

MANITOBA

ASSESSMENT OF NEW MALTING BARLEY VARIETIES FOR PRODUCTION AND MALTING SELECTION

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ASSESSMENT OF NEW MALTING BARLEY VARIETIES FOR PRODUCTION AND MALTING SELECTION IN MANITOBA

BACKGROUND

In the early 1980s over two million acres were seeded to barley production in Manitoba. Over the next 30 years, with more cropping options including canola, soybeans and peas, barley seeded area decreased steadily hitting a low of 265,000 acres in 2017. Area has since bounced back to 415,000 acres in 2023 driven by improved relative returns for barley and other factors such as enhanced yields and disease resistance in new varieties. Area seeded to malting versus feed barley varieties is split roughly 50/50 in Manitoba.

Although malting barley is often shown to be one of the most profitable crops by Manitoba Agriculture, like any crop certain regions and farms tend to be better suited for production based on factors such as soil, weather, disease pressure and delivery opportunities. And while barley has been challenged in the past in Manitoba with diseases like fusarium head blight (FHB) today there are a number of new malting barley varieties that have been registered with improved disease resistance and agronomic characteristics such as AAC Connect, AAC Goldman, AAC Prairie, CDC Fraser, CDC Bow, CDC Churchill and CDC Copper.

In this applied project, these new malting barley varieties were grown in several on-farm trials over a three-year period in different locations in Manitoba. The results show that the new varieties perform well in terms of both agronomics (yields) and malting barley quality, demonstrating that malting barley can be a competitive cropping option for producers. Other factors today such as improved production management practices and effective chemistries to deal with diseases like FHB enable producers to secure better returns on malting barley.

The objectives of this project were to:

- 1 Examine the performance of new malting varieties at different growing sites in Manitoba with optimized agronomic practices;
- 2 Investigate the barley selection rate for malting at harvest and to test for barley quality and malting & brewing performance; and
- 3 Identify the growing locations and agronomic practices which are best suited for malting barley production with new barley varieties in Manitoba.

PROJECT OUTLINE

The “Assessment of New Malting Barley Varieties for Production and Malting Selection in Manitoba,” hereafter referred to as the **Manitoba On-Farm Trials** project, was carried out as a collaboration between the CMBTC and the Manitoba Crop Alliance (MCA) with the support of Agriculture and Agri-Food Canada, the Grain Research Laboratory of the Canadian Grain Commission and ToneAg Consulting services with funding provided by Canadian Agricultural Partnership (CAP) Ag Action Manitoba and MCA.

As indicated above, the objective of this project was to evaluate new malting barley varieties through on-farm trials grown across Manitoba over a three-year period, examining their performance both in terms of agronomics as well as barley quality, malting and brewing performance.

TRIAL LOCATIONS

Over the course of the project, three farms participated in all three years, while two farms participated in two years, and two additional farms participated in just one year each.

2020	2021	2022
Oakland - Wawanesa	Oakland - Wawanesa	Oakland - Wawanesa
Victoria - Holland	Victoria - Holland	Victoria - Holland
Argyle - Baldur	Argyle - Baldur	Argyle - Baldur
Morris	Morris	Alexander - Dencross
Pembina - Manitou	Westlake - Gladstone - Westbourne	Westlake - Gladstone - Westbourne
		Glenella - Landsdowne

VARIETIES INCLUDED

The varieties included in the trials were AAC Connect, CDC Fraser, CDC Copper, AAC Goldman, CDC Bow, CDC Churchill and AAC Prairie with AAC Synergy as the check.

2020	2021	2022
Check: AAC Synergy	Check: AAC Synergy	Check: AAC Synergy
AAC Connect	AAC Connect	AAC Connect
CDC Fraser	CDC Fraser	CDC Fraser
CDC Copper	CDC Copper	CDC Copper
AAC Goldman	CDC Bow	CDC Churchill
CDC Bow	CDC Churchill	AAC Prairie

OPTIMIZED PRODUCTION

Soil sampling was conducted at each farm prior to seeding with recommendations for optimized fertilization provided by ToneAg Consulting.



SUMMARY AVERAGE RESULTS BY VARIETY 2020-2022

The following tables provide summary average results by variety over the three years of the project. Given the differing number of crop year samples for each variety, making comparisons between varieties based on the absolute averages is not necessarily meaningful, with these results intended to provide a high-level overview of indicators. Details by year and location are provided in the Appendix where the reader can see the comparison with the checks and the other varieties at that location, a more apples-to-apples comparison.

TABLE 1 | SUMMARY OF YIELD AND QUALITY OF TESTED VARIETIES - AVERAGE 2020-2022

Variety	n	Yield, % as compared to the check	Barley DON, Ppm	Protein %	Germination Energy, %	Water Sensitivity, %	1,000 Kernel Weight, g	6/64", %	SN RV Units
AAC Synergy	13	100.0	0.2	12.1	96.2	79.7	51.1	95.4	130
AAC Connect	9	97.2	0.2	12.2	97.1	80.9	49.8	92.4	123
CDC Fraser	4	90.3	0.2	12.1	97.6	81.0	50.2	95.7	86
CDC Copper	4	94.5	0.3	12.2	94.7	63.6	48.2	91.6	128
CDC Bow	1	94.4	0.2	11.9	97.8	87.3	51.7	94.3	60
CDC Churchill	3	100.3	0.2	12.8	98.4	86.1	46.1	94.3	109
AAC Goldman	1	89.3	0.2	11.8	96.5	70.8	54.6	94.5	157



Field Day at Elder Farm, Wawanesa, Aug. 2, 2022.

Yield Data Summary

All the barley varieties tested in the study performed well agronomically with good yields. The variety CDC Churchill edged out the check variety AAC Synergy in terms of yields on average.

Barley Quality Summary

While there were no statistical differences between varieties based on barley quality, there were some differences in terms of averages:

Germination Energy –

- All varieties were in the range of the target minimum germination energy for malting barley of 95% on average.
- While some CDC Copper samples fell below the desired minimum of 95%, this may be the result of some dormancy in CDC Copper. In years with a wet harvest, this may offer an advantage.

Water Sensitivity –

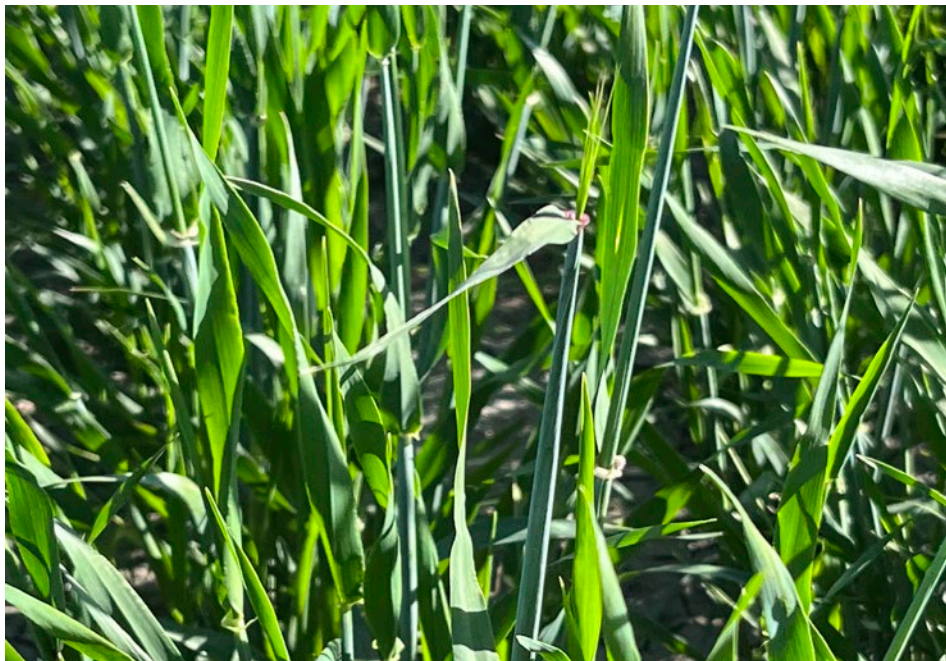
- CDC Copper and AAC Goldman demonstrated water sensitivity above desirable levels. As indicated above, in the case of CDC Copper this may be attributable to some dormancy inherent in this variety.

1,000 Kernel Weight –

- AAC Goldman recorded the heaviest 1,000 kernel weight of the new varieties although this was based on just one year and one location.

Plumpness –

- All varieties showed good plumpness, above the minimum desired 90% levels.



GLOSSARY OF TECHNICAL TERMS

BARLEY QUALITY

Protein

The measure of protein content by % weight. Protein content affects potential sugar extract.

Germination Energy (GE)

Percentage of 100 kernels found to germinate in 4ml of H₂O after a period of three days. Good quality barley will have a high Germination Energy.

Water Sensitivity (WS)

Percentage of 100 kernels found to germinate under water stress (8ml H₂O) after a period of three days. A lower value indicates water sensitivity to the malting process.

1,000 Kernel Weight (TKW)

The weight of 1,000 barley corns. Useful for determining seed size.

Plumpness

Percentage of kernels retained over a 6/64" slotted screen. Kernels retained on this screen are considered plump in width.

Stirring Number (SN)

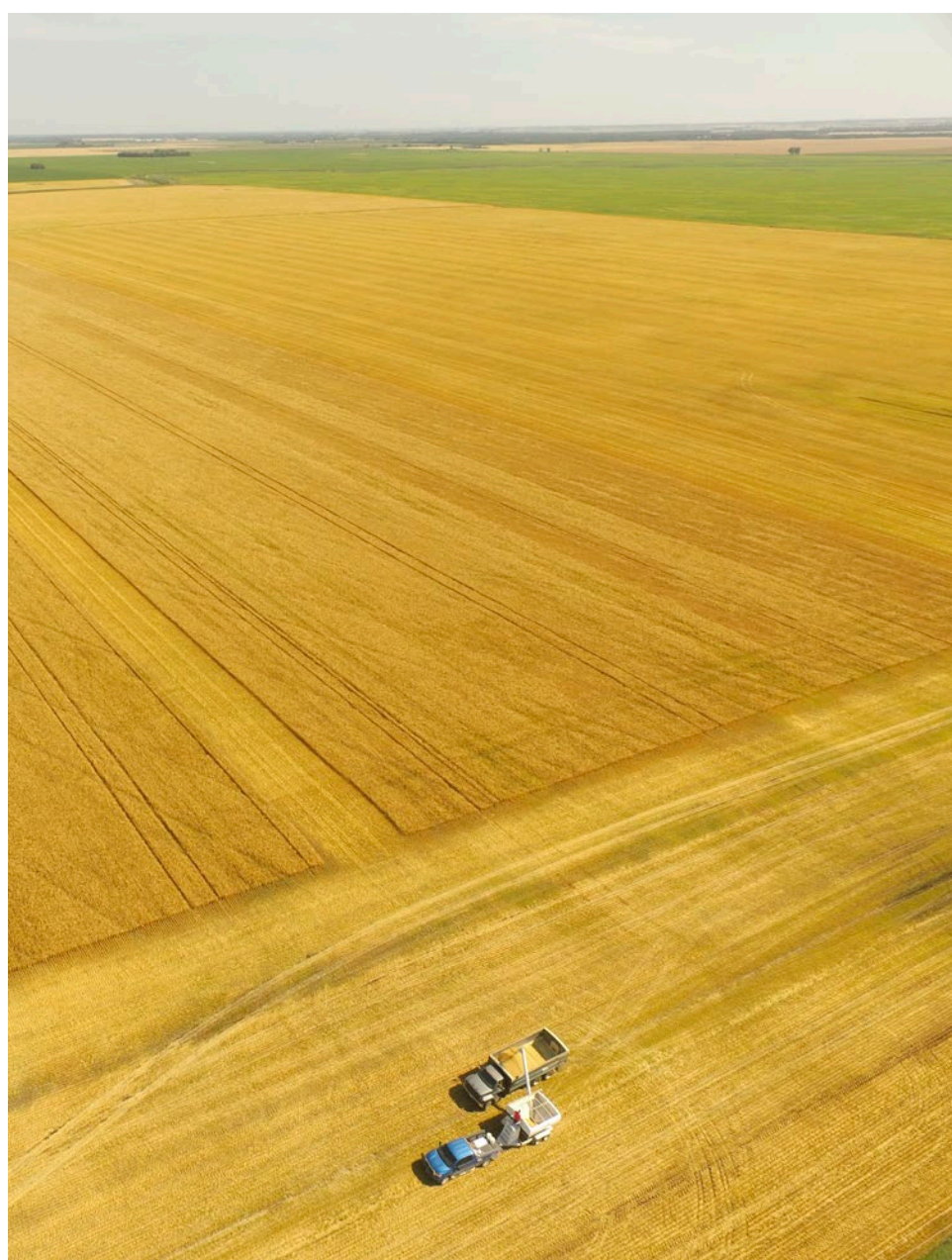
Measures pre-sprout damage using Rapid Visco Analysis (RVA). Strong pre-sprout damage is linked to lower viscosity and subsequently lower SN values.

TABLE 2 | SUMMARY OF MALT PROCESSING OF TESTED VARIETIES – AVERAGE 2020-2022

Variety	n	Barley DON, ppm	Malt DON, Ppm	Chit %	Steep Out Moisture, %	Acrospire Length
AAC Synergy	13	0.2	1.0	94.1	46.4	0.78
AAC Connect	9	0.2	0.7	98.2	46.0	0.75
CDC Fraser	4	0.2	1.0	94.0	46.9	0.81
CDC Copper	4	0.3	1.4	94.8	47.5	0.77
CDC Bow	1	0.2	1.5	100.0	46.0	0.81
CDC Churchill	3	0.2	0.3	98.0	47.2	0.84
AAC Goldman	1	0.2	0.4	95.0	44.3	0.80

Malt Processing Summary

There were no statistical differences between varieties based on water uptake and chitting after the steep process. This was also observed in the germination process where overall modification was similar across all lines based on acrospire length.



Malting Barley Farm Trials, Holland, MB, Aug. 22, 2020.

GLOSSARY OF TECHNICAL TERMS

MALT PROCESSING

Chit

Describes the emergence of sprouting grain. During malt processing, the percentage of germinating kernels are counted and described as the chitting percentage.

Steep Out

Moisture percentage of green malt as it progresses through the end of steep out. High steep-out moisture is usually an indication of pre-sprouted/water sensitive grain.

Acrospire Length

The average acrospire length to grain length ratio. This calculation describes the distribution of the acrospire length. This measurement takes place at the end of germination, to determine how slow or fast overall modification takes place.

Stained

Visual grading of discolouration/ weathering/mildew presence on a scale from 0-3 (0 = good, 3 = bad).

TABLE 3 | SUMMARY OF MALT QUALITY OF TESTED VARIETIES – AVERAGE 2020–2022

Variety	n	Malt Moisture %	Friability %	Fine Extract %	Coarse Extract %	F/C Diff %	Soluble Protein %	Malt Protein %	Kolbach S/T Ratio	Diastatic Power °L	α-Amylase D.U.	β-Glucan mg/L	Colour °L	Viscosity cP	FAN mg/L
AAC Synergy	13	4.3	83.5	81.4	80.9	0.5	5.42	11.70	46.5	144	80.7	152	2.26	1.44	209
AAC Connect	9	4.2	83.7	81.9	81.1	0.8	5.49	12.00	45.9	157	94.3	231	2.19	1.45	207
CDC Fraser	4	4.2	92.9	81.7	81.4	0.3	6.00	11.80	51.0	169	84.4	71	2.84	1.42	242
CDC Copper	4	4.3	83.3	81.3	80.4	0.9	5.30	11.95	44.4	146	75.9	108	3.43	1.44	191
CDC Bow	1	4.3	84.4	81.9	81.3	0.6	6.04	11.60	52.1	157	86.7	86	2.68	1.42	225
CDC Churchill	3	4.2	86.5	81.1	80.2	0.9	5.67	12.43	45.8	151	89.9	121	2.29	1.42	228
AAC Goldman	1	4.6	76.8	81.0	79.9	1.1	4.61	11.50	40.2	149	73.5	165	1.64	1.45	161

Malt Quality Summary

While there were no statistical differences between varieties based on malt quality, there were some differences in terms of averages of note:

Fine Extract

- AAC Connect, CDC Fraser, CDC Churchill and AAC Goldman all exhibited very good extract levels of 81% or higher.
- CDC Fraser, CDC Bow and AAC Connect all exceeded the extract levels of the check.

Beta-Glucan

- While average beta-glucan levels were higher than would typically be desired by maltsters and brewers in some instances, this was due to some outlier results in 2022 which brought up averages. Given this was only the case in limited samples, statistically it was not considered significant.

Diastatic Power (DP)

- CDC Fraser had the highest average DP levels overall while CDC Copper had the lowest. However, there was no statistical differences in terms of DP levels among the varieties.

Colour

- CDC Copper exhibited the darkest wort colour while AAC Goldman exhibited the lightest.

GLOSSARY OF TECHNICAL TERMS

MALT QUALITY

Moisture

The amount of water content by percentage weight. High moisture can cause degradation of the malt. Low moisture will enable malt to break easier.

Friability

A measure of how “crushable” the malt is. Well-modified malt should have > 85% of its weight to contain friable material.

Protein

The measure of protein content by percentage weight. Protein content affects potential sugar extract.

Fine extract dry basis (d.b.)

A measure of potential sugar content in the malt.

Diastatic Power (DP)

A measure of saccharifying (enzymatic) potential of the malt.

Alpha-amylase

Activity of a key saccharifying enzyme in malt.

Soluble Protein

Percentage weight of protein in malt that has been broken down during the malting process. These smaller proteins are soluble and subsequently measured in the wort.

S/T Ratio

Percentage of soluble protein/malt protein. Can be used to determine how well modified a malt is.

Free Amino Nitrogen (FAN)

Measure of small nitrogen containing compounds used for yeast vitality.

Colour

Scale used to measure the colour of malt. A higher number indicates a darker malt.

Beta-glucan

Non-starch polysaccharide that surrounds starch cell walls. Too much beta-glucan can cause filtering/lautering issues in the brewing process.

Viscosity

Viscosity is a measure of the resistance to shearing forces. Well modified malt should exhibit lower viscosity values due to the breakdown of long chain structures housed in the barley.

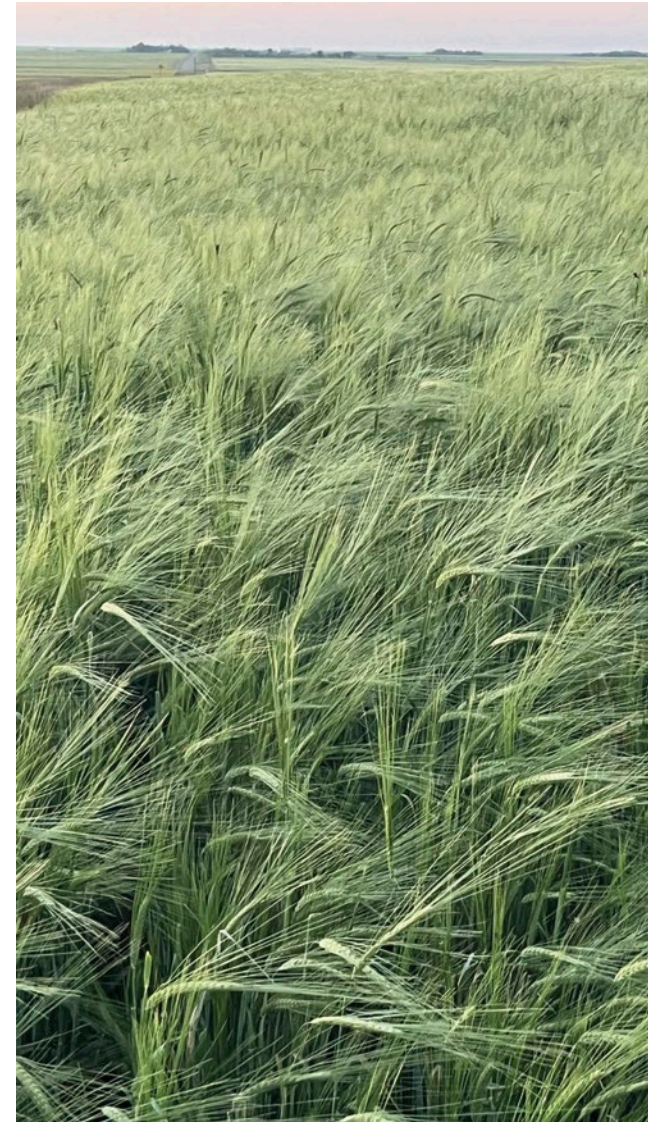


TABLE 4 | SUMMARY OF BEER QUALITY OF TESTED VARIETIES – AVERAGE 2020–2022

Variety	n	Overnight AE	Overnight ABV %	Conversion Time Min	Attenuation Limit %	Wort Maltotriose g/L	Wort Maltose g/L	Wort Glucose g/L	Wort Fructose g/L
AAC Synergy	13	1.23	5.45	18.67	89.77	16.52	60.28	15.85	2.19
AAC Connect	9	1.17	5.42	18.43	90.41	16.86	62.49	16.67	2.08
CDC Fraser	4	1.12	5.81	21.25	90.97	16.86	60.40	17.18	2.43
CDC Copper	4	1.19	5.29	21.25	89.78	16.43	59.84	15.80	2.34
CDC Bow	1	1.19	5.72	24.00	90.51	16.32	59.83	15.97	2.00
CDC Churchill	3	1.13	5.58	19.00	90.63	16.45	59.19	17.28	2.67
AAC Goldman	1	1.38	5.27	23.00	87.88	13.27	54.49	12.18	1.74

Brewing Performance and Beer Quality Summary

While there were no statistical differences between varieties based on brewing performance and overall beer quality, there were some differences in terms of averages:

Conversion Time

- AAC Connect and CDC Churchill had the lowest conversion times among new varieties, both below 20 minutes.

Attenuation Limit

- AAC Connect, CDC Fraser and CDC Churchill all exhibited very good fermentation with high attenuation limits.

GLOSSARY OF TECHNICAL TERMS

BEER QUALITY

Fermentable Sugars

As starch is converted in the mash process the wort will comprise of the following fermentable sugar molecules:

Wort Maltotriose

A trisaccharide comprised of three glucose sugars. Measured in grams per litre.

Wort Maltose

A disaccharide comprised of two glucose sugars. Measured in grams per litre.

Wort Glucose

A monosaccharide comprised of a single glucose. Measured in grams per litre.

Wort Fructose

A monosaccharide identical to glucose in molecular formula but is different in structure. Measured in grams per litre.

BREWING PERFORMANCE

Overnight Apparent Extract (AE)

Lab bench test where wort is fermented overnight followed by the measurement of total residual dissolved solids left in the wort. This is measured by determining the wort's specific gravity.

Overnight Alcohol by Volume (ABV)

The standard measure of alcohol content within a given volume after wort fermentation. Higher ABV indicates a desirable quality trait.

Conversion Time

The time it takes for the enzyme content within the mash portion of the brewing process to convert the starch amylose into fermentable sugars. This is determined by adding an Iodine -KI reagent. A shorter time is indicative of better performance.

Attenuation Limit

The sum of all sugars that the yeast ferments expressed as a percentage of total extract. This measurement provides the potential for the fermentation process, where a higher percentage equates to better fermentation.

APPENDIX

The following tables include detailed results by year, farm and variety. At each farm, AAC Synergy served as the check variety. A glossary of terms is provided on the last page of this report explaining each of the quality parameters measured in this study.

2020 SUMMARY

Fifty-six (56) individual samples were collected at harvest representing the different varieties, locations and field reps. Results indicated that 86% of samples were of selectable quality. Micro malting trials were conducted at the CMBTC on individual samples while pilot malting was conducted on composite samples at the Grain Research Laboratory. Eleven composite samples were then brewed on the CMBTC's small pilot scale brewing system.

APPENDIX | TABLE A: 2020 DETAIL BY VARIETY AND LOCATION

Year	Variety	Location	AGRONOMICS							MALT PROCESSING					BEER QUALITY	
			Yield Bu/ac	Protein, % db	Germination on Energy, %	Water Sensitivity	1000 Kernel Weight, g	Plumps, %	Barley DON, ppm	Fine Extract %	Kolbach S/T Ratio	β-Glucan mg/L	Diastatic Power °L	FAN mg/L	Overnight Apparent Extract	Overnight Fermentation ABV, %v/v
2020	AAC Synergy	Baldur	87	11.8	98.9	86.1	52.5	91.8	0.3	81.5	47.5	73	164	198	1.28	5.40
2020	CDC Fraser	Baldur	79	11.8	99.1	79.6	52.3	93.3	0.3	81.7	49.9	81	180	219	1.18	5.54
2020	CDC Copper	Baldur	85	11.8	91.6	59.5	50.2	93.1	0.3	81.1	43.4	95	155	174	1.44	5.44
2020	CDC Bow	Baldur	82	11.9	97.8	87.3	51.7	94.3	0.2	81.9	52.1	86	157	225	1.19	5.72
2020	AAC Synergy	Holland	92	11.9	99.0	62.4	50.4	96.1	0.3	82.1	46.8	241	128	199	N/A	N/A
2020	AAC Connect	Holland	85	11.6	98.8	65.4	50.6	95.5	0.3	82.8	46.7	317	139	189	N/A	N/A
2020	AAC Synergy	Lowe Farm	84	11.6	96.4	78.1	51.6	97.7	0.2	82.4	48.6	68	152	209	1.04	5.24
2020	CDC Fraser	Lowe Farm	71	12.2	96.4	68.6	51.0	96.8	0.2	81.7	48.5	73	170	231	1.30	5.61
2020	AAC Synergy	Manitou	98	11.2	97.9	90.0	48.1	92.5	0.2	81.8	45.3	104	140	183	1.30	5.45
2020	AAC Connect	Manitou	96	11.6	96.6	86.6	49.3	86.6	0.2	81.6	45.0	91	163	170	1.23	5.73
2020	CDC Copper	Manitou	100	11.6	93.6	52.0	46.9	88.8	0.3	81.0	42.2	142	128	165	1.23	5.38
2020	AAC Synergy	Wawanesa	95	11.5	98.6	52.0	52.4	96.6	0.2	82.3	50.4	166	128	206	1.32	5.73
2020	AAC Connect	Wawanesa	92	11.3	98.3	83.4	54.3	95.0	0.2	83.6	48.3	244	151	202	N/A	N/A
2020	AAC Goldman	Wawanesa	85	11.8	96.5	70.8	54.6	94.5	0.2	81.0	40.2	165	149	161	1.38	5.27

2021 SUMMARY

Thirty-eight (38) samples were collected from four of the sites representing the different varieties, locations and field reps (the fifth site, Baldur, was lost due to the extreme heat and drought). Results indicated that 91% of samples were of selectable malting quality. Pilot malting trials and malt quality were conducted on 11 samples (composites) in the Grain Research Laboratory. Brewing trials were completed in the CMBTC small pilot brewing system.

APPENDIX | TABLE B: 2021 DETAIL BY VARIETY AND LOCATION

Year	Variety	Location	AGRONOMICS							MALT PROCESSING					BEER QUALITY	
			Yield Bu/ac	Protein, % db	Germination on Energy, %	Water Sensitivity	1000 Kernel Weight, g	Plumps, %	Barley DON, ppm	Fine Extract %	Kolbach S/T Ratio	β-Glucan mg/L	Diastatic Power °L	FAN mg/L	Overnight Apparent Extract	Overnight Fermentation ABV, %v/v
2021	AAC Synergy	Holland	95	12.5	97.8	97.0	50.4	97.3	0.2	80.4	45.2	114	134	212	1.25	5.82
2021	AAC Connect	Holland	88	13.8	98.9	97.9	48.8	95.3	0.2	79.9	41.8	143	178	215	1.03	5.39
2021	AAC Synergy	Lowe Farm	90	13.2	98.8	97.8	48.8	96.6	0.2	79.6	45.0	69	157	240	N/A	6.18
2021	AAC Connect	Lowe Farm	83	13.5	98.8	98.8	49.5	95.3	0.2	80.1	45.9	75	168	253	1.33	6.10
2021	CDC Churchill	Lowe Farm	92	13.0	98.2	98.3	45.8	96.8	0.2	80.1	45.8	72	141	249	1.21	6.00
2021	AAC Synergy	Wawanesa	93	12.0	99.5	98.6	48.7	97.9	0.2	80.5	49.2	71	145	231	1.01	6.16
2021	AAC Connect	Wawanesa	88	12.8	99.4	98.9	49.0	96.3	0.2	80.9	48.8	76	178	234	0.95	6.00
2021	CDC Fraser	Wawanesa	85	12.1	99.5	97.6	47.2	97.7	0.2	80.7	51.0	69	153	242	0.90	6.84
2021	AAC Synergy	Westbourne	19	15.5	97.7	93.2	42.3	96.8	0.2	74.9	32.1	71	142	166	1.13	4.04
2021	CDC Copper	Westbourne	22	15.6	97.3	91.0	40.6	97.2	0.2	74.3	33.2	102	124	181	1.50	4.43
2021	CDC Bow	Westbourne	15	16.0	94.5	68.7	41.7	97.6	0.2	75.1	31.6	74	140	165	2.16	5.12

2022 SUMMARY

Sixteen (16) composite samples were collected from the five sites and assessed for barley quality, malting and brewing performance (one site was flagged for preharvest glyphosate and not used). Yield was collected from each site and DON evaluated on all samples. 62.5% were deemed selectable. All 16 samples were evaluated for barley quality and malting and brewing performance.

APPENDIX | TABLE C: 2022 DETAIL BY VARIETY AND LOCATION

			AGRONOMICS							MALT PROCESSING					BEER QUALITY	
Year	Variety	Location	Yield Bu/ac	Protein, % db	Germination on Energy, %	Water Sensitivity	1000 Kernel Weight, g	Plumps, %	Barley DON, ppm	Fine Extract %	Kolbach S/T Ratio	β -Glucan mg/L	Diastatic Power °L	FAN mg/L	Overnight Apparent Extract	Overnight Fermentation ABV, %v/v
2022	AAC Synergy	Arden	43	12.5	86.0	44.0	50.3	90.4	0.2	80.0	44.1	464	145	220	1.65	5.16
2022	AAC Connect	Arden	43	12.0	90.5	54.5	43.8	80.0	0.2	82.3	48.1	358	150	213	1.31	5.01
2022	CDC Copeland	Arden	35	12.1	84.0	59.0	43.6	88.5	0.2	80.6	47.5	256	143	245	1.51	4.92
2022	AAC Synergy	Baldur	99	12.2	98.5	86.5	51.2	95.0	0.4	82.4	50.8	81	156	240	1.11	5.34
2022	CDC Fraser	Baldur	93	12.5	95.5	78.0	50.4	95.0	0.2	82.7	54.6	62	174	277	1.08	5.26
2022	CDC Copper	Baldur	85	12.3	98.0	66.0	47.8	92.8	0.4	82.0	50.9	93	162	235	1.08	5.29
2022	CDC Churchill	Baldur	97	12.0	99.5	87.5	45.6	93.0	0.2	82.3	52.5	117	163	257	0.97	5.49
2022	AAC Prairie	Baldur	77	12.3	98.0	76.0	42.8	89.1	0.3	81.7	58.3	47	183	310	1.02	5.19
2022	AAC Synergy	Holland	105	12.5	94.0	74.0	53.1	95.1	0.3	81.7	43.5	321	132	194	1.50	4.65
2022	AAC Connect	Holland	110	12.1	96.5	78.5	53.0	92.4	0.3	82.6	40.7	541	140	180	1.42	4.73
2022	AAC Synergy	Wawanesa	85	11.4	95.0	65.0	52.6	97.0	0.4	82.6	47.4	139	139	204	0.96	4.89
2022	AAC Connect	Wawanesa	90	11.6	96.0	64.0	49.9	95.5	0.4	83.5	48.2	237	150	203	0.90	4.96
2022	AAC Prairie	Wawanesa	85	12.0	72.5	21.5	45.1	94.4	0.3	83.0	52.9	49	171	254	1.35	5.22
2022	AAC Synergy	Westbourne	124	13.0	90.5	76.0	54.6	95.8	0.2	80.9	40.1	61	149	181	1.05	5.43
2022	CDC Copper	Westbourne	114	13.1	95.5	77.0	47.8	91.6	0.2	80.9	40.9	99	140	191	1.02	5.05
2022	CDC Churchill	Westbourne	125	13.3	97.5	72.5	47.0	93.1	0.2	80.9	39.1	174	148	179	1.21	5.24



MB Farm Trials - AAC Connect (left) & CDC Fraser (right) at Wawanesa, MB.

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