Canadian Grain Commission
Commission canadienne des grains

Barley Production and Quality of Western Canadian Malting Barley

2022

Annual Barley Harvest Report

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Photos courtesy of Dr. Ana Badea, Brandon Research and Development Centre, Agriculture and Agri-Food Canada (AAFC)

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Summary

In western Canada, the total area seeded with barley was 2.761 million hectares in 2022. The total barley production is estimated at 9,666,000 tonnes, approximately 46% higher than last year. This year's favourable growing conditions resulted in an estimated barley yield of 70.5 bushels per acre (BPA) which is higher than the 10-year average yield (64.7 BPA).

CDC Copeland and AAC Synergy were the predominant cultivars of malting barley in western Canada but the area seeded with CDC Copeland continued to decline. The popularity of newer varieties (AAC Connect, CDC Fraser and CDC Churchill) increased noticeably in 2022, whereas the area seeded with AC Metcalfe continued to decline.

The favourable growing conditions in 2022 had positive effects on the quality of malting barley. The average level of barley proteins (12.3%) in 2022 was considerably lower than last year (13.2%). 2022 barley exhibited an excellent average germination energy of 99% with no water sensitivity. The average 1000 kernel weight was 45.0 g, which is close to the 10-year average (45.3 g). The newer varieties with kernels larger than AC Metcalfe and CDC Copeland contributed to the overall high average kernel weight. The average test weight of 2022 barley was 66.7 kg/hL, which is higher than last year (64.8 kg/hL), and equal to the 10-year average (66.7 kg/hL). The average plumpness of barley was 93.8%, which is lower than last year (96.1%), but higher than the 10-year average (93.3%). The majority of barley grown in 2022 was generally very sound with average RVA values above 120 RVU.

Overall, the malting quality of barley selected in 2022 was very good. Careful processing resulted in well-modified malt with adequate levels of enzymes (diastatic power and α-amylase). Wort was characterized by satisfactory levels of soluble proteins, free amino nitrogen (FAN), β-glucans, and viscosity. A lower concentration of grain protein in 2022 barley contributed to about 1.5% higher malt extract levels compared to 2021.

Part 1: Growing and harvest conditions in 2022

In 2022, the growing season in Alberta began with dry conditions and cool temperatures. The rainfall in June, however, was much higher than normal (Figure 1.1) and supplied enough moisture for crop growth. From the beginning of July to the end of the growing season, temperatures were above average, which resulted in favourable growing conditions that advanced the progress of harvest by two to three weeks (Figures 1.6, 1.7 and 1.8). The favourable weather conditions during the growing season and harvest resulted in above average yields and quality.

In Saskatchewan, cool temperatures and early spring snowstorms delayed seeding for many producers. By the end of May, producers in western Saskatchewan were close to being finished seeding, while many in the east were behind schedule due to rain and extremely wet fields. Across the province, crops grew quickly in June and July due to sufficient rainfall and relatively warm weather (Figures 1.1, 1.2 and 1.6). Hot and dry weather in August allowed for good harvest progress, especially in the southwest and west-central regions (Figures 1.3 and 1.7). The east-central region received heavy rainfall, which slowed down the maturation of crops or halted harvest. In September, the weather remained warm and dry, and producers were able to harvest their crop without any major issues (Figures 1.4 and 1.8).

In Manitoba, a very wet spring led to overland flooding and saturated soils, and seeding was delayed by up to four weeks. A warm summer followed in July, allowing crops to reach their expected development for that time of year (Figure 1. 6). Rain in July and August (Figures 1.2 and 1.3) resulted in crops with average and above average yields. Manitoba had a lengthy harvest due to late seeding and late September rain in some areas. A generally warm and dry September (Figures 1.4 and 1.8) resulted in barley with good yields and quality.

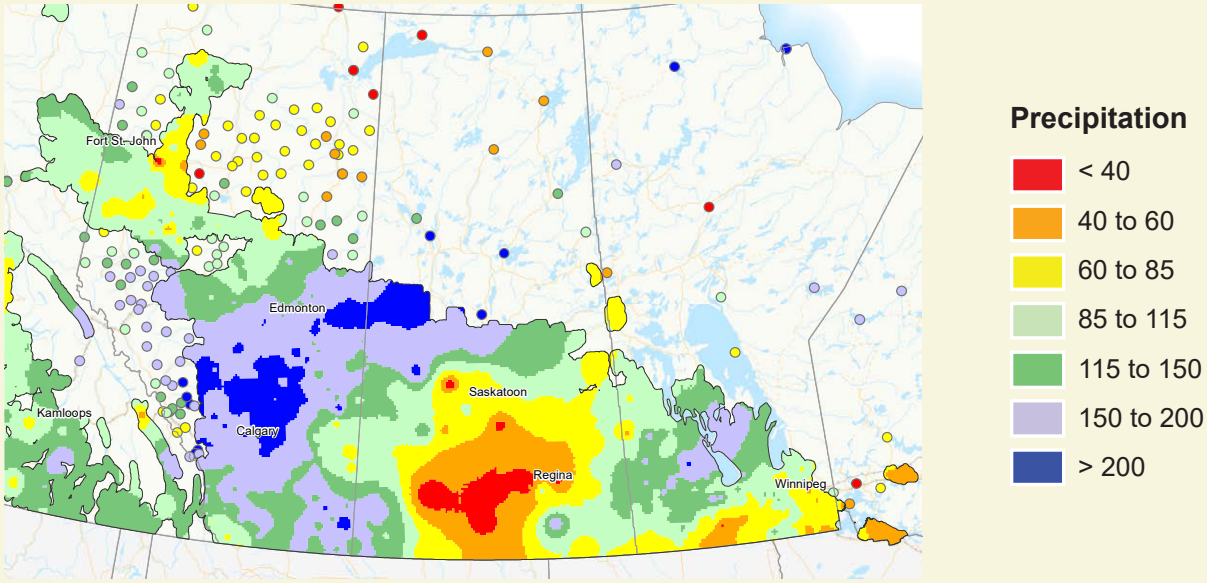


Figure 1.1 Percent of average precipitation in June 2022.

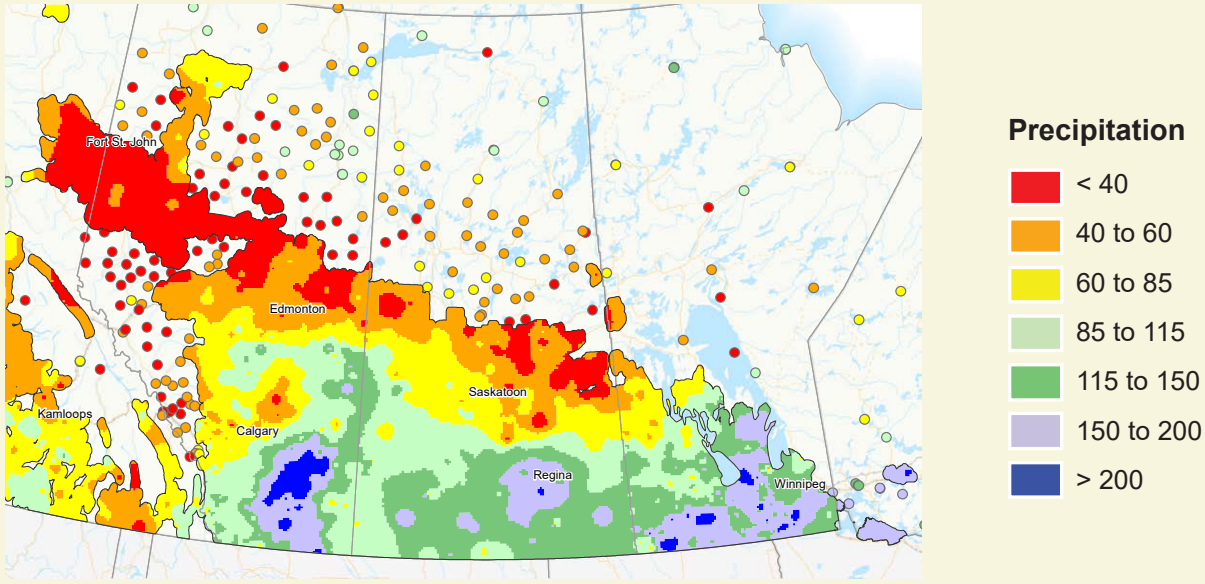


Figure 1.2 Percent of average precipitation for July 2022.

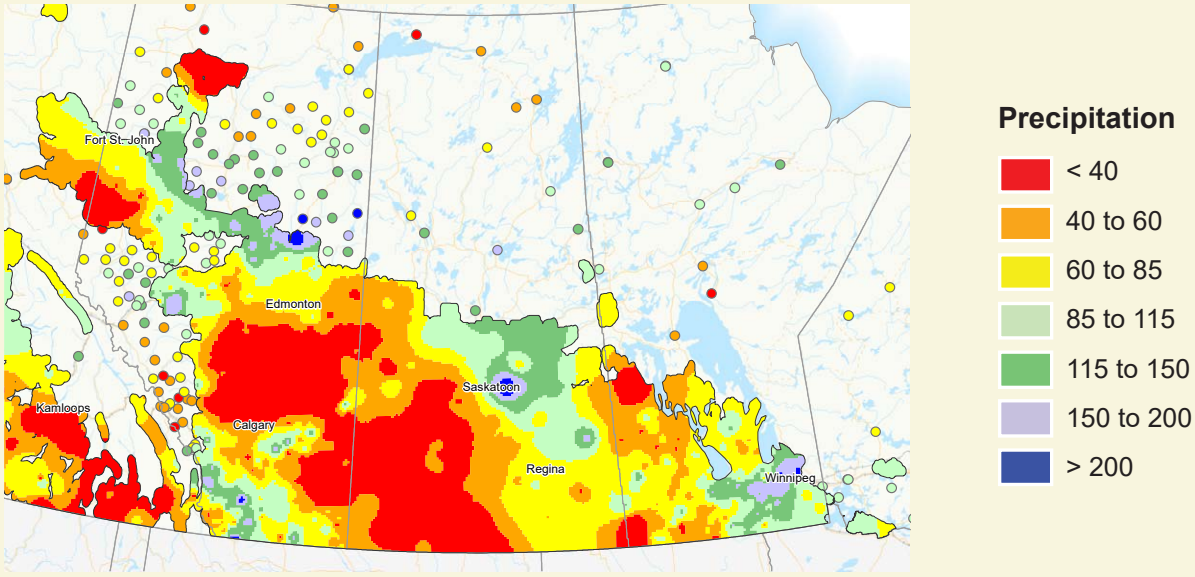


Figure 1.3 Percent of average precipitation in August 2022.

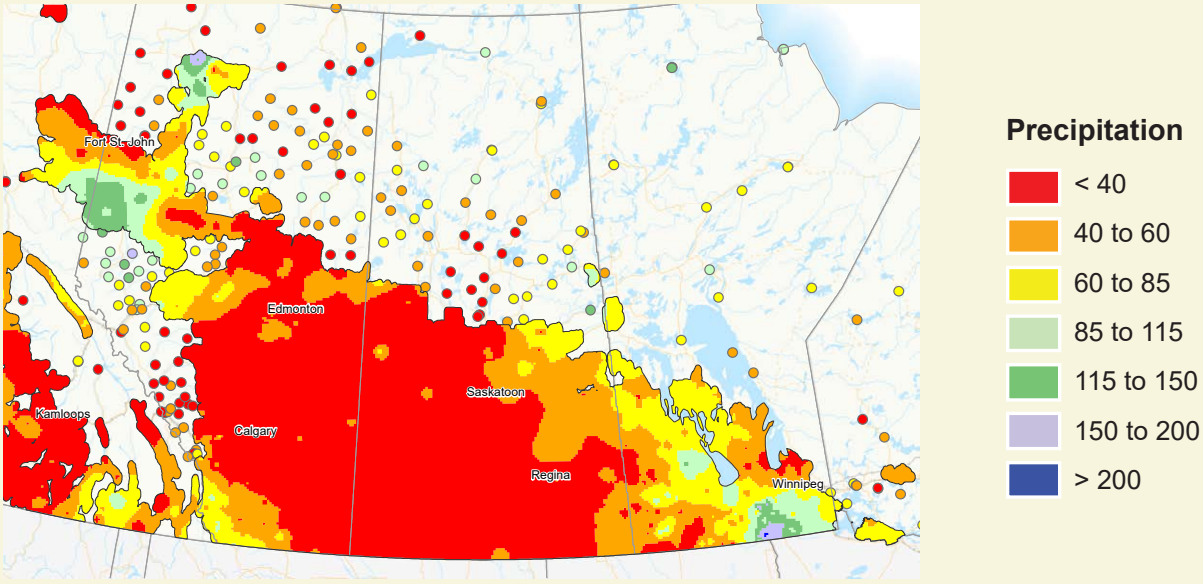


Figure 1.4 Percent of average precipitation in September 2022.

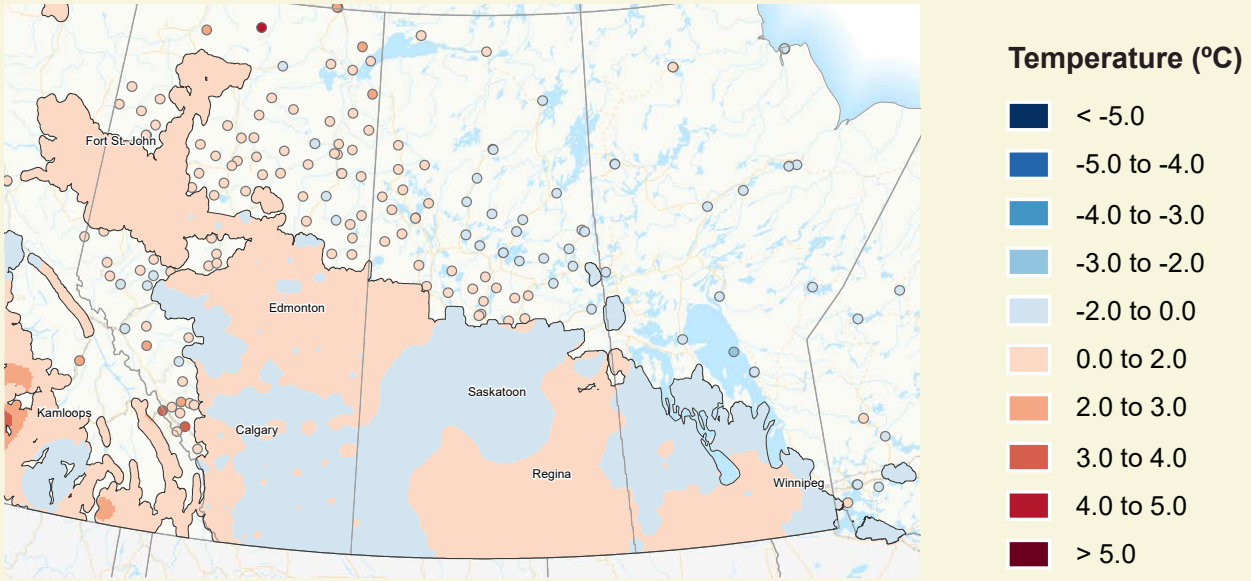


Figure 1.5 Mean temperature difference from normal for June 2022.

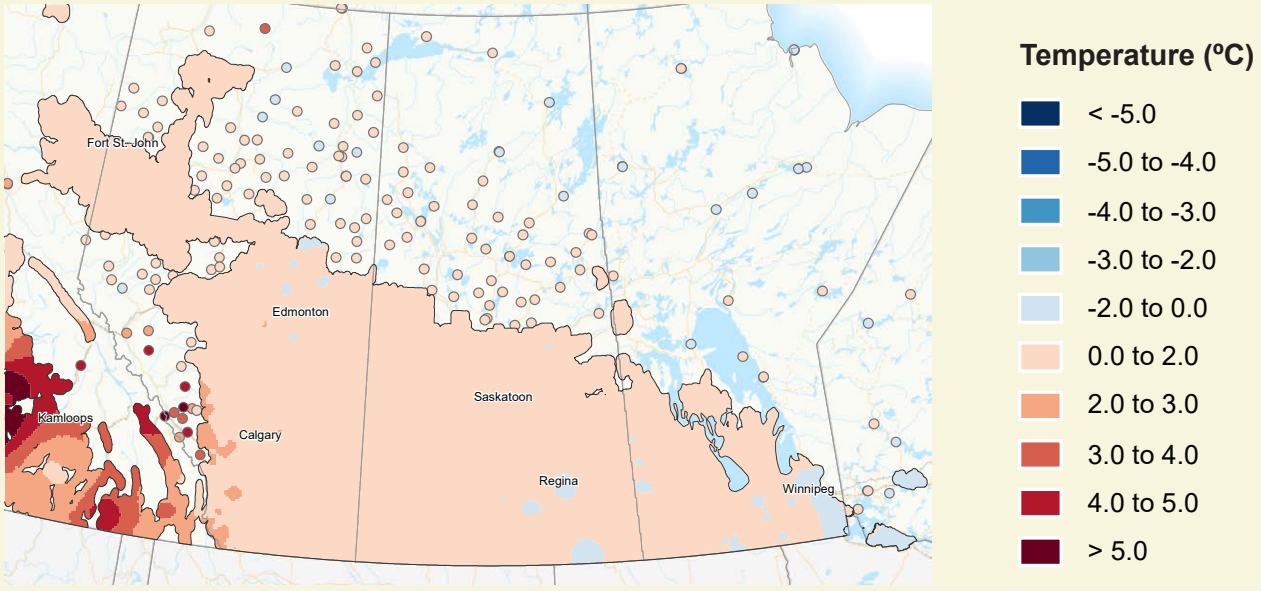


Figure 1.6 Mean temperature difference from normal for July 2022.

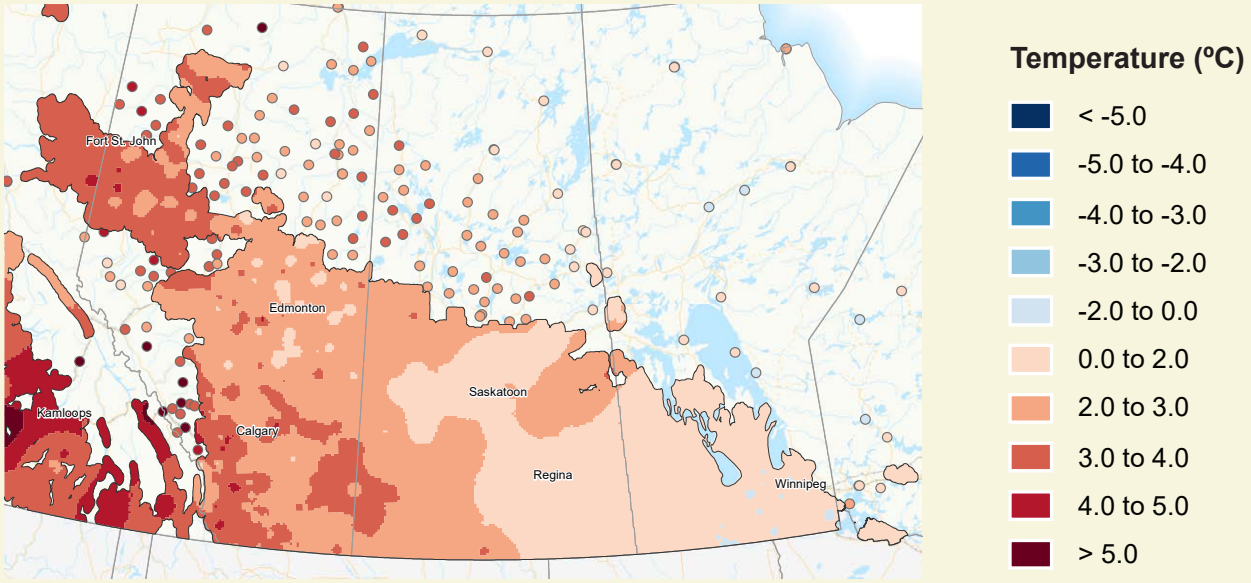


Figure 1.7 Mean temperature difference from normal for August 2022.

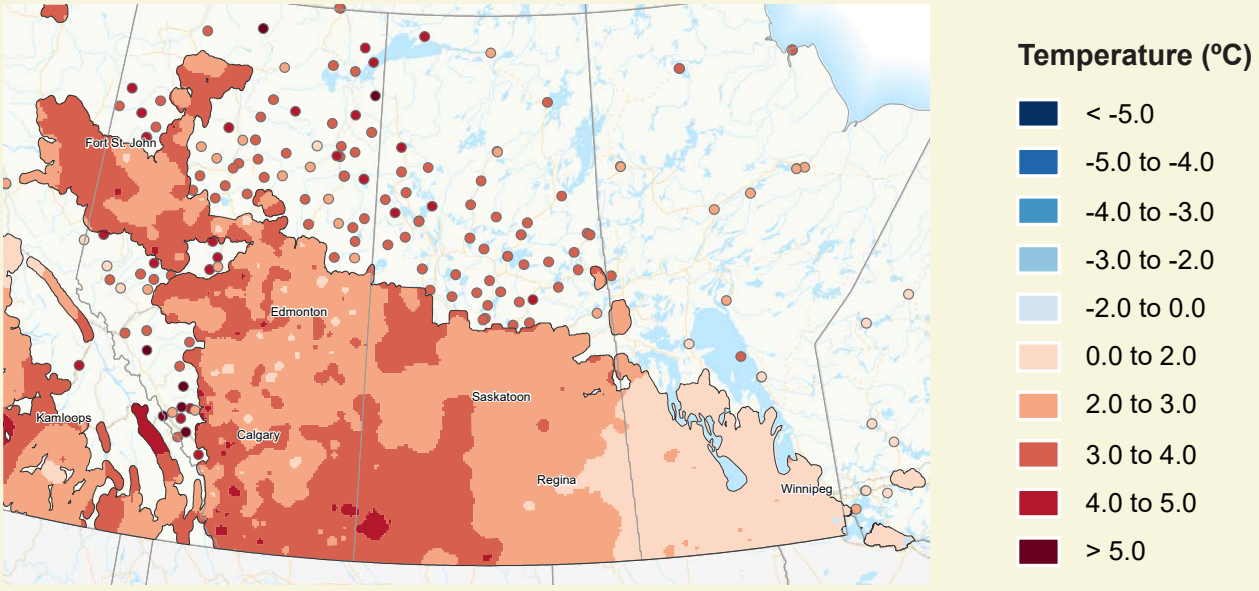


Figure 1.8 Mean temperature difference from normal for September 2022.

Part 2: Barley production in 2022

2.1 Annual production statistics

In 2022, the total area seeded with barley in western Canada was 2.761 million hectares. This is lower than last year (3.262 million hectares), but close to the 10-year average (2.684 million hectares) (Table 2.1). Barley production in western Canada in 2022 is estimated at 9.666 million tonnes. This is approximately 46% higher than last year and 17% higher than the 10-year average (Table 2.2). The favourable growing conditions in 2022 resulted in an estimated barley yield of 70.5 bushels per acre (BPA), higher than the 10-year average yield (64.7 BPA) (Table 2.3 and Figure 2.3).

Table 2.1 Area (million hectares) seeded with barley in Canada

Area seeded with barley (million hectares)			
	2022[1]	2021	10-year average[2]
Manitoba	0.171	0.167	0.162
Saskatchewan	1.126	1.500	1.092
Alberta &	1.438	1.565	1.405
British Columbia	0.026	0.030	0.025
Western Canada	**2.761**	**3.262**	**2.684**
Canada	**2.851**	**3.362**	**2.812**

[1]Source: Statistics Canada, estimated as of December 2, 2022.
[2]10-year average from 2012 to 2021

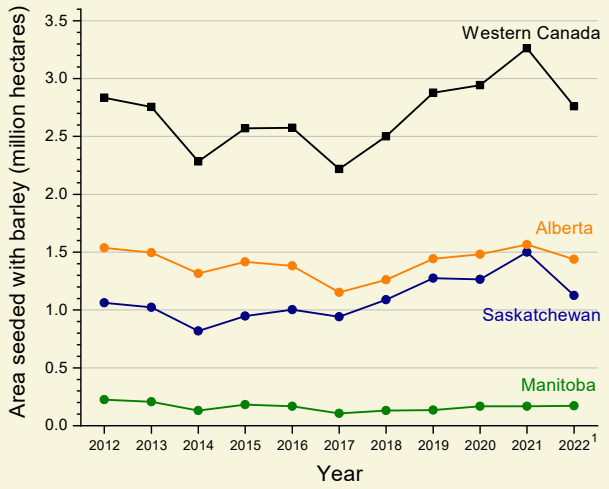


Figure 2.1 Annual comparison of area (million hectares) seeded with barley in western Canada.

[1]Source: Statistics Canada, estimated as of December 2, 2022.

Table 2.2 Barley production (million tonnes) in Canada

Barley production (million tonnes)	2022[1]	2021	10-year average[2]
Manitoba	0.657	0.432	0.550
Saskatchewan	3.551	2.547	3.213
Alberta	5.381	3.571	4.454
British Columbia	0.077	0.063	0.060
Western Canada	**9.666**	**6.613**	**8.277**
Canada	**9.987**	**6.959**	**8.686**

Table 2.3 Average barley yield (bushels per acre) in Canada

Yield (bushels per acre)	2022[1]	2021	10-year average[2]
Manitoba	74.3	54.8	69.6
Saskatchewan	63.4	35.5	59.7
Alberta	75.9	47.4	67.8
British Columbia	59.5	41.0	57.7
Western Canada	**70.5**	**42.2**	**64.7**
Canada	**70.4**	**43.0**	**64.3**

[1]Source: Statistics Canada, estimated as of December 2, 2022.
[2]10-year average from 2012 to 2021

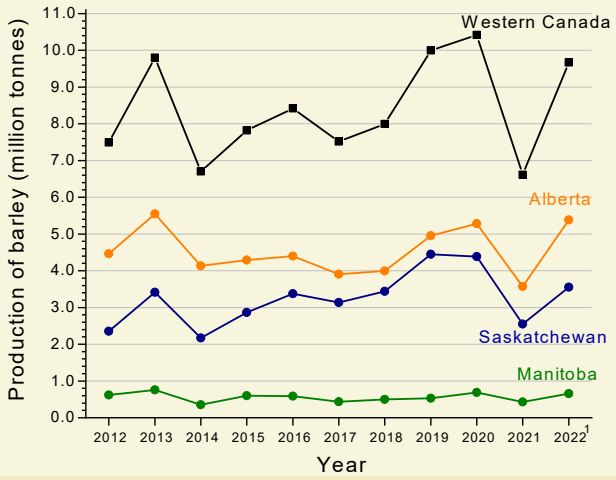


Figure 2.2 Annual comparison of barley production (million tonnes) in western Canada

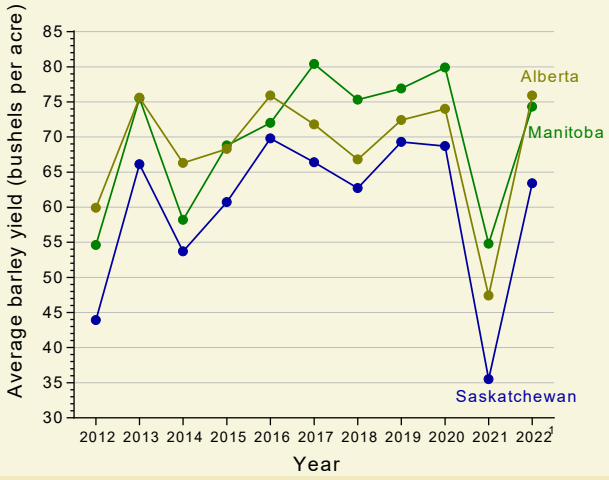


Figure 2.3 Annual comparison of average barley yield (bushels per acre) in western Canada

[1]Source: Statistics Canada, estimated as of December 2, 2022.

2.2 Distribution of barley classes

Barley is grown across the Canadian prairies and is used for malting, food, and general purposes (feed and forage). Based on insured commercial acres in 2022, general purpose barley accounted for 53.2% of the area seeded with barley in Alberta and British Columbia while malting barley accounted for 42.7% (Figure 2.4a). In Saskatchewan, the majority of the area seeded with barley (56.2%) was planted with malting barley varieties (Figure 2.4a). In Manitoba, approximately 40.5% of the area seeded with barley was planted with malting varieties and 54.1% with general purpose varieties (Figure 2.4a). Across western Canada in 2022, the area seeded with barley consisted of 48.2% malting barley, 44.3% general purpose barley, and 2.4% food barley (Figure 2.4b).

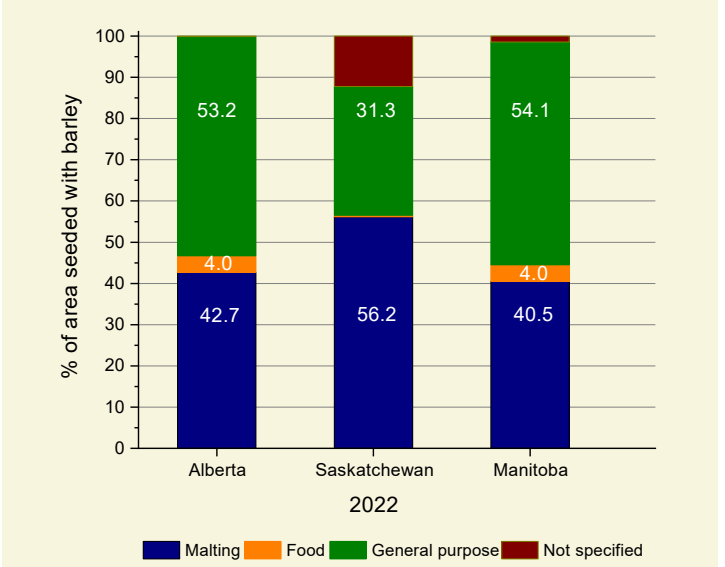


Figure 2.4a Distribution of barley classes as a percentage of total area seeded with barley in each province in 2022[3].

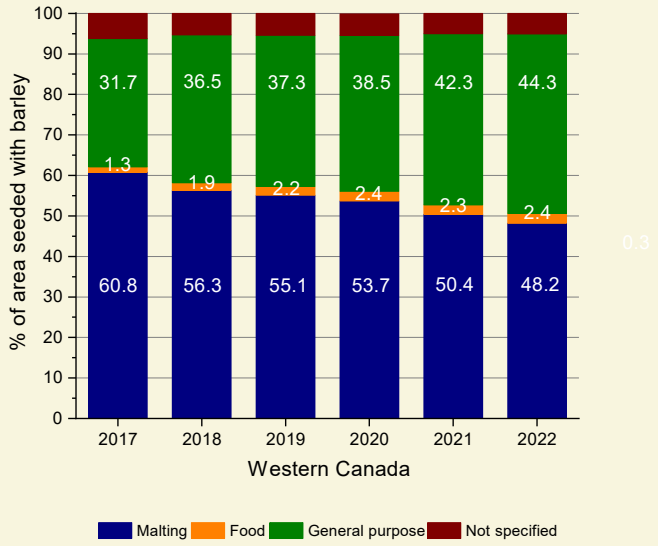


Figure 2.4b Distribution of barley classes as a percentage of area seeded with barley in western Canada from 2017-2022[3].

[3]Source: Sask Crop Insurance, Alberta Ag Financial Services Corp., Manitoba Agricultural Services Corporation, BC Crop Insurance

2.3 Distribution of malting varieties

In 2022, CDC Copeland and AAC Synergy were the most common cultivars of malting barley grown in western Canada (Table 2.4). The area seeded with CDC Copeland was 31.2% in 2022, a decrease from 34.8% in 2021 (Table 2.4 and Figure 2.5). The area seeded with AAC Synergy, which has been steadily growing since 2015, increased only slightly to 28.5% from 28.2% in 2021. The area seeded with AC Metcalfe decreased to 9.2% from 11.2% in 2021 (Figure 2.5). AAC Connect is becoming a popular variety whose acreage shows a steady growth and in 2022, it increased to 9.7% from 8.7% in 2021. The area planted with recently registered two-rowed cultivars, especially CDC Fraser, CDC Copper, CDC Churchill, and Sirish, continued to grow. In 2022, the area planted with CDC Bow decreased to 1.9% from 2.7% in 2021 (Figure 2.6). The newer malting barley varieties accounted for approximately 15.4% of the total area seeded with malting barley varieties in western Canada (Table 2.4).

The production of six-rowed malting barley continued to decline. In 2022, six-rowed cultivars accounted for approximately 2.7% of the total area seeded with malting barley, down from 2.8% in 2021 and 3.3% in 2020. Legacy, Celebration and Tradition remained the top three six-rowed varieties (Table 2.4).

In each province, the production of two-rowed cultivars predominated (Table 2.4). CDC Copeland and AAC Synergy were predominant in Alberta and Saskatchewan. The area seeded with malting barley in Manitoba was relatively low, compared to other western provinces. In 2022, the most popular cultivars in Manitoba were AAC Synergy and AAC Connect, followed by CDC Copeland (Table 2.4).

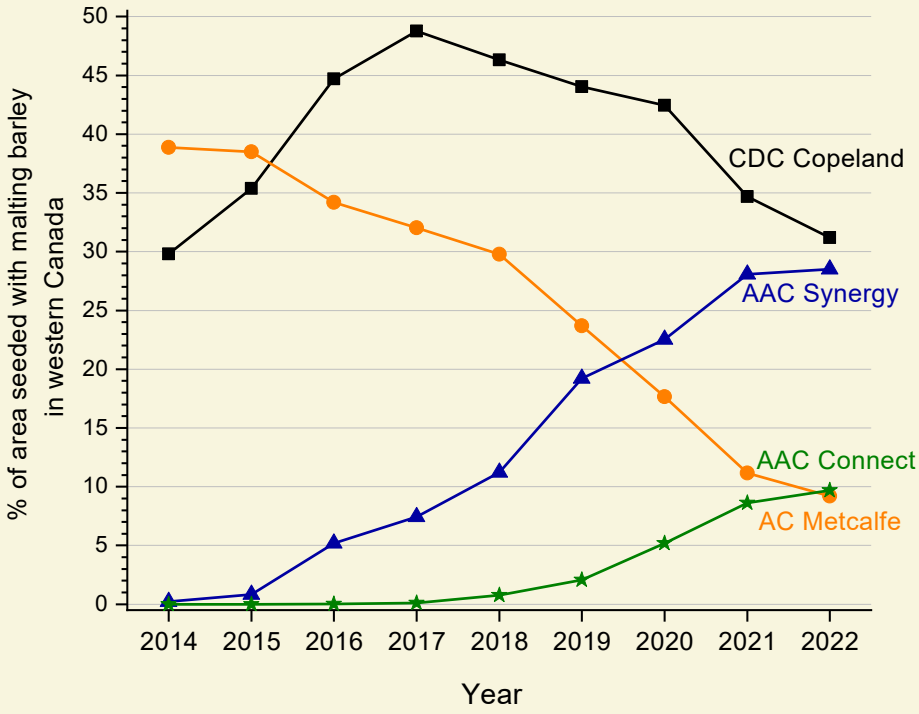


Figure 2.5 Comparison of the area seeded with top malting barley cultivars in western Canada from 2014 to 2022[3].

[3]Source: Sask Crop Insurance, Alberta Ag Financial Services Corp., Manitoba Agricultural Services Corporation, BC Crop Insurance

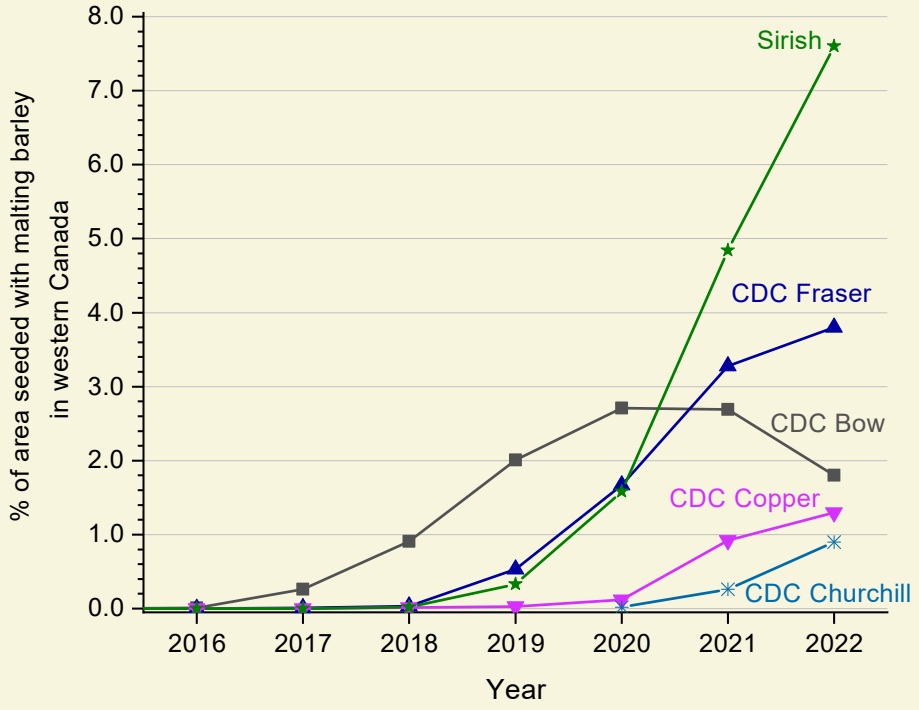


Figure 2.6 Comparison of the area seeded with recently registered malting barley cultivars in Western Canada from 2016 to 2022[3]. CDC Bow (2015), CDC Fraser (2016), Sirish (2017), and CDC Copper (2018); year in brackets indicates the date of variety registration.

[3]Source: Sask Crop Insurance, Alberta Ag Financial Services Corp., Manitoba Agricultural Services Corporation, BC Crop Insurance.

Table 2.4 Distribution of malting barley cultivars as a percentage (%) of area seeded with malting barley in western Canada in 2022[3]

% of area seeded with malting barley in western Canada in 2022				
Malting barley cultivars	**Alberta**	**Saskatchewan**	**Manitoba**	**Western Canada**
2-rowed	%	%	%	%
CDC Copeland	13.31	16.78	0.81	31.15
AAC Synergy	11.95	14.87	1.54	28.49
AAC Connect	3.54	4.32	1.52	9.67
AC Metcalfe	4.06	4.45	0.55	9.19
Sirish	7.02	0.09	0.07	7.55
CDC Fraser	1.11	2.29	0.38	3.78
CDC Bow	0.98	0.71	0.12	1.82
CDC Copper	1.00	0.22	0.05	1.31
CDC Churchill	0.54	0.34	0.05	0.93
Newdale	0.08	0.40	0.34	0.83
Cerveza	0.57	0.10	0.04	0.71
Bill Coors 100	0.57	0.04	0.00	0.61
Bentley	0.26	0.02	0.00	0.28
CDC Meredith	0.09	0.19	0.00	0.28
CDC Goldstar	0.00	0.15	0.00	0.15
CDC Platinumstar	0.00	0.15	0.00	0.15
AB Brewnet	0.08	0.00	0.00	0.08
CDC Clear	0.00	0.06	0.00	0.06
Other	0.21	0.12	0	0.33
Total 2-rowed	**45.56**	**45.30**	**5.47**	**97.34**
6-rowed	**%**	**%**	**%**	**%**
Legacy	0.35	1.54	0.04	1.94
Celebration	0.00	0.16	0.31	0.47
Tradition	0.00	0.00	0.16	0.16
Other	0.06	0.00	0.03	0.09
Total 6-rowed	**0.42**	**1.70**	**0.54**	**2.66**

[3]Source: Sask Crop Insurance, Alberta Ag Financial Services Corp., Manitoba Agricultural Services Corporation, BC Crop Insurance

2.4 Distribution of general purpose and food barley varieties

Based on the 2022 insured acreage in western Canada, food (F) and general purpose (GP) barley varieties accounted for 46.7% of the total area seeded with barley (Figure 2.4b). CDC Austenson continued to predominate the area seeded with GP barley cultivars; however, the area seeded with CDC Austenson decreased to 41.5% in 2022 from 46.0% in 2021. (Table 2.5 and Figure 2.7). The area seeded with Brahma, Oreana, and Claymore decreased slightly in 2022 compared to 2021. The acreage of CDC Maverick increased from 3.5% in 2021 to 4.9% in 2022.

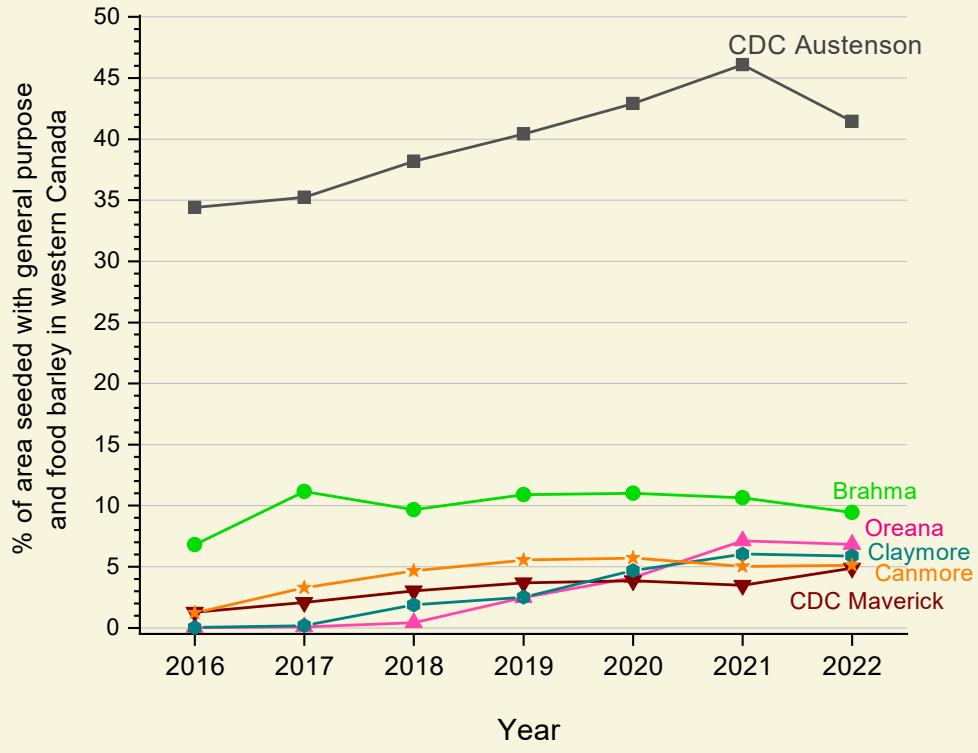


Figure 2.7 Comparison of areas seeded with the top five general purpose and food barley cultivars in western Canada from 2016 to 2022[3].

[3]Source: Sask Crop Insurance, Alberta Ag Financial Services Corp., Manitoba Agricultural Services Corporation, BC Crop Insurance

Table 2.5 Distribution of barley cultivars as a percentage (%) of area seeded with general purpose and food barley in western Canada in 2022[3]

% of area seeded with general purpose and food barley in western Canada in 2022				
General purpose cultivars	**Alberta**	**Saskatchewan**	**Manitoba**	**Western Canada**
CDC Austenson	20.19	16.09	4.97	41.45
Brahma	9.12	0.09	0.00	9.43
Oreana	6.02	0.78	0.03	6.83
Claymore	3.03	2.44	0.41	5.88
Canmore (F)	4.38	0.13	0.61	5.12
CDC Maverick	1.62	3.08	0.17	4.87
Conlon	1.88	0.11	2.19	4.18
Champion	2.64	0.90	0.03	3.57
Xena	2.94	0.32	0.00	3.26
CDC Coalition	2.81	0.00	0.00	2.81
Esma	2.17	0.08	0.22	2.47
Altorado	1.52	0.58	0.11	2.21
CDC Cowboy	0.83	0.94	0.00	1.77
AB Cattelac	0.76	0.48	0.11	1.35
AB Advantage	0.84	0.48	0.00	1.33
AC Rosser	0.08	0.24	0.00	0.32
CDC Thompson	0.28	0.00	0.00	0.28
Sundre	0.14	0.11	0.00	0.26
Ponoka	0.25	0.00	0.00	0.25
Seebe	0.23	0.00	0.00	0.23
Amisk	0.23	0.00	0.00	0.23
CDC Trey	0.23	0.00	0.00	0.23
Gadsby	0.16	0.04	0.00	0.20
AB Wrangler	0.09	0.05	0.00	0.14
AB Hague	0.07	0.06	0.00	0.13
Alston	0.11	0.00	0.00	0.11
CDC McGwire (HB, F)	0.00	0.11	0.00	0.11
Other	0.69	0.16	0.03	0.97
Total general purpose and food	**63.3**	**27.3**	**8.9**	**100.00**

[3]Source: Sask Crop Insurance, Alberta Ag Financial Services Corp., Manitoba Agricultural Services Corporation, BC Crop Insurance
F=Food; HB=hulless barley

Part 3: Annual harvest survey of malting barley

3.1 Sampling and survey methodology

The 2022 malting barley survey is based on varietal composites that represent about 1,795,000 tonnes of malting barley selected for domestic processing or for export. The grain handling and malting companies involved in the selection process were Cargill Ltd., Canada Malting Co. Ltd., Boortmalt, Rahr Malting Canada Ltd., Richardson International Ltd., Viterra Inc., and Malteurop Canada Ltd. The tonnage included in this survey represents only a portion of the total volume of malting barley selected in western Canada. Some samples included in this report came from the Canadian Grain Commission's Harvest Sample Program. Samples were received from the beginning of harvest until November 15, 2022.

3.2 Quality of barley selected for malting in 2022: general trends

In 2022, the average protein content in malting barley was 12.3%. This is significantly lower than last year (13.2%) and slightly higher than the 10-year average (11.8%) (Figure 3.1). The average test weight was 66.7 kg/hL, which is higher than last year (64.8 kg/hL), and equal to the 10-year average (66.7 kg/hL) (Figure 3.2). The average 1000 kernel weight was 45.0 g, which is close to the 10-year average (45.3 g) (Figure 3.3). Kernel plumpness, measured by counting the number of kernels remaining on a 6/64" slotted screen, had an average value of 93.8%. This is lower than last year (96.1%) and close to the 10-year average (93.3%) (Figure 3.4). 2022 barley exhibited excellent average germination energy at 4 mL (99%) (Figure 3.5). In 2022, the average germination energy at 8 mL was 92%, which indicates very little water sensitivity (Fig. 3.6). The results presented in Figures 3.1 to 3.6 represent weighted averages based on the tonnage of composite samples received and analysed.

3.3 Comparison of physicochemical parameters in individual barley varieties

Kernel hardness was determined for individual varieties using a single kernel characterization system. The results indicated some differences among barley varieties (Figure 3.7). The length of kernels of different malting varieties is shown in Figure 3.8. AAC Connect was characterized by longer kernels compared to other varieties. The content of β-glucans in selected malting varieties grown in western Canada in 2022 is shown in Figure 3.9. Among the two-row varieties, CDC Copeland exhibited the lowest β-glucan content and AC Metcalfe the highest. The content of arabinoxylans in selected malting varieties grown in western Canada is shown in Figure 3.10. The yearly variations in 1000 kernel weight and grain protein level for several established and new malting barley varieties are presented in Figure 3.11 and Figure 3.12, respectively. The 1000 kernel weight of CDC Copper, CDC Copeland, CDC Churchill, and AC Metcalfe was slightly lower than last year. The kernel weight of AAC Connect, CDC Fraser, CDC Bow and AAC Synergy was high and similar to values observed last year. All varieties show substantially lower protein content in 2022 compared to last year.

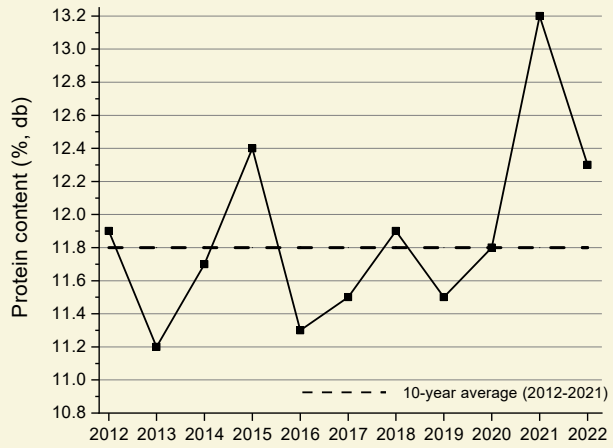


Figure 3.1 Average protein content in barley selected for malting from 2012 to 2022.

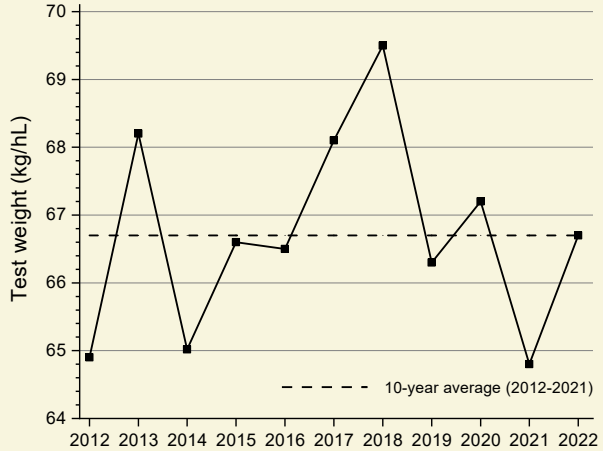


Figure 3.2 Average test weight of barley selected for malting from 2012 to 2022.

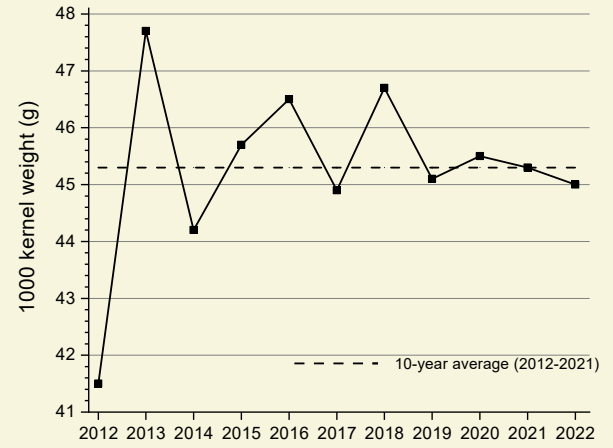


Figure 3.3 Average 1000 kernel weight of barley selected for malting from 2012 to 2022.

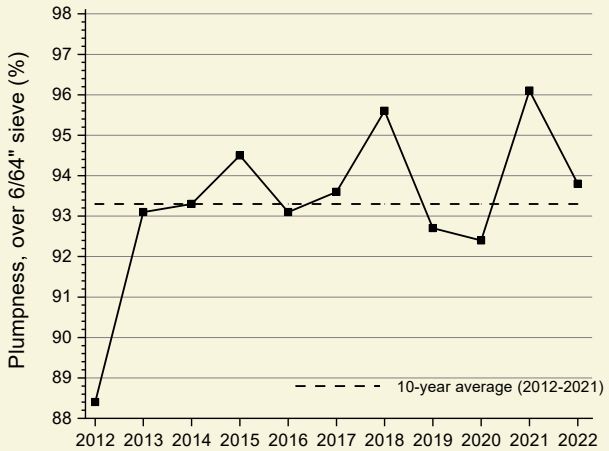


Figure 3.4 Average plumpness of barley selected for malting from 2012 to 2022.

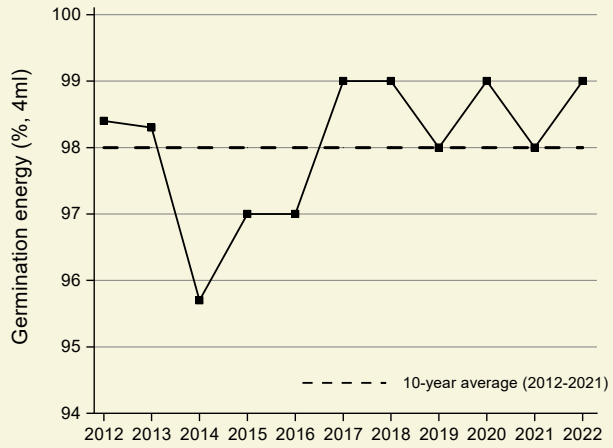


Figure 3.5 Average germination energy (4ml) of barley selected for malting from 2012 to 2022.

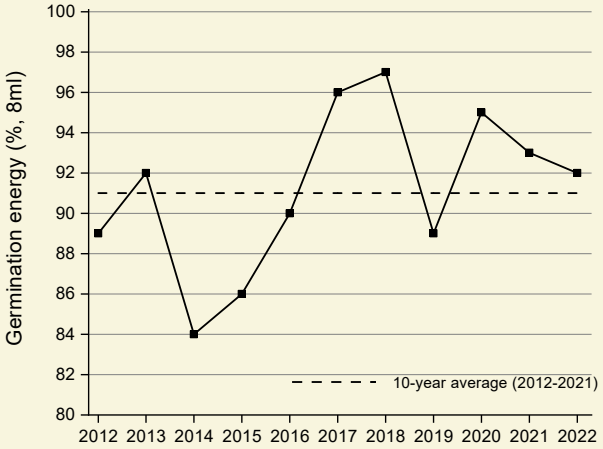


Figure 3.6 Average germination energy (8ml) of barley selected for malting from 2012 to 2022.

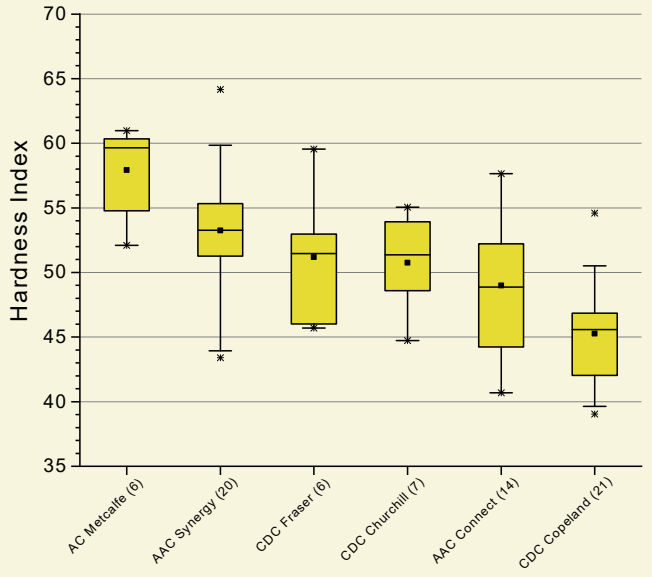


Figure 3.7 Kernel hardness index for barley cultivars selected for malting in 2022. Sample numbers for each variety are indicated in brackets.

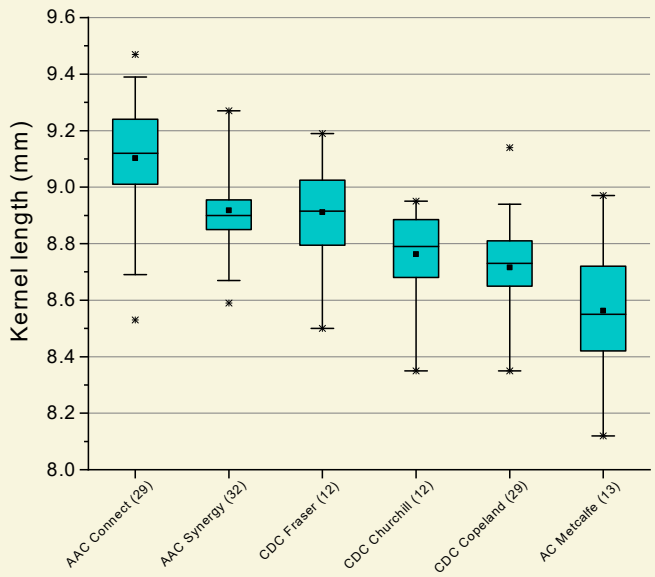


Figure 3.8 Kernel length for barley cultivars selected for malting in 2022. Sample numbers for each variety are indicated in brackets.

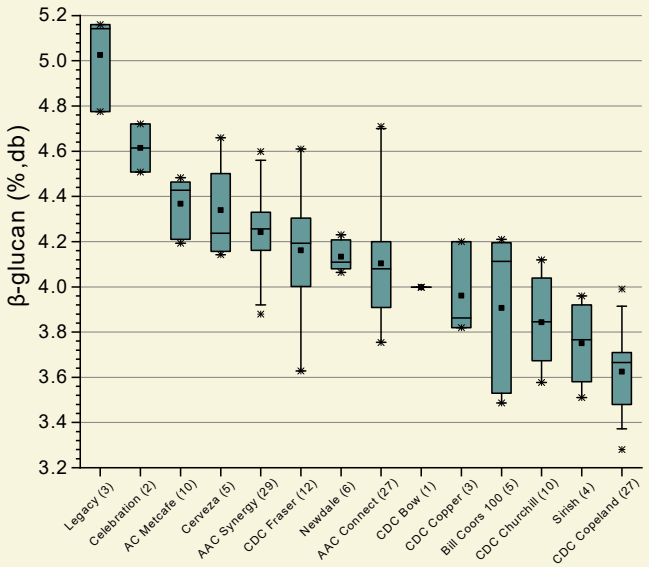


Figure 3.9 Content of β-glucans in selected barley cultivars in 2022. Sample numbers for each variety are indicated in brackets.

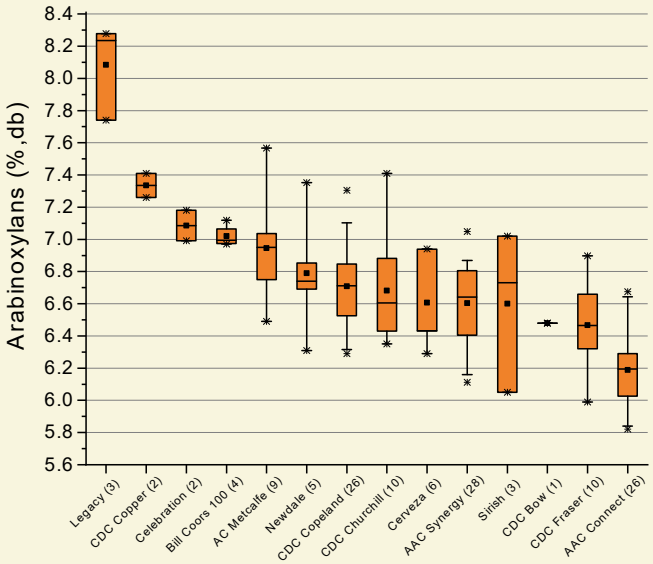


Figure 3.10 Content of arabinoxylans in selected barley cultivars in 2022. Sample numbers for each variety are indicated in brackets.

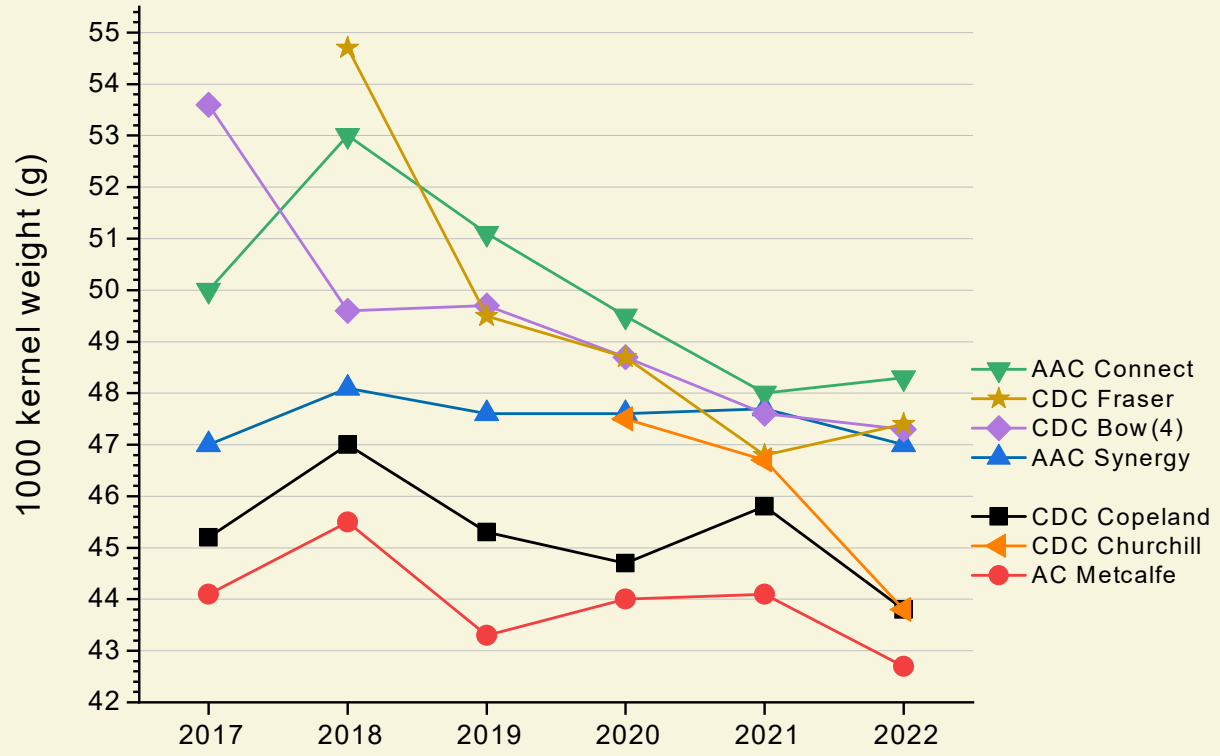


Figure 3.11 Comparison of the average 1000 kernel weight of selected barley varieties from 2017 to 2022. Values represent arithmetic averages. Samples for CDC Bow are limited to 4.

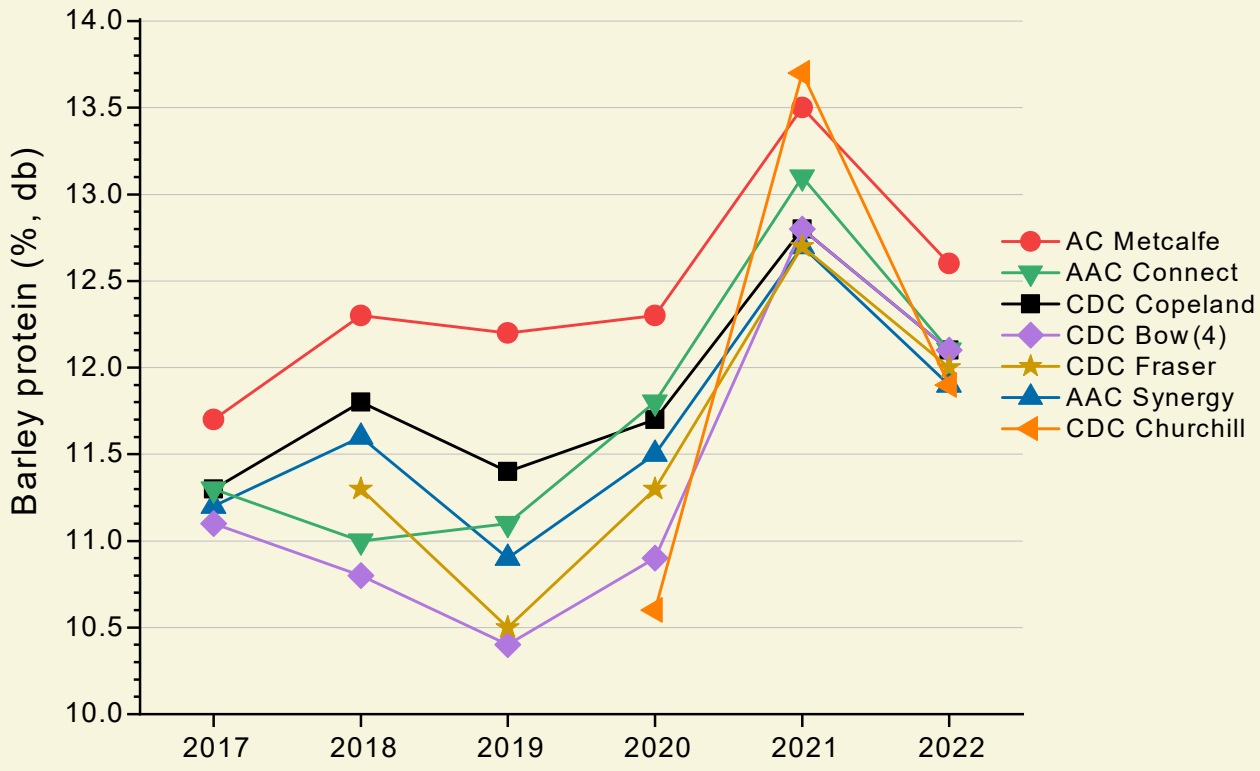


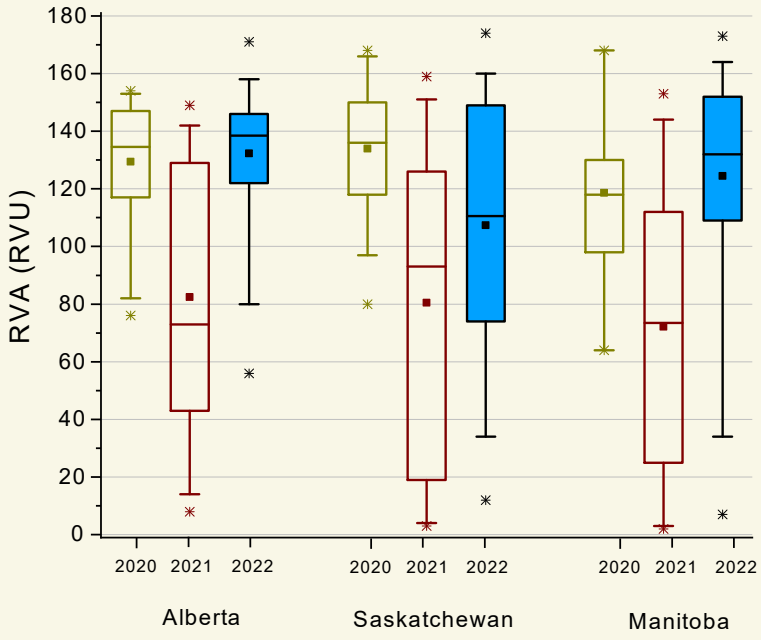
Figure 3.12 Comparison of the average protein content in selected barley varieties from 2017 to 2022. Values represent arithmetic averages. Samples for CDC Bow are limited to 4.

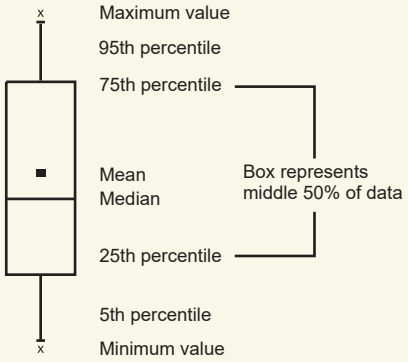
3.4 Pre-harvest sprouting

Pre-harvest sprouting can occur when mature grain remains unharvested in the field during prolonged periods of wet weather. One of the enzymes produced very early during germination is α-amylase. Since the level of α-amylase in sound grain is very low compared to that in germinating grain, the content of α-amylase in grain can be used as a marker of germination. Rapid visco analysis (RVA) indirectly estimates the amount of α-amylase in barley by measuring the viscosity of ground barley in water. The viscosity results are expressed in Rapid Visco Units (RVU) which then can be converted to centipoise (cP) (1 RVU = 12 cP).

Barley selectors use RVA to identify sound, moderately and strongly pre-germinated barley, and to manage their supply accordingly. Samples with final viscosity values greater than 120 RVU are considered sound, and the probability that they will retain germination energy after storage is very high. Samples with RVA values of 50 to 120 RVU are moderately pre-germinated while samples with RVA values less than 50 RVU are substantially pre-germinated and have a high probability of losing germination energy during storage. They should be malted as soon as possible. To more accurately predict safe storage time, storage conditions (temperature and relative humidity) and the initial moisture content of the grain must be considered in addition to the RVA values.

The majority of barley grown in 2022 was generally very sound with average RVA values above 120 RVU. In certain areas of Saskatchewan, above average precipitation in August contributed to some pre-harvest sprouting. However, generally warm and dry harvest conditions on the prairies resulted in sound grain with high RVA values. (Figure 3.13).





Risk of germination loss in storage	RVA viscosity (RVU)
Low	≥120
Intermediate	50-120
High	<50

Figure 3.13 Rapid visco analysis (RVA) results for barley selected for malting in 2022 in comparison with previous years.

3.5 Malting conditions and methodologies

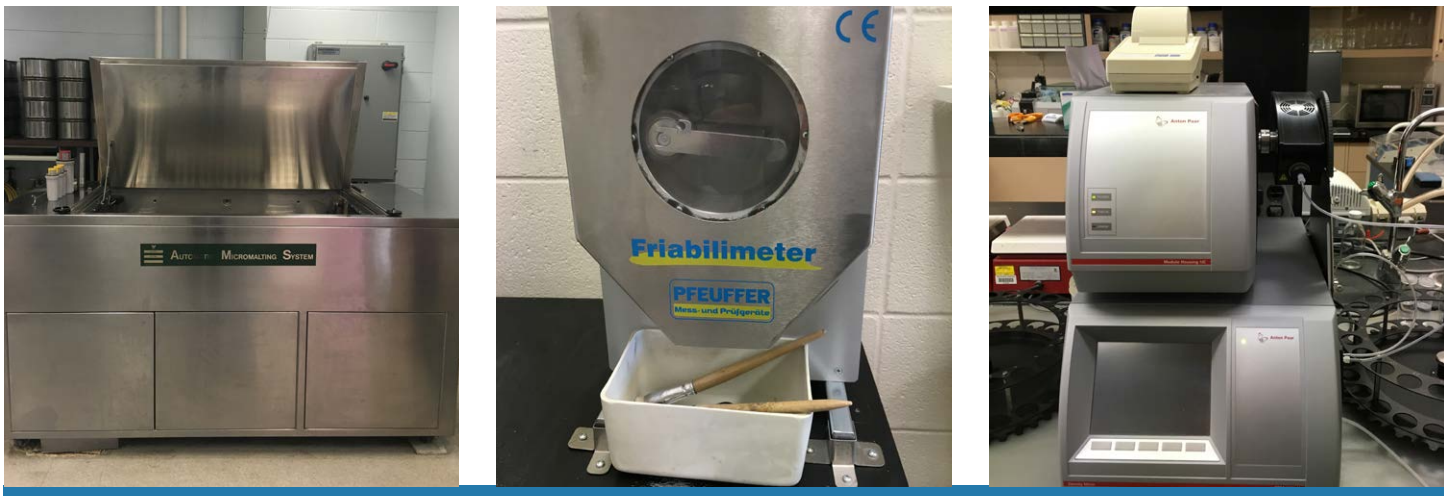
Initial malting trials indicated that during steeping, barley from 2022 did not absorb water as easily as last year's barley. Several factors contributed to somewhat slower water absorption, including higher test weight, higher kernel density, and a greater degree of soundness. Consequently, the second wet steeping cycle was increased from 7 hours in 2021 to 9 hours in 2022. In addition, samples of barley varieties with large kernel size and weight were sprayed with water during germination to achieve adequate hydration levels and modification. Similar to last year, the steeping temperature was 14 ºC and the entire germination process (96 hours) was conducted at 15 ºC. The kilning steps were conducted according to the same schedules as last year. All the analytical methods used to assess barley, malt and wort quality in this survey are listed in Appendix I.

Table 3.1 Comparison of micromalting conditions used with the Grain Research Laboratory Phoenix Micromalting System in 2021 and 2022

	2021	2022
Steeping		
1st wet cycle	9 h	9 h
1st dry cycle	14 h	14 h
2nd wet cycle	7 h	9 h
2nd dry cycle	14 h	14 h
Temperature	14 °C	14 °C
Germination	96 h at 15 ºC	96 h at 15 °C
Kilning	12 h at 60-65 °C, 6 h at 65 °C, 2 h at 75 °C, 5 h at 83-85 °C, 2 h at 60 °C, 2 h at 40 °C	12 h at 60-65 °C, 6 h at 65 °C, 2 h at 75 °C, 5 h at 83-85 °C, 2 h at 60 °C, 2 h at 40 °C

3.6 Malting quality in 2022: varietal and yearly comparisons

Figures 3.14 to 3.19 compare the average values of malt proteins, fine extract, malt diastatic power, malt α-amylase, wort free amino nitrogen (FAN), and wort β-glucans among varieties annually evaluated in our survey since 2017. Values shown in the graphs represent the arithmetic averages. This year, we received a limited number of CDC Copper samples, and as a result, this variety is not included in our varietal comparison.



Phoenix Micromalting System (left), friabilimeter (middle), and densitometer (right) at the malting and malt analysis labs of the Grain Research Laboratory.

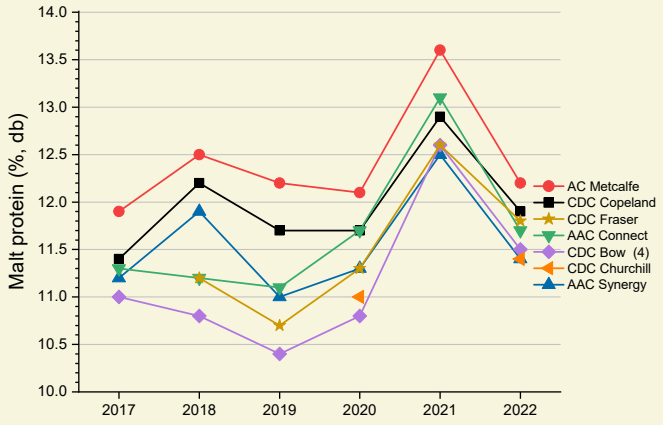


Figure 3.14 Comparison of the average concentration of proteins in the malt of selected barley varieties from 2017 to 2022. Samples for CDC Bow are limited to 4.

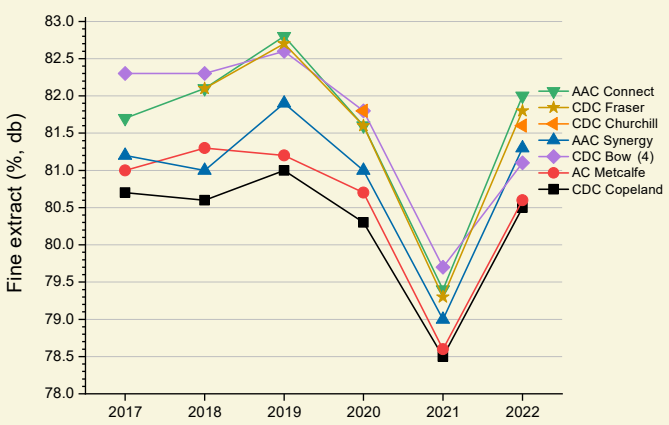


Figure 3.15 Comparison of the average extract levels from the malt of selected barley varieties from 2017 to 2022. Samples for CDC Bow are limited to 4.

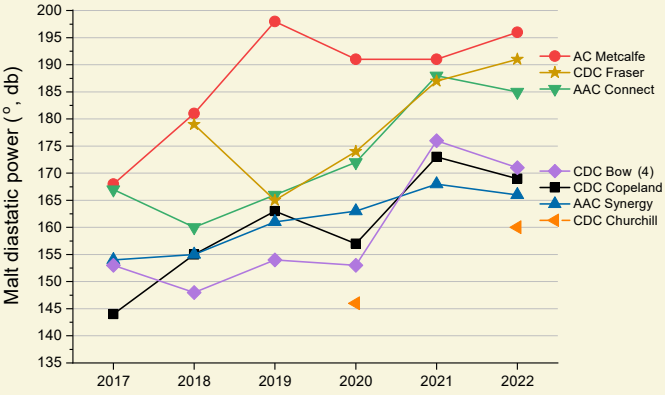


Figure 3.16 Comparison of the average diastatic power in the malt of selected barley varieties from 2017 to 2022. Samples for CDC Bow are limited to 4.

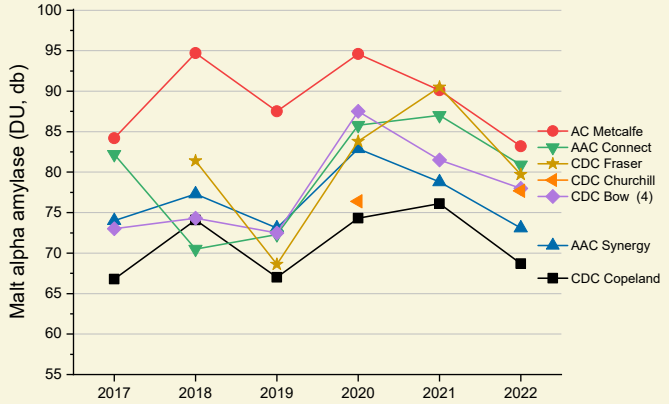


Figure 3.17 Comparison of the average activity of α-amylase in the malt of selected barley varieties from 2017 to 2022. Samples for CDC Bow are limited to 4.

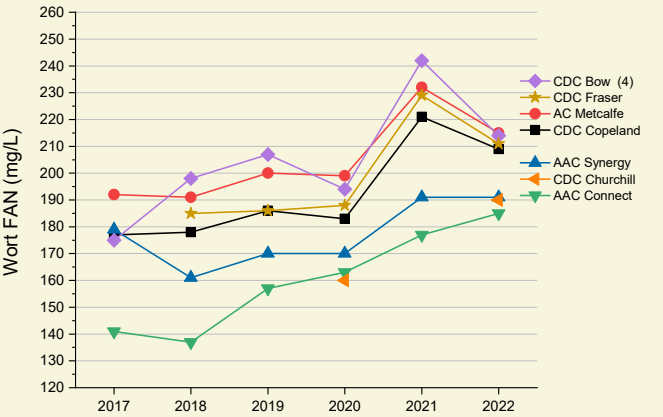


Figure 3.18 Comparison of the average FAN level in wort produced from the malt of selected barley varieties from 2017 to 2022. Samples for CDC Bow are limited to 4.

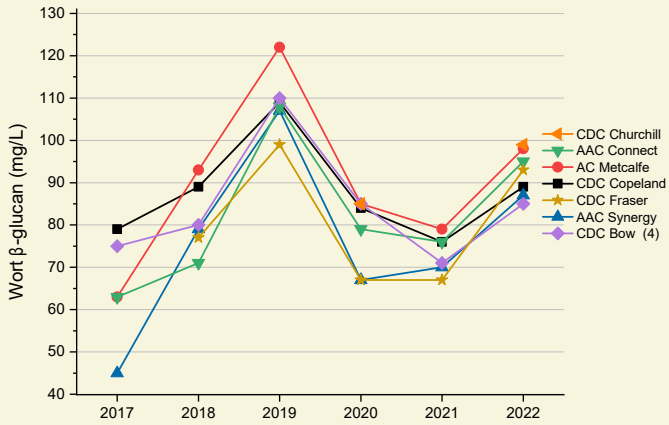


Figure 3.19 Comparison of the average β-glucan concentration in wort produced from the malt of selected barley varieties from 2017 to 2022. Samples for CDC Bow are limited to 4.

3.7 Highlights of malting barley quality in 2022

- The favourable growing conditions across the prairie provinces in 2022 significantly improved barley production and yield, and restocked the supply of Canadian malting barley for both the domestic and international markets.
- In 2022, CDC Copeland and AAC Synergy were the predominant cultivars of malting barley in western Canada, but the area seeded with CDC Copeland continued to decline. The popularity of newer varieties (AAC Connect, CDC Fraser, and CDC Churchill) increased noticeably whereas the area seeded with AC Metcalfe continued to decline.
- The favourable growing conditions had positive effects on the quality of malting barley. The average level of barley proteins was 12.3% in 2022, which is considerably lower than in 2021 (13.2%).
- Barley in 2022 exhibited an excellent average germination energy of 99% with no water sensitivity.
- The average 1000 kernel weight in 2022 was 45.0 g, which is close to the 10-year average (45.3 g). The newer varieties with kernels larger than AC Metcalfe and CDC Copeland contributed to the overall high average kernel weight.
- In 2022, the average test weight of barley was 66.7 kg/hL, which is higher than in 2021 (64.8 kg/hL) and equal to the 10-year average. The average plumpness was 93.8%, which is lower than in 2021 (96.1%) but higher than the 10-year average (93.3%).
- The majority of barley grown in 2022 was generally very sound with average RVA values above 120 RVU.
- The combination of higher test weight and lower plumpness values in 2022 barley resulted in higher grain density, which required a slightly longer steeping time to achieve adequate modification of barley during the malting process.
- Well-modified malt was obtained from 2022 barley with adequate levels of enzymes (diastatic power and α-amylase), soluble proteins, and free amino nitrogen (FAN).
- A lower concentration of grain protein in 2022 barley contributed to about 1.5% higher malt extract levels compared to 2021.

Part 4: Quality data for individual varieties

CDC Copeland

CDC Copeland remained the predominant variety of malting barley grown in western Canada in 2022. Its excellent brewing characteristics, combined with protein and enzyme levels that are lower than AC Metcalfe, provide an excellent balance among malting barley varieties.

AAC Synergy

The popularity of AAC Synergy on the prairies continued in 2022. AAC Synergy is a high-yielding variety that is characterized by relatively high kernel weight and plumpness, and relatively low grain protein content. AAC Synergy has shorter and stronger straw than AC Metcalfe and CDC Copeland. It is resistant to spotted net blotch, netted net blotch and spot blotch. AAC Synergy has a desirable malting quality profile with high malt extract, good protein modification, low levels of wort β-glucans, and intermediate levels of starch-degrading enzymes. Overall, AAC Synergy's excellent combination of agronomic traits and malting quality makes it a desirable two-rowed malting barley variety for western Canadian producers and the malting and brewing industry.

AAC Connect

AAC Connect, registered in 2016, was a popular choice this year. It has excellent agronomic traits and disease resistance: shorter and stronger straw than AC Metcalfe and CDC Copeland, heavier and plumper kernels than AC Metcalfe and CDC Copeland, maturity similar to AC Metcalfe, resistance to spotted net blotch, surface-borne smuts and stem rust, and moderate resistance to fusarium head blight (FHB). This variety offers high extract, moderate to high enzymes and relatively low FAN levels, as well as good brewhouse performance and fermentability.

AC Metcalfe

IIn 2022, the production of AC Metcalfe declined to 9.2% of the area seeded with malting barley. With high levels of starch-degrading enzymes, however, AC Metcalfe exhibits excellent brewing performance.

CDC Fraser

CDC Fraser, registered in 2016, is a high yielding variety with shorter and stronger straw and excellent lodging resistance. Its yields are 14% higher than AC Metcalfe and 8% higher than CDC Copeland. High kernel weight and plumpness and good resistance to spot blotch and spotted net blotch characterize CDC Fraser. This variety offers high extract, and high enzyme and FAN levels.

CDC Bow

CDC Bow, registered in 2015, is a high-yielding variety of malting barley with excellent agronomic traits and disease resistance. Its yields are 9% higher than AC Metcalfe and 3% higher than CDC Copeland. CDC Bow has strong straw and good resistance to lodging and is resistant to covered smut and stem rust. It is characterized by high kernel weight and plumpness. CDC Bow offers high extract, moderate to high enzymes, high FAN levels, high fermentability and good overall brewhouse performance.

CDC Copper

CDC Copper is a recently registered variety (2018) and its production is still limited on the prairies. It is a high yielding variety with a strong leaf disease package, low grain protein, malt enzymatic activity similar to CDC Copeland and high extract potential.

CDC Churchill

CDC Churchill is a recently registered variety (2019) with increasing, but still limited production on the prairies. It is a high yielding variety with low grain protein, low to moderate levels of malt enzymes, and high extract potential.

CDC Copeland

Table 4.1 Quality data for CDC Copeland malting barley[a]

Origin of selected samples	Alberta		Saskatchewan		Manitoba		Prairie provinces		
Year	**2022**	**2021**	**2022**	2021	**2022**	2021	**2022**	2021	2017-2021 Average
Number of samples	**10**	12	**14**	10	**1**	4	**25**	26	
Tonnage represented by samples (thousands of tonnes)[b]	**247**	85	**305**	152	**13**	11	**565**	248	910
Barley									
Test weight (kg/hL)	**66.1**	64.1	**65.6**	63.7	**65.2**	63.2	**65.8**	63.8	66.5
1000 kernel weight (g)	**43.1**	44.6	**43.1**	42.7	**42.3**	42.5	**43.1**	43.4	45.1
Plump, over 6/64" sieve (%)	**92.4**	96.2	**92.9**	95.4	**91.8**	95.4	**92.7**	95.7	93.8
Intermediate, over 5/64" sieve (%)	**5.9**	2.8	**5.5**	3.3	**5.9**	3.3	**5.6**	3.1	4.9
Moisture[c] (%)	**11.2**	12.0	**12.2**	12.5	**10.4**	11.9	**12.0**	12.3	11.8
Protein (%, db)	**12.3**	13.0	**12.5**	13.5	**12.3**	13.1	**12.4**	13.3	11.9
Germination, 4 ml (%)	**98**	99	**99**	99	**98**	98	**99**	99	99
Germination, 8 ml (%)	**94**	90	**92**	92	**90**	89	**93**	91	95
Malt									
Yield (%)	**90.5**	90.2	**90.4**	89.2	**91.4**	89.1	**90.5**	89.5	90.7
Steep-out moisture (%)	**45.4**[d]	46.1	**46.3**	46.7	**46.2**	46.8	**45.9**	46.5	45.3
Friability (%)	**83.0**	74.1	**80.2**	72.4	**82.2**	75.8	**81.4**	73.1	76.5
Moisture (%)	**4.5**	4.4	**4.6**	4.4	**4.4**	4.4	**4.6**	4.4	4.7
Protein (%, db)	**12.1**	13.0	**12.4**	13.6	**12.3**	13.1	**12.2**	13.4	12.1
Diastatic power (°, db)	**169**	181	**172**	189	**171**	189	**171**	186	161
α-Amylase (DU, db)	**69.5**	80.2	**68.7**	80.3	**70.8**	83.2	**69.1**	80.4	72.5
Wort									
Fine grind extract (F) (%, db)	**80.7**	78.9	**80.5**	78.6	**80.5**	78.9	**80.5**	78.8	80.3
Coarse grind extract (C) (%, db)	**79.8**	78.1	**79.7**	77.8	**79.5**	78.0	**79.7**	77.9	79.5
F-C difference (%, db)	**0.9**	0.8	**0.8**	0.8	**1.0**	0.9	**0.8**	0.8	0.7
ß-Glucan (mg/L)	**93**	91	**91**	79	**103**	81	**92**	83	89
Viscosity (cP)	**1.43**	1.43	**1.44**	1.42	**1.43**	1.42	**1.43**	1.42	1.44
Soluble protein (%, db)	**5.17**	5.35	**5.30**	5.52	**5.24**	5.48	**5.24**	5.46	4.81
Ratio S/T (%)	**43.0**	41.2	**42.9**	40.6	**42.7**	41.7	**42.9**	40.8	39.8
FAN (mg/L)	**204**	190	**208**	210	**205**	201	**207**	203	190
Colour (°)	**2.0**	2.0	**2.2**	2.0	**2.2**	2.1	**2.1**	2.0	1.9

[a] Values represent weighted averages based on tonnage of composite samples received.
[b] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[c] Moisture values are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.
[d] Additional spraying with water at the beginning of germination was required for some samples to achieve adequate hydration level and modification.
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

AAC Synergy

Table 4.2 Quality data for AAC Synergy malting barley[a]

Origin of selected samples	Alberta		Saskatchewan		Manitoba		Prairie provinces		
Year	**2022**	2021	**2022**	2021	**2022**	2021	**2022**	2021	2017-2021 Average
Number of samples	**18**	12	**10**	8	**3**	2	**31**	22	
Tonnage represented by samples (thousands of tonnes)[b]	**275**	80	**263**	81	**13**	6.8	**551**	168	255
Barley									
Test weight (kg/hL)	**67.5**	65.5	**66.8**	65.5	**66.5**	64.9	**67.1**	65.5	67.3
1000 kernel weight (g)	**46.5**	50.0	**46.2**	46.2	**46.1**	46.2	**46.3**	48.0	47.7
Plump, over 6/64" sieve (%)	**94.9**	97.3	**94.6**	96.7	**94.4**	96.2	**94.8**	97.0	96.1
Intermediate, over 5/64" sieve (%)	**3.6**	1.4	**4.1**	2.4	**3.8**	2.8	**3.8**	2.0	2.9
Moisture[c] (%)	**11.5**	12.4	**12.3**	12.8	**12.8**	12.3	**12.0**	12.6	12.0
Protein (%, db)	**12.0**	12.5	**12.5**	13.2	**12.3**	13.2	**12.2**	12.9	11.6
Germination, 4 ml (%)	**98**	95	**98**	99	**97**	99	**98**	97	98
Germination, 8 ml (%)	**93**	90	**92**	96	**90**	94	**92**	93	93
Malt									
Yield (%)	**90.7**	90.3	**90.1**	90.2	**90.5**	89.2	**90.4**	90.2	90.6
Steep-out moisture (%)	**45.3**	47.0	**46.1**	46.2	**46.0**	47.2	**45.7**	46.6	46.0
Friability (%)	**82.7**	59.3	**79.3**	65.6	**80.7**	63.9	**81.0**	62.6	71.6
Moisture (%)	**4.5**	4.9	**4.7**	4.7	**4.6**	4.8	**4.6**	4.8	4.9
Protein (%, db)	**11.4**	12.3	**12.2**	13.1	**11.7**	12.8	**11.8**	12.7	11.6
Diastatic power (°, db)	**167**	163	**171**	169	**177**	168	**169**	166	160
α-Amylase (DU, db)	**75.5**	77.3	**77.8**	81.8	**81.2**	85.7	**76.7**	79.8	77.4
Wort									
Fine grind extract (F) (%, db)	**81.6**	79.5	**80.9**	78.2	**81.4**	78.3	**81.3**	78.8	80.8
Coarse grind extract (C) (%, db)	**81.1**	78.7	**80.5**	77.4	**80.9**	77.9	**80.8**	78.0	80.3
F-C difference (%, db)	**0.5**	0.8	**0.4**	0.8	**0.5**	0.4	**0.5**	0.8	0.5
ß-Glucan (mg/L)	**83**	70	**83**	74	**79**	67	**83**	72	74
Viscosity (cP)	**1.41**	1.41	**1.42**	1.40	**1.41**	1.39	**1.42**	1.40	1.42
Soluble protein (%, db)	**5.09**	5.10	**5.10**	4.88	**5.13**	4.98	**5.10**	4.99	4.62
Ratio S/T (%)	**45.0**	41.5	**42.1**	37.3	**44.2**	38.8	**43.6**	39.4	39.8
FAN (mg/L)	**193**	194	**188**	184	**199**	191	**191**	189	174
Colour (º)	**1.9**	1.9	**2.0**	1.7	**2.0**	1.9	**2.0**	1.8	1.8

[a] Values represent weighted averages based on tonnage of composite samples received.
[b] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[c] Moisture values are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

AAC Connect

Table 4.3 Quality data for AAC Connect malting barley[a]

Origin of selected samples	Alberta		Saskatchewan		Manitoba		Prairie provinces		
Year	**2022**	**2021**	**2022**	2021	**2022**	2021	**2022**	2021	2017-2021 Average
Number of samples	**12**	8	**10**	9	**6**	13	**28**	30	
Tonnage represented by samples (thousands of tonnes)[b]	**108**	33	**87**	39	**5**	6	**200**	78	34
Barley									
Test weight (kg/hL)	**67.6**	65.1	**66.8**	65.1	**66.8**	64.6	**67.2**	65.0	67.0
1000 kernel weight (g)	**47.5**	47.0	**48.4**	45.9	**48.6**	46.6	**47.9**	46.4	50.0
Plump, over 6/64" sieve (%)	**93.8**	95.6	**96.3**	95.2	**93.7**	95.2	**93.7**	95.4	95.7
Intermediate, over 5/64" sieve (%)	**4.7**	3.2	**4.9**	3.6	**4.7**	3.6	**4.8**	3.4	3.3
Moisture[c] (%)	**11.5**	12.2	**12.5**	12.2	**13.0**	12.8	**12.2**	12.6	13.1
Protein (%, db)	**11.7**	13.2	**12.6**	13.6	**12.0**	13.1	**12.1**	13.4	11.7
Germination, 4 ml (%)	**99**	98	**99**	99	**100**	99	**99**	99	99
Germination, 8 ml (%)	**96**	92	**95**	96	**94**	95	**95**	94	93
Malt									
Yield (%)	**89.1**	90.2	**90.5**	89.9	**90.4**	89.9	**89.8**	90.0	91.0
Steep-out moisture (%)	**44.6**[d]	46.3	**46.2**	46.2	**45.9**	46.8	**45.3**	46.3	45.2
Friability (%)	**85.9**	71.1	**79.5**	72.5	**82.4**	78.3	**83.0**	72.3	78.6
Moisture (%)	**5.1**	4.7	**4.8**	4.7	**4.8**	4.7	**5.0**	4.7	4.9
Protein (%, db)	**11.5**	13.4	**12.4**	13.6	**11.9**	13.1	**11.9**	13.4	11.7
Diastatic power (°, db)	**195**	200	**187**	206	**189**	192	**192**	203	174
α-Amylase (DU, db)	**84.8**	91.4	**83.5**	94.9	**85.6**	89.1	**84.2**	93.0	80.8
Wort									
Fine grind extract (F) (%, db)	**82.1**	79.5	**81.6**	79.1	**81.9**	79.4	**81.9**	79.3	81.5
Coarse grind extract (C) (%, db)	**81.7**	78.7	**80.9**	78.2	**81.3**	78.7	**81.3**	78.4	80.9
F-C difference (%, db)	**0.4**	0.8	**0.7**	0.9	**0.7**	0.7	**0.6**	0.9	0.6
ß-Glucan (mg/L)	**86**	95	**98**	97	**94**	89	**91**	80	80
Viscosity (cP)	**1.41**	1.40	**1.41**	1.41	**1.42**	1.41	**1.41**	1.41	1.42
Soluble protein (%, db)	**5.23**	5.23	**5.17**	5.18	**5.15**	5.08	**5.20**	5.19	4.45
Ratio S/T (%)	**45.6**	39.2	**41.8**	37.8	**43.4**	38.4	**43.9**	38.4	37.8
FAN (mg/L)	**201**	194	**175**	191	**192**	188	**189**	192	158
Colour (°)	**2.0**	1.9	**2.0**	1.8	**2.1**	1.9	**2.0**	1.9	1.8

[a] Values represent weighted averages based on tonnage of composite samples received.
[b] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[c] Moisture values are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.
[d] Additional spraying with water at the beginning of germination was required for some samples to achieve adequate hydration level and modification.
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

AC Metcalfe

Table 4.4 Quality data for AC Metcalfe malting barley[a]

Origin of selected samples	Prairie provinces			
Year	**2022**	2021	2020	2017-2021 Average
Number of samples	**11**	7	19	
Tonnage represented by samples (thousands of tonnes)[b]	**94**	52	365	535
Barley				
Test weight (kg/hL)	**67.1**	67.2	68.4	68.5
1000 kernel weight (g)	**42.7**	43.6	44.0	44.1
Plump, over 6/64" sieve (%)	**91.8**	95.9	91.6	93.3
Intermediate, over 5/64" sieve (%)	**6.5**	2.7	6.7	5.2
Moisture[c] (%)	**12.0**	12.4	11.9	11.9
Protein (%, db)	**12.9**	13.2	12.3	12.3
Germination, 4 ml (%)	**100**	99	99	99
Germination, 8 ml (%)	**89**	95	93	94
Malt				
Yield (%)	**90.6**	90.2	90.1	90.5
Steep-out moisture (%)	**45.7**	46.1	46.1	45.5
Friability (%)	**72.2**	70.5	65.9	66.6
Moisture (%)	**4.6**	4.5	4.8	4.9
Protein (%, db)	**12.5**	13.4	12.1	12.4
Diastatic power (°, db)	**196**	186	191	185
α-Amylase (DU, db)	**81.6**	91.4	94.6	90.5
Wort				
Fine grind extract (F) (%, db)	**80.6**	78.8	80.7	80.6
Coarse grind extract (C) (%, db)	**80.0**	78.3	80.2	80.0
F-C difference (%, db)	**0.6**	0.5	0.5	0.6
ß-Glucan (mg/L)	**103**	86	85	90
Viscosity (cP)	**1.43**	1.42	1.43	1.43
Soluble protein (%, db)	**5.28**	5.35	5.29	4.93
Ratio S/T (%)	**42.3**	39.9	43.6	39.7
FAN (mg/L)	**214**	225	199	201
Colour (º)	**2.1**	2.1	2.0	2.0

[a] Values represent weighted averages based on tonnage of composite samples received.
[b] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[c] Moisture values are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

CDC Fraser

Table 4.5 Quality data for CDC Fraser malting barley[a]

Origin of selected samples	Prairie provinces			
Year	**2022**	2021	2020	2018-2021 Average
Number of samples	**11**	11	13	
Tonnage represented by samples (thousands of tonnes)[b]	**53.8**	33.0	7.7	10.3
Barley				
Test weight (kg/hL)	**66.7**	64.6	66.7	66.8
1000 kernel weight (g)	**47.1**	45.9	48.7	49.7
Plump, over 6/64" sieve (%)	**95.2**	97.2	95.6	97.3
Intermediate, over 5/64" sieve (%)	**3.2**	1.7	3.3	1.7
Moisture[c] (%)	**11.5**	12.7	12.5	12.9
Protein (%, db)	**11.7**	13.1	11.3	11.6
Germination, 4 ml (%)	**98**	99	98	99
Germination, 8 ml (%)	**88**	91	84	91
Malt				
Yield (%)	**89.8**	88.6	88.9	89.7
Steep-out moisture (%)	**46.4**	47.1	47.4	46.6
Friability (%)	**84.6**	82.5	87.7	82.8
Moisture (%)	**4.7**	4.6	4.7	5.1
Protein (%, db)	**11.6**	13.2	11.2	11.6
Diastatic power (°, db)	**191**	182	174	175
α-Amylase (DU, db)	**80.6**	90.7	83.8	81.1
Wort				
Fine grind extract (F) (%, db)	**81.8**	78.7	81.6	81.3
Coarse grind extract (C) (%, db)	**81.2**	78.1	81.2	81.0
F-C difference (%, db)	**0.6**	0.6	0.4	0.3
ß-Glucan (mg/L)	**100**	66	67	77
Viscosity (cP)	**1.42**	1.40	1.43	1.42
Soluble protein (%, db)	**5.30**	5.34	5.44	4.92
Ratio S/T (%)	**45.6**	40.5	48.8	42.7
FAN (mg/L)	**218**	225	188	196
Colour (º)	**2.3**	2.1	2.5	2.1

[a] Values represent weighted averages based on tonnage of composite samples received.
[b] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[c] Moisture value are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

CDC Churchill

Table 4.6 Quality data for CDC Churchill malting barley[a]

Origin of selected samples	Prairie provinces		
Year	**2022**	2021	2020
Number of samples	**10**	3	5
Tonnage represented by samples (thousands of tonnes)	**22.7**	na[c]	na[c]
Barley			
Test weight (kg/hL)	**67.9**	64.9	69.5
1000 kernel weight (g)	**43.8**	46.7	47.5
Plump, over 6/64" sieve (%)	**92.9**	95.2	93.4
Intermediate, over 5/64" sieve (%)	**5.5**	3.8	5.3
Moisture[b] (%)	**11.7**	11.5	12.0
Protein (%, db)	**11.9**	13.7	10.6
Germination, 4 ml (%)	**98**	99	99
Germination, 8 ml (%)	**89**	96	82
Malt			
Yield (%)	**90.8**	90.7	90.0
Steep-out moisture (%)	**45.4**	45.7	45.4
Friability (%)	**82.7**	71.9	83.0
Moisture (%)	**4.7**	4.8	4.6
Protein (%, db)	**11.4**	13.9	11.0
Diastatic power (°, db)	**160**	188	146
α-Amylase (DU, db)	**77.7**	87.0	76.4
Wort			
Fine grind extract (F) (%, db)	**81.6**	78.9	81.8
Coarse grind extract (C) (%, db)	**81.1**	78.0	81.4
F-C difference (%, db)	**0.5**	0.9	0.4
ß-Glucan (mg/L)	**99**	99	85
Viscosity (cP)	**1.42**	1.41	1.43
Soluble protein (%, db)	**4.81**	5.09	4.82
Ratio S/T (%)	**42.4**	36.6	43.9
FAN (mg/L)	**182**	178	160
Colour (°)	**2.1**	1.7	2.0

[a] Values represent the arithmetic averages of samples analyzed.
[b] Moisture values are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.
[c] Not available
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

CDC Bow

Table 4.7 Quality data for CDC Bow malting barley[a]

Origin of selected samples	Prairie provinces			
Year	**2022**	2021	2020	2017-2021 average
Number of samples	**4**	4	17	
Tonnage represented by samples (thousands of tonnes)	**8.2**	12.7	11.9	6.9
Barley				
Test weight (kg/hL)	**66.8**	65.7	68.5	68.2
1000 kernel weight (g)	**47.3**	47.6	48.7	49.8
Plump, over 6/64" sieve (%)	**95.3**	97.3	95.8	97.0
Intermediate, over 5/64" sieve (%)	**3.9**	2.0	2.9	2.1
Moisture[b] (%)	**11.5**	11.8	11.7	12.4
Protein (%, db)	**12.1**	12.8	10.9	11.2
Germination, 4 ml (%)	**100**	98	98	99
Germination, 8 ml (%)	**94**	91	88	93
Malt				
Yield (%)	**88.3**	89.2	89.8	90.4
Steep-out moisture (%)	**44.8**[c]	47.0	46.1	45.7
Friability (%)	**83.6**	78.1	83.0	79.3
Moisture (%)	**4.7**	4.6	4.6	4.7
Protein (%, db)	**11.5**	12.6	10.8	11.1
Diastatic power (°, db)	**171**	176	153	158
α-Amylase (DU, db)	**78.0**	81.5	87.5	77.8
Wort				
Fine grind extract (F) (%, db)	**81.1**	79.7	81.8	81.7
Coarse grind extract (C) (%, db)	**80.9**	79.3	81.6	81.5
F-C difference (%, db)	**0.2**	0.3	0.2	0.3
ß-Glucan (mg/L)	**85**	72	85	84
Viscosity (cP)	**1.41**	1.41	1.42	1.43
Soluble protein (%, db)	**5.47**	5.83	5.37	5.03
Ratio S/T (%)	**47.9**	46.2	50.0	44.8
FAN (mg/L)	**214**	242	194	203
Colour (º)	**2.1**	2.4	2.3	2.1

[a] Values for 2021 and 2022 represent the arithmetic averages of samples analyzed. Values for 2020 represent the weighted averages based on tonnage of composite samples received.
[b] Moisture values are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof containers.
[c] Additional spraying with water at the beginning of germination was required for some samples to achieve adequate hydration level and modification.
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

CDC Copper

Table 4.8 Quality data for CDC Copper malting barley[a]

Origin of selected samples	Prairie provinces		
Year	**2022**	2021	2020
Number of samples	**2**	4	6
Barley			
Test weight (kg/hL)	**65.3**	65.7	66.8
1000 kernel weight (g)	**40.1**	45.9	47.7
Plump, over 6/64" sieve (%)	**89.6**	94.5	94.3
Intermediate, over 5/64" sieve (%)	**8.6**	4.2	4.6
Moisture[b] (%)	**11.9**	13.2	12.8
Protein (%, db)	**12.1**	13.3	10.8
Germination, 4 ml (%)	**99**	98	97
Germination, 8 ml (%)	**98**	96	63
Malt			
Yield (%)	**88.7**	89.1	88.3
Steep-out moisture (%)	**47.6**	47.0	47.6
Friability (%)	**85.2**	63.6	80.8
Moisture (%)	**4.7**	5.1	4.7
Protein (%, db)	**11.3**	13.2	11.0
Diastatic power (°, db)	**175**	170	152
α-Amylase (DU, db)	**67.5**	74.5	74.7
Wort			
Fine grind extract (F) (%, db)	**80.3**	78.1	81.5
Coarse grind extract (C) (%, db)	**79.5**	77.5	81.0
F-C difference (%, db)	**0.8**	0.6	0.5
ß-Glucan (mg/L)	**75**	82	80
Viscosity (cP)	**1.43**	1.43	1.45
Soluble protein (%, db)	**4.52**	4.64	4.98
Ratio S/T (%)	**40.1**	35.2	45.6
FAN (mg/L)	**160**	169	157
Colour (º)	**2.7**	2.1	3.2

[a] Values represent the arithmetic averages of samples analyzed.
[b] Moisture values are not representative of new crop moisture levels as samples were not collected or stored in moisture-proof container
db = dry basis; DU = dextrinizing units; S/T = soluble/total protein; cP =centipoise

Appendix I - Methods

This section describes methods used at the Grain Research Laboratory. Unless otherwise specified, analytical results for barley and malt are reported on a dry weight basis (db).

α-Amylase activity
α-Amylase activity was determined according to American Society of Brewing Chemists (ASBC) method MALT 7B by segmented flow analysis, using ASBC dextrinized starch as the substrate, and calibrated with standards that have been determined by method ASBC Malt 7A.

Arabinoxylans
Total arabinoxylan content in grain was determined after acid hydrolysis by gas-chromatographic (GC) analysis of alditol acetates using a flame ionization detector.

Assortment
Grain was passed through a Carter Dockage Tester equipped with a No. 6 riddle to remove foreign material and two slotted sieves to sort the barley. Plump barley is the material retained on a 6/64" (2.38 mm) x 3/4" slotted sieve.Intermediate is barley that passes through the 6/64" x 3/4" sieve but is retained on a 5/64" (1.98 mm) x 3/4" slotted sieve.

β-Glucan content in wort
β-Glucan content was determined in malt extract by segmented flow analysis using Calcofluor staining of soluble, high molecular weight ß-glucan (ASBC Wort-18B).

β-Glucan content in grain
β-Glucan content was determined in ground barley using the Megazyme Streamlined Method – assay procedure for determination of mixed linkage β-glucan content in oat and barley flour (Association of Official Analytical Chemists (AOAC) Method 995.16, American Association for Cereal Chemistry (AACC) International Method 32-23, International Association for Cereal Chemistry (ICC) Standard Method No 168).

Diastatic power
Diastatic power was determined by segmented flow analysis, using an automated neocuproin assay for reducing sugars, which is calibrated using malt standards analysed following the official ferricyanide reducing sugar method, (ASBC Malt 6A).

Fine-grind and coarse-grind extracts
Extracts were prepared using an Industrial Equipment Corporation (IEC) mash bath and the Congress mashing procedure from 45 °C to 70 °C. Specific gravities are determined at 20 °C with an Anton Paar DMA 5000M digital density meter (ASBC Malt-4).

Free Amino Nitrogen (FAN)
Free amino nitrogen (FAN) was determined in fine extract by segmented flow analysis using the official ASBC method Wort-12.

Germination energy
Germination energy was determined by placing 100 kernels of barley on two layers of Whatman No.1 filter paper in a 9.0 cm diameter petri dish and adding 4.0 ml of purified water. Samples were germinated at 20 ºC and 90% relative humidity in a germination chamber. Germinated kernels were removed after 24 h and 48 h and a final count was made at 72 h (ASBC Barley 3C).

Kolbach index (ratio S/T)
Kolbach index was calculated from the formula: (% soluble protein / % malt protein) x 100.

Micromalting
Malts were prepared using an Automated Phoenix Micromalting System designed to handle 24 barley samples of 500 g or 48 barley samples of 250 g per batch.

Malt mills
Fine-grind malt was prepared with a Bühler-Miag disc mill set to fine-grind. Coarse-grind malt was prepared with the same mill set to coarse-grind. The settings for fine- and coarse-grinds are calibrated quarterly, based on the screening of a ground ASBC standard check malt (ASBC Malt-4).

Moisture content of barley
Moisture content of barley was predicted on dockage-free barley using the Foss Infratec™ 1241 whole grain near infrared analyzer.

Moisture content of malt
Moisture content of malt was determined on a ground sample by oven drying at 104 ºC for 3 h (ASBC Malt-3).

Protein content (N x 6.25)
Barley protein content was predicted on dockage-free barley using the Foss Infratec™ 1241 whole grain near infrared analyzer. The Foss Infratec™ 1241 performance is checked annually against the reference combustion nitrogen analysis (CNA) method. Annual reference check barley protein and malt protein was measured by CNA using a LECO Model FP-628 CNA analyzer calibrated by ethylenediamine tetraacetic acid (EDTA). Samples were ground on a UDY Cyclone Sample Mill fitted with a 1.0 mm screen. A moisture analysis was also performed and results were reported on a dry matter basis (ASBC Barley 7C).

Rapid Viscosity Analysis
The degree of pre-germination in barley was determined as described by Izydorczyk (2005) https://www.grainscanada.gc.ca/en/grain-research/scientific-reports/rva/. Samples were analyzed using the RVA 4500 (PerkinElmer) and the Stirring Number Program. Final viscosity values are reported in Rapid Visco Units (RVU).

Viscosity
Viscosity was measured on fine grind Congress Mash wort using an Anton Paar Lovis 2000 automated rolling ball viscometer (ASBC Wort-13B).

Water sensitivity
Water sensitivity was determined exactly as described for germination energy, except that 8.0 ml of purified water was added to each petri dish (ASBC 3C, IOB and EBC procedure). The water sensitivity value is the numerical difference between the 4 ml and 8 ml tests.

Weight per thousand kernels
A 500 g sample of dockage-free barley was divided several times in a mechanical divider to obtain one representative sub-sample weighing 40 g. All foreign material and broken kernels were removed from a single 40 g portion and the net weight determined. The number of kernels was then counted with a mechanical counter and the 1000 kernel weight was calculated (as is basis) (Institute of Brewing's Recommended Methods of Analysis, Barley 1.3 (1997)).

Wort-soluble protein
Wort-soluble protein was determined spectrophotometrically using ASBC method Wort-17.

Wort colour
Wort color was determined spectrophotometrically using ASBC method Wort-9 and Beer-10.

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