Ranchero	43	--	--	--	--	53.2	--	--	--	--	15.2	--	--	--	--	--	--	--	--
Trial Mean	54	48	61	83		57.8	59.1	58.5	60.8		15.2	15.4	14.0	14.3		2.0	2.4	1.7	
C.V. %	7.8	10.1	5.7	3.7		1.1	0.4	0.4	0.6		2.8	1.3	1.4	1.5		45	35.5	38.9	
LSD 5%	5.9	4.6	3.0	4.3		0.9	0.2	0.2	0.6		0.6	0.2	0.2	0.3		1.3	1.4	0.6	
LSD 10%	5.0	3.9	2.5	3.5		0.7	0.2	0.2	0.5		0.5	0.2	0.1	0.3		1.1	1.2	0.5	

[1]Average of 2020, 2022, and 2023. 2021 excluded due to shattering.

[2]Relative Rating 0-9. There was significant negative correlation between yield and shatter of -0.62.

HRSW Summary, Towner County 2019-2023

	Yield (bu/a)						Test Weight (lbs/bu)						Protein (%)					
Variety	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**
SY Ingmar	75	54	66	63	73	67	57.9	60.0	59.9	60.8	61.5	60.7	14.2	16.7	15.2	16.4	15.0	15.5
SY Valda	75	65	72	71	79	74	56.4	60.2	59.2	61.0	61.2	60.5	13.6	15.6	14.4	15.3	14.2	14.6
LCS Trigger	84	65	69	75	81	75	57.4	60.8	57.9	61.4	58.7	59.3	12.4	13.9	12.9	13.2	12.1	12.7
TCG-Spitfire	79	63	67	72	83	74	56.9	59.3	58.1	60.3	59.6	59.3	13.6	15.1	15.4	15.2	13.7	14.8
AP Murdock	74	57	68	66	74	69	55.7	59.8	58.8	60.0	59.4	59.4	14.1	16.4	14.6	15.2	14.1	14.6
Commander	75	59	65	64	73	67	57.2	59.5	60.2	60.5	61.2	60.6	14.2	15.4	14.8	15.9	14.2	15.0
Ambush	69	57	74	72	82	76	57.6	59.9	61.1	59.9	61.7	60.9	15.1	17.1	15.1	15.6	14.2	15.0
Ballistic	77	58	80	67	92	79	55.2	58.4	57.7	61.1	59.6	59.5	14.2	16.1	14.1	16.4	13.3	14.6
LCS Cannon	67	62	67	58	74	66	56.1	61.4	60.4	61.6	61.6	61.2	14.5	15.8	14.7	15.4	14.5	14.9
SY 611 CL2	76	57	65	70	77	71	58.4	60.5	59.6	61.0	61.9	60.8	14.2	15.6	15.3	15.4	14.8	15.2
TCG-Heartland	68	56	73	61	75	70	58.2	60.8	60.7	61.6	61.8	61.4	14.9	16.9	15.9	16.4	15.3	15.9
MN-Torgy	--	61	72	64	85	74	--	60.0	59.6	60.7	60.9	60.4	--	16.9	15.2	16.2	14.5	15.3
AP Smith	--	55	72	62	81	72	--	59.7	59.4	60.2	60.7	60.1	--	15.9	14.6	15.5	14.3	14.8
TCG-Wildcat	--	51	74	69	69	71	--	60.5	60.1	60.4	61.5	60.7	--	17.4	15.4	16.5	15.3	15.7
CP3530	71	--	78	62	77	72	57.7	--	57.9	60.2	59.6	59.2	14.5	--	14.3	16.7	14.1	15.0
ND Thresher	--	--	67	50	80	66	--	--	57.8	59.1	59.8	58.9	--	--	15.5	16.2	14.1	15.3
MS Cobra	--	--	70	63	73	69	--	--	59.4	60.1	61.1	60.2	--	--	15.0	15.7	14.7	15.1
ND Heron	--	--	70	60	76	68	--	--	60.5	61.9	61.6	61.3	--	--	15.7	16.7	15.0	15.8
LCS Ascent	--	--	--	63	87	--	--	--	--	61.1	61.5	--	--	--	--	14.4	13.5	--
LCS Dual	--	--	--	66	76	--	--	--	--	61.4	60.8	--	--	--	--	15.3	13.7	--
MN-Rothsay	--	--	--	69	88	--	--	--	--	60.5	60.2	--	--	--	--	16.2	14.0	--
MS Charger	--	--	--	74	84	--	--	--	--	60.5	60.4	--	--	--	--	13.9	12.8	--
CP3915	--	--	--	--	78	--	--	--	--	--	60.6	--	--	--	--	--	13.9	--
Ascend-SD	--	--	--	--	83	--	--	--	--	--	60.7	--	--	--	--	--	13.9	--
LCS Boom	--	--	--	--	72	--	--	--	--	--	61.6	--	--	--	--	--	14.9	--
LCS Buster	--	--	--	--	89	--	--	--	--	--	57.7	--	--	--	--	--	11.8	--
LCS Hammer AX	--	--	--	--	78	--	--	--	--	--	60.1	--	--	--	--	--	13.8	--
TCG-Teddy	--	--	--	--	79	--	--	--	--	--	60.2	--	--	--	--	--	14.3	--
WB9590	--	--	--	--	79	--	--	--	--	--	60.8	--	--	--	--	--	14.9	--
WB9719	--	--	--	--	82	--	--	--	--	--	63.0	--	--	--	--	--	14.0	--
MN-Washburn	67	50	67	67	--	--	57.6	58.4	59.1	60.1	--	--	14.1	15.9	14.7	15.3	--	--
Faller	77	59	76	67	--	--	57.0	58.3	58.8	60.4	--	--	13.8	15.7	14.4	15.4	--	--
ND Frohberg	--	59	63	67	--	--	--	60.1	60.3	61.5	--	--	--	16.5	15.0	16.5	--	--
AP Gunsmoke CL2	--	--	77	71	--	--	--	--	59.2	60.8	--	--	--	--	15.3	16.5	--	--
CP3119A	--	--	65	73	--	--	--	--	55.0	57.3	--	--	--	--	13.7	13.6	--	--
CP3188	--	--	61	71	--	--	--	--	56.4	60.1	--	--	--	--	13.3	13.8	--	--
CP3099A	--	--	--	78	--	--	--	--	--	58.9	--	--	--	--	--	13.6	--	--
LCS Rebel	78	60	75	--	--	--	58.7	60.8	60.1	--	--	--	14.3	16.4	15.1	--	--	--
MS Barracuda	74	62	62	--	--	--	56.2	60.2	59.4	--	--	--	14.5	17.0	15.4	--	--	--
SY McCloud	75	54	66	--	--	--	59.0	59.6	60.9	--	--	--	14.4	16.3	16.1	--	--	--
LCS Buster	--	66	69	--	--	--	--	59.7	56.2	--	--	--	--	14.1	12.7	--	--	--
Driver	--	--	77	--	--	--	--	--	59.8	--	--	--	--	--	14.6	--	--	--
Linkert	64	54	--	--	--	--	56.7	59.6	--	--	--	--	15.1	16.2	--	--	--	--
Bolles	66	37	--	--	--	--	56.3	54.0	--	--	--	--	15.7	17.9	--	--	--	--
Shelly	67	58	--	--	--	--	56.3	59.8	--	--	--	--	14.2	16.0	--	--	--	--
ND VitPro	73	58	--	--	--	--	60.4	60.8	--	--	--	--	15.0	16.7	--	--	--	--
Lang-MN	72	67	--	--	--	--	59.4	59.8	--	--	--	--	15.2	15.8	--	--	--	--
CP3055	--	68	--	--	--	--	--	58.1	--	--	--	--	--	13.9	--	--	--	--
CP3915	--	60	--	--	--	--	--	61.1	--	--	--	--	--	15.4	--	--	--	--
Velocity	--	58	--	--	--	--	--	60.6	--	--	--	--	--	16.8	--	--	--	--
MS Ranchero	--	62	--	--	--	--	--	57.7	--	--	--	--	--	15.5	--	--	--	--
Trial Mean	71	58	70	67	80		57.3	59.7	59.1	60.4	60.6		14.5	16.0	14.7	15.5	14.1	
C.V. %	5.4	8.3	7.0	7.6	6.3		1.0	0.8	0.5	0.5	0.7		2.4	2.4	1.1	2.5	1.9	
LSD 5%	5.4	6.8	4.2	7.3	7.1		0.8	0.7	0.3	0.5	0.6		0.5	0.5	0.1	0.5	0.4	
LSD 10%	4.5	5.7	3.6	6.0	5.9		0.7	0.6	0.2	0.4	0.5		0.4	0.5	0.1	0.4	0.3	

HRSW Summary, Walsh County 2019-2023

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

HRWW Summary, Langdon 2019-2023*

	Yield (bu/a)					Test Weight (lbs/bu)					Julian Days to Head	Height (in)	Protein (%)				
Variety	**19**	**20**	**22**	**23**	**3yr**	**19**	**20**	**22**	**23**	**3yr**	**23**	**23**	**19**	**20**	**22**	**23**	**3yr**
AC Emerson	87	41	71	51	54	60.4	59.5	61.1	63.3	61.3	163	24	11.5	14.7	13.4	14.4	14.2
Jerry	84	44	81	63	63	59.1	58.9	60.8	62.8	60.8	160	25	11.2	14.3	12.8	13.3	13.5
Northern	90	43	62	69	58	59.2	58.3	57.9	63.8	60.0	161	23	11.1	14.3	13.3	13.6	13.7
SY Monument	85	36	61	60	52	58.3	56.3	56.4	62.7	58.5	159	21	11.0	35.8	12.8	12.6	20.4
Keldin	89	36	62	71	56	60.5	58.5	58.4	64.0	60.3	162	24	10.9	14.0	13.0	12.9	13.3
SY Wolverine	85	39	50	48	46	59.7	58.9	58.5	63.3	60.2	157	19	11.5	14.4	13.2	14.2	13.9
ND Noreen	87	48	85	62	65	59.7	61.6	62.8	64.5	63.0	161	25	11.6	14.1	13.0	14.1	13.7
AAC Wildfire	--	45	70	66	61	--	58.7	57.4	63.8	60.0	164	23	--	14.0	13.5	12.4	13.3
AAC Vortex	--	--	91	61	--	--	--	61.6	63.3	--	160	22	--	--	13.0	14.0	--
AP Bigfoot	--	--	61	48	--	--	--	59.8	63.1	--	158	64	--	--	12.4	13.5	--
MS Maverick	--	--	67	58	--	--	--	60.8	63.7	--	159	21	--	--	12.9	13.9	--
SD Andes	--	--	87	66	--	--	--	61.2	64.4	--	160	23	--	--	12.3	12.9	--
SD Midland	--	--	79	69	--	--	--	61.2	64.1	--	159	24	--	--	12.6	12.5	--
WB4309	--	--	69	55	--	--	--	60.0	63.4	--	158	21	--	--	13.8	14.2	--
Winner	--	--	82	58	--	--	--	61.9	63.4	--	157	22	--	--	12.4	13.2	--
ND Allison	--	--	85	69	--	--	--	60.9	63.7	--	161	23	--	--	11.5	12.0	--
Goldrush	--	--	--	66	--	--	--	--	63.4	--	163	25	--	--	--	13.4	--
MS Sundown	--	--	--	55	--	--	--	--	63.0	--	155	21	--	--	--	13.2	--
Draper	--	--	72	--	--	--	--	60.4	--	--	--	--	--	--	12.6	--	--
MS Iceman	--	--	44	--	--	--	--	59.6	--	--	--	--	--	--	14.9	--	--
Ray	--	--	63	--	--	--	--	54.1	--	--	--	--	--	--	13.1	--	--
WB4510CLP	--	--	59	--	--	--	--	60.9	--	--	--	--	--	--	12.7	--	--
Ideal	86	43	--	--	--	59.7	59.2	--	--	--	--	--	11.0	13.3	--	--	--
Peregrine	90	44	--	--	--	60.3	60.2	--	--	--	--	--	10.4	13.2	--	--	--
SY Wolf	87	41	--	--	--	59.5	59.5	--	--	--	--	--	11.5	14.3	--	--	--
SY Sunrise	82	24	--	--	--	59.4	57.9	--	--	--	--	--	11.4	13.4	--	--	--
Oahe	83	39	--	--	--	59.7	59.3	--	--	--	--	--	11.5	14.0	--	--	--
Thompson	90	40	--	--	--	59.9	58.6	--	--	--	--	--	10.9	13.8	--	--	--
TCG-Boomlock	79	41	--	--	--	60.3	59.9	--	--	--	--	--	11.6	14.2	--	--	--
WB4462	80	35	--	--	--	60.0	58.1	--	--	--	--	--	11.8	13.8	--	--	--
WB4595	89	21	--	--	--	61.8	59.4	--	--	--	--	--	10.3	13.5	--	--	--
CP7017AX	--	40	--	--	--	--	57.7	--	--	--	--	--	--	13.0	--	--	--
CP7050AX	--	32	--	--	--	--	59.6	--	--	--	--	--	--	14.9	--	--	--
CP7909	--	27	--	--	--	--	59.2	--	--	--	--	--	--	13.8	--	--	--
Loma	78	--	--	--	--	58.3	--	--	--	--	--	--	11.3	--	--	--	--
Trial Mean	84	39	69	61		59.7	58.9	59.7	63.5		160	23	11.3	14.0	12.9	13.3	
C.V. %	3.6	12.4	9.5	6.5		0.6	1.1	1.3	0.4		0.4	5.5	1.9	2.4	2.7	1.9	
LSD 5%	4.3	6.8	6.3	5.6		0.5	1.0	0.7	0.4		1.0	1.8	0.3	0.5	0.5	0.4	
LSD 10%	3.6	5.7	5.2	4.7		0.4	0.8	0.6	0.3		0.8	1.5	0.3	0.4	0.4	0.3	

No lodging in the trials above.

Winter survival was 100% for all varieties in 2023.

Overwinter leaf stage ranged from 1.5 to 2 leaf.

Fungicides were not used in any of the trials above.

*The 2021 trial was lost due to winter kill.

Buckwheat, Langdon 2023

Variety	Days to Flower	Plant Height (in)	1000 KWT (g)	Test Weight (lbs/bu)	Yield 2023	Yield 2 yr Avg	Yield 3 yr Avg
					----------lbs/a----------		
Devyatka	32	37	29	49.2	1920	2037	1739
Horizon	43	48	35	49.9	2149	2488	2123
Koma	42	44	29	51.1	1839	2189	1855
Kota	40	47	35	50.9	2300	2638	2221
KenMar	41	49	35	48.6	2186	--	--
Mean	39	46	32	49.8	2103		
C.V. %	1.5	4.1	2.0	2.8	14.5		
LSD 5%	0.9	2.8	1.0	2.1	NS		
LSD 10%	0.7	2.3	0.8	1.7	NS		

Winter Rye, Langdon 2023

Variety	Julian Days to Head	Plant Height (in)	Test Weight (lbs/bu)	Yield 2023 (bu/a)	Yield 2 yr avg. (bu/a)	Yield 3 yr avg. (bu/a)
Aroostok	151	38	56.1	47.1	51.6	47.1
Danko	154	31	57.0	58.0	57.5	48.7
Hazlet	153	31	57.3	60.5	58.9	49.7
KWS Serafino	157	27	56.5	75.9	66.2	53.0
KWS Tayo	157	24	54.9	73.4	64.1	50.9
ND Dylan	152	36	56.7	59.9	58.3	50.8
ND Gardner	150	37	56.5	49.8	53.1	47.6
Rymin	155	32	55.8	49.2	52.5	45.6
Spooner	152	36	56.3	50.5	53.4	47.7
KWS Receptor	156	26	56.3	78.5	67.4	--
Trial Mean	154	30	56.5	63.9		
C.V. %	0.6	5.2	0.9	8.9		
LSD 5 %	1.3	2.3	0.8	8.1		
LSD 10%	1.1	1.9	0.6	6.7		

Winter survival was 100% for all varieties.
No lodging in the trial.

Corn Grain, Langdon 2023

Brand	Hybrid	RM[1]	Hybrid Traits[1]	Insect Traits	Days to Silk	Harvest Moisture	Test Weight	Yield		
								2022	2023	2yr Avg
						(%)	(lbs/bu)	----------bu/a----------		
Innvictis	A7988VT2PRIB	79	GT	VT2P	67	28	52.6	148.9	140.5	144.7
Integra	3009VT2	80	RR2	VT2	68	27	53.5	158.1	137.2	147.6
Legacy	LC275-21	77	GT		74	41	54.4	112.6	116.4	114.5
Legacy	LC304-21	80	Enlist	PWE	71	33	53.0	124.2	137.4	130.8
Legacy	LC311-20	81	RR2	VT2P	72	32	53.6	147.5	132.6	140.1
Pioneer	P7417AM	74	RR2Y/LL	AcreMax (AM)	68	22	53.8	151.3	127.4	139.3
Pioneer	P7861AM	78	RR2Y/LL	AcreMax (AM)	70	25	54.4	129.8	130.6	130.2
Proseed	1974 RR	74	RR2		69	27	56.3	161.6	134.9	148.3
Thunder	T4072 RR	72	RR2		68	25	55.8	149.6	120.9	135.3
Thunder	T6278 VT2P	78	RR2	VT2P	70	30	51.7	161.7	126.0	143.8
Thunder	T6977 VT2P	77	RR2	VT2P	69	29	51.9	154.4	137.5	146.0
Innvictis	A7883VT2PRIB	78	GT	VT2P	71	27	56.8	--	133.3	--
Integra	3114VT2	81	RR2	VT2	70	31	54.0	--	141.3	--
Pioneer	P6910AM	69	RR2Y/LL	AcreMax (AM)	68	21	55.4	--	119.8	--
Pioneer	P7389AM	73	RR2Y/LL	AcreMax (AM)	68	23	53.8	--	135.3	--
REA	73B59	73	RR2	Bt	68	24	56.0	--	126.6	--
REA	80B57	80	RR2	Bt	70	31	53.1	--	147.5	--
Thunder	T4477 GT	77	GT		75	32	52.2	--	127.0	--
Trial Mean					70	28	54.0	144.6	131.8	
C.V. %					1.2	6.6	1.7	6.0	6.9	
LSD 5%					1.4	3.2	1.6	11.1	15.6	
LSD 10%					1.2	2.6	1.3	9.2	13.0	

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

Yield reported at 15.5% moisture.

GDD from May 16 to October 6 were 2088. Normal is 1746.

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

Barley Summary, Langdon 2019-2023

	Height (in)						Protein (%)						Days to Head					
Variety	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**
Tradition*	28	28	24	32	33	30	12.8	12.9	13.5	10.9	12.0	12.1	55	47	57	50	46	51
Pinnacle	29	27	23	30	31	28	12.1	11.5	13.7	10.0	11.2	11.6	56	49	61	52	50	54
ND Genesis	29	28	26	33	34	31	11.3	10.6	12.5	9.7	11.3	11.2	57	50	61	54	51	55
AAC Synergy	28	27	26	30	33	30	12.4	12.1	13.6	10.4	12.9	12.3	59	51	62	54	51	56
Explorer	24	24	22	24	25	24	12.4	12.4	13.9	9.7	12.1	11.9	57	50	61	55	51	56
Conlon	25	28	25	29	31	28	13.0	11.9	14.1	10.5	12.6	12.4	54	47	58	51	42	50
AAC Connect	27	26	24	28	32	28	13.1	12.5	14.5	10.3	12.8	12.5	58	50	62	54	52	56
ABI Cardinal	26	25	22	29	30	27	12.0	12.8	14.2	10.3	12.2	12.2	58	51	61	57	52	57
Brewski	--	26	24	30	32	29	--	11.6	13.0	10.1	11.8	11.6	--	50	61	54	53	56
ND Treasure*	--	--	22	27	31	26	--	--	12.7	10.3	11.7	11.6	--	--	59	51	45	52
CDC Fraser	--	--	25	29	30	28	--	--	13.7	10.3	13.2	12.4	--	--	62	57	53	57
Lacey*	29	--	--	30	34	--	12.7	--	--	11.0	12.4	--	55	--	--	50	44	--
CDC Prairie	--	--	--	--	33	--	--	--	--	--	13.1	--	--	--	--	--	51	--
Firefoxx	--	--	--	--	27	--	--	--	--	--	11.3	--	--	--	--	--	51	--
Winston	--	--	--	--	26	--	--	--	--	--	11.5	--	--	--	--	--	54	--
BC Ellinor	--	--	22	28	--	--	--	--	13.0	10.5	--	--	--	--	62	57	--	--
BC Lexy	--	--	22	27	--	--	--	--	13.1	10.0	--	--	--	--	62	57	--	--
BC Leandra	--	--	20	27	--	--	--	--	15	9.5	--	--	--	--	62	56	--	--
Trial Mean	27	27	23	29	31		12.1	11.5	13.2	10.0	12.1		56	49	61	53	49	
C.V. %	5.5	4.1	7.3	5.4	5.4		3.5	3.6	3.7	4.6	4.9		1.5	1.4	2.2	2.1	2.9	
LSD 5%	2.1	1.6	2.0	2.2	2.4		0.6	0.6	0.6	0.7	0.9		1.2	0.9	2.0	1.6	2.0	
LSD 10%	1.8	1.3	2.0	1.9	2.0		0.5	0.5	0.4	0.6	0.7		1.0	0.4	1.0	1.4	1.7	

*6-row

Barley Summary, Langdon 2019-2023

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)				Plump (%)					
Variety	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**17**	**19**	**20**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**
Tradition*	121	119	79	99	111	96	48.3	46.4	47.2	50.0	48.5	48.6	2.3	0.0	0.2	0.8	92	90	93	95	97	95
Pinnacle	127	106	84	99	109	97	50.6	45.3	50.2	51.6	51.7	51.2	0.0	0.0	0.1	0.0	99	85	99	97	100	99
ND Genesis	123	131	91	100	117	103	48.7	46.7	48.8	48.8	51.2	49.6	0.0	0.3	0.5	0.3	97	92	98	95	100	98
AAC Synergy	123	132	92	105	113	104	50.1	46.2	48.2	50.5	51.2	50.0	3.5	1.3	2.7	2.5	97	86	94	97	99	97
Explorer	123	99	80	106	102	96	49.1	43.6	48.2	48.9	49.9	49.0	0.0	0.0	0.1	0.0	96	76	96	95	99	97
Conlon	110	109	57	100	107	88	51.0	48.4	49.9	51.1	51.6	50.9	--	1.8	0.3	--	98	90	98	98	99	98
AAC Connect	120	127	90	100	109	100	49.7	45.5	47.1	49.5	50.9	49.2	--	0.5	2.0	--	97	77	90	95	98	94
ABI Cardinal	120	109	83	103	109	98	49.3	46.5	46.9	50.6	50.3	49.3	--	1.0	1.7	--	96	87	93	97	98	96
Brewski	--	120	91	109	108	103	--	45.4	48.3	50.1	50.6	49.7	--	--	1.1	--	--	82	98	96	99	98
ND Treasure*	--	--	83	112	113	103	--	--	44.5	48.5	46.6	46.5	--	--	--	--	--	--	89	97	94	93
CDC Fraser	--	--	82	105	113	100	--	--	46.3	49.4	48.9	48.2	--	--	--	--	--	--	95	97	98	97
Lacey*	124	--	--	98	110	--	48.9	--	--	49.3	49.2	--	0.3	0.0	--	--	95	--	--	95	97	--
CDC Prairie	--	--	--	--	117	--	--	--	--	--	50.4	--	--	--	--	--	--	--	--	--	96	--
Firefoxx	--	--	--	--	125	--	--	--	--	--	48.4	--	--	--	--	--	--	--	--	--	99	--
Winston	--	--	--	--	117	--	--	--	--	--	49.5	--	--	--	--	--	--	--	--	--	100	--
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	123	124	85	107	112		49.4	46.3	47.7	49.5	49.8		1.7	0.5	0.5		97	89	96	96	98	
C.V. %	3.4	4.2	9.9	5.0	6.8		0.7	0.9	1.5	1.1	1.0		122	149	126		1.3	2.4	2.8	1.8	1.0	
LSD 5%	5.9	7.5	9.9	7.6	11.0		0.5	0.6	0.8	0.8	0.7		2.8	1.0	0.9		1.8	3.0	3.0	2.4	1.4	
LSD 10%	4.9	6.2	7.7	6.3	9.1		0.4	0.5	0.6	0.7	0.7		2.4	0.9	0.7		1.5	2.5	2.0	2.0	1.1	

*6-row

Oat Summary, Langdon 2018-2023

	Yield (bu/a)						Test Weight (lbs/bu)						Days to Head						Height (in)						Lodging (0-9)				
Variety	**18**	**19**	**20**	**22**	**23**	**3yr**	**18**	**19**	**20**	**22**	**23**	**3yr**	**18**	**19**	**20**	**22**	**23**	**3yr**	**18**	**19**	**20**	**22**	**23**	**3yr**	**16**	**17**	**19**	**20**	**3yr**
Beach	164	152	185	160	119	155	41.6	40.6	39.9	43.2	40.9	41.3	51	58	47	50	48	48	35	38	42	43	42	42	4.0	3.4	0.2	2.5	2.0
HiFi	179	155	188	185	137	170	40.8	38.5	36.5	41.1	36.6	38.1	52	59	50	51	51	51	36	42	40	44	43	42	5.5	3.4	0.0	2.6	2.0
Killdeer	192	185	199	189	128	172	39.8	38.0	36.3	40.0	35.0	37.1	51	57	48	49	50	49	32	35	38	40	37	38	5.5	5.2	0.0	2.4	2.5
Otana	192	175	181	165	145	164	41.0	39.5	35.1	41.0	39.1	38.4	53	59	50	51	51	51	38	42	42	45	43	43	6.7	6.1	1.3	5.3	4.2
Rockford	178	168	170	182	127	160	41.7	40.4	37.7	42.8	37.5	39.3	52	59	50	52	50	51	37	39	44	45	42	44	4.7	5.4	0.2	2.4	2.7
Newburg	178	167	195	205	136	179	40.0	37.8	34.9	40.5	38.9	38.1	52	58	50	51	50	50	38	42	43	43	38	41	7.5	6.3	1.1	4.3	3.9
Leggett	195	189	193	186	140	173	41.2	39.5	36.6	41.5	38.3	38.8	52	59	49	50	48	49	35	37	40	42	42	41	4.3	5.4	0.2	2.5	2.7
Jury	208	192	191	183	140	171	40.3	37.6	35.4	40.8	36.8	37.7	52	61	49	50	51	50	38	40	45	47	49	47	6.5	5.3	0.7	4.8	3.6
Paul*	149	129	146	126	91	121	47.4	44.1	44.0	46.8	39.0	43.3	52	61	51	53	50	51	38	40	47	45	51	48	6.0	5.0	0.1	1.7	2.3
Deon	182	184	223	185	145	184	40.4	38.0	36.6	41.0	37.4	38.3	52	60	51	52	51	51	36	39	47	44	43	45	4.3	3.6	0.0	0.9	1.5
CS Camden	208	188	209	197	143	183	38.7	36.3	33.6	38.9	34.1	35.5	52	59	49	49	50	49	35	36	42	39	41	41	2.5	0.5	0.0	0.5	0.3
ND Heart	171	157	194	175	127	165	40.7	39.5	37.3	41.5	33.4	37.4	51	58	48	50	51	50	37	39	42	45	45	44	4.7	6.3	0.5	3.6	3.5
ND Carson	187	182	220	205	148	191	41.0	37.8	41.1	41.1	37.7	40.0	52	60	50	51	52	51	37	38	44	42	44	43	--	--	0.0	1.0	--
ND Spilde	174	184	209	187	148	181	39.2	37.7	39.8	39.8	38.5	39.4	52	58	49	50	53	51	36	39	43	43	47	44	--	--	0.1	3.3	--
ND Crema*	--	120	133	125	87	115	--	46.1	48.2	48.2	36.6	44.3	--	60	52	53	52	52	--	41	45	48	42	45	--	--	0.0	2.2	--
AAC Douglas	--	--	--	187	156	--	--	--	--	39.8	36.9	--	--	--	--	49	48	--	--	--	--	42	42	--	--	--	--	--	--
MN-Pearl	--	--	--	192	129	--	--	--	--	39.7	36.0	--	--	--	--	50	49	--	--	--	--	42	41	--	--	--	--	--	--
SD Buffalo	--	--	--	189	132	--	--	--	--	41.2	37.7	--	--	--	--	48	57	--	--	--	--	43	44	--	--	--	--	--	--
CDC Endure	--	--	--	--	153	--	--	--	--	--	35.7	--	--	--	--	--	51	--	--	--	--	--	43	--	--	--	--	--	--
Ore Level 48	--	--	--	--	136	--	--	--	--	--	37.9	--	--	--	--	--	48	--	--	--	--	--	43	--	--	--	--	--	--
CDC Minstrel	181	177	199	189	--	--	40.2	37.2	34.5	40.2	--	--	52	58	49	50	--	--	33	36	42	42	--	--	3.7	3.4	0.1	0.2	1.2
Warrior	--	163	179	169	--	--	--	38.7	35.8	41.2	--	--	--	56	46	48	--	--	--	35	39	39	--	--	--	--	0.0	1.0	--
CDC Dancer	182	189	192	--	--	--	41.0	39.5	36.9	--	--	--	52	59	49	--	--	--	36	40	44	--	--	--	5.7	5.0	0.0	2.3	2.4
Hytest	139	160	181	--	--	--	42.5	40.5	38.9	--	--	--	51	57	47	--	--	--	37	41	44	--	--	--	7.2	4.3	0.8	1.6	2.2
Souris	165	166	186	--	--	--	39.9	38.5	36.7	--	--	--	51	58	48	--	--	--	34	37	39	--	--	--	3.0	2.6	0.1	0.0	0.9
Stallion	183	165	170	--	--	--	42.1	40.8	38.3	--	--	--	53	58	48	--	--	--	38	39	43	--	--	--	8.0	5.1	0.1	2.7	2.6
Hayden	169	177	181	--	--	--	41.2	40.3	38.0	--	--	--	52	58	48	--	--	--	35	40	41	--	--	--	6.0	4.3	0.1	2.3	2.2
AC Pinnacle	184	151	--	--	--	--	40.9	38.9	--	--	--	--	52	58	--	--	--	--	40	42	--	--	--	--	5.5	6.7	1.0	--	--
Trial Mean	181	170	192	182	135		41.0	39.2	37.2	41.5	37.5		52	59	49	51	51		37	40	42	44	44		5.1	4.4	0.2	2.1	
C.V. %	5.8	4.1	3.7	3.7	6.1		1.1	1.1	1.6	0.8	1.9		1.2	1.0	1.5	1.2	1.9		4.3	4.1	4.3	3.2	5.0		35.2	37.6	234	76	
LSD 5%	17.2	11.5	11.7	9.4	11.5		0.7	0.7	1.0	0.5	1.0		1.0	1.0	1.2	0.8	1.4		2.6	2.6	3.0	2.0	3.0		2.5	2.3	0.8	2.6	
LSD 10%	14.3	9.6	9.8	7.9	9.6		0.6	0.6	0.8	0.4	0.8		0.8	0.8	1.0	0.7	1.1		2.1	2.2	2.5	1.7	2.5		2.1	2.0	0.7	2.2	

*Hull-less variety

The 2021 trial was not harvested.

Flax Summary, Langdon 2019-2023

	Yield (bu/a)						Test Weight (lbs/bu)						Lodging (0-9)			Height (in)						Days to Flower					
Variety	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**17**	**22**	**2yr**	**19**	**20**	**21**	**22**	**23**	**3yr**	**19**	**20**	**21**	**22**	**23**	**3yr**
Carter*	42	43	21	57	35	37	53.2	53.1	53.1	53.7	51.5	52.8	0.0	0.4	0.2	25	25	21	28	30	26	53	47	52	48	47	49
CDC Glas	42	50	21	65	28	38	50.6	52.0	51.2	52.9	48.4	50.8	0.1	0.0	0.1	22	25	19	29	30	26	53	51	54	50	52	52
Omega*	39	40	21	50	31	34	53.4	53.2	53.2	53.8	51.8	52.9	0.4	1.9	1.2	23	20	19	27	31	26	54	45	54	50	45	50
Webster	42	46	23	59	31	37	52.5	53.7	52.6	54.0	50.4	52.3	0.6	0.0	0.3	24	26	21	30	30	27	52	50	52	51	49	51
York	43	48	20	63	35	40	51.7	53.4	52.3	53.6	51.2	52.4	0.0	0.0	0.0	28	25	20	31	33	28	52	47	53	48	51	51
Gold ND*	41	48	21	56	32	36	52.7	53.4	53.0	52.6	52.2	52.6	0.1	0.6	0.4	25	23	20	31	32	28	53	49	55	51	50	52
CDC Neela	43	43	22	59	35	39	51.4	53.0	52.1	53.7	51.3	52.4	0.0	0.5	0.3	23	24	20	29	33	27	51	50	53	50	50	51
ND Hammond	38	40	21	58	31	37	51.5	52.9	52.3	53.0	49.2	51.5	0.0	0.0	0.0	24	23	21	32	32	28	52	46	52	48	49	50
AAC Bright*	38	51	21	62	32	38	48.9	51.1	51.0	51.0	47.0	49.7	--	0.0	--	23	25	20	29	31	27	52	49	54	51	52	52
CDC Dorado*	--	38	18	55	30	34	--	52.8	51.8	53.9	47.2	51.0	--	0.1	--	--	23	19	29	29	26	--	43	51	49	44	48
AAC Marvelous	--	--	22	64	30	39	--	--	52.5	53.9	50.5	52.3	--	0.1	--	--	--	20	28	29	26	--	--	53	49	51	51
CDC Rowland	--	--	21	68	35	41	--	--	52.5	53.4	50.2	52.0	--	0.1	--	--	--	17	29	29	25	--	--	55	49	50	51
CDC Kernen	--	--	--	57	23	--	--	--	--	53.7	46.0	--	--	1.8	--	--	--	--	29	31	--	--	--	--	51	47	--
CDC Plava	40	39	21	--	--	--	51.6	52.1	52.1	--	--	--	0.0	--	--	22	26	19	--	--	--	52	46	53	--	--	--
CDC Buryu	42	40	21	--	--	--	52.9	53.1	52.4	--	--	--	--	--	--	24	26	19	--	--	--	52	48	52	--	--	--
Prairie Thunder	43	44	--	--	--	--	52.1	53.2	--	--	--	--	0.1	--	--	26	28	--	--	--	--	54	50	--	--	--	--
CDC Melyn	35	--	--	--	--	--	47.4	--	--	--	--	--	--	--	--	23	--	--	--	--	--	54	--	--	--	--	--
Trial Mean	41	45	21	58	31		52.2	53.1	52.6	53.5	50.7		0.2	0.6		25	25	20	30	31		53	48	53	50	50	
C.V. %	5.8	5.2	5.0	5.0	8.3		0.8	0.5	0.3	0.7	2.1		340	131		5.0	6.9	4.0	3.3	5.6		1.3	1.8	0.7	1.5	2.6	
LSD 5%	3.9	3.9	1.4	4.7	5.6		0.6	0.4	0.2	0.6	1.7		1.1	1.2		2.0	2.8	1.1	1.6	2.8		1.1	1.4	0.6	1.2	2.1	
LSD 10%	3.2	3.3	1.2	4.0	--		0.5	0.4	0.2	0.5	1.5		0.9	1.0		1.7	2.4	0.9	1.3	2.4		0.9	1.2	0.5	1.0	1.7	

*Yellow seed color.

Canola - Clearfield, Langdon 2023

Company/Brand	Variety	Type[1]	Blackleg Rating[2]	Clubroot Resistant[4]	Days to First Flower (days)	Flower Duration (days)	Days to Mature (days)	Plant Height (in)	Cover[3] (%)	Oil[5] (%)	Yield[5] (lbs/a)
Dyna-Gro	DG 280 CLC	CL	R	Yes	44	17	85	51	92	44.4	2603
Photosyntech	PST SC 0742 CL	CL	MR	N/A	50	19	92	59	84	41.4	2636
Photosyntech	PST SC 1159 CL	CL	MR	N/A	53	17	94	60	89	41.1	2282
Rubisco	RUB378-M	CL	R	N/A	43	20	89	55	87	44.8	3040
Rubisco	RUB368-D	CL	R	N/A	39	23	85	51	88	42.0	2734
	LL Check	LL			40	21	86	51	85	41.6	3279
	RR Check	RR			39	22	87	48	84	42.7	3018
Trial Mean					43	20	88	53	81	42.0	2604
C.V. %					2.7	5.7	1.8	5.0	6.2	1.3	10.6
LSD 5%					1.7	1.6	2.3	3.8	7.2	0.8	397
LSD 10%					1.4	1.4	1.9	3.1	6.0	0.7	329

All varieties are traditional oil type and commercially available.

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

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

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

[4]Has clubroot resistance gene(s).

[5]8.5% moisture

No lodging in the trial.

Canola - Liberty Link, Langdon 2022-2023

Company/Brand	Variety	Type[1]	Blackleg Rating[2]	Clubroot Resistant[4]	Days to First Flower			Flower Duration (days)			Days to Mature			% Cover[3]		
					22	23	2yr	22	23	2yr	22	23	2yr	22	23	2yr
BASF	InVigor L233P	LL	R	No	41	42	42	20	18	19	93	84	89	98	86	92
BASF	InVigor L345PC	LL	R	Yes	41	46	44	20	17	19	93	87	90	99	88	94
BASF	InVigor L340PC	LL	R	Yes	40	43	42	20	18	19	91	85	88	100	85	93
Bayer	DKTFLL21SC	TFLL	R	No	37	40	39	21	21	21	87	84	86	95	81	88
Bayer	DKLL82SC	LL	R	No	38	41	40	21	21	21	88	86	87	100	86	93
CANTERRA SEEDS	CS4000 LL	LL	R	Yes	40	42	41	20	19	20	93	85	89	101	85	93
BASF	InVigor L350PC	LL	R	Yes	45	48	47	19	17	18	98	90	94	99	88	94
BASF	InVigor LR354PC	TFLL	R	Yes	47	47	47	17	17	17	98	88	93	96	86	91
BASF	InVigor L343PC	LL	R	Yes	40	43	42	19	17	18	92	86	89	98	82	90
Bayer	DKLL83SC	LL	R	No	38	39	39	19	21	20	88	84	86	97	78	88
Pioneer	P505MSL	LL	R	Yes	40	44	--	19	17	18	92	85	89	99	88	94
CROPLAN	CP7250LL	LL	R	Yes	--	44	--	--	20	--	--	89	--	--	87	--
Dyna-Gro	DG 661 LCM	LL	R	Yes	--	43	--	--	19	--	--	88	--	--	85	--
Pioneer	P612L	LL	R	Yes	--	47	--	--	18	--	--	89	--	--	83	--
Trial Mean					41	44		20	19		92	87		99	85	
C.V. %					1.9	3.4		5.0	7.6		1.1	2.0		1.8	5.7	
LSD 5%					1.1	2.1		1.4	2.0		1.4	2.5		2.5	6.9	
LSD 10%					0.9	1.8		1.2	1.7		1.2	2.1		2.0	5.8	

All varieties are traditional oil type and commercially available.

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

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

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

[4]Has clubroot resistance gene(s).

Canola - Liberty Link, Langdon 2020-2023

Company/Brand	Variety	Height (in)			Lodging (0-9)			Oil[1] (%)			Yield[1] (lbs/a)					
		22	23	2yr	20	22	2yr	22	23	2yr	2020	2021	2022	2023	2yr	3yr[2]
BASF	InVigor L233P	48	53	51	5.8	4.5	5.2	42.7	41.0	41.9	3565	1436	3171	2892	3032	3209
BASF	InVigor L345PC	47	55	51	6.3	4.1	5.2	41.8	41.0	41.4	3135	1512	3734	2454	3094	3108
BASF	InVigor L340PC	47	51	49	5.3	4.2	4.8	41.4	40.1	40.8	3414	1351	3573	2644	3109	3210
Bayer	DKTFLL21SC	46	48	47	4.8	2.9	3.9	43.2	41.0	42.1	3327	978	2793	2473	2633	2864
Bayer	DKLL82SC	45	46	46	4.5	5.0	4.8	41.4	40.8	41.1	3169	812	3094	2428	2761	2897
CANTERRA SEEDS	CS4000 LL	50	53	52	--	4.0	--	42.9	41.5	42.2	3321	1076	3237	2907	3072	3155
BASF	InVigor L350PC	51	58	55	--	1.7	--	45.2	41.4	43.3	--	--	3615	2668	3142	--
BASF	InVigor LR354PC	56	57	57	--	1.1	--	44.1	41.7	42.9	--	--	3351	2429	2890	--
BASF	InVigor L343PC	47	52	50	--	3.8	--	41.6	41.2	41.4	--	--	3627	2541	3084	--
Bayer	DKLL83SC	49	48	49	--	3.9	--	43.5	41.3	42.4	--	--	3182	2314	2748	--
Pioneer	P505MSL	53	56	55	--	5.8	--	41.9	40.9	41.4	--	--	2647	2346	2497	--
CROPLAN	CP7250LL	--	52	--	--	--	--	--	41.2	--	--	--	--	2554	--	--
Dyna-Gro	DG 661 LCM	--	52	--	--	--	--	--	41.4	--	--	--	--	2243	--	--
Pioneer	P612L	--	58	--	--	--	--	--	42.0	--	--	--	--	2584	--	--
Trial Mean		49	53		5.2	3.8		42.7	41.3		2881	1308	3261	2530		
C.V. %		5.5	4.3		18.4	12.9		1.2	1.3		8.2	17.6	3.9	9.9		
LSD 5%		3.9	3.3		1.3	0.5		0.7	0.8		331	204	122	360		
LSD 10%		3.2	1.7		1.1	0.4		0.6	0.6		277	172	102	299		

[1]8.5% moisture

[2]Average of 2020, 2022, and 2023 data.

Canola - Roundup Ready, Langdon 2022-2023

Company	Variety	Type[1]	Blackleg Rating[2]	Oil Type	Clubroot Resistant[4]	Days to First Flower			Flower Duration (days)			Days to Mature			% Cover[3]		
						22	23	2yr	22	23	2yr	22	23	2yr	22	23	2yr
CANTERRA SEEDS	CS2600 CR-T	TF	R	Trad.	Yes	38	39	39	19	21	20	88	83	86	99	88	94
CROPLAN	CP9978TF	TF	R	Trad.	No	39	38	39	20	24	22	92	86	89	98	90	94
Star	StarFlex	TF	R	Trad.	No	40	38	39	21	25	23	93	86	90	97	92	95
BrettYoung	BY 6211TF	TF	R	Trad.	No	39	40	40	21	21	21	91	85	88	99	87	93
CANTERRA SEEDS	CS3000 TF	TF	R	Trad.	Yes	37	37	37	20	22	21	90	83	87	98	85	92
Nuseed	NC155 TF	TF	R	Trad.	No	38	39	39	24	25	25	91	89	90	100	82	91
Nuseed	NC471 TF	TF	R	Trad.	No	40	41	41	20	22	21	92	89	91	100	65	83
Nuseed	NC527CR TF	TF	R	Trad.	Yes	39	39	39	22	22	22	92	86	89	99	90	95
CANTERRA SEEDS	CS3100 TF	TF	R	Trad.	Yes	44	43	44	20	25	23	97	92	95	98	83	91
BASF	LR354PC	TFLL	R	Trad.	Yes	--	47	--	--	17	--	--	89	--	--	83	--
Bayer	DK900TF	TF	R	Trad.	Yes	--	42	--	--	21	--	--	85	--	--	88	--
CROPLAN	CP9221TF	TF	R	Trad.	Yes	--	38	--	--	22	--	--	83	--	--	78	--
Dyna-Gro	DG 760 TC	TF	R	Trad.	Yes	--	39	--	--	21	--	--	83	--	--	90	--
Dyna-Gro	DG 781 TCM	TF	R	Trad.	Yes	--	42	--	--	18	--	--	89	--	--	88	--
Pioneer	P511G	OptG	R	Trad.	Yes	--	43	--	--	21	--	--	87	--	--	72	--
Pioneer	P515G	OptG	R	Trad.	Yes	--	41	--	--	21	--	--	84	--	--	83	--
Proseed	TR 23127	TF	R	Trad.	Yes	--	42	--	--	22	--	--	88	--	--	80	--
Trial Mean						41	41		21	22		92	87		99	84	
C.V. %						1.4	2.9		4.7	6.9		1.4	2.4		1.7	10.6	
LSD 5%						0.8	2.0		1.4	2.5		1.8	3.5		2.5	14.8	
LSD 10%						0.7	1.7		1.1	2.0		1.5	2.9		2.0	12.3	

[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).

Canola - Roundup Ready, Langdon 2022-2023

Company	Variety	Height (in)			Lodging (0-9)	Oil[1] (%)			Yield[1] (lbs/a)		
		22	23	2yr	22	22	23	2yr	22	23	2yr
CANTERRA SEEDS	CS2600 CR-T	46	50	48	3.7	41.5	42.6	42.1	2409	2608	2508
CROPLAN	CP9978TF	45	51	48	3.8	41.7	41.1	41.4	2710	2932	2821
Star	StarFlex	45	52	49	2.0	41.8	42.7	42.3	3149	2676	2913
BrettYoung	BY 6211TF	45	51	48	2.8	40.6	40.4	40.5	3295	2515	2905
CANTERRA SEEDS	CS3000 TF	45	49	47	3.6	41.5	41.6	41.6	2929	2578	2754
Nuseed	NC155 TF	49	53	51	2.0	41.6	40.8	41.2	2963	2412	2687
Nuseed	NC471 TF	47	53	50	1.8	42.3	41.8	42.1	2360	2072	2216
Nuseed	NC527CR TF	48	52	50	3.2	42.0	41.3	41.7	2797	2471	2634
CANTERRA SEEDS	CS3100 TF	48	53	51	2.3	42.2	42.7	42.5	3382	2609	2996
BASF	LR354PC	--	55	--	--	--	41.1	--	--	2344	--
Bayer	DK900TF	--	52	--	--	--	42.4	--	--	2757	--
CROPLAN	CP9221TF	--	46	--	--	--	40.6	--	--	2412	--
Dyna-Gro	DG 760 TC	--	49	--	--	--	41.7	--	--	2818	--
Dyna-Gro	DG 781 TCM	--	53	--	--	--	42.2	--	--	2526	--
Pioneer	P511G	--	55	--	--	--	42.2	--	--	2391	--
Pioneer	P515G	--	50	--	--	--	41.3	--	--	2551	--
Proseed	TR 23127	--	53	--	--	--	42.1	--	--	2709	--
Trial Mean		48	52		2.5	42.0	41.6		3245	2516	
C.V. %		5.9	5.1		15.1	1.0	2.3		7.1	5.1	
LSD 5%		4.1	4.4		0.3	0.6	1.6		204	341	
LSD 10%		3.4	3.7		0.3	0.5	1.3		170	--	

[1] 8.5% moisture

No lodging in trial.

Dry Bean Summary, Langdon 2021-2023

Variety	Market Class	Days to Maturity	Plant Height	Lodging	100 Seed Weight	Yield					
						2021	2022	2023	2 yr Avg.	3 yr Avg.	4 yr Avg.
			(in)	(0-9)	(g)	(lbs/a)					
LaPaz	Pinto	101	21	2	33.1	1827	3155	3496	3326	2826	3043
Lariat	Pinto	102	20	3	36.6	1714	3026	3416	3221	2719	2903
Monterrey	Pinto	99	20	2	34.3	2105	3189	3254	3221	2849	3089
ND Falcon	Pinto	103	21	1	33.9	1695	3278	2684	2981	2552	2693
ND Palomino	Pinto	103	19	3	38.0	1585	2632	2557	2594	2258	2448
Torreon	Pinto	98	19	2	29.8	2165	3558	2767	3163	2830	3074
Vibrant	Pinto	99	20	2	32.9	2114	3626	3227	3426	2989	3250
Windbreaker	Pinto	99	16	6	34.4	1587	2490	3109	2800	2395	2765
Cowboy	Pinto	98	18	3	34.5	1638	3074	3246	3160	2653	--
ND Rodeo	Pinto	104	21	4	37.5	--	--	2868	--	--	--
Diamondback	Pinto	103	21	2	38.2	--	--	3050	--	--	--
Rattler	Pinto	102	20	2	36.5	--	--	3546	--	--	--
Stampede	Pinto	--	--	--	--	2028	3432	--	--	--	--
Blizzard	Navy	103	22	0	19.6	1962	3350	3210	3280	2841	2961
HMS Medalist	Navy	103	20	0	17.9	2197	2847	3238	3042	2761	3043
T9905	Navy	104	18	2	21.2	1835	3326	3118	3222	2760	3015
Armada	Navy	103	20	1	20.1	--	3194	3064	3129	--	--
ND Polar	Navy	103	21	2	19.2	--	3172	2994	3083	--	--
Black Tails	Black	103	22	2	19.8	2063	3463	3512	3488	3013	3199
Eclipse	Black	101	20	0	19.0	2049	3132	2935	3033	2705	2937
ND Twilight	Black	101	16	4	20.2	1522	2901	2458	2679	2294	2522
Zorro	Black	102	19	0	20.3	1899	2421	3209	2815	2510	--
ND Pegasus	Great Northern	103	18	3	37.8	2320	4098	3176	3637	3198	--
Powderhorn	Great Northern	99	17	3	34.6	--	--	3078	--	--	--
Rosetta	Pink	104	19	1	31.6	2044	2580	3128	2854	2584	--
Merlot	Small Red	102	19	4	35.8	2036	2875	2493	2684	2468	2623
Ruby	Small Red	102	17	6	32.8	--	--	2799	--	--	--
Viper	Small Red	--	--	--	--	2587	3422	--	--	--	--
Trial Mean		102	19	2	29.8	1937	3160	3063			
C.V. %		1.5	7.5	39.9	7.0	9.5	8.9	7.0			
LSD 5%		2.6	2.4	1.5	3.4	235	463	480			
LSD 10%		2.1	2.0	1.2	2.8	197	336	--			

Days to mature (R9) at least 80% of pods showing yellow and mostly ripe.
Trials were direct harvested 2021-2023.

Field Pea, Langdon 2021-2023

Variety	Days to 1st Flower	Mature	Canopy Ht. at Harvest	Harvest Ease[1]	1000 KWT	Seeds/ Pound	Test Weight	Protein[2]	Yield				
									2021	2022	2023	2 yr Avg.	3 yr Avg.
		(days)	(in)	(0-9)	(g)		(lbs/bu)	(%)	bu/a				
Yellow Cotyledon Type													
AAC Profit	47	81	37	1	226	2022	63.3	26.2	49.5	73.4	81.0	77.2	68.0
Agassiz	45	82	37	0	229	1995	63.2	26.1	44.2	66.0	87.2	76.6	65.8
CDC Amarillo	49	82	36	0	230	1982	63.5	24.4	53.1	71.3	76.8	74.0	67.1
DS Admiral	42	77	33	2	247	1846	63.0	24.2	39.6	70.3	82.1	76.2	64.0
ND Dawn	44	79	30	0	243	1859	62.8	23.7	38.4	46.4	73.7	60.0	52.8
CDC Inca	47	83	39	0	238	1911	63.6	24.7	50.4	71.0	77.7	74.4	66.4
CDC Spectrum	47	82	35	1	242	1875	62.9	25.3	45.4	61.0	83.9	72.4	63.4
MS GrowPro	46	82	37	0	321	1413	63.1	26.2	52.9	69.9	80.0	74.9	67.6
Orchestra	42	80	34	2	279	1628	62.7	26.2	41.8	55.9	82.1	69.0	59.9
AAC Chrome	48	83	31	1	247	1840	63.1	24.0	61.8	70.8	84.5	77.6	72.4
AAC Julius	47	80	35	0	206	2197	63.7	24.9	53.3	58.6	86.6	72.6	66.2
Hyline	46	80	33	2	244	1863	64.3	23.5	53.1	55.6	85.3	70.4	64.7
Salamanca	43	79	35	1	262	1728	63.8	25.5	46.4	64.1	77.0	70.5	62.5
PSTSPS50	45	80	36	2	324	1403	63.5	26.3	--	77.5	81.5	79.5	--
Spider	46	80	37	1	251	1806	63.8	25.2	--	--	80.4	--	--
AAC Beyond	48	80	32	2	215	2110	62.3	25.3	--	--	87.8	--	--
MS ProStar	47	78	34	1	251	1819	62.5	24.4	--	--	78.0	--	--
PG Cash	45	77	33	0	264	1721	63.1	24.4	--	--	75.9	--	--
Pizzazz	37	77	32	5	309	1466	63.6	24.5	--	--	78.0	--	--
Green Cotyledon Type													
Aragorn	42	77	26	4	224	2032	63.0	25.7	34.7	40.4	67.6	54.0	47.6
Arcadia	43	78	29	5	215	2111	63.0	23.9	39.5	43.9	78.5	61.2	54.0
CDC Striker	46	78	33	0	240	1898	63.7	25.6	44.6	46.6	70.2	58.4	53.8
Shamrock	47	80	34	0	233	1943	63.0	25.0	48.0	61.4	81.4	71.4	63.6
ND Victory	50	86	41	1	175	2608	63.0	26.3	--	44.9	72.4	58.6	--
Trial Mean	45	80	35	1.6	248	1860	63.2	25.1	45.9	60.8	78.9		
C.V. %	2.4	1.6	8.1	77.0	3.2	3.6	1.0	2.8	13.3	7.4	7.4		
LSD 5%	1.8	2.0	4.6	2.0	12.8	110.3	1.1	1.1	10.0	6.0	9.5		
LSD 10%	1.5	1.7	3.8	1.7	10.7	92.2	0.9	1.0	8.3	5.0	7.9		

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

[2] 0% moisture basis

Crambe, Langdon 2023

Variety	Days to 1st Flower	Days to Maturity	Plant Height (in)	Test Weight (lbs/bu)	Yield (lbs/a)
BelAnn	44	87	44	29.0	2254
BelEnzian	46	87	44	28.5	2260
Meyer	43	85	42	28.2	2018
Westhope	45	86	46	28.3	2169
Canola Check	38	88	46	--	3503
Mean	43	87	44	28.5	2441
C.V. %	2.1	1.2	2.8	1.2	7.3
LSD 5%	1.4	1.6	1.9	0.6	276
LSD 10%	1.1	1.3	1.5	0.5	225

No lodging in the trial.

Faba Bean, Langdon 2023

Company	Variety	Days to 1st Flower	Days to Mature	Plant Height	1000 KWT	Seeds/lb	Protein[2]	Test Weight	Seed Yield[2] 2021	2022	2023	2-yr Avg.	3-yr Avg.
		(DAP[1])	(DAP[1])	(in)	(g)		(%)	(lbs/bu)	----------(bu/a)----------				
Premier Genetics	Fabelle	39	96	36	469	968	26.7	64.1	40.1	111.9	57.2	84.5	69.7
Premier Genetics	Tiffany	39	96	36	459	989	26.2	63.2	42.2	108.3	50.4	79.3	66.9
Valesco Genetics	Hammer	38	94	34	449	1011	25.1	63.8	--	--	55.9	--	--
Valesco Genetics	Callas	38	92	34	473	962	25.6	64.9	--	--	67.4	--	--
Valesco Genetics	Mystic	39	94	36	453	1003	25.5	63.7	--	--	59.9	--	--
Trial Mean		40	95	36	454	1004	25.1	63.4	80.0	38.8	55.2		
C.V. %		3.7	1.1	8.5	4.4	4.3	1.9	0.6	8.5	6.7	11.8		
LSD 5%		2.6	1.7	5.3	34.2	74.2	0.8	0.5	10.1	3.4	11.0		
LSD 10%		2.1	1.4	4.4	22.3	61.4	0.7	0.4	8.4	2.8	9.1		

[1] DAP - Days after planting

[2] Yield and protein at 16% moisture.

Soybean - RR2XF, Enlist E3, and GT, Langdon 2023 *(page 1 of 2)*

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Protein (%)	Oil (%)	Yield 2023 (bu/a)	Yield 2 yr Avg. (bu/a)	Yield 2-site Avg.[4] (bu/a)
Dahlman	7301XF	RR2XF	0.1	9/6	23	33.9	16.3	31.8	49.7	43.6
Dahlman	74009XF	RR2XF	00.9	8/31	20	33.5	17.0	32.1	--	40.6
Dahlman	7401XF	RR2XF	0.1	9/2	22	32.0	16.6	35.0	--	46.9
Dahlman	AE0140	Enlist E3	0.1	9/11	20	33.3	16.1	35.4	--	45.8
Dairyland	DSR-0220E	Enlist E3	0.2	9/9	20	33.1	16.9	38.8	52.3	--
Dairyland	DSR-C801E	Enlist E3	00.8	8/30	17	32.1	17.2	28.5	--	--
Dyna-Gro	S006XF83	RR2XF	00.6	8/28	16	32.2	17.5	29.0	48.4	41.5
Dyna-Gro	S009EN24	Enlist E3	00.9	9/4	18	32.6	16.8	33.5	--	45.8
Dyna-Gro	S009XF33	RR2XF	00.9	9/1	20	32.1	16.4	29.6	45.9	42.7
Golden Harvest	GH00864XF	RR2XF	00.8	8/31	18	33.1	17.2	30.0	--	45.3
Golden Harvest	GH00973E3	Enlist E3	00.9	9/2	19	34.6	16.0	32.5	51.9	45.2
Golden Harvest	GH0234E3	Enlist E3	0.2	9/9	22	33.8	15.9	38.5	--	50.9
Innvictis	A00821XF	RR2XF	00.8	9/1	19	35.1	15.9	31.7	46.1	42.3
Innvictis	A00979X	RR2XF	00.9	9/5	18	33.1	17.5	29.5	45.1	45.7
Integra	XF0063	RR2XF	00.6	8/27	17	34.1	16.9	34.6	--	45.5
Integra	E0113	Enlist E3	0.1	9/6	19	33.9	16.2	36.5	53.6	49.4
Integra	XF0082	RR2XF	00.9	9/1	20	34.3	16.9	32.6	48.9	41.4
Integra	E0084	Enlist E3	00.8	9/6	20	31.9	16.9	36.5	--	48.6
Legacy	LS0068-23 XF	RR2XF	00.6	9/2	21	30.5	16.7	32.8	--	43.7
Legacy	LS008-23 E	Enlist E3	00.8	9/7	20	33.2	16.5	33.9	--	45.0
Legacy	LS0098-23 XF	RR2XF	00.9	9/5	20	33.2	16.7	34.8	--	48.0
Legacy	LS012-23 E	Enlist E3	0.1	9/10	20	33.6	16.2	34.5	--	46.7
Legacy	LS014-23 XF	RR2XF	0.1	9/5	23	33.2	17.1	33.4	--	47.4
Legacy	LS024-23 XF	RR2XF	0.2	9/6	19	34.5	17.2	29.3	--	40.7
LG Seeds	LGS00719XF	RR2XF	00.7	8/31	17	33.5	16.8	31.8	--	47.3
LG Seeds	LGS00901E3	Enlist E3	00.9	9/8	19	33.1	16.6	30.5	--	--
LG Seeds	LGS0125XF	RR2XF	0.1	9/3	19	33.0	17.0	35.0	--	48.2
LG Seeds	LGS0139XF	RR2XF	0.1	9/5	23	34.2	15.1	37.3	--	48.6
NDSU	ND17009GT	GT	00.9	9/2	19	34.4	17.7	29.1	45.6	41.1
NDSU	ND21008GT20	GT	00.8	8/29	17	34.2	16.7	28.4	46.6	38.2
NK Seeds	NK009-G7E3	Enlist E3	00.9	9/4	18	36.0	15.4	31.1	50.2	43.4
NK Seeds	NK009-T1XF	RR2XF	00.9	9/1	19	32.8	17.0	30.4	51.1	42.7
NK Seeds	NK02-H6E3	Enlist E3	0.2	9/8	20	33.6	15.7	36.7	--	50.3
NK Seeds	NK02-M4XF	RR2XF	0.2	9/1	21	31.5	17.4	36.6	53.0	--
Paloma	PL2E013	Enlist E3	0.1	9/11	21	32.2	16.5	33.7	--	44.8

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2XF, Enlist E3, and GT, Langdon 2023 *(page 2 of 2)*

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Protein (%)	Oil (%)	Yield 2023 (bu/a)	Yield 2 yr Avg. (bu/a)	Yield 2-site Avg.[4] (bu/a)
Pioneer	P005A59E	Enlist E3	00.5	8/29	16	34.8	17.6	22.9	41.3	--
Pioneer	P007A68E	Enlist E3	00.7	8/30	17	32.7	17.8	27.3	--	--
Pioneer	P009T18E	Enlist E3	00.9	9/3	21	34.3	16.1	35.5	44.6	--
Pioneer	P02A78E	Enlist E3	0.2	9/5	19	31.5	17.0	31.2	--	--
Proseed	EL 40-093N	Enlist E3	00.9	9/10	20	32.0	17.1	28.6	--	38.1
Proseed	XF 30-062	RR2XF	00.6	8/27	18	32.5	16.4	32.2	48.4	43.1
Proseed	XF 30-092N	RR2XF	00.9	9/5	19	32.0	17.1	34.4	55.8	48.6
Proseed	XF 40-12	RR2XF	0.1	9/5	22	33.5	15.7	37.5	--	50.7
REA	R00934XF	RR2XF	00.9	9/2	20	32.2	16.7	33.2	--	47.5
Stine	01EG23	Enlist E3	00.9	9/11	20	33.3	17.3	36.4	--	48.3
Stine	03EG62	Enlist E3	0.2	9/14	19	33.7	16.3	29.9	--	42.3
Thunder	TE7101N	Enlist E3	0.1	9/9	18	32.8	16.9	34.8	49.2	47.3
Thunder	TE7302N	Enlist E3	0.2	9/3	18	34.2	16.3	32.0	49.6	46.9
Thunder	TX8301	RR2XF	0.1	9/2	17	33.1	16.2	30.4	46.6	44.2
Thunder	TX8402N	RR2XF	0.2	9/5	24	33.2	15.9	37.0	--	47.4
Xitavo	XO 0094E	Enlist E3	0.0	9/8	20	33.0	16.7	37.5	--	48.2
Xitavo	XO 0213E	Enlist E3	0.2	9/10	22	32.3	17.4	37.0	48.9	48.3
Xitavo	XO 0234E	Enlist E3	0.2	9/13	18	33.4	16.2	34.1	--	47.7
Trial Mean				9/4	19	33.2	16.6	32.7		
C.V. %				1.4	10.8	2.4	3.1	11.3		
LSD 5%				2.4	2.9	1.6	1.0	6.4		
LSD 10%				1.0	2.5	1.4	0.9	--		

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

[2]Maturity Group provided by company.

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

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2XF, Enlist E3, and GT, Pembina County 2023

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Lodging (0-9)	Protein (%)	Oil (%)	Yield 2023	Yield 2 yr Avg.	Yield 2-site Avg.[4]
									bu/a		
Dahlman	7301XF	RR2XF	0.1	9/25	38	2.3	35.1	15.6	55.4	61.7	43.6
Dahlman	74009XF	RR2XF	00.9	9/22	33	2.3	33.4	16.4	49.1	--	40.6
Dahlman	7401XF	RR2XF	0.1	9/24	37	1.8	33.6	15.3	58.8	--	46.9
Dahlman	AE0140	Enlist E3	0.1	9/27	29	0.4	34.7	15.7	56.1	--	45.8
Dyna-Gro	S006XF83	RR2XF	00.6	9/13	33	1.1	31.9	16.7	54.0	63.3	41.5
Dyna-Gro	S009EN24	Enlist E3	00.9	9/23	29	1.4	34.9	15.7	58.1	--	45.8
Dyna-Gro	S009XF33	RR2XF	00.9	9/18	29	0.1	32.7	16.3	55.8	62.9	42.7
Golden Harvest	GH00864XF	RR2XF	00.8	9/21	34	1.0	34.0	15.8	60.7	--	45.3
Golden Harvest	GH00973E3	Enlist E3	00.9	9/21	29	1.0	34.2	16.0	57.9	65.8	45.2
Golden Harvest	GH0234E3	Enlist E3	0.2	9/28	31	0.3	34.4	15.3	63.4	--	50.9
Innvictis	A00821XF	RR2XF	00.8	9/19	32	1.9	32.9	16.3	53.0	54.2	42.3
Innvictis	A00979X	RR2XF	00.9	9/24	30	0.6	33.9	16.1	62.0	61.3	45.7
Integra	XF0063	RR2XF	00.6	9/15	36	0.5	32.1	16.5	56.3	62.0	45.5
Integra	E0113	Enlist E3	0.1	9/25	29	1.2	34.1	15.6	62.3	63.5	49.4
Integra	XF0082	RR2XF	00.9	9/20	35	1.9	33.7	16.1	50.1	52.6	41.4
Integra	E0084	Enlist E3	00.8	9/24	28	1.0	34.6	15.8	60.8	--	48.6
Legacy	LS0068-23 XF	RR2XF	00.6	9/19	34	0.6	32.4	16.2	54.7	--	43.7
Legacy	LS008-23 E	Enlist E3	00.8	9/24	28	1.5	34.4	15.8	56.0	--	45.0
Legacy	LS0098-23 XF	RR2XF	00.9	9/21	33	2.7	33.7	16.0	61.2	--	48.0
Legacy	LS012-23 E	Enlist E3	0.1	9/27	29	0.6	34.3	15.9	58.9	--	46.7
Legacy	LS014-23 XF	RR2XF	0.1	9/21	39	2.2	33.6	15.7	61.3	--	47.4
Legacy	LS024-23 XF	RR2XF	0.2	9/23	30	0.8	34.1	16.9	52.0	--	40.7
LG Seeds	LGS00719XF	RR2XF	00.7	9/17	35	1.2	33.1	16.9	62.8	--	47.3
LG Seeds	LGS0125XF	RR2XF	0.1	9/23	34	3.0	33.7	16.2	61.5	--	48.2
LG Seeds	LGS0139XF	RR2XF	0.1	9/21	36	2.1	34.0	15.5	60.0	--	48.6
NDSU	ND17009GT	GT	00.9	9/20	37	1.8	35.2	16.5	53.2	58.1	41.1
NDSU	ND21008GT20	GT	00.8	9/18	34	1.9	34.3	15.9	48.1	53.4	38.2
NK Seeds	NK009-G7E3	Enlist E3	00.9	9/22	30	1.7	34.9	15.5	55.6	64.9	43.4
NK Seeds	NK009-T1XF	RR2XF	00.9	9/19	31	1.8	33.1	16.1	55.0	61.6	42.7
NK Seeds	NK02-H6E3	Enlist E3	0.2	9/26	34	0.6	34.4	15.2	63.9	--	50.3
NK Seeds	NK03-V5E3	Enlist E3	0.3	9/26	32	2.3	34.8	15.9	65.6	--	--
Paloma	PL2E013	Enlist E3	0.1	9/27	31	0.9	33.9	15.5	55.9	--	44.8
Proseed	EL 40-093N	Enlist E3	00.9	9/29	28	0.6	34.4	15.7	47.6	--	38.1
Proseed	XF 30-062	RR2XF	00.6	9/14	33	0.7	32.2	17.0	53.9	62.4	43.1
Proseed	XF 30-092N	RR2XF	00.9	9/20	35	2.9	33.5	16.1	62.7	70.3	48.6
Proseed	XF 40-12	RR2XF	0.1	9/22	36	3.5	33.5	15.7	63.9	--	50.7
REA	R00934XF	RR2XF	00.9	9/19	37	1.1	32.8	15.7	61.8	--	47.5
Stine	01EG23	Enlist E3	00.9	9/26	30	0.0	34.6	15.7	60.1	--	48.3
Stine	03EG62	Enlist E3	0.2	10/1	28	0.6	33.3	15.8	54.6	--	42.3
Thunder	TE7101N	Enlist E3	0.1	9/25	28	0.2	33.2	16.1	59.7	67.1	47.3
Thunder	TE7302N	Enlist E3	0.2	9/22	28	1.6	33.5	16.0	61.8	65.0	46.9
Thunder	TX8301	RR2XF	0.1	9/20	30	0.4	33.1	16.0	58.1	64.4	44.2
Thunder	TX8402N	RR2XF	0.2	9/21	35	2.4	34.3	15.2	57.8	--	47.4
Xitavo	XO 0094E	Enlist E3	0.0	9/26	28	0.7	34.8	15.7	58.8	--	48.2
Xitavo	XO 0213E	Enlist E3	0.2	9/28	33	2.8	33.5	16.5	59.6	60.2	48.3
Xitavo	XO 0234E	Enlist E3	0.2	9/29	30	0.0	34.2	15.6	61.2	--	47.7
Trial Mean				9/22	32	1.4	33.8	16.0	57.6		
C.V. %				1.6	6.8	93	1.6	1.8	6.7		
LSD 5%				2.8	3.1	1.8	1.1	0.6	5.4		
LSD 10%				2.3	2.6	1.5	0.9	0.5	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).

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2XF, Enlist E3, and GT, Nelson County 2023

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Protein (%)	Oil (%)	Yield 2023 (bu/a)	Yield 2 yr Avg. (bu/a)	Yield 2-site Avg.[4] (bu/a)
Dahlman	7304XF	RR2XF	0.4	9/9	27	35.0	16.4	54.7	57.3	47.7
Dyna-Gro	S01XF43	RR2XF	0.1	8/31	25	34.8	15.9	51.9	51.7	45.1
Dyna-Gro	S03EN94	Enlist E3	0.3	9/10	24	34.3	16.5	49.2	--	44.4
Golden Harvest	GH0234E3	Enlist E3	0.2	9/7	27	35.6	15.7	52.2	--	46.2
Golden Harvest	GH0363E3	Enlist E3	0.3	9/6	24	35.3	15.9	55.2	56.6	49.4
Golden Harvest	GH0384XF	RR2XF	0.3	9/7	29	35.0	16.2	56.7	--	47.9
Integra	E0113	Enlist E3	0.1	9/5	27	35.6	16.1	57.0	52.6	46.2
Integra	XF0493	RR2XF	0.4	9/10	26	35.2	16.1	51.9	--	44.9
Integra	E0324	Enlist E3	0.3	9/11	23	34.2	16.3	46.9	--	41.3
Legacy	LS0098-23 XF	RR2XF	00.9	9/3	28	33.6	16.5	59.8	--	46.6
Legacy	LS012-23 E	Enlist E3	0.1	9/7	27	35.5	16.1	55.7	--	48.4
Legacy	LS014-23 XF	RR2XF	0.1	8/1	31	33.7	15.6	53.6	--	46.6
Legacy	LS024-23 XF	RR2XF	0.2	9/4	25	35.3	17.1	47.8	--	41.8
Legacy	LS032-23E	Enlist E3	0.3	9/9	24	34.3	16.7	52.8	--	46.4
Legacy	LS044-23 XF	RR2XF	0.4	9/9	28	34.6	16.7	55.1	--	47.5
LG Seeds	LGS0125XF	RR2XF	0.1	9/3	28	34.3	16.4	55.3	--	46.4
LG Seeds	LGS0139XF	RR2XF	0.1	9/1	30	33.3	15.9	54.3	--	46.0
LG Seeds	LGS0444XF	RR2XF	0.4	9/8	26	34.8	16.3	55.1	--	48.2
NDSU	ND17009GT	GT	00.9	8/28	25	36.3	16.9	45.4	45.3	40.4
NDSU	ND21008GT20	GT	00.8	8/26	28	35.0	16.3	44.4	45.8	40.6
NK Seeds	NK009-G7E3	Enlist E3	00.9	9/4	27	36.2	15.9	55.0	56.3	45.9
NK Seeds	NK009-T1XF	RR2XF	00.9	8/30	25	34.3	16.4	49.3	51.5	42.6
NK Seeds	NK02-H6E3	Enlist E3	0.2	9/6	24	36.1	15.1	54.9	--	47.8
NK Seeds	NK02-M4XF	RR2XF	0.2	8/31	26	33.6	16.7	58.3	54.1	--
NK Seeds	NK03-V5E3	Enlist E3	0.3	9/7	26	35.5	15.8	57.4	58.0	48.4
NK Seeds	NK04-A9E3	Enlist E3	0.4	9/10	27	34.6	16.2	60.5	--	52.6
Paloma	PL2E013	Enlist E3	0.1	8/8	26	34.4	15.8	55.8	--	47.9
Paloma	PL2E043	Enlist E3	0.4	9/7	26	35.7	15.9	52.9	--	45.3
Proseed	XF 30-42	RR2XF	0.4	9/9	27	34.8	16.3	53.0	--	46.4
Proseed	XF 30-52N	RR2XF	0.5	9/7	32	34.8	16.2	52.9	--	47.4
Proseed	XF 40-12	RR2XF	0.1	8/30	30	33.9	15.9	54.3	--	46.4
REA	R00934XF	RR2XF	00.9	8/30	27	33.2	15.9	54.9	--	45.3
REA	R0422XF	RR2XF	0.4	9/11	28	35.0	16.5	51.0	55.6	43.2
Xitavo	XO 0094E	Enlist E3	0.0	9/9	25	34.9	16.4	49.7	--	42.3
Xitavo	XO 0213E	Enlist E3	0.2	9/7	26	34.4	17.1	51.6	50.3	45.0
Xitavo	XO 0234E	Enlist E3	0.2	9/9	24	35.4	15.8	51.7	--	46.1
Trial Mean				9/5	27	34.8	16.2	53.3		
C.V. %				1.5	8.6	1.2	1.2	7.8		
LSD 5%				2.1	3.2	0.8	0.4	5.8		
LSD 10%				1.8	2.7	0.7	0.3	4.9		

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

[2]Maturity Group provided by company.

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

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

Yield, oil and protein reported at 13% moisture.

Soybean - RR2XF, Enlist E3, and GT, Walsh County 2023

Brand	Variety	Herb. Trait[1]	Maturity Group[2]	Maturity date[3]	Plant Height (in)	Protein (%)	Oil (%)	Yield 2023	Yield 2 yr Avg.	Yield 2-site Avg.[4]
								bu/a		
Dahlman	7304XF	RR2XF	0.4	8/31	22	32.6	17.3	40.7	61.1	47.7
Dairyland	DSR-0220E	Enlist E3	0.2	9/16	21	32.3	17.2	36.1	--	--
Dairyland	DSR-C801E	Enlist E3	00.8	9/3	17	31.6	17.8	27.1	--	--
Dyna-Gro	S01XF43	RR2XF	0.1	9/7	26	31.4	17.1	38.3	57.5	45.1
Dyna-Gro	S03EN94	Enlist E3	0.3	9/19	21	31.1	17.5	39.5	--	44.4
Golden Harvest	GH0234E3	Enlist E3	0.2	9/13	23	32.4	16.5	40.3	--	46.2
Golden Harvest	GH0363E3	Enlist E3	0.3	9/14	23	31.7	16.9	43.6	64.7	49.4
Golden Harvest	GH0384XF	RR2XF	0.3	9/18	25	32.7	17.2	39.2	--	47.9
Integra	E0113	Enlist E3	0.1	9/10	21	33.3	16.7	35.5	57.0	46.2
Integra	XF04093	RR2XF	0.4	9/13	23	31.7	17.3	38.0	--	44.9
Integra	E0324	Enlist E3	0.3	9/20	21	31.4	17.3	35.6	--	41.3
Latham	L 00725 XF	RR2XF	00.7	8/31	23	31.0	17.3	35.4	--	--
Latham	L 0114 XF	RR2XF	0.1	9/10	25	31.3	16.9	39.5	--	--
Latham	L 0254 XF	RR2XF	0.2	9/13	28	31.7	17.6	42.6	--	--
Latham	L 0235 E3	Enlist E3	0.2	9/19	22	31.6	17.2	38.4	--	--
Latham	L 0133 E3	Enlist E3	0.1	9/17	21	32.7	16.8	40.0	--	--
Legacy	LS0098-23 XF	RR2XF	00.9	9/5	24	31.6	17.6	33.4	--	46.6
Legacy	LS012-23 E	Enlist E3	0.1	9/17	23	32.8	16.6	41.2	--	48.4
Legacy	LS014-23 XF	RR2XF	0.1	9/8	26	30.7	16.9	39.7	--	46.6
Legacy	LS024-23 XF	RR2XF	0.2	9/12	21	32.9	17.6	35.9	--	41.8
Legacy	LS032-23E	Enlist E3	0.3	9/19	24	32.0	17.1	40.0	--	46.4
Legacy	LS044-23 XF	RR2XF	0.4	9/19	22	32.1	17.5	40.0	--	47.5
LG Seeds	LGS00901E3	Enlist E3	00.9	9/12	22	32.7	17.2	38.4	--	--
LG Seeds	LGS0125XF	RR2XF	0.1	9/9	24	31.0	17.6	37.6	--	46.4
LG Seeds	LGS0139XF	RR2XF	0.1	9/7	27	31.2	16.8	37.8	--	46.0
LG Seeds	LGS0444XF	RR2XF	0.4	9/20	23	31.8	17.1	41.4	--	48.2
NDSU	ND17009GT	GT	00.9	9/2	26	34.1	17.5	35.4	52.5	40.4
NDSU	ND21008GT20	GT	00.8	8/31	25	32.2	17.1	36.8	54.7	40.6
NK Seeds	NK009-G7E3	Enlist E3	00.9	9/9	22	34.0	16.4	36.9	59.9	45.9
NK Seeds	NK009-T1XF	RR2XF	00.9	9/5	22	31.8	17.5	35.9	57.9	42.6
NK Seeds	NK02-H6E3	Enlist E3	0.2	9/14	25	32.5	16.2	40.7	--	47.8
NK Seeds	NK03-V5E3	Enlist E3	0.3	9/13	22	31.6	17.1	39.5	59.5	48.4
NK Seeds	NK04-A9E3	Enlist E3	0.4	9/18	23	32.1	16.7	44.7	--	52.6
Paloma	PL2E013	Enlist E3	0.1	9/14	24	31.0	17.5	39.9	--	47.9
Paloma	PL2E043	Enlist E3	0.4	9/15	23	33.2	17.0	37.7	--	45.3
Proseed	EL 40-093N	Enlist E3	00.9	9/15	20	32.6	17.2	32.9	--	--
Proseed	XF 30-092N	RR2XF	00.9	9/5	22	31.7	17.4	32.7	61.2	--
Proseed	XF 30-42	RR2XF	0.4	9/19	23	32.2	17.6	39.7	--	46.4
Proseed	XF 30-52N	RR2XF	0.5	9/18	26	30.1	18.0	41.8	--	47.4
Proseed	XF 40-12	RR2XF	0.1	9/9	24	31.4	16.8	38.5	--	46.4
REA	R00934XF	RR2XF	00.9	9/5	24	30.5	17.4	35.7	--	45.3
REA	R0422XF	RR2XF	0.4	9/19	20	31.9	17.4	35.4	58.8	43.2
Xitavo	XO 0094E	Enlist E3	0.0	9/12	21	31.9	17.4	35.0	--	42.3
Xitavo	XO 0213E	Enlist E3	0.2	9/17	24	33.0	16.9	38.4	53.1	45.0
Xitavo	XO 0234E	Enlist E3	0.2	9/19	22	33.3	16.7	40.4	--	46.1
Trial Mean				9/13	23	32.0	17.1	38.1		
C.V. %				1.6	6.9	1.58	1.82	9.7		
LSD 5%				2.4	2.2	1.0	0.6	5.2		
LSD 10%				2.0	1.9	0.9	0.5	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).

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

Yield, oil and protein reported at 13% moisture.

Soybean - Conventional, Langdon 2023

Brand	Variety	Maturity Group[1]	Maturity	Plant Height	Protein	Oil	Yield 2023	Yield 2 yr Avg.	Yield 2 -site Avg.[3]
Conventional:			**date[2]**	**(in)**	**(%)**	**(%)**	**---------bu/a--------**		
Legacy	LS0090-20C	00.8	9/2	20	39.1	16.2	27.1	39.4	29.6
Legacy	LS0090-23C	00.9	9/4	22	35.2	17.5	37.6	50.6	37.7
Legacy	LSX020-23C	0.2	8/30	22	37.2	16.1	38.3	--	37.6
NDSU	ND Benson	0.4	9/12	22	34.7	17.2	34.1	--	37.0
NDSU	ND Rolette	00.9	9/8	21	33.8	17.4	35.4	51.7	36.0
Richland IFC	MK009	00.9	9/8	22	35.1	15.9	30.6	40.5	34.0
Richland IFC	MK0249	0.2	9/9	17	33.2	16.8	36.4	46.5	37.5
Trial Mean			9/5	21	35.0	16.7	36.5		
C.V. %			1.7	11.2	2.4	1.8	7.4		
LSD 5%			3.1	4.4	1.8	0.7	5.1		
LSD 10%			2.0	2.7	1.5	0.5	--		

[1]Maturity Group provided by company.

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

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

Yield, oil and protein reported at 13% moisture.

Soybean - Conventional, Walsh County 2023

Brand	Variety	Maturity Group[1]	Maturity	Plant Height	Protein	Oil	Yield 2023	Yield 2 yr Avg.	Yield 2-site Avg.[3]
Conventional:			**date[2]**	**(in)**	**(%)**	**(%)**	**---------bu/a--------**		
Legacy	LS0090-20C	00.8	9/6	22	36.9	15.7	32.1	41.2	29.6
Legacy	LS0090-23C	00.9	9/12	24	33.2	17.1	37.9	52.6	37.7
Legacy	LSX020-23C	0.2	9/8	23	34.4	16.6	36.9	--	37.6
NDSU	ND Benson	0.4	9/21	25	34.0	17.2	40.0	--	37.0
NDSU	ND Rolette	00.9	9/11	28	33.8	16.9	36.6	53.1	36.0
Richland IFC	MK009	00.9	9/14	25	32.7	16.3	37.5	48.4	34.0
Richland IFC	MK0249	0.2	9/16	21	31.2	16.9	38.5	48.8	37.5
Trial Mean			9/11	26	33.8	16.6	38.0		
C.V. %			2.1	8.1	1.8	1.7	7.7		
LSD 5%			3.1	3.0	1.4	0.6	4.2		
LSD 10%			2.6	2.5	1.1	0.5	3.5		

[1]Maturity Group provided by company.

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

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

Yield, oil and protein reported at 13% moisture.

Oil Sunflower, Langdon 2023

Brand	Hybrid	Hybrid Type[1]	Days to Flower	Days to Mature	Plant Height	Oil	Test Weight	Harvest Moist.	Yield				
									2020	2022	2023	2yr Avg.	3yr Avg.
			(days)[2]	(days)[2]	(in)	(%)	(lbs/bu)	(%)	lbs/a				
CROPLAN	CP432E	NS,EX,DMR	66	112	41	45.2	33.5	10.1	3414	2989	2248	2618	2884
CROPLAN	CP455E	HO,EX,DMR	68	112	47	46.3	32.2	9.8	3426	2814	2609	2712	2950
Dyna-Gro	H42HO18CL	HO,CL	68	114	40	46.0	34.0	9.4	3209	2650	2624	2637	2828
Dyna-Gro	H45HO10EX	HO,EX	68	113	41	45.1	32.9	9.0	3235	2437	2064	2250	2579
Dyna-Gro	H45NS16CL	CL,NS	69	110	43	48.2	34.3	8.3	3616	3045	2279	2662	2980
Dyna-Gro	H49HO19CL	HO, CL	71	112	39	46.5	33.1	9.7	3524	2734	2950	2842	3069
Nuseed	Falcon	NS,EX	71	114	39	47.0	34.3	9.3	2956	2550	2226	2388	2577
Nuseed	N4H422 CL	HO,CL,DMR	70	114	42	45.9	35.6	10.9	3161	2720	2478	2599	2786
Nuseed	N4H470 CLP	HO,CP,DMR	71	115	42	49.0	34.5	8.8	3124	2409	1971	2190	2501
Pioneer	P63HE501	HO,EX,DMR	68	112	42	43.6	33.6	8.4	3293	2009	2662	2336	2655
Proseed	E-91 E	HO,EX,DMR	71	116	47	47.1	34.9	10.0	3213	2622	2080	2351	2638
Dyna-Gro	H47HO11EX	HO,EX	70	116	47	44.4	34.2	11.4	--	2534	2472	2503	--
Dyna-Gro	H50HO20CP	HO,CP	71	117	42	51.0	34.3	9.3	--	2533	2029	2281	--
Pioneer	P63HE920	HO,EX,DMR	68	113	46	44.0	33.6	10.8	--	2618	2226	2422	--
Sunrich	4415	HO,CP,DMR	70	114	43	43.0	32.5	10.7	--	2651	2117	2384	--
Sunrich	4425CL	MO,CL,CON	67	113	46	42.4	33.3	9.5	--	2768	2407	2588	--
Proseed	2446 E	HO,EX,DMR	75	114	48	45.7	30.1	9.8	--	2275	2274	2274	--
CROPLAN	CP4255E	HO,EX,DMR	67	115	46	45.3	33.2	10.0	--	--	2687	--	--
CROPLAN	CP5045CL	NS, CL, DMR	70	112	40	47.1	33.7	9.2	--	--	2339	--	--
CROPLAN	CP5249CL	HO,CL	70	110	37	49.6	33.8	8.0	--	--	2120	--	--
CROPLAN	CP4475E	HO,EX	67	113	46	48.3	32.0	8.3	--	--	2768	--	--
Nuseed	Badger DMR	NS,CL,DMR,CON	66	110	45	39.9	32.7	9.2	--	--	2421	--	--
Nuseed	Hornet	HO,CL,DMR	71	112	39	46.8	33.2	11.0	--	--	2264	--	--
Nuseed	N4H521 CL	HO,CL,DMR	71	116	41	46.2	32.3	11.1	--	--	2431	--	--
Pioneer	P64ME01	MO,EX,DMR	70	115	45	42.9	32.1	11.3	--	--	2382	--	--
Proseed	50068 CL	HO,CL,DMR	70	116	43	45.8	34.7	11.2	--	--	2240	--	--
Proseed	50502 CL	HO,CL,DMR	72	115	39	49.1	33.8	9.4	--	--	1805	--	--
Proseed	E-93 E	HO,EX,DMR	71	112	47	44.5	32.2	9.4	--	--	2438	--	--
Proseed	E-94 CP	HO,CP,DMR	70	116	50	46.0	33.9	10.2	--	--	2378	--	--
USDA[3]	894	Trad.	67	110	45	45.4	32.1	8.4	3062	2797	2515	2656	2791
Trial Mean			69	113	44	45.7	33.2	9.6	3281	2584	2374		
C.V. %			1.2	1.4	6.9	3.5	2.0	8.9	11.5	9.3	11.9		
LSD 5%			1.4	2.7	5.1	2.7	1.1	1.4	617	307	617		
LSD 10%			1.2	2.2	4.2	2.2	0.9	1.2	516	256	--		

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

[2]Days after planting

[3]Long-term hybrid check

Oil and yield were adjusted to 10% moisture.

Days after planting maturity checks: Honeycomb NS=104, 8N270CLDM=109, Falcon=114, 559CL=111

Confection (non-oil) Sunflower, Langdon 2023

Brand	Hybrid	Hybrid Type[1]	Days to Flower (days)[3]	Days to Mature (days)[3]	Plant Height (in)	Test Weight (lbs/bu)	Harvest Moist. (%)	Seed over screen 22/64 (% over)	Seed over screen 20/64 (% over)	Seed over screen 18/64 (% over)	Yield 2023 (lbs/a)	Yield 2-yr Avg. (lbs/a)
Nuseed	Panther DMR	Trad., DMR	63	109	41	26.2	9.1	14	53	90	2592	2345
Sunrich	SS91	Trad.	71	118	41	26.3	16.8	30	60	81	2625	2508
USDA	924[2]	Trad.	68	112	41	27.4	12.7	0	17	54	2412	2551
Trial Mean			67	113	42	27.8	12.1				2470	
C.V. %			3.0	1.3	6.0	5.0	22.5				8.6	
LSD 5%			2.6	1.9	3.3	1.8	3.6				NS	
LSD 10%			2.1	1.6	2.7	1.5	3.0				NS	

[1]Type: Trad. - no herbicide tolerance trait, DMR - Downy Mildew Resistant

[2]Long term hybrid check.

[3]Days after planting

Yield adjusted to 10% moisture.

Field Pea and Canola Intercropping Trial, 2023

NDSU Langdon Research Extension Center

Bryan Hanson, Lawrence Henry, Rick Duerr

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

A field pea and canola intercropping trial was continued from 2021 to determine the optimum seeding ratios of these two crops to attain maximum LER. The 100% monocrop seeding rate for peas was 325,000 pure live seed (PLS)/a (7.5 seeds/ft^2) and 435,600 PLS/a (10 seeds/ft^2) for canola. The ratios for field pea at 66, 50, and 33% were 5.0, 3.7, and 2.4 seed/ft^2, respectively. The ratios for canola were 7, 5, and 3 seeds/ft^2 for 66, 50 and 33%, respectively. The trial was planted May 31 on conventionally tilled Svea-Barnes loam soil in 6-inch row spacing. The soil test for N-P-K was 26-17-430. Canola was considered the primary crop and fertilized as such which included 80 lbs/a of 21-0-0-24 and 77 lbs/a of 46-0-0. A semi-leafless yellow pea and Clearfield canola variety were used. Trifluralin was applied PPI at 1 qt/a for weed control. The field design was a randomized complete block with four replications.

Yield, LER and economic returns are presented in Table 1 which includes yield and LER from 2021. Pea and canola yields were the highest for the 100% monocrop in 2023. Average yield of the various seeding ratios for pea decreased by 52% compared to 100% monocrop while yield for the various ratios for canola decreased only 37% compared to the 100% monocrop canola. The individual LER's for the peas was much lower than the canola indicating that canola was the dominant crop in this study. The only significant difference between the total LER's was the Pea/Canola ratio of 100/33 was significantly higher than the ratio of 33/66. However, the 100/33 ratio still had a lower gross revenue than the monocrop canola. Prices for each crop was calculated at $23.10/cwt for the canola and $10/bu for the pea. The relationship between the prices of each crop may affect the gross economic returns on a yearly basis. In 2021 no significant differences were seen between the total LER's. Previous pea-canola intercropping research in North Dakota and Canada has generally indicated LER's ranging from 1.05 to 1.25. Economic

returns do not include cost of production and additional seed cleaning costs associated with intercropping, which would result in lower net revenue. Thorough planning is needed to determine costs and determine if intercropping is profitable for your farm.

Table 1. Pea – Canola intercropping yield, LER and gross revenue for 2021 and 2023.

	2021		2021			2023		2023			Gross Economic Returns 2023		
	Yield		Land Equivalent Ratio			Yield		Land Equivalent Ratio					Gross
Pea/Canola	Pea	Canola	Pea	Canola	Total	Pea	Canola	Pea	Canola	Total	Pea	Canola	Revenue
Seeding Ratio	bu/a	lbs/a				bu/a	lbs/a				----------$/a----------		
100/0	43.6	-	1	-	1	51.8	-	1	-	1	518	-	518
0/100	-	1847	-	1	1	-	2806	-	1	1	-	648	648
66/66	12.6	1392	0.29	0.75	1.04	25.7	1721	0.50	0.62	1.11	257	397	654
33/66	6.3	1694	0.14	0.92	1.06	17.1	2015	0.33	0.72	1.05	171	465	636
50/50	12.4	1459	0.28	0.79	1.07	25.2	1789	0.49	0.64	1.13	252	413	665
66/33	14.2	1346	0.33	0.73	1.06	22.4	1854	0.43	0.67	1.09	224	428	652
100/33	21.1	1065	0.49	0.56	1.07	34.9	1425	0.67	0.51	1.18	349	329	678
LSD (0.05)	3.9	233	0.08	0.13	NS	6.1	262	0.12	0.08	0.09			
C.V. %	14.0	10.5	13.2	10.8	7.3	13.6	9.0	13.9	8.12	5.7			

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

Venkat Chapara, Amanda Arens, Larissa Jennings and Andrew Friskop

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

Location: NDSU Langdon Research Extension Center

Experimental design: Randomized complete block, replicated four times.

Previous crop: Canola

Cultivar of HRSW tested: WB Mayville

Planting: 1.5 million pure live seeds/acre planted on May 22, 2023. A border plot was planted between treated plots to minimize interference from spray drift.

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

Herbicides applied: Pre-emergent Treflan @ 1.5pt/a was applied, incorporated and then planted. Post-emergent Huskie FX (18 oz/a) + Axial Bold (15 fl oz/a) was applied on June 8, 2023.

Inoculation: Plots were inoculated by spreading corn spawn inoculum at the approximate boot stage (Feekes 9-10) at the rate of 300 g/plot (6/29/2023).

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

Fungicide treatments: Fungicides were applied with a CO_2-pressurized backpack sprayer with a three-nozzle boom (XR-8002) and water volume at 20 GPA. Fungicides and their rate in fluid oz/a in parenthesis are as follows: Prosaro (6.5), Caramba (13.5), Miravis Ace (13.7), Prosaro Pro (10.3), Sphaerex (7.3), Teagro (5.2), and Tebuconazole (4). These fungicides were applied at 10% flowering (anthesis or 10.5.1 stage) on July 15. Likewise, five days after anthesis (July 20), sprays were completed in those treatments as required in the protocol. Refer to Table 1 for the treatments and application timings.

Disease assessment: FHB incidence was obtained on fifty random heads showing FHB symptoms at hard dough stage (8/7/2023). FHB head severity was rated using 0 -100% scale on fifty random heads, excluding two outer rows. FHB index (Index) was calculated using formula: Index = (SEV*INC)/100.

Harvest: Plots were harvested on September 7 with a small plot combine and the yield was determined at 13.5% moisture.

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

Results: There were significant differences found between the non-treated check and the fungicide treatments that were applied at different timings among the variables tested. Among the fungicides tested there were no significant difference observed except for Taegro. The performance of Taegro when applied at 10% flowering was similar to non-treated check in the variables tested except yield. There were no significant differences found among the application timings in the yield obtained among the fungicide

treatments. There were significant differences found among the treatments in terms of test weight (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	**% Incidence**	**% Severity**	**INDEX**	**DON**	**bu/A**	**lbs/bu**
Non-Treated Check	29	12	3.67	2.6	57	56.4
Prosaro	8	7	0.49	0.9	67	57.8
Caramba	7	4	0.36	0.8	57	57.4
Miravis Ace	6	5	0.32	1.6	62	58.1
Prosaro Pro	7	5	0.46	0.4	57	58.6
Sphaerex	5	6	0.45	0.9	59	57.6
Miravis Ace fb** Prosaro Pro	3	3	0.13	0.3	61	58.9
Miravis Ace fb** Sphaerex	2	1	0.05	0.5	62	57.9
Miravis Ace fb** Tebuconazole	3	2	0.06	1.0	65	58.2
SphaerexLATE	9	8	1.13	0.3	72	57.6
Taegro	29	9	3.00	2.6	66	56.8
Taegro+Tebuconazle	11	6	0.60	1.7	54	57.5
Tebuconazole	14	11	1.46	2	63	56.9
Mean	**10.0**	**6**	**0.94**	**1.9**	**61.7**	**58**
CV%	**82.5**	**60**	**118.0**	**68.0**	**16.7**	**1.4**
LSD	**11.9**	**5**	**1.6**	**1.2**	**NS**	**1.1**
P-Value (0.05)	**0.0002***	**0.0022***	**0.0003***	**0.0005***	**NS**	**0.0038***

***** Indicates treatments are statistically significant.
fb**: The first spray is followed after 4-5 days of anthesis
Note: All treatments were applied with non-ionic surfactant (NIS) @ 0.125 v/v.

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Management of Fusarium Head Blight in Barley

Venkat Chapara, Amanda Arens, Larissa Jennings and Andrew Friskop

This field study was planted on May 22 at the NDSU Langdon Research Extension Center. The experimental trial was designed in a randomized complete block with four replications. Plots were arranged in seven rows with six-inch row spacing and a row length of 20 feet trimmed to 15 feet for harvest. The cultivar 'ND - Genesis' barley was seeded at a rate of 1.2 million pure live seeds/a. An untreated border plot was planted between treated plots to minimize interference from spray drift. The previous crop was field peas. Pre-emergent herbicide Treflan @ 1.5 pt/a was applied before the research area was tilled. Huskie FX (18 oz/a) + Axial Bold (15 oz/a) were used to control weeds. The plots were inoculated by spreading corn spawn inoculum at boot stage (Feekes 9-10) at a rate of 300 g/plot. Supplemental moisture was provided by running overhead irrigation from Feekes 10.5 to 11.25 for one hour per day to provide a conducive environment for Fusarium Head Blight (FHB) development. Fungicides were applied with a CO_2 backpack sprayer equipped with a three-nozzle boom (XR8001) operated at 40 psi delivering a water volume of 15 GPA. Fungicide application was made at Feekes 10.51 (10% flowering) on July 9 (wind speed 10 MPH, 77^{O} F at 11:30 am).

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

Results: There were significant differences in FHB (% Incidence, % Severity, Index and DON) between the non-treated control and the various fungicide treatments. There were no significant differences observed among the fungicide groups in the above-mentioned FHB categories. No significant differences were found in the yields and test weights (Table 1).

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

				FHB			Yield	Test Weight
Treatment	**Rate (Oz/A)**	**% Incidence**	**% Severity**	**Index**	**DON (ppm)**	**Plump**	**(bu/A)**	**(lbs/bu)**
Non-Treated	0	36	10	3.8	3.1	99	78	46.0
Prosaro	8.2	7	4	0.3	0.6	99	85	46.7
Prosaro Pro (Low)	10.3	5	2	0.1	0.2	99	90	47.7
Prosaro Pro (High)	13.6	5	3	0.2	0.2	99	79	47.4
Miravis Ace	13.7	5	3	0.1	1.2	99	82	47.3
Sphaerex	7.3	5	3	0.2	0.3	99	81	46.8
	Mean	**10**	**4**	**0.8**	**0.93**	**99**	**83**	**47.0**
	CV (%)	**68**	**54**	**129**	**75**	**0.38**	**5.4**	**0.8**
	LSD	**10.5**	**3.4**	**1.6**	**1.0**	**NS**	**6.7**	**0.6**
	P-Value (0.05)	**0.0001***	**0.0021***	**0.0007***	**0.0002***	**NS**	**0.0271***	**0.0002***

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Evaluation of Fungicides to Manage White Mold in Canola

Venkat Chapara, Amanda Arens and Larissa Jennings

This research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of fungicides to manage white mold in canola. The trial was planted on May 23, 2023 with the Roundup Ready canola variety 'DKL DKTFLL21SC' in a randomized complete block design replicated four times. The trial followed state recommended practices for land preparation, fertilization, seeding rate and weed control. The plot size was 5 ft. wide x 16 ft. long with a canola border on either side of each plot. The trial was irrigated with an overhead sprinkler system set at one hour each day beginning one week before the start of bloom and continuing four weeks after bloom to help increase disease infection levels. Fungicides were applied at 20% bloom using a CO_2-pressurized backpack style sprayer with a three-nozzle boom (XR-8002) at 20 GPA. Ascospores were sprayed at the 20% flowering stage to obtain white mold infection in the research plots. Disease assessments were done on fifty plants within each plot and the levels of incidence and severity were recorded for each plant prior to swathing (August 25) on a 0-5 scale, where 1 = superficial lesions or small branch infected; 2 = large branch(es) dead; 3 = main stem at least 50% girdled; 4 = main stem girdled but plant produced good seed; 5 = main stem girdled, much reduced yield. A white mold mean disease severity index (MDS) was calculated with weighted mean of incidence and the number of plants in each severity rating.

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

	White Mold			
Treatment	**% Incidence**	**MDS (1-100)**	**Yield lbs/a**	**Test Weight lbs/bu**
Non-treated Check	19	16	3298	52
Experimental + Masterlock @ 6 oz/a	30	26	3113	52
ProPulse @ 13.6 fl oz/a + Masterlock @ 6 oz/a	6	4	3411	52
Priaxor @ 8 fl oz/a + Masterlock @ 6 oz/a	18	12	3240	52
Topsin 70% @ 2 lb/a + Masterlock @ 6 oz/a	14	11	3303	52
Endura @ 6 fl oz/a + Masterlock @ 6 oz/a	10	6	3280	52
Mean	**16**	**13**	3274	52
CV%	**49**	**60**	10	0.45
LSD	**12**	**12**	514	0.35
P-Value (0.05)	**0.0091***	**0.0113***	NS	NS

NS: Statistically non-significant

Results: There were significant differences observed in white mold incidence and mean disease severity (MDS) among the treatments tested. The fungicide ProPulse provided the best control of white mold over any of the other fungicides tested followed by Endura (Table 1). There were no significant differences found among the treatments tested (p-value non-significant) in terms of yield and test weight.

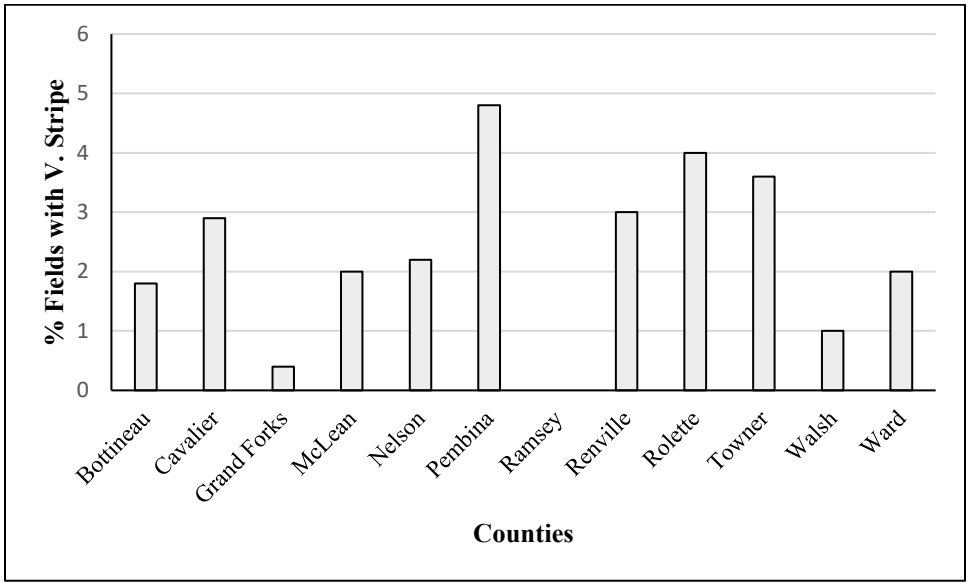
Acknowledgements: Special thanks to Jacob Kram (NDSU), Brock Freer and Kartheek Chapara.

Verticillium Stripe on Canola: Survey and Cultivar Screening

Venkat Chapara, Amanda Arens and Larissa Jennings

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

Figure 1: Percent incidence of Verticillium stripe from canola growing counties in North Dakota, 2023.



Results: The survey was done from fields of major canola-growing counties in North Dakota indicated there was a presence of the disease Verticillium stripe in eleven out of twelve counties (Figure 1). The county-wide incidence data suggest the disease was found in low amounts (five percent and below).

Cultivar Screening to Manage Verticillium Stripe

Canola cultivars/varieties: Eleven commercial canola cultivars with unknown resistance to Verticillium stripe were planted to monitor the level of resistance against the pathogen *Verticillium longisporum* in the research ground (Table 1). The trial was planted in the first week of June in a randomized complete block design (RCBD) with four replications. The amount of Verticillium stripe infection obtained in the research plots was from natural soil borne inoculum.

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

Cultivar	Description
CP9978TF	Croplan Genetics
CP7130LL	Croplan Genetics
CP7144LL	Croplan Genetics
InVigor LR344PC	BASF
InVigor L340PC	BASF
InVigor L255PC	BASF
InVigor L345PC	BASF
InVigor L343PC	BASF
InVigor L233P	BASF
CP9221TF	Croplan Genetics
CP7250LL	Croplan Genetics

Percent incidence and severity of Verticillium stripe was evaluated on September 9, 2023 by cross-section clipping of canola stems a half inch below ground level. Percent incidence was determined by the percent of infected stems and percent severity was determined by the percent of the pith infected in each stem.

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

Figure 1: Mean Verticillium stripe incidence and severity percentages were recorded on various commercial cultivars of canola tested in 2023.

	Verticillium Stripe	
NAME	Incidence %	Severity %
CP9978TF	36	6
CP7130LL	39	8
CP7144LL	25	8
INVIGORLR344PC	45	12
INVIGORL340PC	34	12
INVIGORL255PC	28	6
INVIGORL345PC	54	9
INVIGORL343PC	29	8
INVIGORL233P	40	10
CP9221TF	21	8
CP7250LL	36	12
Mean	**35**	**9**
CV%	**38**	**57**
LSD	**NS**	**NS**
P-Value (0.1)	**NS**	**NS**

Results: None of the cultivars showed resistance to Verticillium stripe and were statistically non-significant from each other with a mean incidence of 35% and a mean severity of 9% (Table 1).

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

Venkat Chapara, Amanda Arens, and Larissa Jennings

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

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

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

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

Plot size: 10 ft. x 5 ft.

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

Cultivar	Description
CP9978TF	Croplan Genetics
CP7130LL	Croplan Genetics
CP7144LL	Croplan Genetics
INVIGORLR344PC	BASF
INVIGORL340PC	BASF
INVIGORL255PC	BASF
INVIGORL345PC	BASF
INVIGORL343PC	BASF
INVIGORL233P	BASF
CP9221TF	Croplan Genetics
CP7250LL	Croplan Genetics

Clubroot Evaluated: Early August (60 days after planting).

Minor sulphur deficiency (refer to stunting data in Table 1) was observed at early stage of canola (Figure 1). To correct the deficiency an EC formulation of sulphur (BLUE LAVA®) was applied at 3 pt/a as a foliar spray and the plants were able to recover in 10 days (refer to Table 1 for the stunting data due sulphur deficiency and Figure 1 & 2).

Table 1: Mean clubroot disease index (%) recorded on various commercial cultivars of canola tested in 2023.

	Response to Clubroot	HR Trait	CRDI %	Stunting*
CP9978TF	Susceptible	Roundup	42	3
CP7130LL	Resistant	Liberty	3	5
CP7144LL	Resistant	Liberty	14	4
InVigorLR344PC	Resistant	Liberty	0	4
InVigorL340PC	Resistant	Liberty	0	4
InVigorL255PC	Resistant	Liberty	0	3
InVigorL345PC	Resistant	Liberty	0	4
InVigorL343PC	Resistant	Liberty	0	5
InVigorL233P	Susceptible	Liberty	54	5
CP9221TF	Resistant	Roundup	0	4
CP7250LL	Resistant	Liberty	1	4
		Mean	10	4
		CV%	122	19
		LSD	18	NS
		P-Value (0.05)	0.00001*	NS

*Stunting observations were rated as: 1-severely stunted; 5-healthy

Results: Canola plants had recovered from stunting after 10 days of the foliar spray with BLUE LAVA® sulphur (height data is non-significant after 20 days, data not shown in the table). Low rainfall in the early stages of canola this year around Langdon resulted in a lower level of clubroot infections on reference checks. Clubroot susceptible cultivars CP9978TF and InVigor L233P were used as reference checks to compare resistance levels. The reference checks showed 42 and 54 percent of CRDI, respectively, indicating the validity of the trial. Other canola cultivar results showed: CP7130LL (CRDI 3%), CP7144LL (CRDI 14%), InVigor LR344PC, InVigor L340PC, InVigor L255PC, InVigor L345PC, InVigor L343PC and CP9221TF had zero CRDI, and CP7250LL (CRDI of 1%). These cultivars are holding their resistance to clubroot and are statistically significant from the reference checks tested.

Figure 1 (LEFT): Sulphur deficiency was observed in the canola plants at an early stage at which sulphur (BLUE LAVA) was applied.

Figure 2 (RIGHT): Recovered canola plants from sulphur deficiency after foliar spray of sulphur.

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

Canola Council of Canada's Monitoring Clubroot in Resistant Varieties

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

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

Ideal Recommendation: Practice longer crop rotations in clubroot endemic areas and use a clubroot resistant variety every three years minimum.

Acknowledgments: Funding from the Northern Canola Growers Association and Todd Christianson (Simplot, Langdon, ND). Thanks to all the product suppliers. Special thanks to Jacob Kram (NDSU), Kartheek Chapara, and Brock Freer.

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

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

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

Survey Procedure:

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

Components 1&2. Visual survey and soil sampling: A clubroot disease survey was conducted in fifty counties of North Dakota to determine prevalence of *Plasmodiophora brassicae*. The visual survey was done by inspecting canola crop roots. One field in every 5,000 acres was targeted for scouting in each county. Soil samples were 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 targeted for scouting.

The survey was done in two phases.

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

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

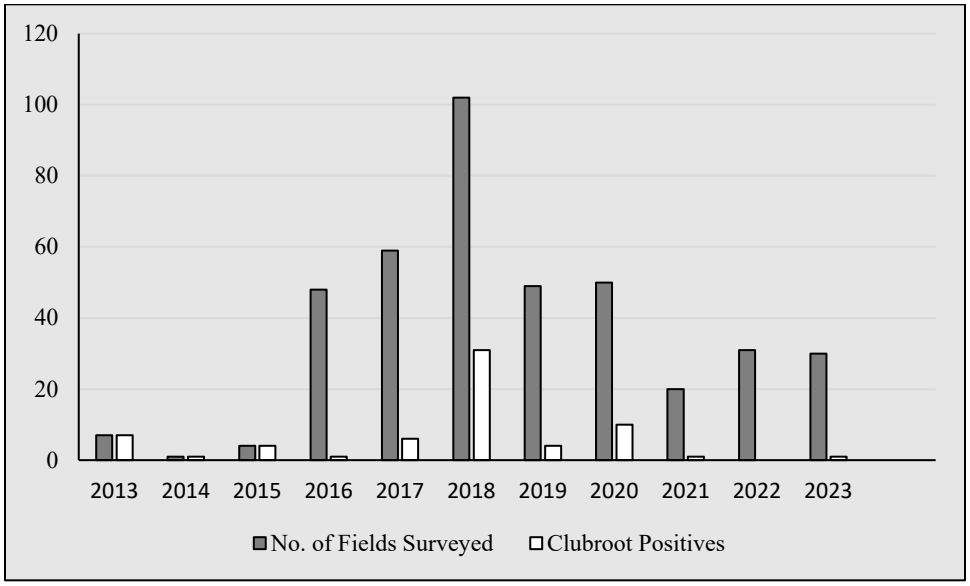
2nd phase: after swathing

Scouting at swathing was based on the methodology followed in Canada by the Alberta Agricultural and Rural Development (AARD) for their annual clubroot disease survey. Reports of AARD indicated that the probability of finding clubroot was higher if scouted at the field entrances. Hence, the survey was done starting from the main entrances/approaches in each field. The survey group walked in a "W" pattern stopping at five spots and uprooting ten consecutive stems from the ground at each spot. Each sampling point was separated by 100 meters or 328 feet. Roots of fifty stems were evaluated for the presence of clubroot and incidence. After removing excess soil, roots were visually examined for the presence of galls. At sample sites where infection was observed or suspected, root specimens with galls, along with soil, were double bagged and labeled with the field location. Infected roots and soil samples from all the fields surveyed were collected and a representative sample was submitted to Dr. Zhaohui Liu's laboratory for molecular quantification of resting spores per gram of soil. An additional half-pound of soil was sent to the NDSU Soil Testing Laboratory for pH determination.

Results: The results of the clubroot survey in North Dakota indicate only one field out of the hundred fields in North Dakota showed canola roots with galls that were infused by the clubroot pathogen. The lone positive sample was from Cavalier County (Figure 1). There is a declining trend in the number of clubroot infected canola fields since 2019. The decline in clubroot could be attributed to the change in

crop production practices by the growers such as implementing longer rotations and the use of clubroot resistant cultivars.

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>

Over 100 samples were collected from major canola growing counties of North Dakota and were submitted for resting spore quantification and pH determination.

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

<u>Results from molecular assays on soil samples</u>: The molecular assays on the soil samples collected from the year 2022 indicated no clubroot pathogen resting spores in any of the samples. There were no visible symptoms observed when the roots were uprooted in the surveyed fields.

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).

Evaluation of Seed Treatments to Manage Blackleg on Canola

Venkat Chapara, Amanda Arens and Larissa Jennings

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

Materials and Methods:
This research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of seed treatments to manage blackleg on canola. The trial was planted on May 23, 2023 with treated seed of various treatments on the canola cultivar 'Westar' and compared with non-treated seed. The design was randomized complete block with four replications. The trial followed state recommended practices for land preparation, fertilization, seeding rate, weed and insect control. The plot size was 5 ft. wide x 16 ft. long. Data on blackleg infections were rated following the scale of 0-5. The research plots were inoculated twice with ascospores of the blackleg pathogen at 2-4 leaf stage. Twenty-five canola stubbles were rated within each plot and the incidence (number of plants that had blackleg infections out of twenty-five cut stems) and severity on each was recorded after swathing (August 18). A 0-5 scale was used to rate disease severity, where 0 = no disease tissue visible in the cross section; 1 = $\leq$ 25% of the cross section has disease tissue; 2 = 26 to 50% of the cross section has disease tissue; 3 = 51 to 75% of the cross section has disease tissue; 4 = $\geq$ 75% of the cross section has disease tissue; 5 = 100% diseased tissue/plant dead. A blackleg mean disease severity index was calculated with weighted mean of incidence and number of plants in each severity rating. Data were subjected to analysis of variance using complete block, balanced orthogonal designs of Agrobase generation II software.

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

		Blackleg on Canola		Yield	Test Weight
Seed Treatments	**Plant Stand**	**% Incidence**	**% Severity**	**(lbs/a)**	**(lbs/bu)**
Vercoras	18	36	29	3485	51.7
Saltro	18	45	45	2795	52.3
Evergol Energy	17	41	42	2898	52.4
Intego Solo	16	31	33	2579	52.6
Rancona Summit	19	35	42	2722	52.3
Trilex	24	38	28	2669	52.4
Non-Treated	18	53	50	2790	52.3
Mean	**18**	**40**	**39**	**2848**	**52.3**
CV%	**22.0**	**21**	**39**	**9**	**0.5**
LSD	**6**	**13**	**NS**	**365**	**0.4**
P-Value (0.05)	**0.0041***	**0.0321***	**NS**	**00.15***	**0.0094***

Results: Canola seed treated with Intego Solo had the lowest blackleg incidence, followed by Rancona Summit and Vercoras. These results are significantly statistically different from the other treatments tested. The seed treatment Vercoras® showed significant difference in yield from the other treatments tested (Table 1).

Evaluation of Seed Treatments to Manage Verticillium Stripe on Canola

Venkat Chapara, Amanda Arens and Larissa Jennings

This research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of seed treatments to manage Verticillium on canola. The trial was planted on May 23, 2023 with treated seed of various treatments on the canola cultivar 'Invigor L233P' and then compared with non-treated seed. The design was randomized complete block with four replications. The trial followed state recommended practices for land preparation, fertilization, seeding rate and weed control. The plot size was 5 ft. wide x 16 ft. long. Data on Verticillium infections were rated following the scale of 0-5 (same as the blackleg rating scale). Inoculum was prepared by inoculating Verticillium cultures/isolates on to corn spawn in the lab during March 2023 and was applied at planting. Twenty-five canola stubbles were rated within each plot and the incidence (number of plants that had Verticillium infections out of twenty-five cut stems) and severity on each was recorded after swathing (August 18). A 0-5 scale was used to rate disease severity, where 0 = no disease tissue visible in the cross section; 1 = $\leq$ 25% of the cross section has disease tissue; 2 = 26 to 50% of the cross section has disease tissue; 3 = 51 to 75% of the cross section has disease tissue; 4 = $\geq$ 75% of the cross section has disease tissue; 5 = 100% diseased tissue/plant dead. A Verticillium mean disease severity index was calculated with weighted mean of incidence and number of plants in each severity rating. Data were subjected to analysis of variance using complete block, balanced orthogonal designs of Agrobase generation II software.

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

	Plant Stand	Verticillium Stripe		Yield	Test Weight
Treatment	**3ft**	**% Incidence**	**% Severity**	**lbs/a**	**lbs/bu**
Vercoras	12	60	26	3873	51.7
Saltro	17	58	23	2960	52.4
Prosper Evergol	17	61	25	3058	52.5
Intego Solo	14	71	32	2698	52.6
Rancona Summit	19	65	29	2985	52.6
Trilex	17	65	30	3082	52.4
Non-Treated	19	62	28	2842	52.5
Mean	**16**	**63**	**28**	**3071**	**52.4**
CV%	**23**	**17**	**21**	**10**	**0.6**
LSD	**5.6**	**16**	**9**	**464**	**0.4**
P-Value (0.05)	**NS**	**NS**	**NS**	**0.0016***	**0.0057***

Results: The tested seed treatments had no effect on plant stand or Verticillium stripe incidence and severity percentages (Table 1). There were significant differences observed in yield and test weights. Vercoras® treated plots had a low plant stand and the highest yield (Table 1).

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

Venkat Chapara, Amanda Arens, and Larissa Jennings

A research trial was conducted at the Langdon Research Extension Center with an objective to evaluate the performance of pesticide compounds to manage bacterial blight (BB) on field pea. The trial was planted on May 17, 2023 with the field pea variety 'Salamanca' in a randomized complete block design replicated four times. The trial followed state recommended practices for land preparation, fertilization, seeding rate, and weed control. The plot size was 5 ft. wide x 16 ft. long with a field pea border on either side of each plot. Pesticide compounds were applied at the Vn stage (nth true leaf unfolded at nth node with tendril present) using a CO_2-pressurized backpack style sprayer with a three-nozzle boom (XR-8002) at 20 GPA. Prevailing weather conditions were dry during the crop growth period so the second spray at R-stage was not applied. The amount of BB infection obtained in the research plots was based on natural infections. A rating scale of 0 - 9 was adopted from Chaudhary 1996, where the severity of BB in a plot was recorded as the percentage of tissue area infected out of total leaf area examined. Fifty leaves from each plot were sampled and measured for the average percentage of lesion area. The rating scale was 0 = 0, 1 = 1-10 %, 3 = 11-30 %, 5 = 31-50 %, 7 = 51-75 %, and 9 = 76-100 %.

A disease index (DI) was calculated based on severity ratings using a formula:

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

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

Results: Significant differences were observed in bacterial blight control when sprayed with pesticide compounds compared to the non-treated check. There were no differences among the pesticide compounds evaluated. The bacterial blight incidence on various treatments on the field peas ranged from 27 to 60%, with a mean disease incidence of 32%. The severity of bacterial blight infections ranged from 5 to 34%, with a mean severity of 9%. The highest incidence and severity of bacterial blight was recorded in the non-treated check (Table 1). There were no significant differences found in the yield (at 13.5% moisture) and test weight (Table 1) among the pesticide compounds tested and the non-treated check (P-value non-significant).

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

		Field Pea Bacterial Blight		Yield	Test wt.
Treatments	**Rate**	**% Incidence**	**% Severity**	(lbs/a)	lbs/bu
Kocide (Copper Hydroxide)	3-6 lbs/a	31	6	2280	66
Copper Sulfate	3-6 lbs/a	27	7	3060	67
Guarda 30/30	3.3 lts/A	34	7	2640	66
Zinc Oxide 400 mg	400mg	30	7	2520	66
Zinx Oxide 800 mg	800mg	34	6	2400	66
Surround WP	½ lb/gallon of water	25	6	2820	66
Resozurin Sodium Salt	10 mg/a	31	7	2160	66
Kanamycin	50 µg/ml	27	5	2400	66
Streptomycin sulfate	3-6 lbs/a	28	6	2400	66
Oxidate	1% V/V	27	6	2580	66
Non-Treated Check	Check	60	34	2580	66
Mean		**32**	**9**	2520	66
CV%		**23**	**43**	20	1.4
LSD		**11**	**6**	NS	NS
P-Value (0.05)		**0.00001***	**0.00001***	NS	NS

Acknowledgements: Funding from the North Dakota Crop Protection Product Harmonization and Registration Board. Special thanks to Jacob Kram (NDSU), Brock Freer, and Kartheek Chapara.

Efficacy of Fungicides to Fusarium Head Blight in Spring Wheat

Venkat Chapara, Amanda Arens, and Larissa Jennings

A field study was planted on May 22, 2023 at the NDSU Langdon Research Extension Center. The experimental design was laid out as a randomized complete block with four replications. Plots were seven rows spaced at six-inch row spacing with a row length of 20 feet trimmed to 15 feet for harvest. The variety 'WB Mayville' HRSW was seeded at a rate of 1.2 million pure live seeds/a. An untreated border plot was planted between treated plots to minimize interference from spray drift. The previous crop was canola. Pre-emergent herbicide Treflan @ 1.5 pt/a was applied on May 22, incorporated, and the trial was planted. Post-emergent herbicide Huskie FX (18 oz/a) + Axial Bold (15 fl oz/a) was applied on June 8, 2023.

The plots were inoculated by spreading corn spawn inoculum at boot stage (Feekes 9-10) at a rate of 300 g/plot. Supplemental moisture was provided by running overhead irrigation from Feekes 10.5 to 11.25 for one hour per day to provide a conducive environment for Fusarium Head Blight (FHB) development. Fungicides were applied with a CO_2 backpack sprayer equipped with a three-nozzle boom (XR8001) operated at 40 psi delivering a water volume of 15 GPA. Fungicide application was made at Feekes 10.51 (10% flowering) on July 6 (wind speed 12 MPH, 60^{O} F at 1:45pm).

Percent FHB incidence (INC) was calculated by counting the number of heads showing FHB symptoms out of 50 randomly selected heads, excluding the two outer rows in the plot. FHB severity (SEV) was rated using a 0-100% scale from those same heads. FHB index (FHBI) was calculated using the formula FHBI=(SEV*INC)/100. Plots were harvested on September 7 with a plot combine. Yield and test weight were determined. Statistical analysis was done using Agrobase Generation II software. Fisher's least significant difference (LSD) was used to compare means at p ($\alpha = 0.05$).

Results

All the fungicides evaluated were very effective in managing percent incidence, severity, INDEX, and DON of FHB when compared with the non-treated check. The lowest FHB incidence, severity and INDEX was observed in Prosaro Pro followed by Miravis Ace and Caramba when sprayed at four days after 10% flowering. The same results were observed with Miravis Ace sprayed twice, at 10% flowering and four days after 10% flowering.

The treatment Prosaro Pro had the highest yields while the lowest yield was in the untreated check.

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

Treatment	Rate (oz/A)	Stage of Application	Fusarium Head Blight		DON		Protein	Yield	Test Weight
			% Incidence	% Severity	INDEX	(ppm)		bu/a	lbs/bu
Non-treated	0	CHECK	26	13	3.49	0.75	15	58	58.2
Miravis Ace	13.7	10%	5	6	0.31	0.93	16	60	59.6
Prosaro Pro	13.6	10%	7	4	0.33	0.8	15	65	59.2
Caramba	15	10%	11	8	1.18	0.98	15	65	58.3
Miravis Ace	13.7	4 DA 10% F	2	1	0.02	0.73	16	69	60.0
Prosaro Pro	13.6	4 DA 10% F	2	1	0.05	0.23	15	73	59.3
Caramba	15	4 DA 10% F	4	2	0.01	0.88	15	68	58.3
Miravis Ace	13.7	10% & 4 DA 10% F	2	2	0.05	0.35	16	70	60.1
		Mean	**7**	**5**	**1**	0.7	15.3	**66**	**59.1**
		CV%	**77**	**59**	**135**	80	3.2	**9**	**0.9**
		LSD	**8**	**4**	**1**	0.8	0.2	**8**	**0.8**
		P-Value	**0.0001***	**0.0001***	**0.0003***	NS	NS	**0.0172***	**0.00001***

10%: 10% of Flowering stage

DA 10 % F: Days after 10% Flowering

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

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SALT AND SODICITY TOLERANCE OF BARLEY, OAT AND SUNFLOWER

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Barley and oats are some of the most salt and sodicity tolerant annual crops producers can profitably grow in North Dakota. At certain salinity and sodicity levels, even barley and oats can result in significant losses. Especially important are the levels of salinity and sodicity in the top six inches of the soils. To determine the economic threshold of soil salinity (Electrical Conductivity or EC) and sodicity (Sodium Adsorption Ratio or SAR) for barley and oats, four barley and four oat varieties were planted at the Langdon REC site in 2023 at three different levels of salinity and sodicity. This trial-demonstration was a repeat of 2020-2022. In addition, four sunflower varieties were added in 2023 to compare salinity and sodicity tolerances of sunflowers versus barley and oats.

Soil Analysis Results

Two-foot-deep composite soil samples separated into 0-6 and 6-24 inch depths were taken on May 15, 2023 by taking three cores for each sample. The three levels of salinity and sodicity were described as levels 1, 2 and 3 and were sampled separately. Level 1 was described as having low to moderate levels of salinity and sodicity, level 2 having moderate to high levels and level 3 having very high levels based on the 0-6 inch depth soil results. These descriptions were based on the salinity and sodicity tolerances of crops like barley and oats and not the sensitive crops such as soybean. Soil EC and SAR were analyzed by using the saturated paste extract method (Table 1).

Table 1. The 2020-2023 soil EC and SAR results of the three levels for the 0-6 and 6-24 inch depths.

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

The main difference between the three levels has been the low to moderate salinity and sodicity levels in the 0-6 inch depth of level 1, while, levels 2 and 3 had moderate to high and very high levels in the 0-6 and 6-24 inch depths. The 6-24 inch depth of level 1 had moderate to high salinity and sodicity levels. The lower salinity and sodicity levels in the 0-6 inch depth of level 1 and corresponding germination, stands, yields and quality in 2020-2023 indicate that the levels of salinity and sodicity in the surface layers are more important than the subsurface layers.

Annual snowfall, resulting spring-melt and rainfall in spring and early growing-season also had an impact on salinity and sodicity, especially in the 0-6 inch depths. Weather in 2020 was normal, 2021 was dry (spring and early growing-season), 2022 was wet (spring and early growing-season) and 2023 was again mostly dry. In the 0-6 inch soil depths, dry weather in 2021 resulted in a slight increase in EC in all levels versus 2020. Wet weather in 2022 resulted in slightly lower EC levels compared to 2021. Lower EC levels combined with high moisture availability in 2022 spring and early growing-season resulted in improved germination, stands and higher yields even at higher salinity and sodicity levels (levels 2 and 3) compared to 2020 and 2021. Dry weather in 2023 resulted in increased salinity and sodicity levels in the 0-6 inch soil depths of all levels.

Plot Sizes, Planting and Harvesting Details

Plot sizes were 4.7 X 22 feet. Planting and harvest details are in Table 2.

Table 2. 2023 crop, variety, planting date, seeding rate 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
2023 Planting Details						
Barley	AAC Synergy (2-row)	May 30, 2023	1.0 million	1 to 1.5	Due to the delay in soil results a uniform rate of 40 pounds of P2O5 and 150 pounds of N per acre was hand broadcasted and rototilled in to all three levels before planting.	Level 1 barley and oats were straight combined on September 8, 2023. Levels 2 and 3 were combined on September 20, 2023.
	ND Genesis (2-row)					
	ND Treasure (6-row)		1.25 million			
	Tradition (6-row)					
Oat	CS Camden		1.0 million			
	ND Heart					
	Rockford					
	ND Spilde					
Sunflower	Sunflower A		20,000 plants per acre			All three levels were harvested on October 17, 2023.
	Sunflower B					
	Sunflower C					
	Sunflower D					

Results and Discussion

Similar to 2020, 2021 and 2022, there were differences between the three levels in seedbed, germination, plant growth and vigor, maturity, yield, and quality in 2023.

Differences in Seedbed

Similar to previous years the seedbed was rough and cloddy with an increase in soil sodicity (levels 2 and 3) compared to areas with low sodicity (level 1) in the surface layers (0-6 inch depths). This effect has been decreasing every year due to continuous tillage, but was still observed in 2023. See seedbed pictures 1-3 below for comparisons.

Pictures 1-3 from left to right: Differences in seedbed between level 1 (low to moderate salinity-sodicity), 2 (moderate to high salinity-sodicity) and 3 (very high salinity-sodicity) on May 25, 2023.

Differences in Germination

Due to the dry 2023-spring, germination was delayed in levels 2 and 3 versus level 1. Barley and oat seed started germinating 5-6 days after planting in level 1. In the seedling stage, oats always appeared slower in growth compared to barley irrespective of the year but would catch up during the growing-season. The sunflower seed took a day or two longer to germinate than barley and oat in levels 1 and 2. Germination in level 2 was 5-6 days delayed compared to level 1. In level 3, sunflowers started germinating 14 days after planting, and the barley and oats took around 20 days to germinate. Effects of increases in soil sodicity also resulted in soil crusting in levels 2 and 3 that affected the germination of barley and oat seed, while the bigger sized sunflower seed started germinating through cracks or pushed through the crusted

soil layers. Smaller sized barley and oat seeds had a disadvantage compared to sunflower as the oat seedlings could not push through the crusted soil layers. See pictures 4-6 below.

Pictures 4-6 from left to right: Sunflower seed germinating without any difficulty in level 1 (low to moderate salinity-sodicity), however, germinating only through soil cracks or by lifting crusted layers in level 2 (moderate to high salinity-sodicity) and level 3 (very high salinity-sodicity) on June 13, 2023.

Differences in Growth, Vigor, Stand and Maturity

Barley and oat growth, vigor and stand looked much better in level 1 versus levels 2 and 3. In level 3, there were hardly any barley and oat plants but was not true for sunflowers. The growth, vigor and stands of sunflowers in all three levels looked almost identical. Both 2021 and 2023 growing-seasons were dry. In 2021-spring there was more moisture in the topsoil compared to 2023-spring when there was less moisture in the topsoil. Since barley and oat plants have shallow fibrous roots compared to longer tap roots of sunflowers, sunflower plants were able to extract moisture from the deeper soil depths. Weather patterns vary from year to year and in growing-seasons producing different results due to differences in moisture levels. See pictures 7-9 below.

Crop maturity was not uniform and was delayed with the increase in salinity and sodicity. When combined, level 1 was fully mature with no green plants, level 2 had some green plants and level 3 had many greens. Sunflowers matured at the same time in all three levels.

Picture 7. Sunflower (left), oat (middle) and barley (right) varieties growing in level 1 on August 18, 2023.

Picture 8. Barley (left), oat (middle) and sunflower (right) varieties growing in level 2 on August 18, 2023.

Picture 9. Barley (left), oat (middle) and sunflower (right) varieties growing in level 3 on August 18, 2023.

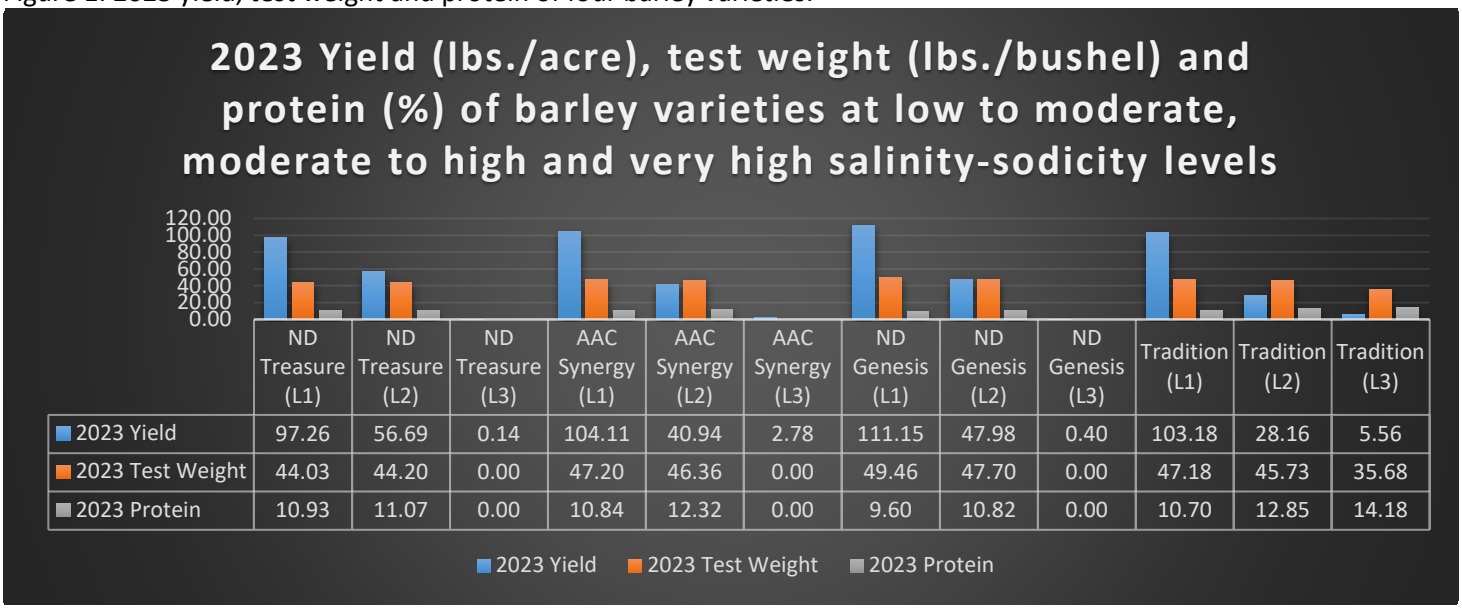
Differences in Yield and Quality

Barley

The 2023 barley varietal yields resembled 2020 yields, which showed a significant yield drop in level 2 and almost 100% loss in level 3 compared to level 1. This was a sharp contrast compared to 2022 and the main difference was the availability of soil moisture. All four varieties yielded high in level 1. There was an average decrease of 62.12% in yield for all varieties in level 2 compared to level 1. Tradition and AAC Synergy were the only varieties to produce over a bushel (5.56 and 2.78 bushels per acre respectively) in level 3.

Protein content increased in all barley varieties with the decrease in yield due to increase in salinity and sodicity. Test weight mostly decreased when salinity and sodicity levels increased. Details are in Figure 1.

Figure 1. 2023 yield, test weight and protein of four barley varieties.



	ND Treasure (L1)	ND Treasure (L2)	ND Treasure (L3)	AAC Synergy (L1)	AAC Synergy (L2)	AAC Synergy (L3)	ND Genesis (L1)	ND Genesis (L2)	ND Genesis (L3)	Tradition (L1)	Tradition (L2)	Tradition (L3)
2023 Yield	97.26	56.69	0.14	104.11	40.94	2.78	111.15	47.98	0.40	103.18	28.16	5.56
2023 Test Weight	44.03	44.20	0.00	47.20	46.36	0.00	49.46	47.70	0.00	47.18	45.73	35.68
2023 Protein	10.93	11.07	0.00	10.84	12.32	0.00	9.60	10.82	0.00	10.70	12.85	14.18

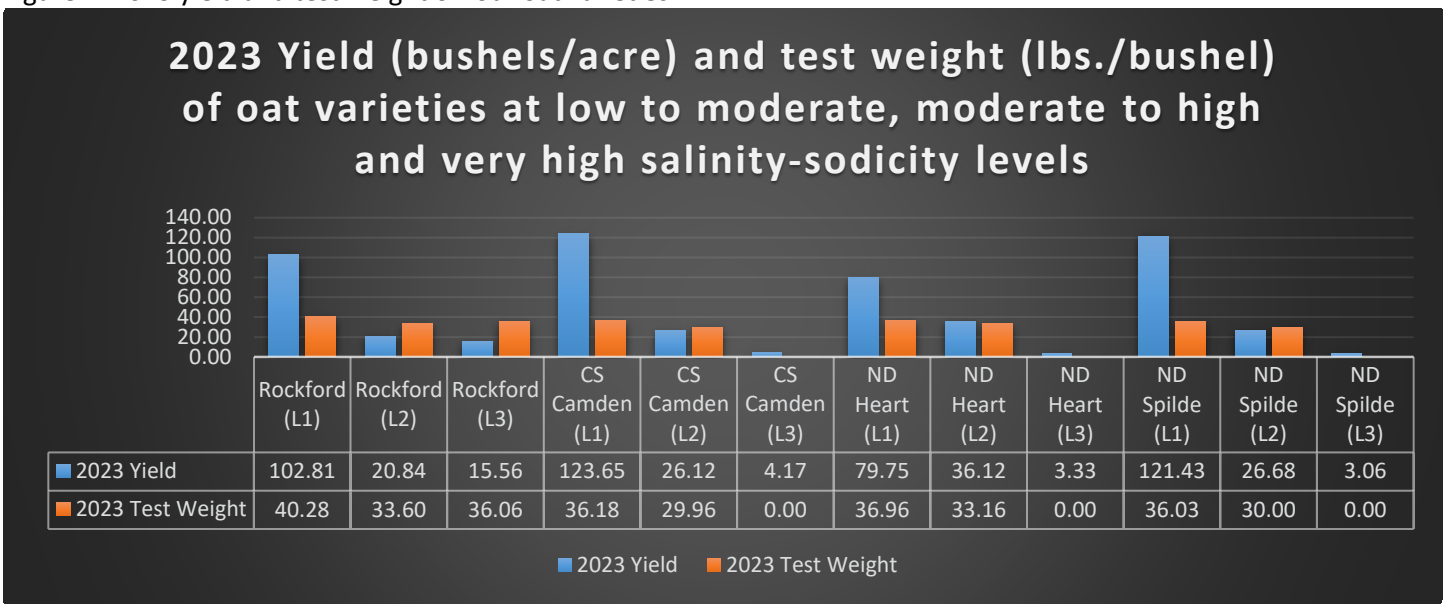
Oats

All varieties, except ND Heart, yielded over 100 bushels per acre in level 1. In level 2, average yield decrease for all varieties was 72.82% compared to level 1. Average yield decrease in level 3 was 93.69% versus level 1. Test weights were generally lower due to reduced growth and vigor at high salinity and sodicity levels. Details are in Figure 2.

Sunflower

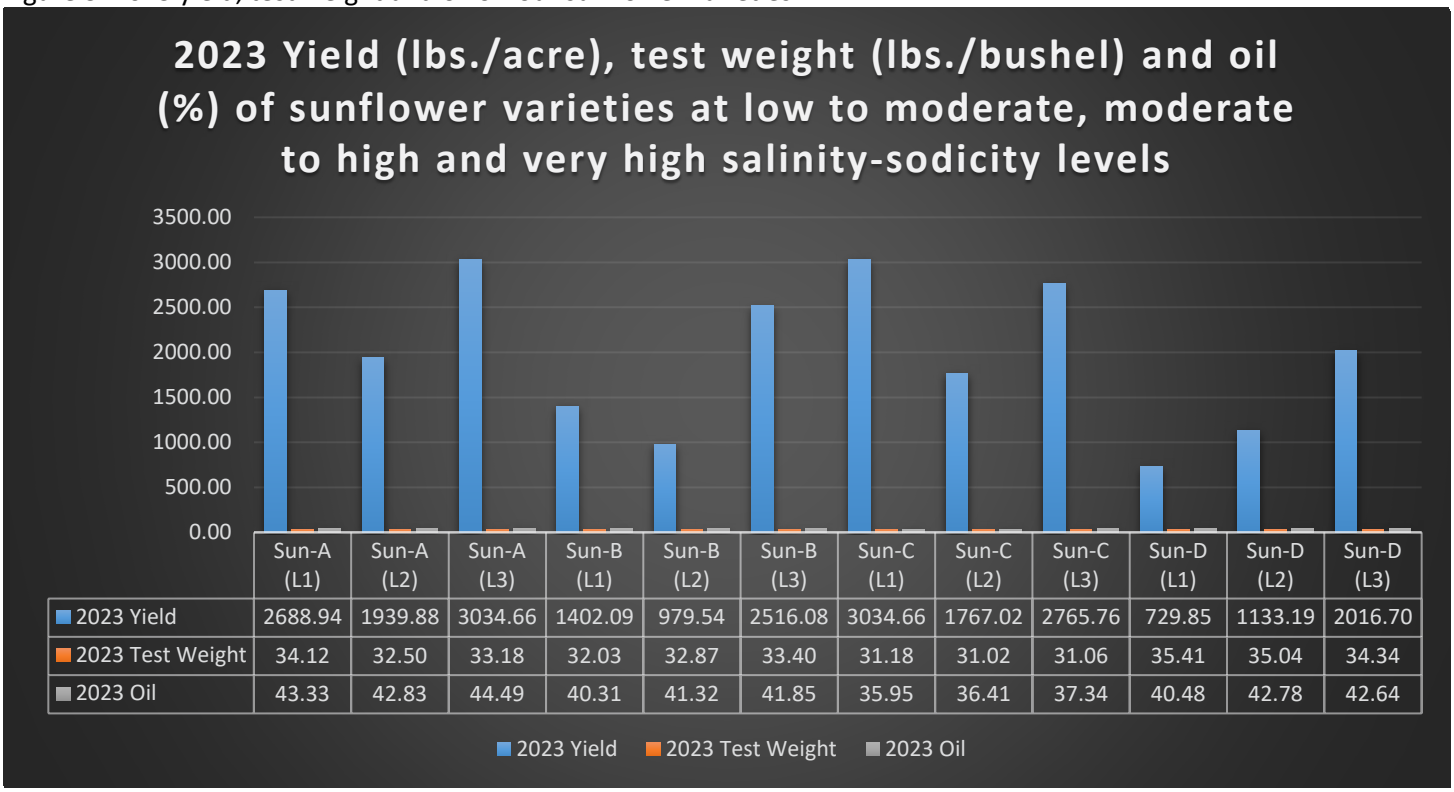
The sunflower varieties A, B and D produced the highest yields in level 3. Variety C yielded high as well in level 3. The comparatively lower sunflower yields in level 1 can be attributed to the damage caused by deer. In level 2, varieties A, B and C average yield decrease was 33.25% compared to level 1. Variety D had a 35.58% increase in yield. Overall, excluding deer damage, there was not much yield difference between levels 1 and 3. The oil % of the sunflower varieties remained quite comparable in all levels. Details are in Figure 3.

Figure 2. 2023 yield and test weight of four oat varieties.



	Rockford (L1)	Rockford (L2)	Rockford (L3)	CS Camden (L1)	CS Camden (L2)	CS Camden (L3)	ND Heart (L1)	ND Heart (L2)	ND Heart (L3)	ND Spilde (L1)	ND Spilde (L2)	ND Spilde (L3)
2023 Yield	102.81	20.84	15.56	123.65	26.12	4.17	79.75	36.12	3.33	121.43	26.68	3.06
2023 Test Weight	40.28	33.60	36.06	36.18	29.96	0.00	36.96	33.16	0.00	36.03	30.00	0.00

Figure 3. 2023 yield, test weight and oil of four sunflower varieties.



	Sun-A (L1)	Sun-A (L2)	Sun-A (L3)	Sun-B (L1)	Sun-B (L2)	Sun-B (L3)	Sun-C (L1)	Sun-C (L2)	Sun-C (L3)	Sun-D (L1)	Sun-D (L2)	Sun-D (L3)
2023 Yield	2688.94	1939.88	3034.66	1402.09	979.54	2516.08	3034.66	1767.02	2765.76	729.85	1133.19	2016.70
2023 Test Weight	34.12	32.50	33.18	32.03	32.87	33.40	31.18	31.02	31.06	35.41	35.04	34.34
2023 Oil	43.33	42.83	44.49	40.31	41.32	41.85	35.95	36.41	37.34	40.48	42.78	42.64

Summary:

- Spring and early growing-season soil moisture levels have a significant impact on germination, growth, yield and quality even at higher salinity and sodicity levels.
- Surface salinity and sodicity (0-6” depths) has more impact on germination, stand and yield than subsurface salinity and sodicity (6-24” depths).
- 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 and crusted surface layers.
- Seed size and plant root structure matters when salinity and sodicity levels increase, especially in a dry growing-season. Bigger seed tends to germinate better through crusted soil surfaces and deeper tap roots help plants extract moisture from the deeper soil depths compared to shallow fibrous roots.

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

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Figure 1. The Langdon Research Extension Center conventional-till versus no-till demonstration site on July 19, 2023.

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

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

Objectives

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

Site Details

An approximately 35-acre field was divided to create a conventional-till and no-till site into rectangular shapes from north to south. The no-till field totals approximately 13.7 acres, whereas, the conventional-till side measures around 20.7 acres with a 15-foot border between the two fields. Both sites include productive, marginal and unproductive areas in order to be truly representative of the farmer fields.

Field Work Details

Conventional-till

Fall-2021

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

Spring and Summer of 2022

- A uniform rate of 125 pounds of N per acre of Urea was spread on May 29 followed by one-pass of the cultivator for incorporation.
- Fargo and Treflan (PPI) were sprayed on June 6 followed by two-passes of a cultivator.
- On June 7, Prosper (HRSW) was planted at the seeding rate of 1.66 bushels per acre using a Concord 40-foot wide air seeder.

Fall-2022

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

Spring and Summer of 2023

- Site was cultivated and harrowed once followed by planting ND21008GT20 (soybean) at the seeding rate of 60 pounds/acre (2916 seeds/pound and 174960 seeds/acre) on May 26, 2023.
- On June 16, Roundup PowerMax 3 at 30 ounces/acre + Kicker at 2.5 gallons/100 gallons of water was sprayed at the rate of 10 gallons/acre.
- On July 10, Roundup PowerMax 3 at 30 ounces/acre + Kicker at 2.5 gallons/100 gallons of water was sprayed at the rate of 10 gallons/acre.

Fall-2023

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

No-till

Spring and Summer of 2022

- No-till site was planted with Prosper (HRSW) on June 13 using a John Deere 1895 disk no-till drill. Seeding rate was 1.66 bushels per acre. Due to an issue of the no-till drill not able to flow high fertilizer rates, only 62.5 pounds per acre of N (135.86 pounds of Urea per acre) was applied at the time of planting. The rest of the 62.5 pounds of N per acre was top dressed later in order to make the no-till fertilizer rate comparable to the conventional-till site.
- No-till site was sprayed with Roundup PowerMax 3 at 20 ounces/acre with Kicker (active ingredient ammonium sulfate) at 2.5 gallons per 100 gallons of water (0.27 gallons of Kicker per acre).

Fall-2022

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

Spring and Summer of 2023

- No-till side was planted on May 30, 2023 with ND21008GT20 (soybeans) at the seeding rate of 60 pounds/acre (2916 seeds/pound and 174960 seeds/acre).

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

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

Fall-2023

- About 70% (9.6 acres out of 13.7) of the no-till site was straight combined on October 13. The remaining 30% (4.1 acres) could not be harvested due to very high weed pressure (mainly Kochia, Green Foxtail and volunteer spring wheat).
- Remaining 30% of the no-till site was cleaned up using a combine in order to evenly spread the residue for spring-2024.
- On October 22, Roundup PowerMax 3 at 30 ounces/acre with 2,4-D at 19 ounces/acre and Kicker at 64 ounces per acre was sprayed at 10 gallons/acre.

Soil Sampling and Analysis

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

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

Soil Chemical Analysis Results

In 2021, conventional-till productive ground had low levels of salinity and no issue of sodicity in the 0-12 inch depth. The levels of salinity were high with moderately high sodicity in the same depth of conventional-till unproductive ground. In the no-till productive ground area, salinity level was moderately high with very low sodicity in the 0-12 inch depth. In the no-till unproductive area, salinity and sodicity levels were very high in the 0-12 inch soil depth. Soil nitrogen (N) and phosphorous (P) levels in the unproductive areas of conventional-till and no-till were very high and high compared to the productive areas of both sites. These results are quite representative of the saline and sodic areas versus areas that do not have these issues as there are hardly any plants growing on saline and sodic areas to take up nutrients from the soils. The fall-2022 soil results showed no salinity and sodicity issues in the 0-12 inch depth of conventional-till productive ground, whereas, conventional-till unproductive ground had an increase in salinity and sodicity in 0-12 inch depth versus fall-2021 results. No-till productive ground, fall-2022 salinity and sodicity results of 0-12 inch depth remained comparable versus fall-2021. The no-till unproductive ground sodicity levels of 0-12 inch depth in 2022 were the same compared to 2021 results, however, salinity levels in fall-2022 showed an increase versus fall-2021. There was an increase in soil nitrogen (N) in the 0-12 inch depth of conventional-till productive ground. No-till productive ground had a decrease in soil nitrogen in the 0-12 depth. Soil P levels had a slight increase in conventional-till productive ground, no-till productive and unproductive ground in 0-12 inch depth. Soil organic matter and pH levels remained mostly the same in both years. The fall-2023 soil chemical analysis results were not available at the time of writing this report.

Soil Bulk Density Analysis Results

Soil bulk density levels remained roughly the same in the fall-2021-2023. The minor differences were not due to tillage practices but differences in the soil moisture levels at the time of sampling.

Measurement of Soil Water Infiltration

Soil water infiltration rates were measured by pounding a six-inch diameter ring into the surface soil. After the ring was in place, 444 ml of deionized water was used to simulate one inch of rain. Once there was no standing water, while soil was

still saturated, a second inch of rain was simulated by pouring 444 ml of additional deionized water. Both simulations were timed for water absorption into the soil. There have been a few key observations regarding soil water infiltration rates:

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

Growing-Season Observations

2022

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

2023

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

Yield Differences in 2022 and 2023

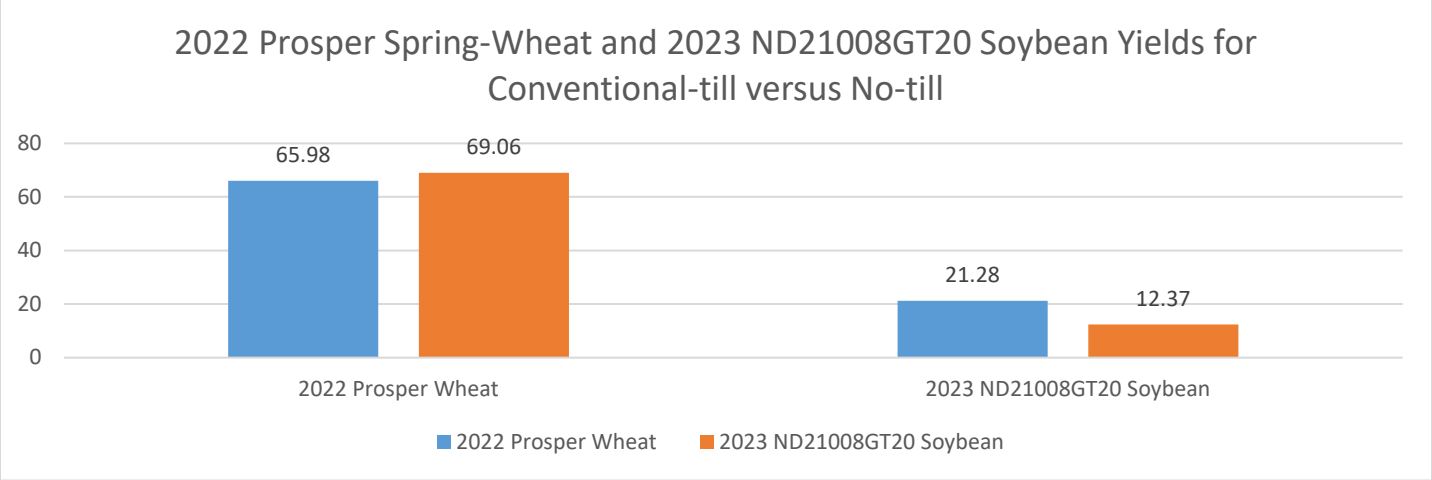

Figure 2. The Langdon Research Extension Center conventional-till versus no-till demonstration 2022 and 2023 yield comparisons.

Prosper spring wheat yields in 2022 were roughly the same for conventional-till and no-till sides with no-till yielding three bushels more per acre. In 2023, conventional-till soybean yield was much higher than no-till, mainly due to severe weed contamination and the fact that 30% of the no-till field could not even be harvested (Figure 2).

Differences in Costs and Profitability

Fall-2021 to 2022

Conventional-till area yielded 1364 bushels (without moisture adjustment) or 66 bushels per acre. No-till area yielded 949 bushels (without moisture adjustment) or 69.1 bushels per acre. Costs and profit details are in Table 1.

Table 1. 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	65.98	$461.86 (at $7.00 per bushel)	$316.21	**+ $145.65**
No-till		69.06	$483.42 (at $7.00 per bushel)	$246.21	**+ $237.21**

2023

Conventional-till area yielded 440 bushels or 21.3 bushels per acre, whereas, no-till area yielded 170 bushels or 12.4 bushels per acre. Due to very high weed pressure, 30% of the no-till site was not harvested. The entire no-till area was considered in the yield calculations (170 bushels/13.7 acres = 12.4 bushels/acre). Both conventional-till and no-till soybeans were taken to the local elevator. The Langdon CHS price for these soybeans per bushel was $12.74 cash (after deducting basis) on November 13, 2023 at 8:39 a.m. Due to very high weed pressure, conventional-till soybean had a dockage of 0.5%, whereas no-till had a 1.0% dockage. These dockages were considered in the Table 2 below.

Table 2. 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	21.28	$269.83 (at $12.74 per bushel)	$174.32	**+ $95.51**
No-till		12.37	$156.05 (at $12.74 per bushel)	$216.93	**- $60.88**

Summary Based on Two-Years

Differences in Planting Dates: In year-one of transitioning to no-till (2022), conventional-till sites looked ready for planting four to five days earlier than no-till. However, in year-two (2023), both conventional-till and no-till sites seemed ready for planting on the same day. The only reason no-till site was planted four days later in 2023 was due to equipment issues.

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

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) and sodium adsorption ratio (SAR) 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:

Mail: 9280 107th Avenue NE, Langdon, ND 58249
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RESULTS AND DISCUSSION

Considering the main objectives of the study, this report includes the statistical analysis of soil EC (salinity) and SAR (sodicity). Differences in these properties are compared at the time of tiling versus after applying the soil amendments (treatments) on tiled land. The treatment means of EC and SAR represent 2014 and 2016-2023 results of three replications for the zero to four-foot soil depths. In addition, water quality results of the tiled-drained field were compared with the results of upstream and downstream water samples.

Annual Changes in Weather

Changes in the soil chemical properties are greatly influenced by fluctuations in the weather such as annual evapotranspiration and rainfall and resulting groundwater depths and capillary rise of soil water. The annual growing-season rainfall and potential evapotranspiration (Penman) data was collected from the NDAWN (North Dakota Agricultural

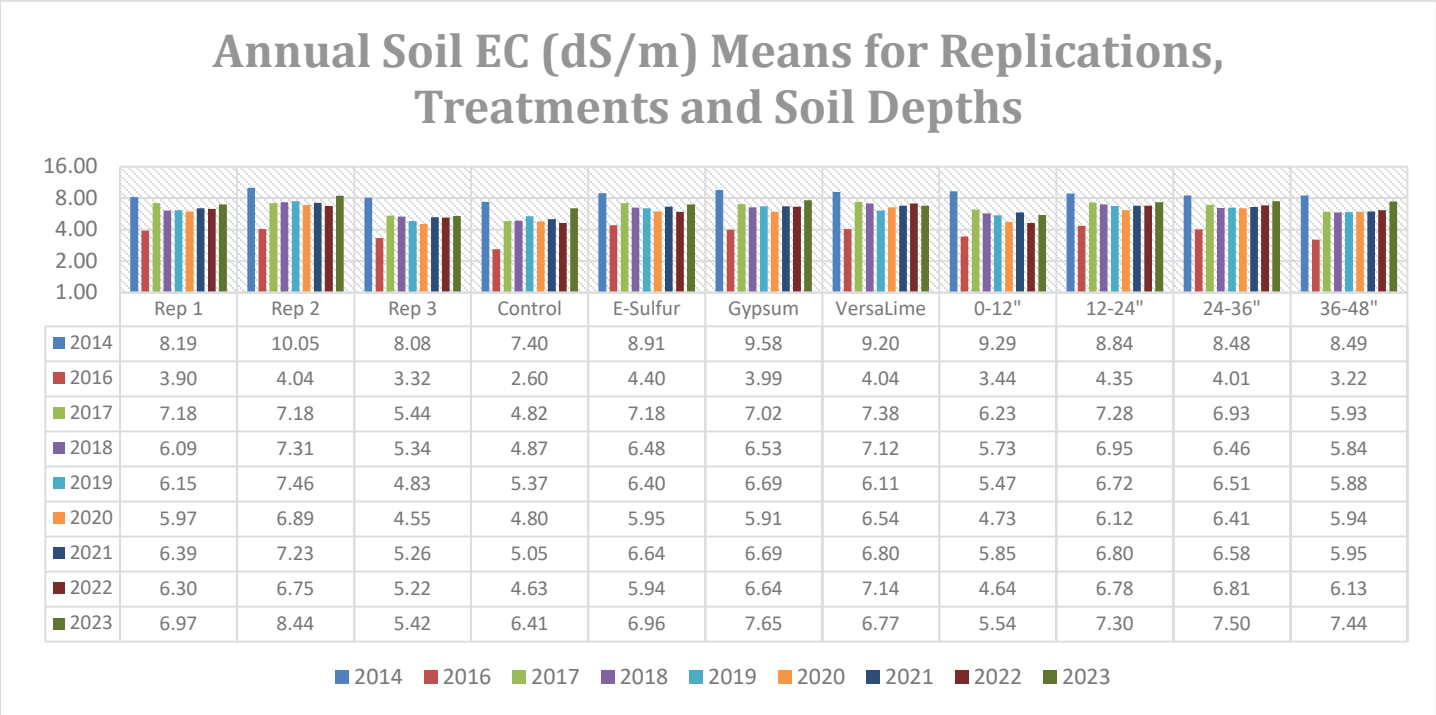
Weather Network) Langdon Station from May 1 to October 31. The average annual growing-season groundwater depths were calculated by averaging the weekly measurements for the same time period.

Increased evapotranspiration versus rainfall generally result in lower groundwater depths with less leaching of water-soluble salts, increased capillary rise of soil water and a slower breakdown of soil amendments. A smaller gap between these two could result in shallower groundwater depths. However, under good soil water infiltration and improved drainage, not only excess salts can be moved out of the fields but soil amendments can also produce favorable results. 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 2016 average growing-season groundwater depths were the shallowest. Groundwater depths in 2018 and 2023 were the deepest.

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 2.

Figure 2. Annual soil EC (dS/m) means for replications, treatments and soil depths.



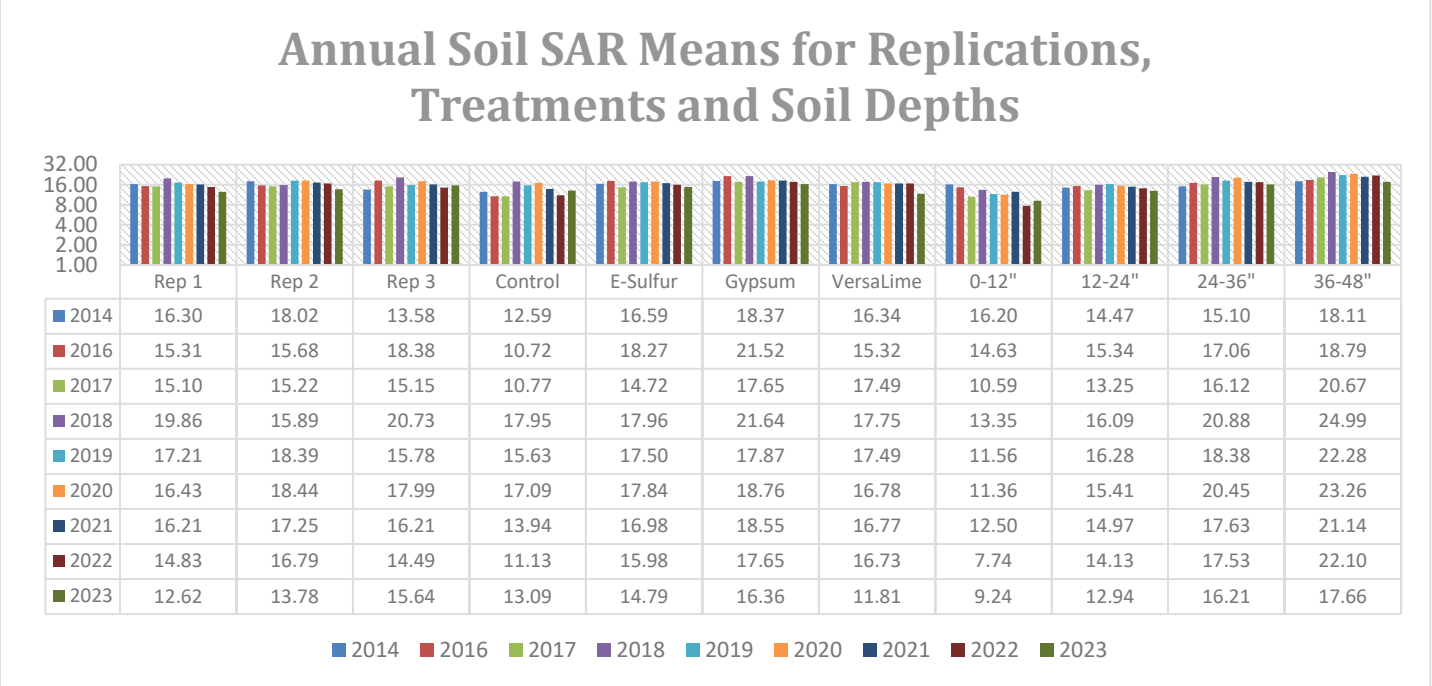
	Rep 1	Rep 2	Rep 3	Control	E-Sulfur	Gypsum	VersaLime	0-12"	12-24"	24-36"	36-48"
2014	8.19	10.05	8.08	7.40	8.91	9.58	9.20	9.29	8.84	8.48	8.49
2016	3.90	4.04	3.32	2.60	4.40	3.99	4.04	3.44	4.35	4.01	3.22
2017	7.18	7.18	5.44	4.82	7.18	7.02	7.38	6.23	7.28	6.93	5.93
2018	6.09	7.31	5.34	4.87	6.48	6.53	7.12	5.73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

Soil EC levels in 2016, were significantly lower despite shallow average annual growing-season groundwater depths due to excess rainfall and improved drainage under tiling. EC levels increased again in 2017 and that trend continued in 2018-2023 despite the land being tiled and the average annual growing-season groundwater depths were mostly deeper than the depth of the tiles. That was a result of increased capillary rise of soil water due to low rainfall and higher evapotranspiration. This proves that tiling the land is just one tool in the toolbox and lowering soil EC levels will need an optimum combination of low enough groundwater depths combined with sufficient rain and good soil water infiltration to push the salts into deeper depths. Sufficient rain will also result in higher moisture levels in the topsoil resulting in decreased capillary rise of groundwater and water-soluble salts.

Differences in Soil SAR (Sodicity) Levels

Changes in soil SAR levels have been inconsistent. That could be due to dry weather resulting in slow breakdown of soil amendments for lowering sodicity. The major change in the SAR level was in 2022 in the 0-12-inch depth that significantly decreased versus 2014-2021. That trend continued in 2023. Details of soil SAR levels are shown in Figure 3.

Figure 3. Annual soil SAR means for replications, treatments and soil depths.



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

SUMMARY

Research data and observations are not conclusive at this point. Since most soils in North Dakota are clayey, the general belief is that these soils will infiltrate water slower. That is true if we only compare clayey soils with silty or sandy soils. However, a clayey soil with high to very high dispersion or swelling will infiltrate water much slower than the same clay type not having these issues. Reducing soil dispersion and/or swelling combined with no or minimum-till practices and 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 takes days for the lift station pump to start draining the excess water. There is slow soil water infiltration due to dispersion caused by sodicity. Another evidence of slower water infiltration is there is very little change in groundwater depths for three to five days even after a heavy rain.

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

Tiling lowered soil salinity (EC) levels under wet weather in 2016. With drier weather, salinity levels have actually increased again in 2017-2023 compared to 2016 despite tiled-land. That is because of the lack of rain water to force excess water-soluble salts into deeper depths and increased rise of capillary water due to increased evapotranspiration.

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

Based on the 2015-2021 water quality analysis results, tile-drained water has added conductivity, total dissolved solids and SAR to the drainage ditch or the surface water resource. Over time depending upon the site-specific soil chemistry, tile drainage water can add salts and sodicity to the surface water resources. Water samples could not be taken in 2022 and 2023 due to dry weather.

Insecticide Seed Treatments for Flea Beetle Control in Spring Canola, 2023

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Materials and Methods

The trial was conducted at three different locations; NDSU Campus Agronomy farm in Fargo, Langdon REC in Langdon, and North Central REC in Minot. In Table 1, the planting dates, trial design, seeding rates and other information for LREC are summarized.

Table 1. Location, experiment and agronomic information.

	Langdon
Trial Latitude (LLC)	48.750036
Trial Longitude (LLC)	-98.333301
Canola Variety	DKTFLL 21 SC
Previous Crop	HRSW
Planting Date	May 22
Emergence Date	May 28
Plot Size	3.5 ft x 20 ft
Row Spacing	6 inches
Seeding Depth	0.75 inch
Seeding Rate	14 seeds/ft^2
Experimental Design	RCBD, 4 reps
Harvest Date	September 18

Seed treatment efficacy was examined for control of crucifer and striped flea beetles in spring canola. Treatments, rates and active ingredients are listed in Table 2. Dekalb DKTFLL 21 SC 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. In addition to testing seed treatment efficacy, we tested a single foliar application of bifenthrin at 2.6 fl oz per acre in combination with certain seed treatments (Treatments 6, 11 and 15) and compared these to the seed treatments alone. We attempted to make applications at the nominal threshold of 20 to 25% defoliation (approximately a rating of 2 on the 0-6 scale). At Langdon, the foliar application to Treatment 11 was made on June 1 at 4 days after emergence (DAE), to Treatment 6 on June 2 at 5 DAE, and to Treatment 15 on June 9 at 12 DAE. Foliar applications were made with a hand boom using TeeJeet 11015 flat fan nozzles at 40 PSI and a carrier volume of 20 GPA.

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. Feeding injury was rated at 3, 7, 10 and 14 DAE. Plant stand was measured after the last injury ratings were made by counting the number of live plants in three square feet at two locations within each plot, and calculating the number of plants per square foot. Plots were harvested at maturity by swathing prior to combining. Yield, percent moisture content, and test weight were collected via the onboard weigh systems on the plot combines. Yields were adjusted to 10% standard grain moisture. All data were analyzed using the GLM procedure in SAS version 9.4 statistical software. Fisher's LSD ($P<0.05$) was used to test for significance among treatment means. Sampling activities, dates and crop stages for the Langdon trial are given in Table 3.

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

Treatment No.	Treatment Name	Product Rate(s)	Active Ingredient(s)	AI Rate(s)
1	Fungicide Check			
2	Helix Vibrance	23 fl oz/cwt	Thiamethoxam	400 g/100 kg
3	Helix Vibrance Fortenza[1,2]	23 fl oz/cwt 10.2 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 400 g/100 kg
4	Helix Vibrance Fortenza[1]	23 fl oz/cwt 15.4 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 600 g/100 kg
5	Helix Vibrance Fortenza[1]	23 fl oz/cwt 20.5 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 800 g/100 kg
6	Helix Vibrance Fortenza[1,2] Brigade 2EC	23 fl oz/cwt 10.2 fl oz/cwt 2.6 fl oz/acre	Thiamethoxam Cyantraniliprole Bifenthrin	400 g/100 kg 400 g/100 kg 18.4 g/acre
7	Prosper Evergol	21.5 fl oz/cwt	Clothianidin	400 g/100 kg
8	Prosper Evergol Lumiderm[2]	21.5 fl oz/cwt 9.8 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 400 g/100 kg
9	Prosper Evergol Lumiderm	21.5 fl oz/cwt 14.8 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 600 g/100 kg
10	Prosper Evergol Fortenza[1]	21.5 fl oz/cwt 20.5 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 800 g/100 kg
11	Prosper Evergol Lumiderm[2] Brigade 2EC	21.5 fl oz/cwt 9.8 fl oz/cwt 2.6 fl oz/acre	Clothianidin Cyantraniliprole Bifenthrin	400 g/100 kg 400 g/100 kg 18.4 g/acre
12	Prosper Evergol Buteo Start[3]	21.5 fl oz/cwt 9.6 fl oz/cwt	Clothianidin Flupyradifurone	400 g/100 kg 300 g/100 kg
13	Prosper Evergol Buteo Start	21.5 fl oz/cwt 16 fl oz/cwt	Clothianidin Flupyradifurone	400 g/100 kg 500 g/100 kg
14	Prosper Evergol Lumiderm[2] Buteo Start[3]	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
15	Prosper Evergol Buteo Start[3] Brigade 2EC	21.5 fl oz/cwt 9.6 fl oz/cwt 2.6 fl oz/acre	Clothianidin Flupyradifurone Bifenthrin	400 g/100 kg 300 g/100 kg 18.4 g/acre

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

Results

Treatment means for response variables from the Langdon location are presented in Table 4 (data from Fargo and Minot locations is available in a detailed report available at the LREC website). Flea beetle density and feeding pressure at Langdon was moderately high. Both crucifer and striped flea beetles were present with crucifer flea beetles being the dominant species. While some significant differences exist among treatments and locations due to differences in flea beetle species and densities, and sampling timing among locations, we feel we can make valid inferences about treatment performance as a whole by combining the data from all locations (Table 5, Figure 1).

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

	Langdon		
Activity	Date	DAE	Crop Stage
Injury Rating 1	May 31	3 DAE	Cotyledon
Injury Rating 2	June 4	7 DAE	1-leaf
Canopy Cover 1	---	---	---
Injury Rating 3	June 7	10 DAE	2-leaf
Canopy Cover 2	---	---	---

Injury Rating 4	June 11	14 DAE	3-leaf
Canopy Cover 3	---	---	---
Stand Counts	June 12	15 DAE	3-leaf

There were no significant differences for flea beetle injury, canopy cover and yield between Helix Vibrance and Prosper Evergol when used alone, or in combination with different rates of cyantraniliprole (Lumiderm / Fortenza). Increasing cyantraniliprole rates above the commercially available rate decreased flea beetle injury and increased yield, but the treatment means were not significantly different except for an increase in yield for Helix Vibrance + Fortenza at 20.5 fl oz/cwt at Langdon. Prosper Evergol combined with Buteo Start resulted in significantly less flea beetle injury and significantly higher yields compared to the neonicotinoids alone and in combination with all rates of cyantraniliprole (Lumiderm / Fortenza), except for yield when a neonicotinoid was combined with the 800 g ai/100 kg cyantraniliprole rate (Lumiderm / Fortenza). Increasing the Buteo Start rate did not give any improvement over the commercially available rate, nor did adding cyantranilprole (Lumiderm / Fortenza) to Buteo Start.

A single foliar application of Brigade 2EC at 2.6 fl oz/acre at the nominal threshold of 20 to 25% defoliation, in combination with a neonicotinoid plus the commercially available rates of cyantraniliprole or Buteo Start, generally resulted in significantly higher yields and lower flea beetle injury compared to all treatments without Brigade 2EC, except for treatments containing Prosper Evergol and Buteo Start, and Helix Vibrance plus Fortenza at 20.5 fl oz/cwt (yield only).

The addition of cyantraniliprole at the commercial rate of 400 g ai/100 kg to either neonicotinoid resulted in less flea beetle injury at 3 DAE compared to using a neonicotinoid alone, but not at 7 DAE or beyond. Nor did the addition of the commercial cyantraniliprole rate result in significantly higher yield compared to the neonicotinoids alone. The addition of Buteo Start at the commercial rate of 300 g ai/100 kg to Prosper Evergol resulted in significantly less flea beetle injury compared to neonicotinoids alone or in combination with cyantraniliprole at the commercial rate, and also resulted in significantly higher yield. The addition of cyantraniliprole to the Prosper Evergol/Buteo Start mix did not have a significant effect.

Using our yield results for treatments across locations, we constructed the following table to calculate profitability based on different commercially available seed treatment scenarios with and without a foliar insecticide application (Table 6). This assumes a canola market value of $28.10/cwt, a seed treatment cost of $8.00/acre/product, and a foliar insecticide application cost of $11.12/acre for a generic bifenthrin product at 2.6 fl oz/acre.

Conclusion

Based on our results, we recommend that canola producers take the following steps to maximize yield potential by protecting seedlings and maximizing seedling health through at least the 4 to 6 leaf growth stage.

- Use a base seed treatment of either Helix Vibrance (thiamethoxam) or Prosper Evergol (clothianidin) and combine with either Lumiderm or Fortenza (cyantraniliprole) at 400 g ai/100 kg or Buteo Start (flupyradifurone) at 300 g ai/100 kg.
- Scout for flea beetle injury frequently, especially from 3 DAE through 21 DAE.
- Budget for a foliar application of insecticide at highest labeled rate when defoliation is above 20 to 25% defoliation (Economic Threshold).
- Apply foliar insecticide quickly when above the Economic Threshold of 20 to 25% defoliation.
- A good weed control program will help seedling vigor and growth.
- Proper fertility, including sulfur, will help seedling vigor and growth.

Acknowledgements

We would like to thank the Northern Canola Growers Association and our field workers, Joslin Forness and Miro Herrera Grant. We also appreciate the untreated canola seed supplied by Jim Johnson of Star Specialty Seeds.

Table 4. Treatment means for flea beetle injury, plant stand, test weight, and grain yield at Langdon, 2023.

Trt. No.	Treatment	Injury 3 DAE	Injury 7 DAE	Injury 10 DAE	Injury 14 DAE	Plant Stand (plants/ft^2)	Test Weight (lbs/bu)	Grain Yield (lbs/acre)
1	Fungicide Check	4.5 a	5.2 a	4.8 a	4.9 a	3.8 d	51.4 bc	2,236.5 f
2	Helix Vibrance @ 23	1.5 bcd	4.1 bc	4.6 ab	4.5 ab	7.7 abc	51.7 abc	2,578.2 ef
3	Helix Vibrance @ 23 Fortenza @ 10.2	1 cde	3.4 b-e	4 c	4.1 bc	8.5 abc	51.7 abc	2,963.7 b-e
4	Helix Vibrance @ 23 Fortenza @ 15.4	0.9 c-f	3.1 de	3.9 c	4.2 bc	7.6 abc	51.6 abc	2,969.1 b-e
5	Helix Vibrance @ 23 Fortenza @ 20.5	0.8 def	2.6 e	4 c	4.2 abc	9.3 ab	52 ab	3,255.5 a-d
6	Helix Vibrance @ 23 Fortenza @ 10.2 Brigade 2EC @ 2.6	0.9 c-f	1.8 f	2.3 de	3.1 de	8.4 abc	52 ab	3,622.9 a
7	Prosper Evergol @ 21.5	2.3 b	4.2 c	4.3 ab	4.5 ab	7.3 bc	51.4 bc	2,728 ef
8	Prosper Evergol @ 21.5 Lumiderm @ 9.8	1.7 bc	3.7 bcd	4.1 bc	4.7 ab	7.1 bc	51.6 abc	2,839.1 de
9	Prosper Evergol @ 21.5 Lumiderm @ 14.8	1.2 cd	3.8 bcd	4 c	4.3 ab	9.9 a	52.1 a	3,014.4 b-e
10	Prosper Evergol @ 21.5 Fortenza @ 20.5	0.9 c-f	3.3 cde	4 c	4.4 ab	8.5 abc	51.8 ab	2,936.1 cde
11	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Brigade 2EC @ 2.6	1.1 cd	1.6 fg	2.5 de	2.8 e	8.4 abc	51.4 abc	3,383.6 abc
12	Prosper Evergol @ 21.5 Buteo Start @ 9.6	0.3 ef	1.2 fg	2.8 d	3.4 de	7 c	51.8 ab	3,369.4 abc
13	Prosper Evergol @ 21.5 Buteo Start @ 16	0.1 f	0.9 g	2.1 e	2.9 de	8.3 abc	51.1 c	3,486.8 ab
14	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Buteo Start @ 9.6	0.3 ef	1.4 fg	2.8 d	3.6 cd	7.6 abc	51.9 ab	3,655.3 a
15	Prosper Evergol @ 21.5 Buteo Start @ 9.6 Brigade 2EC @ 2.6	0.2 ef	1.2 fg	2.6 de	3 de	7.5 bc	51 c	3,386 abc
	F-value	**14.16**	**20.59**	**20.15**	**8.93**	**2.82**	**1.80**	**4.79**
	P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0047**	**0.0721**	**<0.0001**
	LSD	**0.82**	**0.84**	**0.57**	**0.68**	**2.32**	**0.67**	**526.84**

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

Table 5. Treatment means for flea beetle injury, canopy cover, plant stand, test weight, and grain yield across locations, 2023.

Trt. No.	Treatment	Injury 3 DAE	Injury 7 DAE	Injury 10 DAE	Injury 14 DAE	Canopy 7 DAE	Canopy 10 DAE	Canopy 14 DAE	Plant Stand (plants/ft²)	Test Weight (lbs/bu)	Grain Yield (lbs/acre)
1	Fungicide Check	4.1 a	4.4 a	4.3 a	3.8 a	4.9 a	14.9 c	41.1 c	6.7 e	52.1 e	1762.9 d
2	Helix Vibrance @ 23	2.4 bc	3.6 b	3.8 b	3.3 b	5.3 a	26.7 ab	53.1 ab	9.4 bcd	52.3 b-e	2195.1 c
3	Helix Vibrance @ 23 Fortenza @ 10.2	1.5 e	3 bcd	3.2 cde	3 bcd	6 a	23.4 ab	49.6 b	10.2 abc	52.6 a-e	2374.6 c
4	Helix Vibrance @ 23 Fortenza @ 15.4	1.6 de	2.8 cd	3.1 cde	3.2 b	5.8 a	26.8 ab	54.2 ab	9.2 cd	52.5 a-e	2394.1 c
5	Helix Vibrance @ 23 Fortenza @ 20.5	1.3 ef	2.5 de	3.2 cd	3.2 bcd	6.4 a	23.7 ab	52.8 ab	10.3 abc	52.9 a	2632.2 ab
6	Helix Vibrance @ 23 Fortenza @ 10.2 Brigade 2EC @ 2.6	1.4 ef	2 ef	1.9 gh	2.4 fg	6.1 a	23.8 ab	54.6 ab	10 a-d	52.8 ab	2841.4 a
7	Prosper Evergol @ 21.5	2.8 b	3.5 bc	3.8 ab	3.3 b	4.7 a	21.8 b	49.8 b	8.9 d	52.2 de	2281.4 c
8	Prosper Evergol @ 21.5 Lumiderm @ 9.8	2 cd	3.3 bc	3.4 bc	3.3 b	6.1 a	25.5 ab	54.4 ab	9.4 bcd	52.4 b-e	2347 c
9	Prosper Evergol @ 21.5 Lumiderm @ 14.8	1.6 de	3.2 bc	3.2 cde	3.1 bcd	6.9 a	27.8 ab	54.9 ab	10.6 a	52.7 abc	2382.2 c
10	Prosper Evergol @ 21.5 Fortenza @ 20.5	1.6 de	3.1 bcd	3 cde	3.2 bc	5.5 a	27.3 ab	54.3 ab	9.7 a-d	52.5 a-e	2416.6 bc
11	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Brigade 2EC @ 2.6	1.5 e	2 ef	2 gh	2.1 gh	7.1 a	26.1 ab	56.2 a	10.4 ab	52.7 abc	2830.5 a
12	Prosper Evergol @ 21.5 Buteo Start @ 9.6	1.2 ef	1.7 f	2.9 de	2.8 de	6.4 a	24.5 ab	54.2 ab	9.3 bcd	52.8 abc	2638.9 ab
13	Prosper Evergol @ 21.5 Buteo Start @ 16	0.6 g	1.4 f	2.3 fg	2.6 ef	6.4 a	27.3 ab	54.9 ab	10 a-d	52.3 cde	2668.6 a
14	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Buteo Start @ 9.6	0.9 fg	1.7 f	2.8 ef	2.8 cde	6 a	29.2 a	55.8 a	9.8 a-d	52.6 a-d	2732.6 a
15	Prosper Evergol @ 21.5 Buteo Start @ 9.6 Brigade 2EC @ 2.6	0.9 fg	1.5 f	1.9 h	2 h	6 a	28.2 ab	57.7 a	9.6 a-d	52.4 b-e	2849.2 a
	F-value	23.19	14.20	19.23	13.74	1.60	2.08	3.56	5.18	1.97	13.43
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	0.12	0.02	<0.0001	<0.0001	0.03	<0.0001
	LSD	0.51	0.67	0.45	0.37	NS	6.82	5.90	1.13	0.45	225.09

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

Table 6. Crop market values when using different insecticide seed treatment and foliar insecticide application options.

Treatment	Market Value (USD/cwt)	Yield (lbs/acre)	Crop Value (USD/acre)	ST Cost (USD/acre)	Foliar Cost (USD/acre)	Total Cost (USD/acre)	Net (USD/acre)
Fungicide Check	$28.10	1,762.9	$495.37	$-	$-	$-	$495.37
Helix Vibrance[1]	$28.10	2,195.1	$616.82	$8.00	$-	$8.00	$608.82
Helix Vibrance[1] Fortenza[3]	$28.10	2,374.6	$667.26	$16.00	$-	$16.00	$651.26
Helix Vibrance[1] Fortenza[3] Bifenthrin[5]	$28.10	2,841.4	$798.43	$16.00	$11.12	$27.12	$771.31
Prosper Evergol[2]	$28.10	2,281.4	$641.07	$8.00	$-	$8.00	$633.07
Prosper Evergol[2] Lumiderm[3]	$28.10	2,347	$659.51	$16.00	$-	$16.00	$643.51
Prosper Evergol[2] Lumiderm[3] Bifenthrin[5]	$28.10	2,830.5	$795.37	$16.00	$11.12	$27.12	$768.25
Prosper Evergol[2] Buteo Start[4]	$28.10	2,638.9	$741.53	$16.00	$-	$16.00	$725.53
Prosper Evergol[2] Buteo Start[4] Bifenthrin[5]	$28.10	2,849.2	$800.63	$16.00	$11.12	$27.12	$773.51

[1]Helix Vibrance at 23 fl oz/cwt (thiamethoxam at 400 g ai/100 kg)
[2]Prosper Evergol at 21.5 fl oz/cwt (clothianidin at 400 g ai/100 kg)
[3]Fortenza at 10.2 fl oz/cwt or Lumiderm at 9.8 fl oz/cwt (cyantraniliprole at 400 g ai/100 kg)
[4]Buteo Start at 9.6 fl oz/cwt (flupyradifurone at 300 g ai/100 kg)
[5]Bifenthrin 2EC at 2.6 fl oz/acre

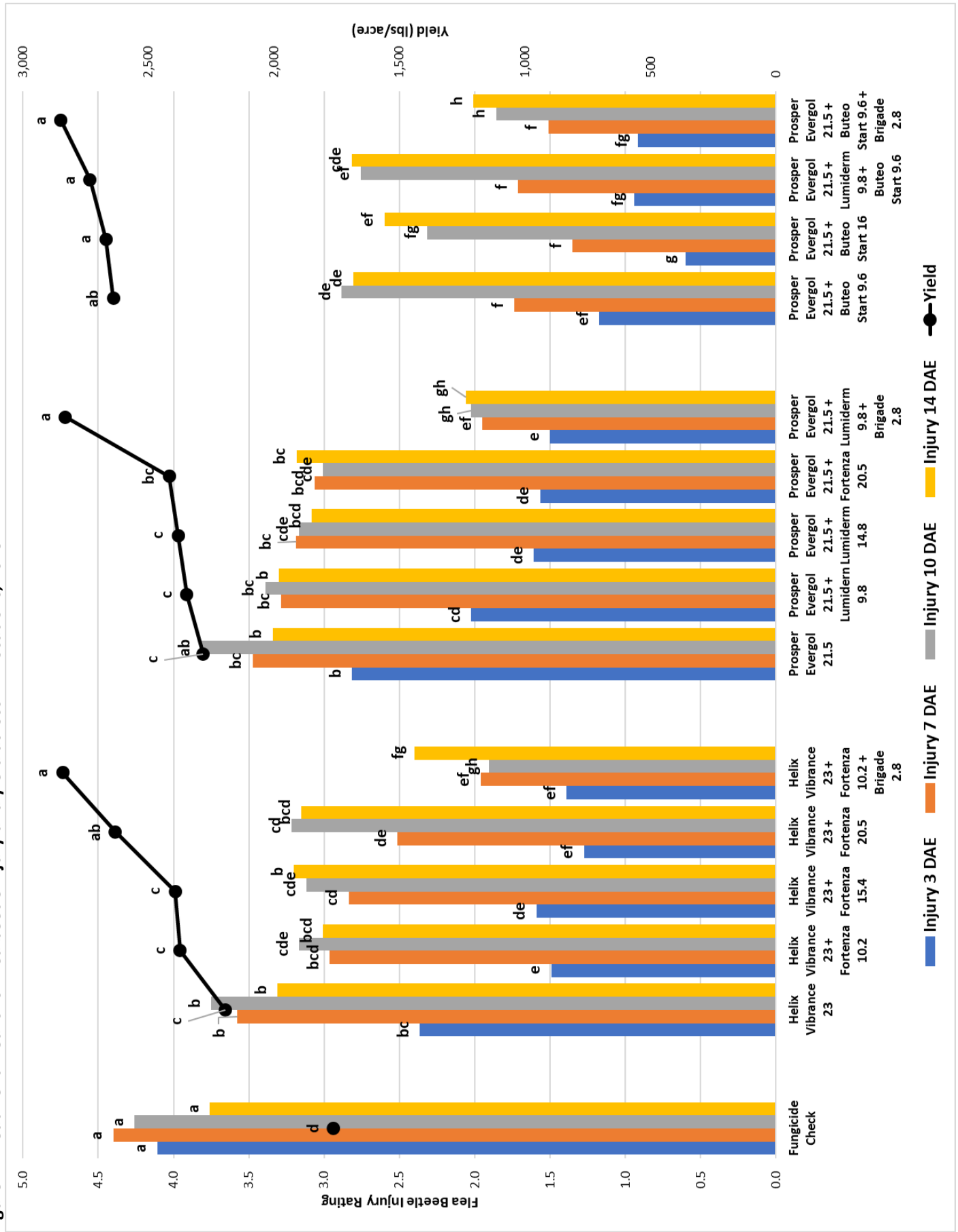

Figure 1. Treatment means for flea beetle injury and yield across ND locations, 2023.

Langdon REC Foundation Seed Stocks Program

The Langdon REC supports a Foundation Seed Stocks (FSS) Program to help increase and distribute the newest NDSU varieties of HRSW, durum, barley, 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 2024 growing season are listed below:

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

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

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

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