

Visual rating for iron-deficiency chlorosis (June 2024)

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Technical Report

a. Title: Visual Ratings for Iron Deficiency Chlorosis

Principal Investigator: Carrie Miranda, PhD

b. Research Overview and Objectives

Research Overview: Iron-deficiency chlorosis (IDC) is common in North Dakota and reduces yield. The best way to reduce the yield losses associated with IDC is to select a tolerant cultivar. Visual yellowing that is caused by IDC has been shown to be closely correlated to yield for fields that have IDC. This visual rating data can be used to quantify cultivar tolerance or susceptibility to IDC. Growers need data that compares varieties from different private companies in the same environments using the same experimental method. This project permits approximately 250 different GMO and non-GMO private company varieties to be evaluated for IDC tolerance. An additional 100 NDSU breeding lines are evaluated. Private companies enter lines for testing directly into the NDSU Soybean Breeding Performance tests based in Fargo, ND. These lines are then grown in 2-3 locations with known IDC symptoms around the Fargo area and scored based tolerance to iron deficiency. This data provides an independent confirmation of the IDC tolerance of company products and enable growers to compare varieties from different companies. This project will aid growers in selection of tolerant cultivars to increase yield on fields that have a past history of IDC.

Objectives:

1. To screen all private company varieties that have been entered into NDSU Soybean Breeding Performance tests based in Fargo, ND for visual ratings of IDC at multiple field locations with a past history of IDC symptoms.
2. To provide visual IDC screening of approximately 100 advanced NDSU breeding lines.

c. Materials and Methods

Objective 1: Online applications were opened in January 2023 to accept entries from private companies for IDC testing. Entries were at no cost. Private company lines that are entered must be released cultivars or planned for release within one year. Twenty five private companies participated. One hundred and ninety three lines were entered into the herbicide resistant trial and 21 lines were entered into the conventional trial. In March 2023, three locations with known IDC symptoms were selected for 2023 trials: Leonard (46.672633, -97.243522), Colfax (46.463402, -96.988577), and Amenia (47.049769, -97.333582). Experimental design was hill plot planting in randomized complete block design with 4 replications. One positive, resistant control was used: ND21008GT20 and one negative, susceptible control was used: ND17009GT. Locations were planted on the following dates: Colfax 6/8/23, Leonard 6/13/2023, and Amenia 6/13/2023. Eight seeds were planted per hill plot and thinned to 3 plants after emergence. Preemergence was sprayed however due to lack of rain, the chemical was not activated and weeding was done by hand for the remainder of the season. Plots were evaluated and rated for IDC symptoms ~30 days after planting. Ratings for IDC symptoms were completed visually based on the visual rating scale found at: <https://www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/crops/soybeans/iron-deficiency-chlorosis-soybean>. Scores were taken on a scale of 1-5 including half numbers were 1 shows no symptoms of deficiency and 5 is plant death due to deficiency severity. A second score was taken 2 weeks after the first scores. Scoring dates are as follows: Colfax 7/7/2023 and 7/21/2023, Leonard 7/14/2023 and 7/28/2023, and Amenia 7/20/2023 and 8/3/2023. Fields were tilled following the second scores and the field portion of the experiment was considered complete.

Data analysis was completed in the Agrobases database (<https://www.agronomix.com/AGROBASE.aspx>). The two scores for each location were averaged together using the SubSample feature in Agrobases. Means across reps were determined and analyzed using the ANOVA function in Agrobases. Means across locations were determined for the final reporting. Total experiment mean, CV%, and LSD ($\alpha = 0.05$ and $=0.10$) were determined with the ANOVA function in Agrobases.

Results were formatted into an easy to read table output and published at <https://vt.ag.ndsu.edu/view/6750> in August 2023 and in print in the A-843 NDSU publication in November 2023.

Online applications were opened for private company submissions in January 2024. This year a \$50 fee was charged for each entry. One hundred and eighty one private company entries were received from 16 companies. 14 lines were conventional and 167 contained herbicide resistance from a GMO event. Based on the advice from Dr. Jay Goos, we added additional locations to have the experiment planted in 4 locations that have known IDC symptoms. These locations are: Amenia IDC (47.094130, -97.361432), Arthur IDC (47.108384, -97.292319), Colfax IDC (46.470334, -96.988151), Wyndmere IDC (46.442546, -97.030900). Due to persistent rainfall in May and June, planting was delayed to the following dates: Amenia IDC June 14th, Arthur IDC June 24th, Colfax IDC June 17th, and Wyndmere June 17th. At the end of this fiscal year, plants have yet to emerge and weed control is being maintained.

Objective 2:

In 2023, 44 conventional lines and 54 glyphosate tolerant lines were entered into identical hill plot trials as described in Objective 1. Lines were selected based on their progress in the breeding pipeline, and all entries in second year yield trials were placed in IDC trials. In 2024, the same method of line selection was used. Fifty six conventional lines and 26 glyphosate tolerant lines are being tested. The reduction in glyphosate tolerant lines is due to the reconstruction of the breeding program pipeline which will place more emphasis on conventional germplasm for trait integration and the reduced market demand for glyphosate tolerant soybean. IDC scores generated from 2023 were used for selection of lines to advance to third year yield testing.

d. Research Results/ Outcomes

Objective 1:

In 2023, IDC symptoms were observed strongly in Colfax and Leonard, and weakly in Amenia. Based on the advice from Dr. Jay Goos, we averaged together all three locations to create a single IDC score for each private company line and the two controls. The controls were highlighted in the published data to allow reference as the IDC symptoms were very strong in 2023. The table was published online <https://ndsu-variety-trials.s3.us-east-1.amazonaws.com/uploads/attachments/2023-NDSU-Enlist-GT27-RR-and-Xtend-Soybean-IDC-Trial.pdf> and <https://ndsu-variety-trials.s3.us-east-1.amazonaws.com/uploads/attachments/2023-NDSU-Conventional-Soybean-IDC-Trial.pdf> and also print (Table 1). Figure 1 is a photo visualization of the IDC symptoms.

Table 1.

2023 NDSU Enlist, GT27, RR and Xtend Soybean Iron-deficiency Chlorosis Trial - Authors, C. Miranda and G. Kreutz (Page 1 of 3).

Company	Variety	Trial Mean IDC ¹	Company	Variety	Trial Mean IDC ¹
AgriGold	G0301E3	3.2	Dairyland	DSR-1290E	3.0
AgriGold	G0431E3	2.8	Dyna-Gro	S01XF43	3.0
AgriGold	G0500XF	2.4	Dyna-Gro	S03EN94	3.0
AgriGold	G0577E3	2.6	Dyna-Gro	S05XF73	2.8
AgriGold	G0854XF	3.5	Golden H.	GH00864XF	3.0
AgriGold	G0893E3	3.6	Golden H.	GH0234E3	3.2
AgriGold	G1055E3	3.0	Golden H.	GH0363E3	2.9
AgriGold	G1202XF	3.5	Golden H.	GH0384XF	3.3
AgriGold	G1209E3	3.0	Golden H.	GH0414E3	3.4
AgriGold	G1490XF	3.0	Golden H.	GH0502XF	3.3
AgriGold	G1493E3	3.3	Golden H.	GH0653XF	2.8
Bayer	AG02XF4	2.9	Golden H.	GH0734E3	2.8
Bayer	AG04XF4	2.9	Golden H.	GH0764XF	3.5
Bayer	AG05XF4	2.2	Golden H.	GH1124XF	3.0
Bayer	AG07XF4	2.8	Golden H.	GH1194E3	3.3
Bayer	AG10XF4	3.1	Golden H.	GH1323XF	3.2
Bayer	AG11XF4	2.7	Legacy	LS0098-23XF	2.8
Bayer	AG13XF4	3.2	Legacy	LS012-23E	2.7
Bayer	AG14XF4	3.6	Legacy	LS014-23XF	2.6
Channel	00924RXXF	2.8	Legacy	LS024-23XF	3.3
Channel	0122RXXF	2.9	Legacy	LS032-23E	3.2
Channel	0218R2X	1.9	Legacy	LS044-23XF	2.2
Channel	0320R2X	2.2	Legacy	LS052-23E	3.2
Channel	0423RXXF	2.3	Legacy	LS064-23XF	3.4
Channel	0724RXXF	3.2	Legacy	LS072-21E	3.1
Channel	0823RXXF	3.0	Legacy	LS074-22XF	3.5
Channel	0924RXXF	3.0	Legacy	LS084-22XF	3.3
Channel	1024RXXF	3.0	Legacy	LS092-22E	3.7
Channel	1224RXXF	2.4	Legacy	LS094-20XF	3.0
Channel	1524RXXF	2.6	Legacy	LS102-22E	3.3
Dahlman	7301XF	2.9	Legacy	LS124-23XF	2.9
Dahlman	7304XF	2.6	LG Seeds	LGS00719XF	3.8
Dahlman	74009XF	3.1	LG Seeds	LGS00901E3	2.9
Dahlman	7401XF	2.6	LG Seeds	LGS0105E3	3.4
Dahlman	7412XF	2.5	LG Seeds	LGS0111RX	3.1
Dahlman	AE00940	3.0	LG Seeds	LGS0125XF	3.1
Dahlman	AE0140	3.4	LG Seeds	LGS0139XF	2.4
Dahlman	AE1220	3.4	LG Seeds	LGS0323E3	3.2
Dairyland	DSR-0220E	3.4	LG Seeds	LGS0405E3	2.5
Dairyland	DSR-0585E	2.7	LG Seeds	LGS0444XF	3.0
Dairyland	DSR-0757E	3.1	LG Seeds	LGS0550E3	3.0
Dairyland	DSR-0920E	3.0	LG Seeds	LGS0701XF	3.1
Dairyland	DSR-1121E	2.8	LG Seeds	LGS0822E3	2.9
Mean		3.0	Mean		3.0
CV %		22.2	CV %		22.2
LSD 0.05		0.5	LSD 0.05		0.5
LSD 0.10		0.4	LSD 0.10		0.4

2023 NDSU Enlist, GT27, RR and Xtend Soybean Iron-deficiency Chlorosis Trial - Authors, C. Miranda and G. Kreutz (Page 2 of 3).

Company	Variety	Trial Mean IDC ¹	Company	Variety	Trial Mean IDC ¹
LG Seeds	LGS0988XF	3.2	Peterson	X2414E	2.9
LG Seeds	LGS1043E3	3.1	Peterson	X24XF01	2.3
LG Seeds	LGS1232XF	3.3	Pioneer	P02A78E	2.9
LG Seeds	LGS1385XF	2.8	Pioneer	P04A98E	2.7
NDSU	ND21008GT20	2.3	Pioneer	P06A38E	2.6
NDSU	ND2108GT73	3.1	Pioneer	P06A85E	2.4
NDSU	ND17009GT	3.7	Pioneer	P08A44E	2.0
Paloma / Farmer's BN	PL2E013	3.6	Pioneer	P11A97E	2.2
Paloma / Farmer's BN	PL2E043	2.8	Proseed	EL40-093N	2.9
Paloma / Farmer's BN	PL2E061	3.1	Proseed	EL40-13N	3.2
Paloma / Farmer's BN	PL2E073	2.7	Proseed	EL40-33N	3.4
Paloma / Farmer's BN	PL2E093	3.0	Proseed	EL40-83N	3.3
Paloma / Farmer's BN	PL2E101	3.3	Proseed	EL41-13N	3.1
Peterson	18X008N	2.3	Proseed	XF40-12	2.5
Peterson	19EN04	2.8	Proseed	XF41-22N	2.7
Peterson	19X03N	3.0	Proseed	XT80-20N	2.2
Peterson	2003E	3.2	REA	R0422XF	2.6
Peterson	2005E	2.4	REA	R0743XF	3.4
Peterson	2013E	3.1	REA	R0944XF	2.7
Peterson	2106E	2.8	REA	R1234XF	2.6
Peterson	2108E	3.4	Stine	009EG32	2.7
Peterson	2109E	3.8	Stine	01EG23	3.2
Peterson	21XF07	2.9	Stine	03EB02	2.9
Peterson	2201E	2.8	Stine	03EG62	3.1
Peterson	2207E	3.2	Stine	05EG26	3.4
Peterson	2212E	2.9	Stine	05EG62	2.9
Peterson	2214E	2.9	Stine	06EC23	2.8
Peterson	22XF009	3.2	Stine	06EG29	3.3
Peterson	22XF03	3.1	Stine	08EC32	3.1
Peterson	22XF06	3.2	Stine	08EG62	2.9
Peterson	22XF10	2.8	Stine	09EG92	3.3
Peterson	22XF12	3.2	Stine	12EB32	3.2
Peterson	22XF14	3.0	Stine	12EG32	3.5
Peterson	2304E	3.3	Syng NK	NK05-W3XF	3.2
Peterson	2309E	3.4	Syng NK	NK06-D9E3	3.3
Peterson	2311E	3.1	Syng NK	NK06-P2XF	2.5
Peterson	23EN009	3.4	Syng NK	NK07-G5E3	2.8
Peterson	23EN10	2.9	Syng NK	NK09-B5XF	2.7
Peterson	23XF009	2.8	Syng NK	NK11-A4E3	3.0
Peterson	23XF01	2.9	Syng NK	NK11-U2XF	3.1
Peterson	23XF09	3.2	Syng NK	NK13-Y4XF	2.9
Peterson	23XF13	3.2	Xitavo	XO 0094E	2.8
Peterson	X2412E	3.5	Xitavo	XO 0213E	2.5
Mean		3.0	Mean		3.0
CV %		22.2	CV %		22.2
LSD 0.05		0.5	LSD 0.05		0.5
LSD 0.10		0.4	LSD 0.10		0.4

2023 NDSU Enlist, GT27, RR and Xtend Soybean Iron-deficiency Chlorosis Trial - Authors, C. Miranda and G. Kreutz (Page 3 of 3).

Company	Variety	Trial Mean IDC ¹	Company	Variety	Trial Mean IDC ¹
Xitavo	XO 0234E	2.9	Xitavo	XO 0993E	3.5
Xitavo	XO 0311E	3.0	Xitavo	XO 1133E	2.9
Xitavo	XO 0554E	3.0	Xitavo	XO 1212E	2.9
Xitavo	XO 0602E	3.2	Xitavo	XO 1372E	3.1
Xitavo	XO 0731E	3.1			
Mean		3.0	Mean		3.0
CV %		22.2	CV %		22.2
LSD 0.05		0.5	LSD 0.05		0.5
LSD 0.10		0.4	LSD 0.10		0.4

Note: ND21008GT20 is the resistant control in green. NDSU ND17009GT is the susceptible control in red.

Scores averaged from three testing locations in North Dakota: Colfax, Leonard, and Amenia

¹IDC score was 1-5, with 1-green, 3-yellow, 5-dead tissue.

2023 NDSU Conventional Soybean Iron-deficiency Chlorosis Trial - Authors, C. Miranda and G. Kreutz.

Company	Variety	Trial Mean IDC ¹	Company	Variety	Trial Mean IDC ¹
Legacy	LS0090-20C	3.0	Richland	MK0603	2.7
Legacy	LS0090-23C	3.0	Richland	MK1023	3.0
Legacy	LSX020-23C	3.0	Richland	MK146	3.1
Legacy	LSX101-23C	3.1	Richland	MK41	2.9
Legacy	LSX102-23C	3.1	Richland	MK808CN	2.8
NDSU	ND Benson	2.7	Sevita	Alinova	2.6
NDSU	ND Dickey	3.0	Sevita	Barton	3.2
NDSU	ND Rolette	2.3	Sevita	Finch	3.2
Richland	MK009	3.2	Sevita	Odessa	3.2
Richland	MK0249	2.8	Sevita	Skyline	3.2
Mean		2.9	Mean		2.9
CV %		13.9	CV %		13.9
LSD 0.05		0.3	LSD 0.05		0.3
LSD 0.10		0.2	LSD 0.10		0.2

¹IDC score was 1-5, with 1-green, 3-yellow, 5-dead tissue.

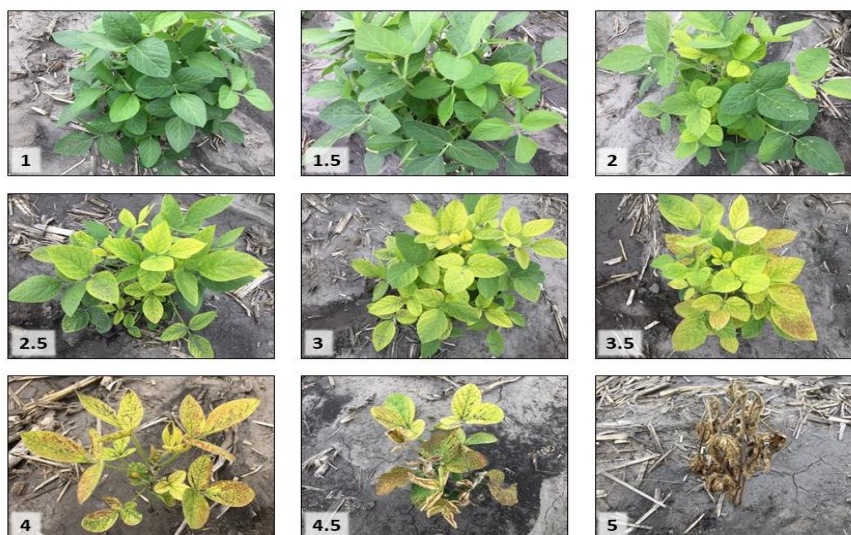


Figure 1. Soybean plants with IDC scores; 1 is green and 5 is dead tissue. Image originally published by Ted Helms.

Objective 2:

For the NDSU experiment, I did not include the Amenia location, as the most severe locations are of interest to me to ensure I am selecting only resistant varieties. Results can be found in Table 2.

Table 2. NDSU experimental line IDC scores: Glyphosate tolerant (GT) and Conventional (Conv) experiments									
Experiment	Name	Colfax	Leonard	Average	Experiment	Name	Colfax	Leonard	Average
Conv.	ND21-16321	1.8	3.8	2.8	GT	ND21-12925(GT)	3.3	4.3	3.8
Conv.	ND ROLETTE	1.8	4	2.9	GT	ND21-11670(GT)	3.3	4.4	3.9
GT	ND21-11516(GT)	2.1	3.1	2.6	Conv.	ND21-16040	3.3	4.6	4.0
Conv.	ND21-14067	2.1	4.1	3.1	Conv.	ND21-15436	3.3	4.8	4.1
Conv.	ND21-14756	2.2	3.1	2.7	Conv.	ND21-16581	3.4	4.5	4.0
Conv.	ND21-14834	2.2	4.2	3.2	GT	ND21-12792(GT)	3.4	4.5	4.0
Conv.	ND21-16580	2.3	4	3.2	GT	ND21-11680(GT)	3.4	4.6	4.0
Conv.	ND21-13877	2.4	4	3.2	Conv.	ND21-16024	3.5	4.1	3.8
Conv.	ND DICKEY	2.4	4.5	3.5	Conv.	ND21-14825	3.5	4.2	3.9
Conv.	ND21-14889	2.4	4.7	3.6	GT	ND21-10977(GT)	3.5	4.2	3.9
Conv.	ND21-15899	2.5	4	3.3	Conv.	ND21-15027	3.5	4.4	4.0
Conv.	ND21-15882	2.5	4.1	3.3	Conv.	ND21-15654	3.5	4.5	4.0
Conv.	P.91M10	2.5	4.4	3.5	GT	ND21-11949(GT)	3.5	4.6	4.1
Conv.	ND STUTSMAN	2.5	4.6	3.6	GT	ND21-10981(GT)	3.5	4.6	4.1
Conv.	ND21-15897	2.6	3.4	3.0	GT	ND21-11604(GT)	3.5	4.6	4.1
Conv.	ND21-15994	2.6	4.4	3.5	GT	ND21-10960(GT)	3.6	3.3	3.5
Conv.	ND21-15838	2.6	4.6	3.6	Conv.	ND21-16718	3.6	4	3.8
Conv.	ND21-15684	2.7	3.7	3.2	Conv.	ND21-14265	3.6	4	3.8
Conv.	ND21-16007	2.7	3.8	3.3	Conv.	ND21-16039	3.6	4.3	4.0
Conv.	ND21-14017	2.8	3.2	3.0	GT	ND21-11001(GT)	3.6	4.7	4.2
Conv.	ND21-13937	2.8	4.2	3.5	Conv.	SHEYENNE	3.7	4.4	4.1
Conv.	ND BENSON	2.8	4.2	3.5	Conv.	ND21-15103	3.7	4.5	4.1
Conv.	ND21-15760	2.8	4.5	3.7	Conv.	ND21-14110	3.7	4.7	4.2
GT	ND21-13089(GT)	2.8	4.5	3.7	Conv.	ND21-16096	3.7	4.8	4.3
Conv.	ND21-14353	2.8	4.6	3.7	GT	ND21-12686(GT)	3.7	4.8	4.3
Conv.	ND21-14145	2.9	3.9	3.4	GT	ND18-20092(GT SCN)	3.8	4.1	4.0
GT	ND14-6120(GT)	2.9	4	3.5	GT	ND21-13039(GT)	3.8	4.1	4.0
GT	ND17-19726(GT)	2.9	4.5	3.7	GT	ND21-11676(GT)	3.8	4.3	4.1
Conv.	ND21-15731	2.9	4.7	3.8	Conv.	ND21-15534	3.8	4.6	4.2
Conv.	ND21-15898	3	3.4	3.2	GT	ND21-11697(GT)	3.9	3.3	3.6
Conv.	ND21-14236	3	3.9	3.5	GT	ND21-10013(GT)	3.9	4.6	4.3
GT	AG005X8	3	4	3.5	GT	ND21-12678(GT)	3.9	4.6	4.3
Conv.	ND21-16142	3	4.4	3.7	GT	ND21-10859(GT)	3.9	4.8	4.4
Conv.	ND21-16519	3	4.6	3.8	GT	ND21-11726(GT)	3.9	4.9	4.4
Conv.	ND21-14181	3	4.9	4.0	GT	ND21-12810(GT)	4	4.4	4.2
GT	AG11X8	3	5	4.0	GT	ND21-10892(GT)	4	4.5	4.3

Conv.	ND21-15836	3.1	4.3	3.7	GT	ND21-13071(GT)	4	4.9	4.5
GT	ND21-10057(GT)	3.1	4.4	3.8	GT	ND21-11583(GT)	4	5	4.5
GT	ND21-11005(GT)	3.1	4.7	3.9	GT	ND17009GT	4	5	4.5
Conv.	ND21-16396	3.1	4.9	4.0	GT	ND21-11950(GT)	4.1	4.1	4.1
GT	ND21-10256(GT)	3.2	4	3.6	GT	ND21-10921(GT)	4.1	4.3	4.2
Conv.	ND21-15810	3.2	4.4	3.8	GT	ND19-18020(GT)	4.2	4.4	4.3
GT	ND21-11841(GT)	3.2	4.5	3.9	GT	ND21-10609(GT)	4.2	4.6	4.4
GT	ND15-22873(GT)	3.2	4.5	3.9	GT	ND21-12856(GT)	4.2	4.8	4.5
GT	AG0333	3.2	4.5	3.9	GT	ND21-11581(GT)	4.2	5	4.6
Conv.	ND21-14121	3.3	4	3.7	GT	ND21-10611(GT)	4.3	4.2	4.3
Conv.	ND21-16300	3.3	4	3.7	GT	ND21-10958(GT)	4.4	4.8	4.6
GT	ND21-13067(GT)	3.3	4.2	3.8					

Lines highlighted in green are released variety checks and/or controls.

Line highlighted in yellow are lines that are in the variety prerelease pipeline and are being reevaluated for IDC score.

e. Listing of inventions

These data are published by NDSU in the A-843 publication and distributed by NDSU extension agents. This publication is typically available online <https://www.ndsu.edu/agriculture/sites/default/files/2023-12/a843-23.pdf> as well as in print.

f. Discussion

The iron deficiency chlorosis (IDC) trials have been conducted and funded by the soybean council for many years. Many farmers and extension agents have personally told me how important these data are for farmers in varieties selection for their fields because private company IDC score self reporting is often unreliable. The NDSU Soybean Breeding Program prides itself on its efficacy of these trials and the useful data that it can provide to the public. However, that does not mean there was not move for improvement. Based on the suggestion from the North Dakota Soybean Council, Dr. Jay Goos, a retired NDSU physiologist, started advising us to improve the data quality of these trials. Dr. Jay Goos's career was spent primarily researching IDC in soybean and he designed the experimental methodology that we currently use. It was his suggestion to increase the number of locations after we two IDC fields fail in 2022. He explained that it is typical to have a 50% field loss in IDC trials due to lack of symptoms, herbicide drift issues, hail, etc so it important to protect the integrity of the trial with increased locations. In 2023, we learned this after planting and only had 3 locations. Until this year, I had followed the experimental methodology that my predecessor taught me so I appreciated this insight. We also included controls in the 2023 and 2024 experiments. I had previously been told to not include controls in the publication or had them removed during revision before printing process but due to staffing changes regarding the publication, I was able to make this change in 2023. I think including resistant and susceptible controls, especially after the severe symptom increase of 2022 and 2023 helps provide context to the results, same as they would for academic research.

The NDSU Soybean Breeding Program does not provide recommendations of private company lines directly because this is often a nuanced decision between a farmer and an extension agronomist. However, based on the performance of the positive/ resistant control, which should have a score of 1 to 1.5, it is easy to see that IDC symptoms, even when averaged with the Amenia location, were more severe than a typical year. The typical cutoff for IDC scores to prevent yield loss is 2.5, 16 herbicide tolerant lines and 0 private company

conventional lines had scores of 2.5 or lower, which suggest high resistance given the strong symptoms of 2023.

The 2023 NDSU scores provide additional data as we explain the data by location. I did not include the Amenia data as I prefer to score the lines in the most severe conditions to ensure high genetic resistance. The Leonard location had more difficult IDC pressure and most lines did not score well, similar to the results in 2022. The Colfax data was the most useful in this regard and allowed for some interpretation of the data. Ten experimental lines scored 2.5 or lower, and will be considered for advancement to the third year of yield testing based on results from 2023 yield testing, SCN resistance testing, Phytophthora resistance testing and/or be considered for use as a parent if it is a conventional line.

In 2024, I took the advice of the soybean council and instituted a \$50 fee for each line entered into the IDC trials. Although there was slight reduction in entries, there are still a good number of company participants. We planted four location in 2024, an increase of 1 location over 2023. We had hoped to increase the number of locations to five this year, however we had a set back because one cooperator retired and his land renter did not want to work with us if we were to rent only 1 acre of land. We needed to find two new cooperators for this year, which is a challenge. Dr. Goos provided us with his old contacts however many of them had retired as well. Fortunately through some digging through records, we found two cooperators that are now land renters of the IDC affected land that Dr. Goos used. We were able to convince them to assist with our trials. We plan to find an additional location fifth in 2025.

2024 had an extraordinarily wet May, and delayed planting of these trials for two weeks than we would typically plant. Fortunately, this trial is short and planting data should not affect the 2024 results. We plan to take scores mid July-early August depending on weather.

g. Conclusion

The iron deficiency chlorosis (IDC) trial provided useful and necessary data to North Dakota farmers to aid their decision process for selecting the most appropriate soybean variety for their fields. This project also allows for testing of NDSU experimental lines, which allows the breeding program to make thoughtful selections for lines based on IDC resistance which is an important trait in eastern North Dakota. These trials will continue on, self supported by private company entry fees in 2025 and onward.