Canadian Grain Commission | Commission canadienne des grains

Barley Production and Quality of Western Canadian Malting Barley

2023

Annual Barley Harvest Report

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Summary

In 2023, the total area seeded with barley in western Canada was 2.881 million hectares. The total barley production is estimated at 8.707 million tonnes, approximately 10% lower than last year. This year's hot and dry growing conditions resulted in a relatively low barley yield.

In 2023, AAC Synergy was the most popular malting barley variety seeded in western Canada. The area seeded with CDC Copeland continued to decline. The popularity of newer varieties, such as AAC Connect, CDC Fraser and CDC Churchill, increased noticeably. The area seeded with AC Metcalfe declined to approximately 4% of the area seeded with malting barley.

The hot and dry growing conditions in 2023 had some effect on the physical characteristics and composition of barley grain but overall, the quality of malting barley this year was good. The average protein content was 12.3%, which is the same as last year's average but slightly higher than the 10-year average (11.9%). The average test weight was 65.0 kg/hL, which is lower than last year's average (66.7 kg/hL) and the 10-year average (66.9 kg/hL). The average 1000 kernel weight was 46.8 g, which is higher than last year's average (45.0 g) and the 10-year average (45.7 g). The newer varieties, such as AAC Connect, AAC Synergy, CDC Fraser and CDC Churchill that have kernels larger than AC Metcalfe and CDC Copeland, contributed to the overall high average kernel weight.

Rainy conditions in August caused some pre-harvest sprouting in this year's barley. In the fall of 2023, however, barley exhibited an excellent average germination energy (98%) with no water sensitivity.

The combination of lower test weight, lower grain density and lower kernel hardness in 2023 barley contributed to easy and quick water absorption during steeping. Well-modified malt was obtained from 2023 barley with high friability and adequate levels of enzymes (diastatic power and α-amylase), soluble proteins and free amino nitrogen (FAN). Wort was characterized by low levels of β-glucans and very good (low) viscosity values. Malt made from 2023 barley generally resulted in average levels of extract with expected differences in extract levels among different Canadian malting varieties.

Part 1: Growing and harvest conditions in 2023

In 2023, seeding in western Canada started relatively late due to a cold and delayed spring. In May, however, the average temperature was well above normal (Figure 1.1) and the barley crop was planted in a timely manner. Soil dryness was a great concern (Figure 1.5). Aside from southeast and parts of south-central Saskatchewan, western Canada was well below normal precipitation this spring (Figure 1.9). The hot and dry conditions predominated in June across the Prairies (Figures 1.2, 1.6 and 1.10).

Soil moisture (Figure 1.7) and precipitation (Figure 1.11) were lacking but a stretch of relatively cooler temperatures during a portion of July (Figure 1.3) helped relieve some crop stress, as did haze from wildfire smoke. Harvest started relatively early in August. Overall, crop development was ahead of normal across a good portion of the Prairies due to the hot and dry conditions throughout much of the season. This allowed for an initial early start to harvest. Occasional rain in August (Figure 1.12) prevented the harvest from being completed in a timely manner. The rain in August also caused some pre-harvest sprouting. Overall, the hot and dry conditions have significantly reduced the barley yield this year.

Mean temperature difference from normal

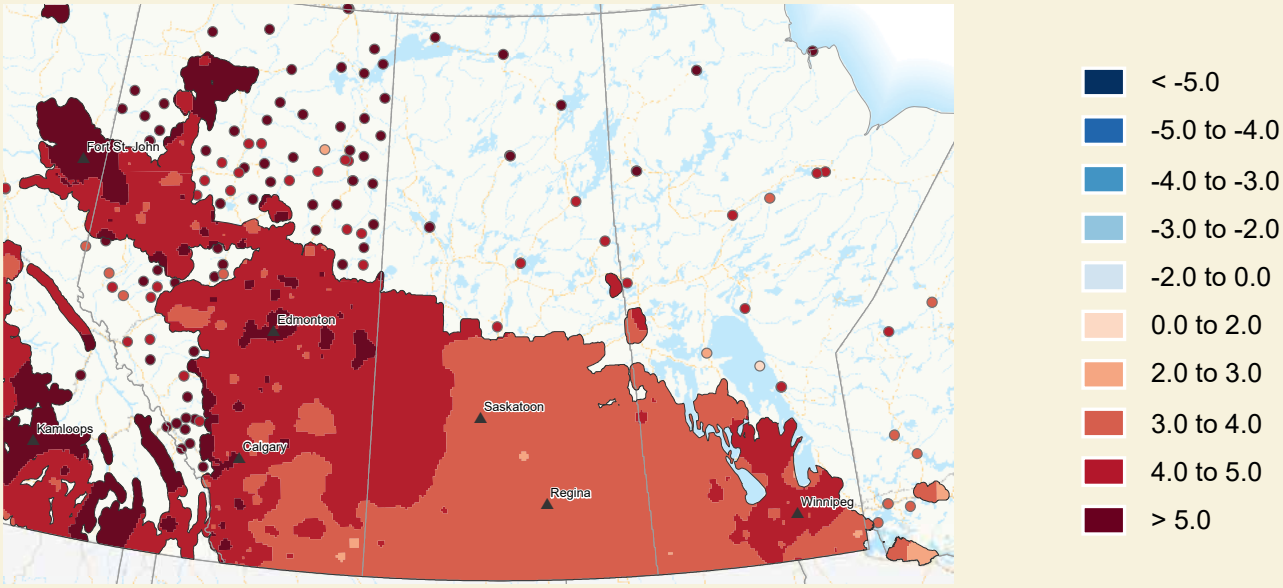


Figure 1.1 Mean temperature difference from normal for May 2023.

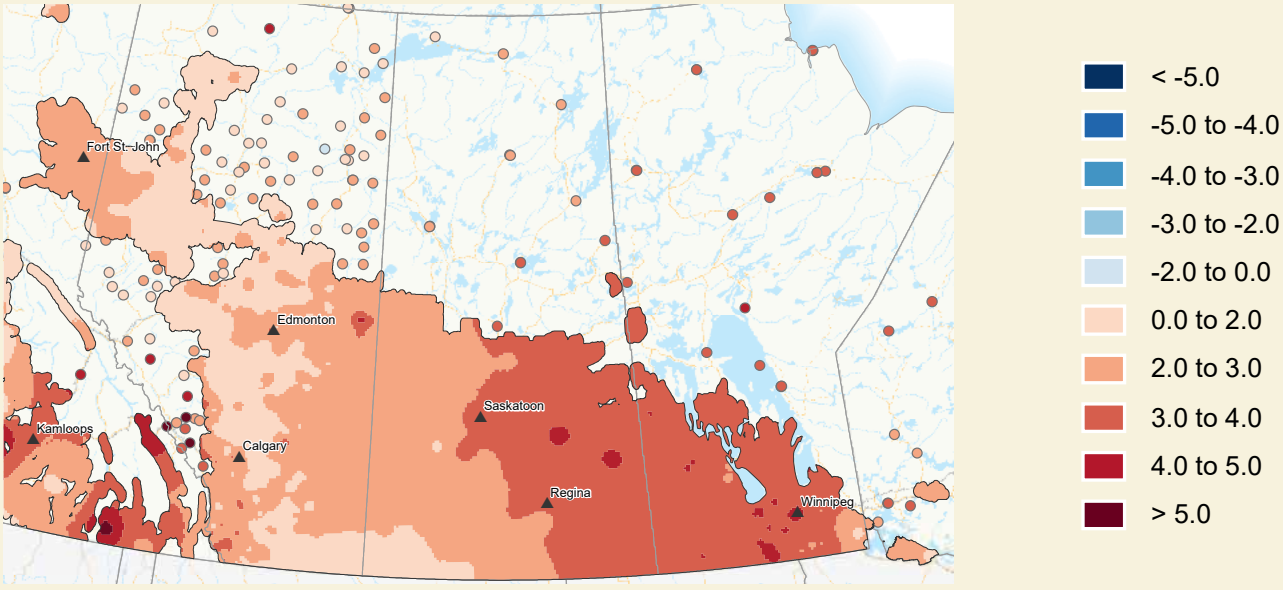


Figure 1.2 Mean temperature difference from normal for June 2023.

Mean temperature difference from normal

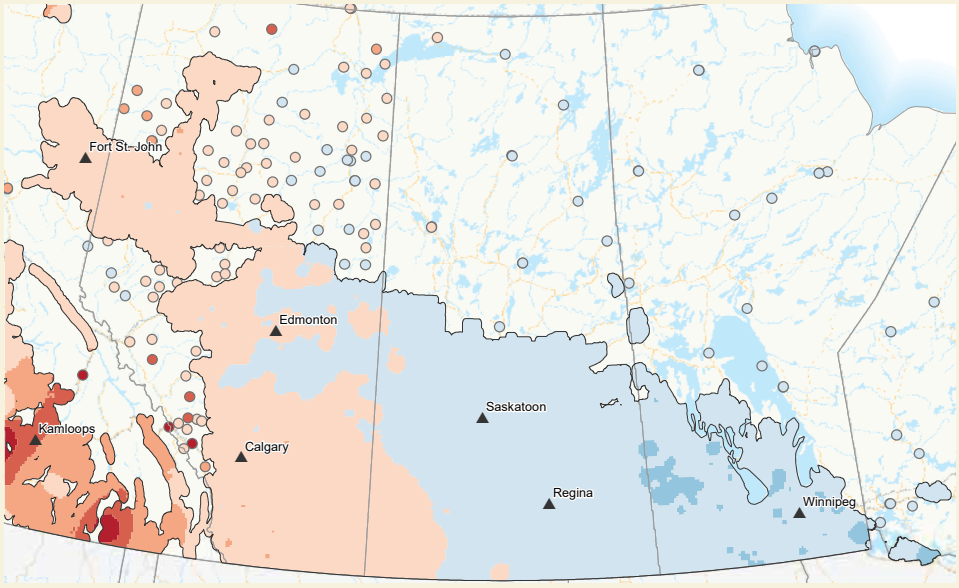


Figure 1.3 Mean temperature difference from normal for July 2023.

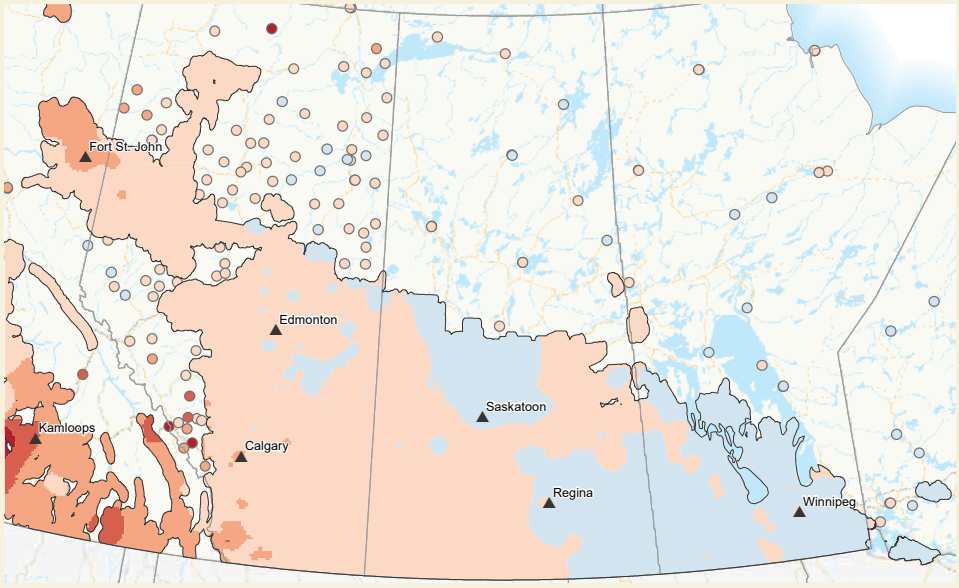


Figure 1.4 Mean temperature difference from normal for August 2023.

Percent of normal soil moisture

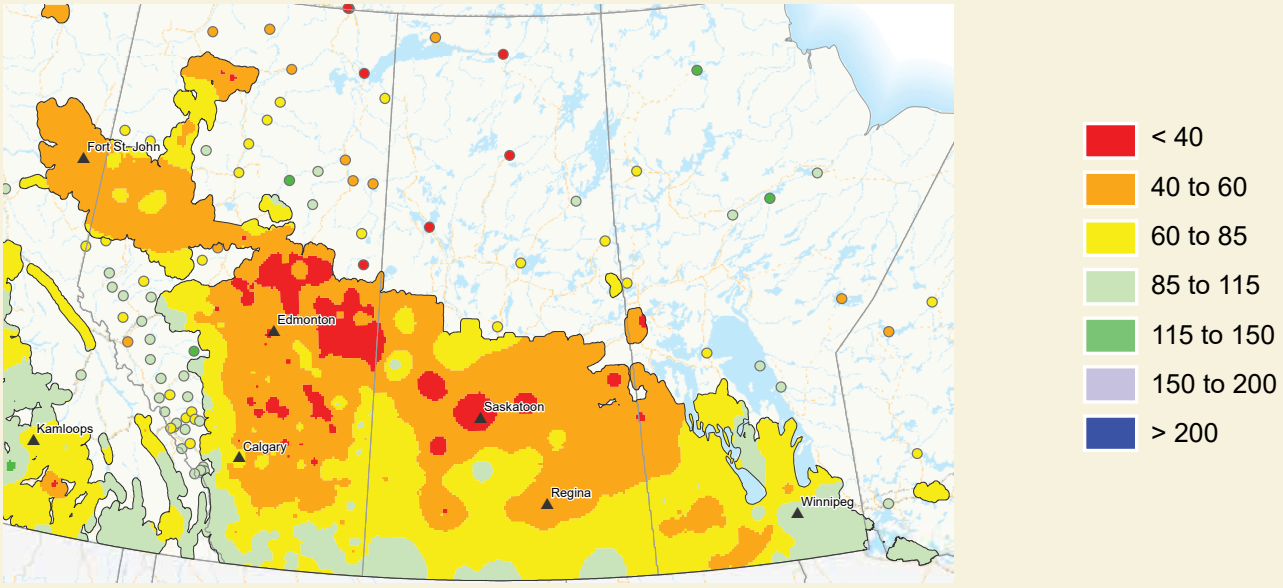


Figure 1.5 Percent of normal soil moisture as of May 15, 2023.

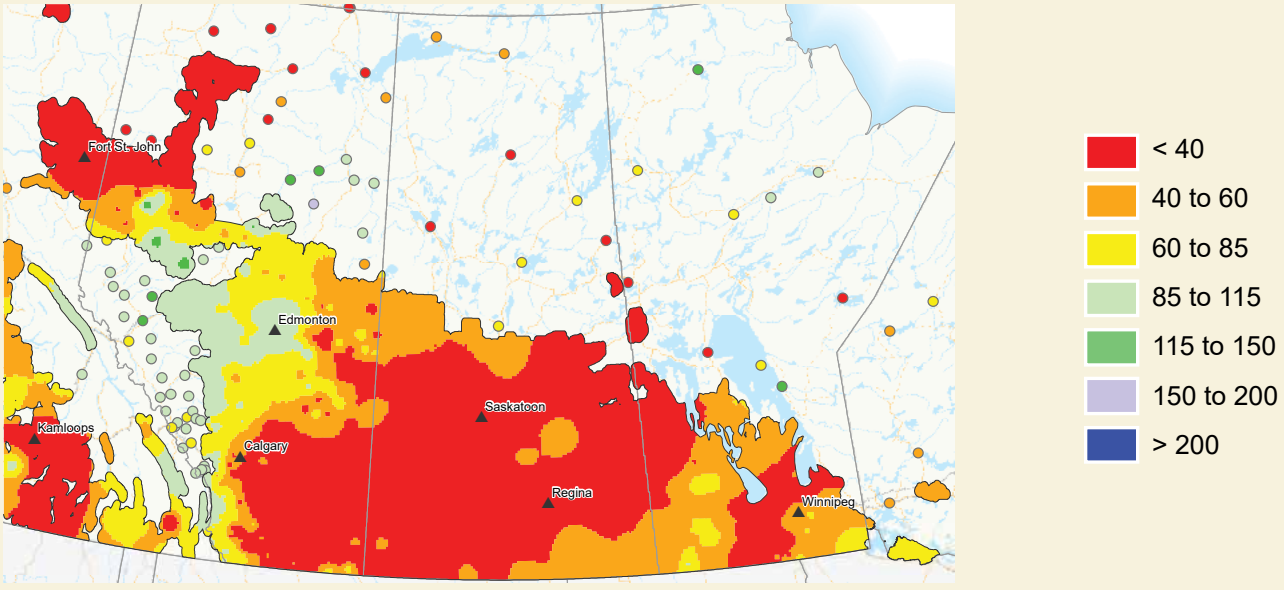


Figure 1.6 Percent of normal soil moisture as of June 26, 2023.

Percent of normal soil moisture

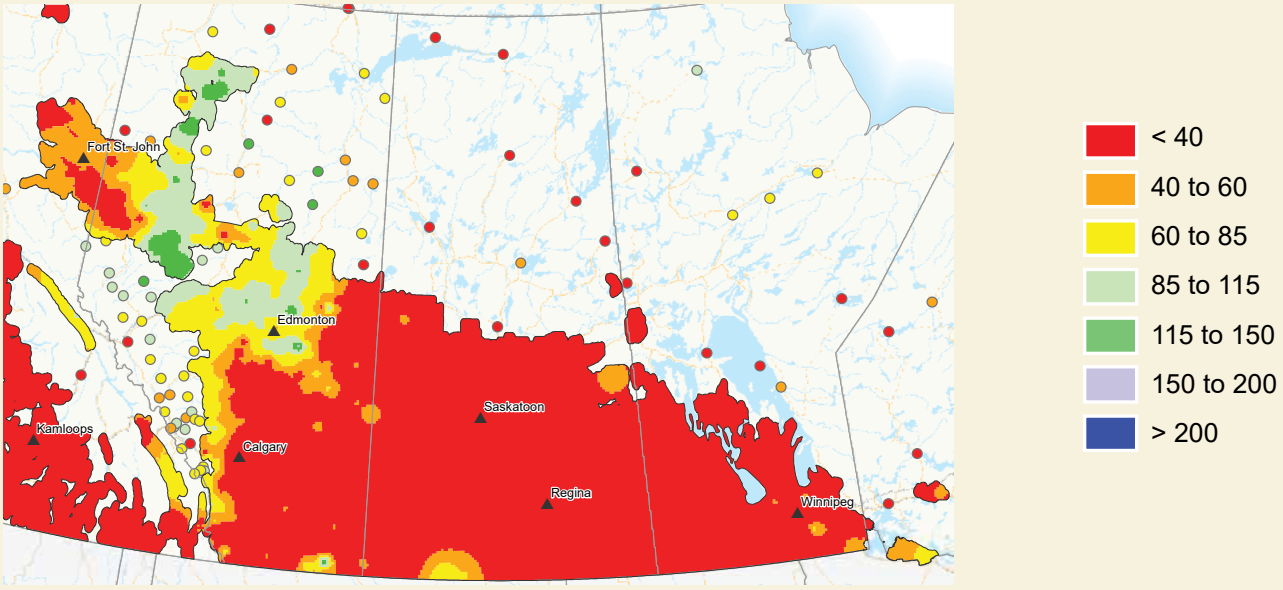


Figure 1.7 Percent of normal soil moisture as of July 31, 2023.

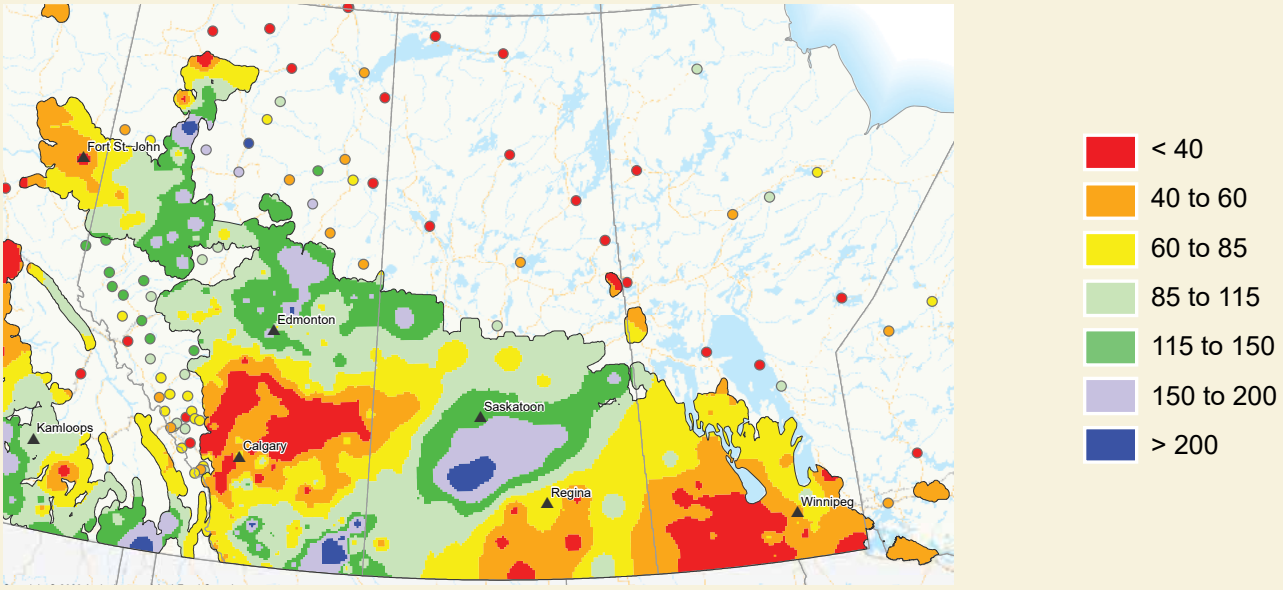


Figure 1.8 Percent of normal soil moisture as of August 31, 2023.

Percent of average precipitation

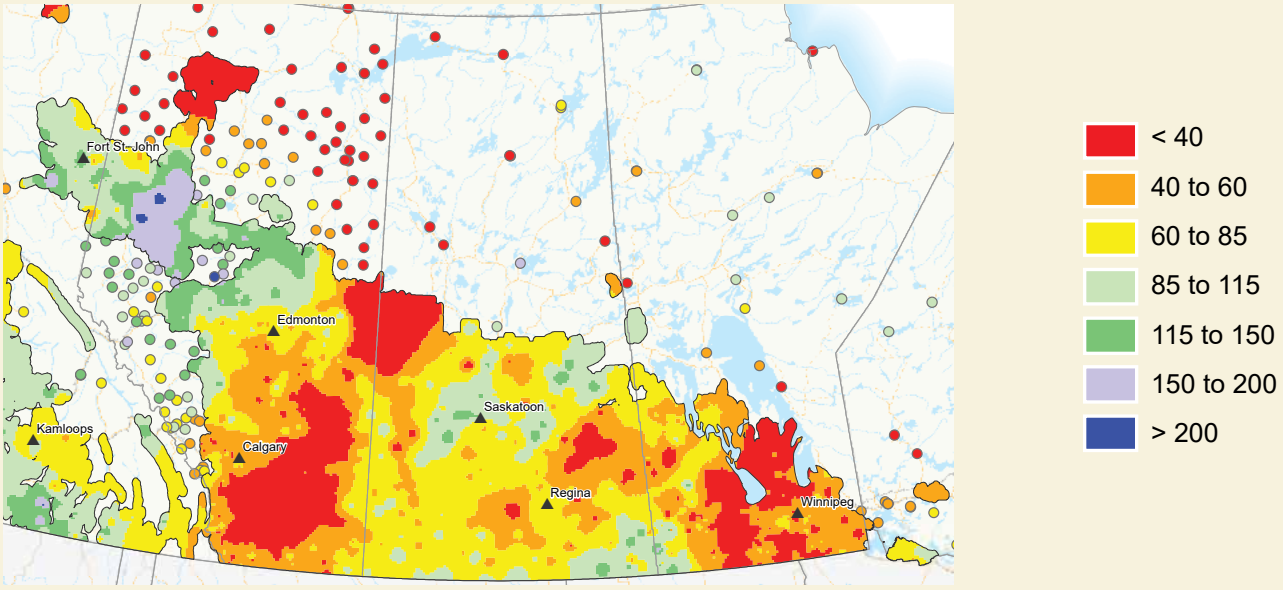


Figure 1.9 Percent of average precipitation in May 2023.

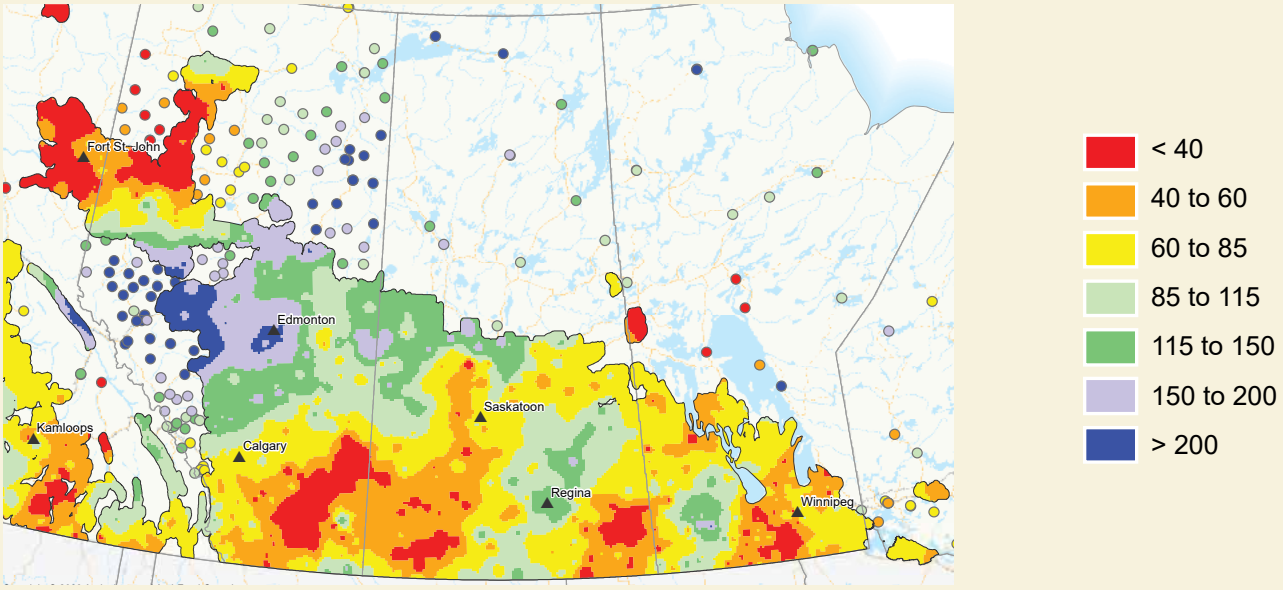


Figure 1.10 Percent of average precipitation in June 2023.

Percent of average precipitation

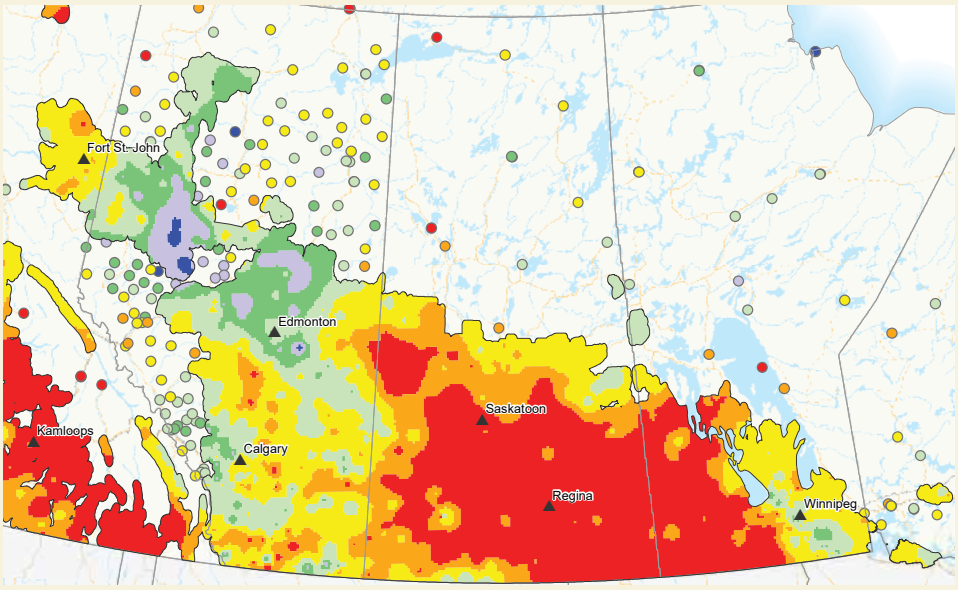


Figure 1.11 Percent of average precipitation in July 2023.

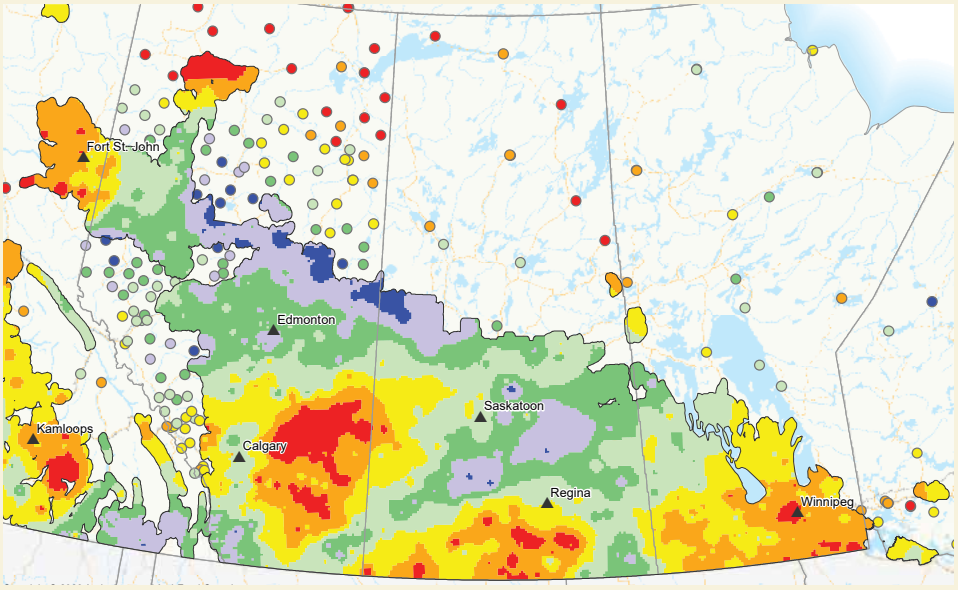


Figure 1.12 Percent of average precipitation in August 2023.

Part 2: Barley production in 2023

2.1 Annual production statistics

In 2023, the total area seeded with barley in western Canada was 2.881 million hectares. This is about 4% higher than last year and 8% higher than the 10-year average (2.676 million hectares) (Table 2.1). Barley production in western Canada in 2023 is estimated at 8.707 million tonnes. This is approximately 10% lower than last year but 2% higher than the 10-year average (Table 2.2). The unfavorable growing conditions in 2023 resulted in a low barley yield of 61.3 bushels per acre (BPA) and contributed to a lower than anticipated barley production in 2023 (Table 2.3 and Figure 2.3).

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

Area seeded with barley (million hectares)			
Location	2023[1]	2022	10-year average[2]
Manitoba	0.168	0.171	0.157
Saskatchewan	1.135	1.126	1.096
Alberta	1.552	1.438	1.398
British Columbia	0.027	0.026	0.024
Western Canada	**2.881**	**2.761**	**2.676**
Canada	**2.963**	**2.851**	**2.797**

[1]Source: Statistics Canada, estimated as of December 4, 2023.
[2]10-year average from 2013 to 2022.

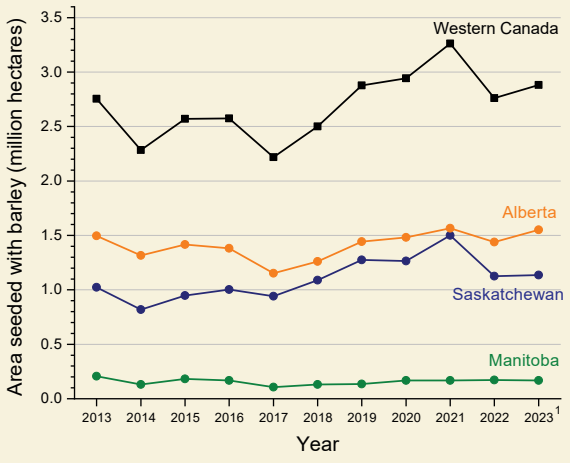


Figure 2.1 Annual comparison of area (million hectares) seeded with barley in western Canada.

[1]Source: Statistics Canada, estimated as of December 4, 2023.

Table 2.2 Barley production (million tonnes) in Canada

Barley production (million tonnes)			
Location	2023[1]	2022	10-year average[2]
Manitoba	0.665	0.657	0.555
Saskatchewan	3.227	3.551	3.328
Alberta	4.751	5.381	4.553
British Columbia	0.064	0.077	0.062
Western Canada	**8.707**	**9.666**	**8.498**
Canada	**8.896**	**9.987**	**8.886**

[1]Source: Statistics Canada, estimated as of December 4, 2023.
[2]10-year average from 2013 to 2022.

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

Yield (bushels per acre)			
Location	2023[1]	2022	10-year average[2]
Manitoba	75.4	74.3	71.6
Saskatchewan	57.4	63.4	61.6
Alberta	62.9	75.9	69.4
British Columbia	55.2	59.5	57.7
Western Canada	**61.3**	**70.5**	**66.4**
Canada	**61.4**	**70.4**	**66.0**

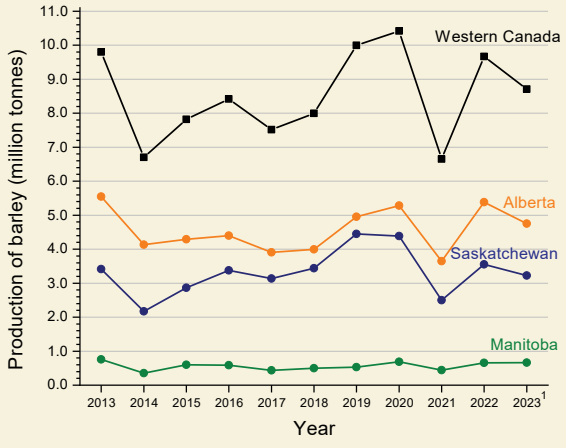


Figure 2.2 Annual comparison of barley production (million tonnes) in western Canada.

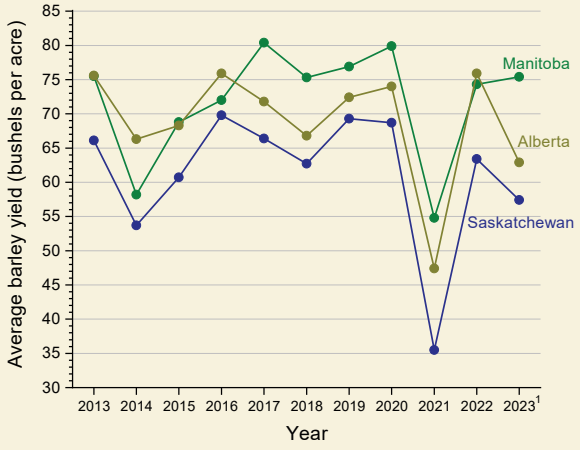


Figure 2.3 Annual comparison of average barley yield (bushels per acre) in western Canada.

[1]Source: Statistics Canada, estimated as of December 4, 2023.

2.2 Distribution of barley classes and varieties

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 2023, Alberta remains the biggest producer of barley in western Canada, followed by Saskatchewan and Manitoba (Figure 2.4). The distribution of barley classes in each province in 2023 was similar to that observed in 2022 (Figure 2.4). More than 50% of the area seeded with barley in western Canada in 2023 was in Alberta. The area seeded with general-purpose barley in Alberta (28.0%) exceeded that seeded with malting barley (22.1%). Saskatchewan accounted for approximately 42% of the area seeded with barley in western Canada. The area

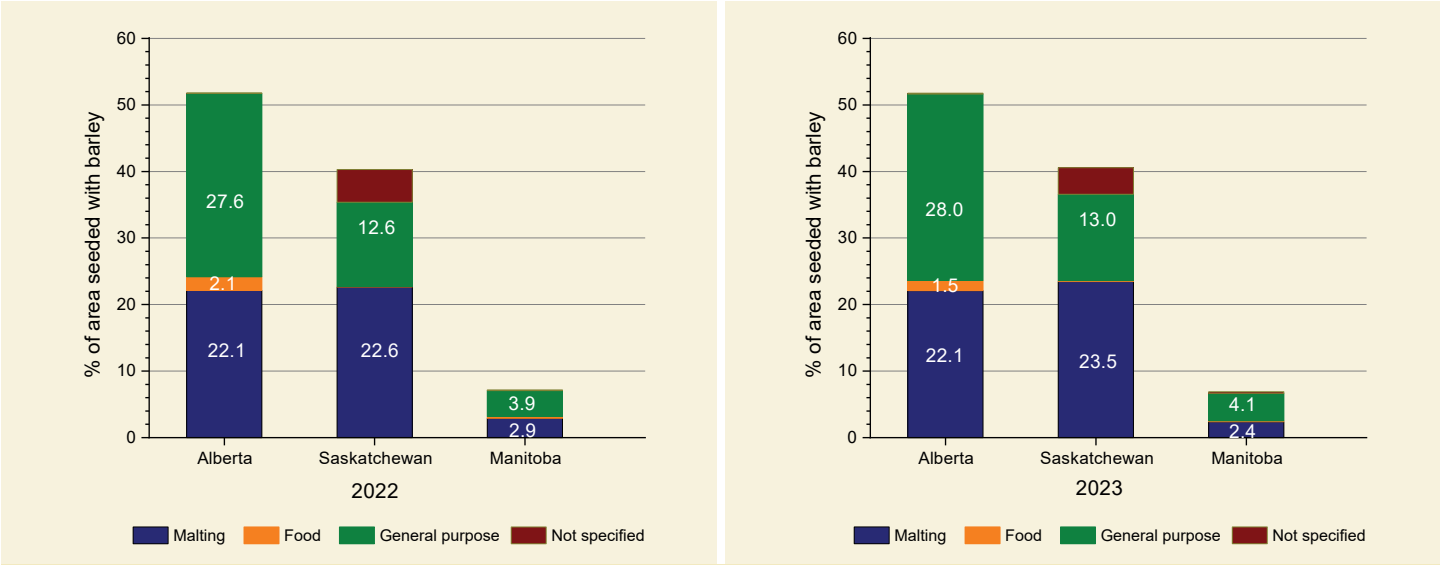


Figure 2.4 Distribution of barley classes in each province as a percentage (%) of area seeded with barley in western Canada in 2022 and 2023. Data based on crop insurance statistics from each province[1].

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

seeded with malting barley in Saskatchewan (23.5%) surpassed that seeded with general purpose barley (13.0%). Manitoba remains the smallest producer of barley in western Canada and accounts for approximately 6.5% of the total area seeded with barley on the Prairies. CDC Austenson, a general purpose barley, was the most popular variety seeded in western Canada in 2023, followed by the malting varieties AAC Synergy, CDC Copeland, AAC Connect, Sirish and CDC Fraser (Figure 2.5). The other popular general purpose varieties were Brahma and Esma.

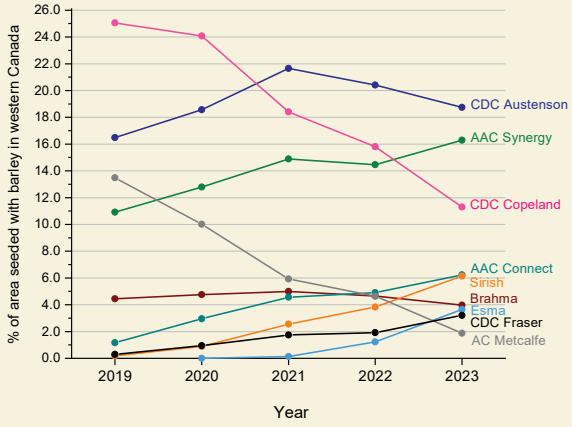


Figure 2.5 Comparison of area seeded with the top barley varieties in western Canada from 2019 to 2023[1].

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

2.3 Distribution of malting varieties

In 2023, AAC Synergy was the most popular variety of malting barley grown in western Canada (Figure 2.6, Table 2.4). The area seeded with AAC Synergy accounted for 32% of the area seeded with all malting varieties in western Canada. The area seeded with CDC Copeland (22%) substantially decreased compared to 2022 (Figure 2.6). The other popular malting varieties in 2023 were AAC Connect (12.3%) and CDC Fraser (6.3%). CDC Churchill is also becoming a popular variety whose acreage increased to 3.05% in 2023 from 0.93% in 2022. The area seeded with Sirish, a malting variety registered in 2017, continues to increase, although this variety is used mostly for general purposes. The areas seeded with AC Metcalfe and CDC Bow continued to decrease, whereas the areas seeded with CDC Copper and Bill Coors 100 remained stable and were similar to last year's estimates (Fig. 2.6, Table 2.4). In 2023, six-rowed varieties accounted for approximately 2.7% of the total area seeded with malting barley, similar to last year's estimates. Legacy, Celebration and Tradition remained the top six-rowed varieties (Table 2.4).

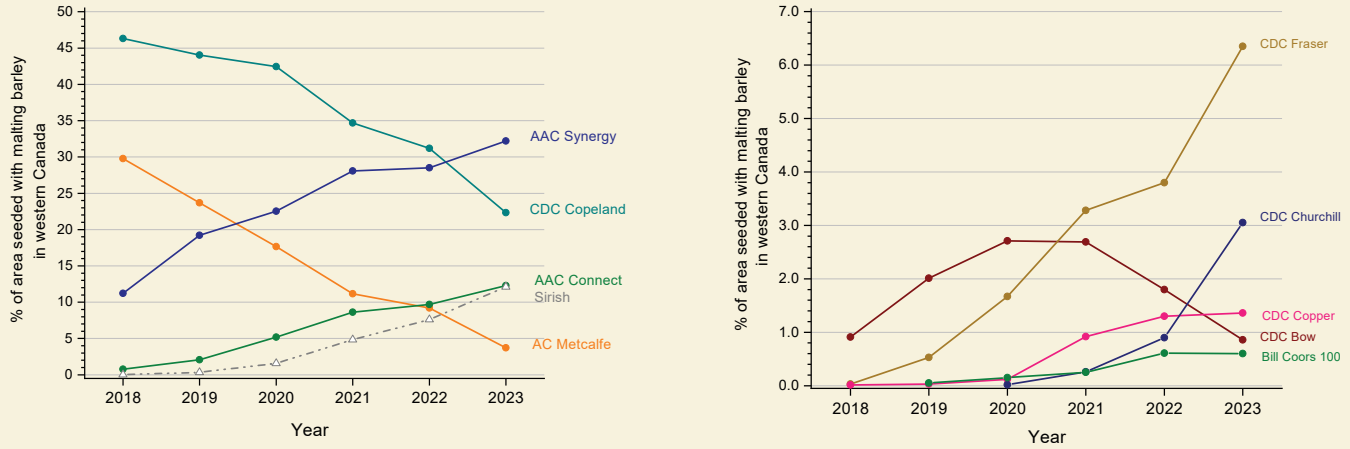


Figure 2.6 Comparison of the area seeded with the top malting barley varieties in western Canada from 2018 to 2023. Data based on crop insurance statistics from each province[1].

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

Table 2.4 Distribution of malting barley varieties as a percentage (%) of area seeded with malting barley in western Canada in 2023[1]

Percentage of area seeded with malting barley in western Canada in 2023				
Malting barley varieties	**Alberta**	**Saskatchewan**	**Manitoba**	**Western Canada**
2-rowed	%	%	%	%
AAC Synergy	11.73	18.64	1.65	32.19
CDC Copeland	10.15	11.70	0.31	22.33
AAC Connect	3.77	6.99	1.39	12.30
Sirish	11.49	0.34	0.08	12.12
CDC Fraser	1.29	4.77	0.29	6.35
AC Metcalfe	1.73	1.61	0.23	3.72
CDC Churchill	1.73	1.17	0.15	3.05
CDC Copper	1.09	0.16	0.07	1.36
CDC Bow	0.56	0.25	0.03	0.86
Bill Coors 100	0.53	0.07	0.00	0.60
Cerveza	0.39	0.13	0.03	0.55
Newdale	0.12	0.19	0.23	0.54
CDC Goldstar	0.00	0.35	0.00	0.35
Bentley	0.23	0.03	0.00	0.26
AB Brewnet	0.20	0.00	0.00	0.20
CDC Platinumstar	0.00	0.13	0.00	0.13
Harrington	0.05	0.04	0.00	0.09
CDC Kendall	0.00	0.08	0.00	0.08
Other	0.18	0.04	0.00	0.22
Total 2-rowed	**45.25**	**46.69**	**4.44**	**97.29**
6-rowed	**%**	**%**	**%**	**%**
Legacy	0.30	1.56	0.03	1.89
Celebration	0.00	0.14	0.32	0.46
Tradition	0.00	0.00	0.12	0.12
Other	0.09	0.12	0.03	0.24
Total 6-rowed	**0.39**	**1.81**	**0.50**	**2.71**

[1]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 2023 insured acreage in western Canada, food (F) and general purpose (GP) barley varieties accounted for approximately 47% of the total area seeded with barley (Figure 2.4). CDC Austenson continued to predominate the area seeded with GP barley varieties; however, the area seeded with this variety has continued to decrease since 2021 (Table 2.5 and Figure 2.7). The area seeded with Brahma, Oreana, Claymore, Canmore, Champion and CDC Coalition decreased slightly in 2023 compared to 2022. The acreage of CDC Maverick in 2023 remained similar to that in 2022. The acreage of several newer GP varieties, such as Altorado, AB Advantage, AB Hague and AB Prime increased in 2023 compared to 2022 (Figure 2.7).

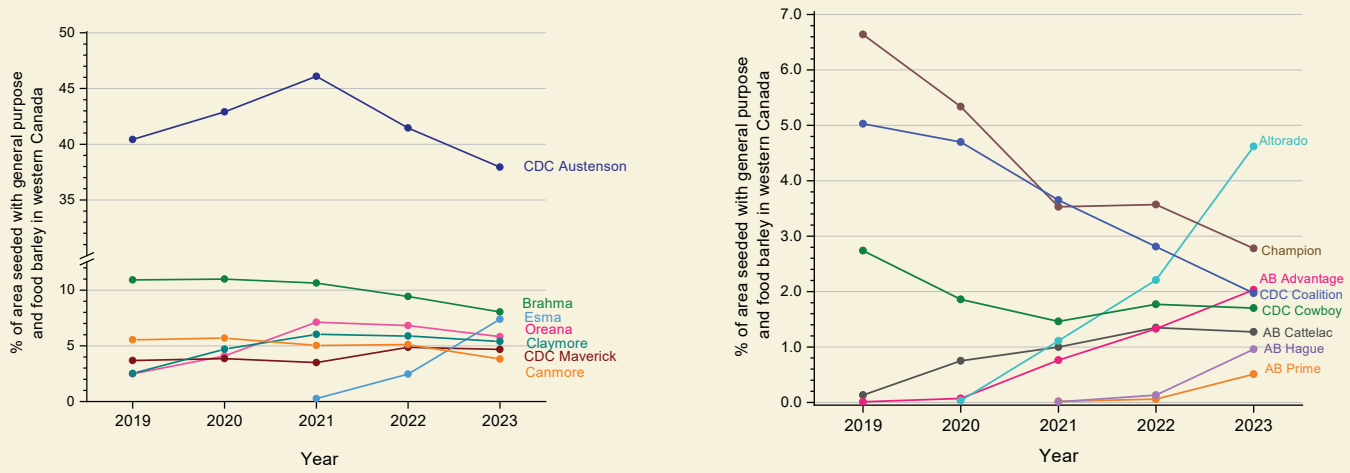


Figure 2.7 Comparison of areas seeded with the top general purpose and food barley varieties in western Canada from 2019 to 2023. Data based on crop insurance statistics from each province[1].

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

Table 2.5 Distribution of barley varieties as a percentage (%) of area seeded with general purpose and food barley in western Canada in 2023[1]

Percentage of area seeded with general purpose and food barley in western Canada in 2023				
General purpose and food varieties	**Alberta**	**Saskatchewan**	**Manitoba**	**Western Canada**
CDC Austenson	16.25	15.84	5.44	37.95
Brahma	7.75	0.15	0.00	8.04
Esma	6.45	0.19	0.71	7.38
Oreana	4.98	0.80	0.04	5.82
Claymore	2.47	2.60	0.32	5.40
CDC Maverick	1.53	2.99	0.14	4.67
Altorado	3.70	0.92	0.00	4.62
Canmore (F)	3.26	0.23	0.32	3.81
Conlon	2.04	0.19	1.52	3.75
Xena	2.75	0.14	0.00	2.88
Champion	2.22	0.52	0.04	2.78
AB Advantage	1.05	0.90	0.04	2.03
CDC Coalition	1.97	0.00	0.00	1.97
CDC Cowboy	0.88	0.82	0.00	1.70
AB Cattelac	0.81	0.32	0.14	1.27
AB Hague	0.45	0.51	0.00	0.96
AB Prime	0.51	0.00	0.00	0.51
KWS Kellie	0.47	0.00	0.00	0.47
AB Wrangler	0.24	0.16	0.00	0.41
Ponoka	0.30	0.00	0.00	0.30
LG Diablo	0.28	0.00	0.00	0.28
Gadsby	0.26	0.00	0.00	0.26
Richer	0.00	0.00	0.26	0.26
Seebe	0.26	0.00	0.00	0.26
Amisk	0.14	0.10	0.00	0.24
CDC Thompson	0.24	0.00	0.00	0.24
AB Tofield	0.22	0.00	0.00	0.22
AC Rosser	0.09	0.12	0.00	0.21
CDC Trey	0.15	0.00	0.00	0.15
AB Standswell	0.14	0.00	0.00	0.14
Other	0.64	0.21	0.09	0.99
Total general purpose and food	**62.58**	**27.73**	**9.06**	**100.00**

[1]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 2023 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 additional samples and varieties (e.g., Sirish) 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, 2023.

3.2 Quality of barley selected for malting in 2023: general trends

In 2023, the average protein content in malting barley was 12.3%, which was the same as last year's average but slightly higher than the 10-year average (11.9%) (Figure 3.1). The average test weight was 65.0 kg/hL, which is lower than last year's average (66.7 kg/hL) and lower than the 10-year average (66.9 kg/hL) (Figure 3.2). The average 1000 kernel weight was 46.8 g, which is higher than last year's average (45.0 g) and higher than the 10-year average (45.7 g) (Figure 3.3). Kernel plumpness, determined by measuring kernels remaining on a 6/64" slotted screen, had an average value of 94.6%. This is higher than the last year's average (93.8%) and slightly higher than the 10-year average (94.0%) (Figure 3.4). 2023 barley exhibited excellent average germination energy at 4 mL (98%) (Figure 3.5). In 2023, the average germination energy at 8 mL was 94%, which indicates no 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 analyzed.

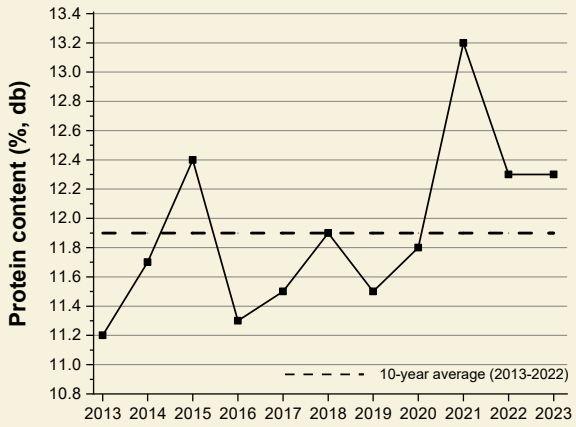


Figure 3.1 Average protein content of barley selected for malting from 2013 to 2023.

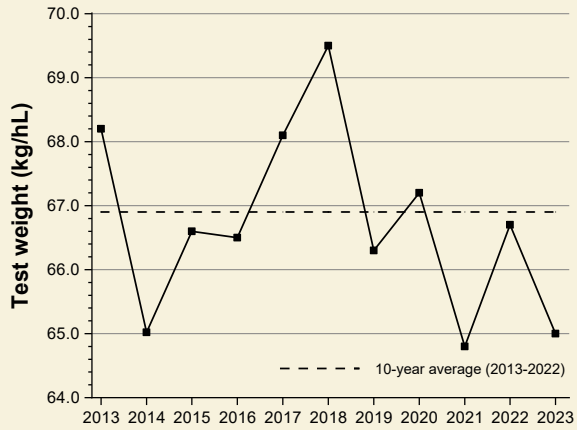


Figure 3.2 Average test weight of barley selected for malting from 2013 to 2023.

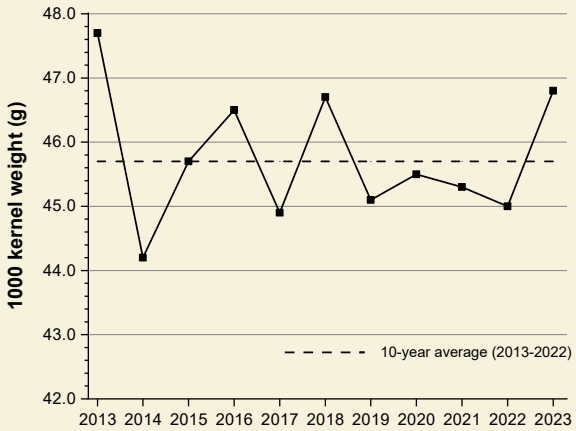


Figure 3.3 Average 1000 kernel weight of barley selected for malting from 2013 to 2023.

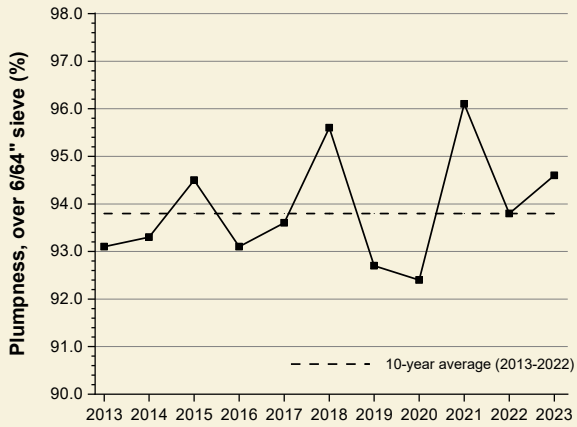


Figure 3.4 Average plumpness of barley selected for malting from 2013 to 2023.

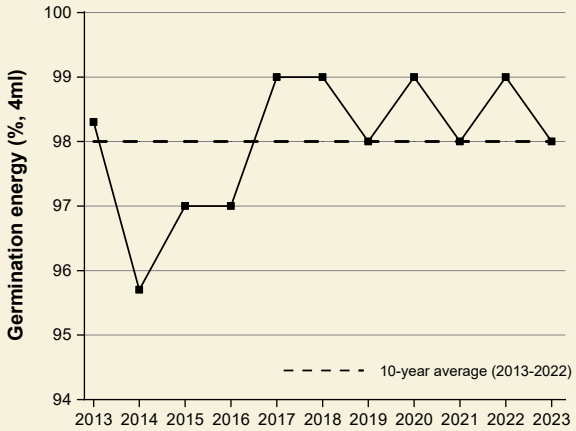


Figure 3.5 Average germination energy (4ml) of barley selected for malting from 2013 to 2023.

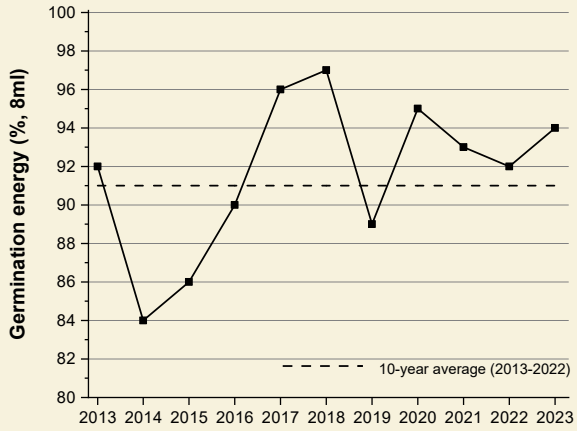
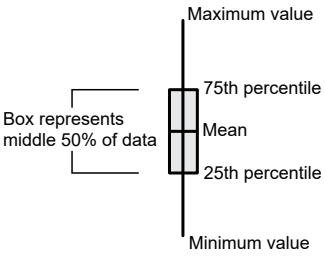


Figure 3.6 Average germination energy (8ml) of barley selected for malting from 2013 to 2023.

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 indicate some differences among barley varieties (Figure 3.7). In addition, the hardness index of barley grain in 2023 was slightly lower than in 2022. Kernel length of different malting varieties is shown in Figure 3.8. The average kernel length in 2023 was higher than in 2022, indicating a somewhat elongated kernel shape. In agreement with 2022 results, AAC Connect this year was also characterized by longer kernels compared to other varieties (Figure 3.8). The β-glucan content in selected malting varieties grown in western Canada in 2022 and 2023 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 arabinoxylan content in selected malting varieties grown in western Canada in 2022 and 2023 is shown in Figure 3.10. In 2023, the β-glucan content in barley grain was slightly lower and the arabinoxylan content was slightly higher compared to 2022. The yearly variations in 1000 kernel weight and grain protein for several established and new malting barley varieties are presented in Figure 3.11 and Figure 3.12, respectively. Values shown in these figures represent the arithmetic averages and the number of samples for 2023 are indicated in parentheses after variety names. The 1000 kernel weight of all varieties in 2023 was slightly higher than last year. The protein content in AC Metcalfe, CDC Churchill and CDC Fraser in 2023 was slightly lower than last year. The protein content of AAC Connect in 2023 was slightly higher than last year.



Box plot explanation: Quartiles and means are represented by boxes and horizontal lines, respectively. Whiskers extend to the maximum and minimum values.

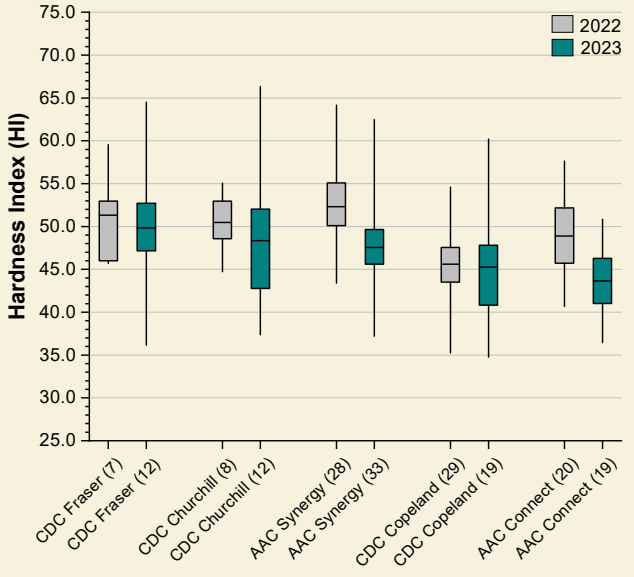


Figure 3.7 Comparison of kernel hardness index for barley varieties selected for malting in 2022 and 2023. Sample numbers for each variety are indicated in parentheses.

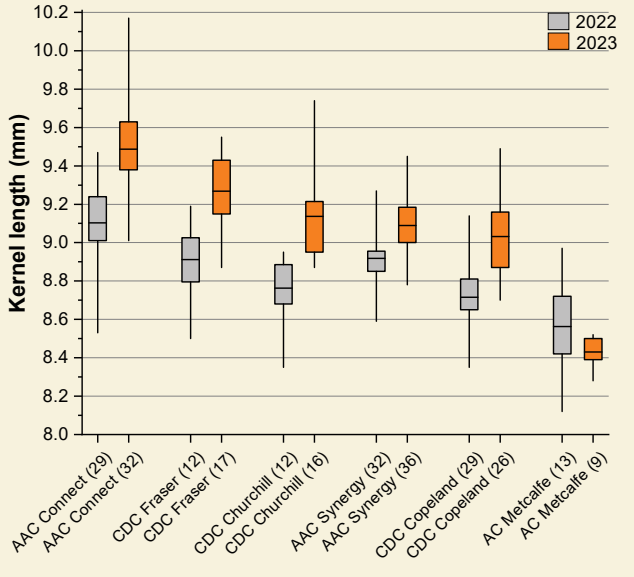


Figure 3.8 Comparison of kernel length for barley varieties selected for malting in 2022 and 2023. Sample numbers for each variety are indicated in parentheses.

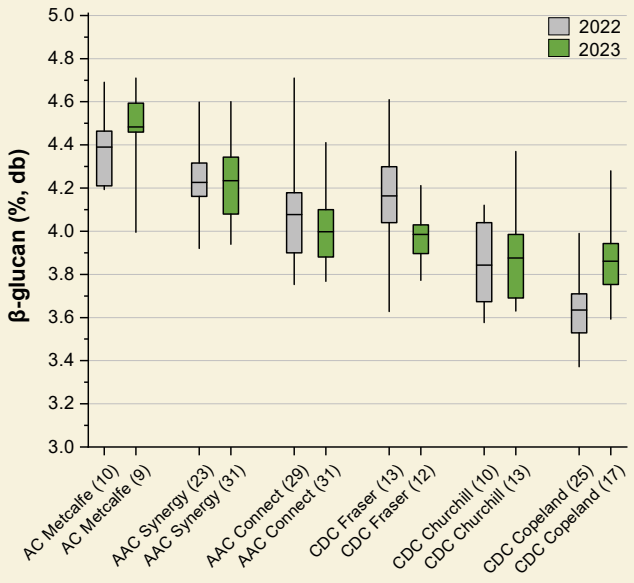


Figure 3.9 Comparison of β-glucan content in selected barley varieties in 2022 and 2023. Sample numbers for each variety are indicated in parentheses.

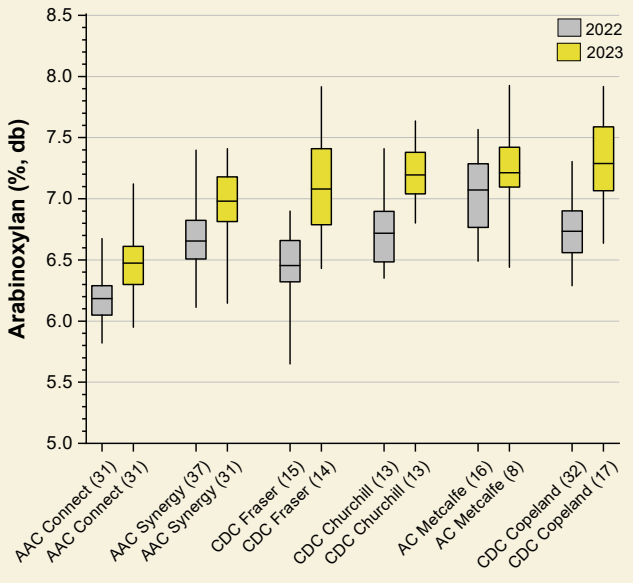


Figure 3.10 Comparison of arabinoxylan content in selected barley varieties in 2022 and 2023. Sample numbers for each variety are indicated in parentheses.

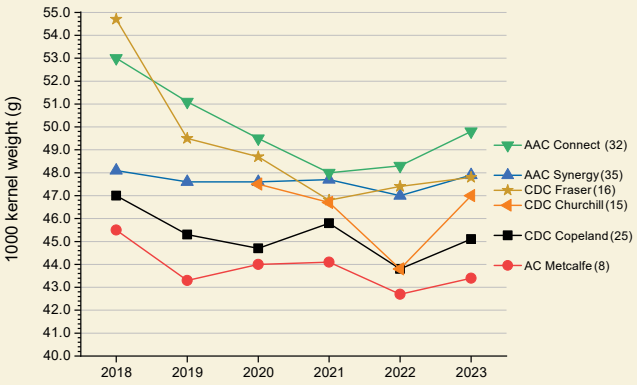


Figure 3.11 Comparison of the average 1000 kernel weight of selected barley varieties from 2018 to 2023.

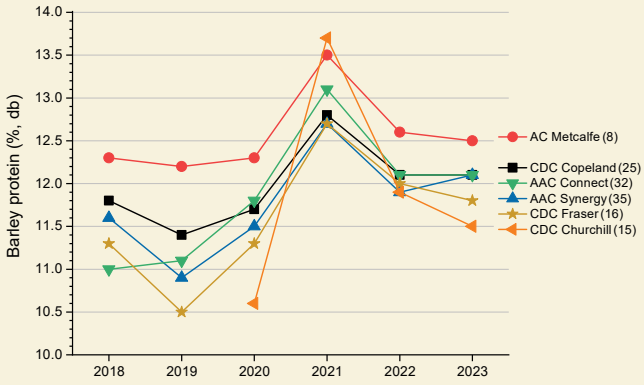


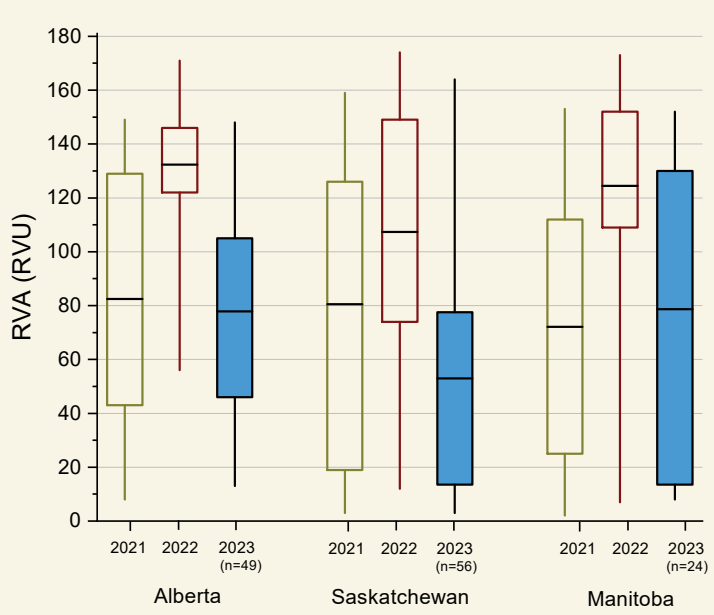
Figure 3.12 Comparison of the average protein content in selected barley varieties from 2018 to 2023.

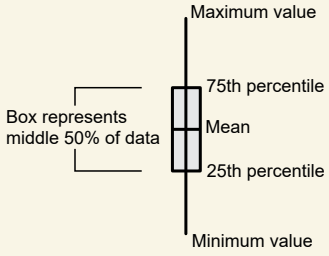
3.4 Pre-harvest sprouting

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 predict safe storage time more accurately, storage conditions (temperature and relative humidity) and the initial moisture content of the grain must be considered in addition to RVA values.

This year's crop was occasionally exposed to rainy conditions during harvest in August. The RVA results show that some samples were affected by pre-harvest sprouting which resulted in RVA values below 80 RVU (Figure 3.13). The RVA results stress the need to identify low RVU barley that should be malted promptly, especially if the moisture content of grain is relatively high. As indicated in the next section of this report, pre-germinated barley malted soon after harvest can produce good quality malt.





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 2023 in comparison with previous years.

Box plot explanation: Quartiles and means are represented by boxes and horizontal lines, respectively. Whiskers extend to the maximum and minimum values.

3.5 Malting conditions and methodologies

Initial malting trials indicated that during steeping, barley from 2023 absorbed water easier and at a faster rate than last year's barley. Several factors contributed to somewhat faster water absorption in 2023 compared to 2022, including lower test weight, kernel density, and kernel hardness. Consequently, the first and second wet steeping cycles were reduced to 8 hours and 7 hours, respectively, from 9 hours used for the respective cycles in 2022. Like last year, the steeping temperature was 14ºC and the entire germination process (96 hours) was conducted at 15ºC. 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 for this report are listed in Appendix I.

Table 3.1 Comparison of micromalting conditions used with the Grain Research Laboratory Phoenix Micromalting System in 2022 and 2023

	2022	2023
Steeping		
1st wet cycle	9 h	8 h
1st dry cycle	14 h	15 h
2nd wet cycle	9 h	7 h
2nd dry cycle	14 h	14 h
Temperature	14 °C	14 °C
Germination	96 h at 15 °C	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

GRL photo collection: cages with barley grain during malting in the Phoenix micromalting unit

3.6 Malting quality in 2023: varietal and yearly comparisons

Figures 3.14 to 3.19 compare average malt protein, fine extract, malt diastatic power, malt α-amylase, wort free amino nitrogen (FAN) and wort β-glucans values for most common varieties annually evaluated in our survey since 2018. Values shown in these figures represent the arithmetic averages and the number of samples from 2023 are indicated in parentheses after variety names.

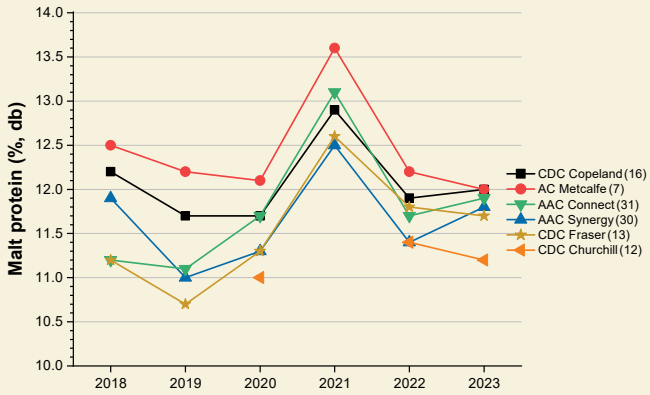


Figure 3.14 Comparison of the average concentration of proteins in the malt of selected barley varieties from 2018 to 2023.

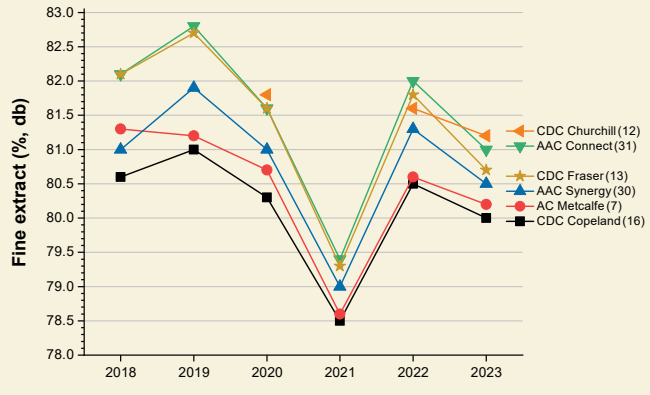


Figure 3.15 Comparison of the average extract levels from the malt of selected barley varieties from 2018 to 2023.

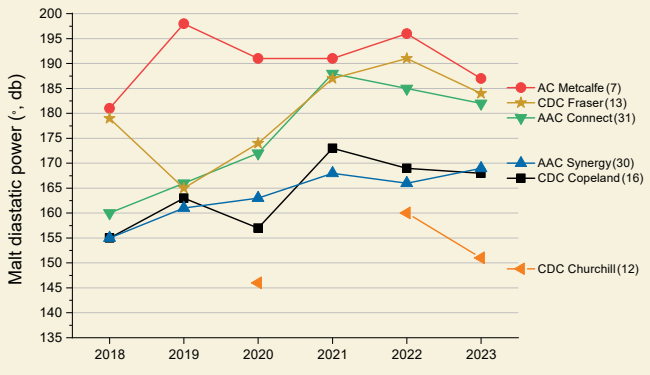


Figure 3.16 Comparison of the average diastatic power in the malt of selected barley varieties from 2018 to 2023.

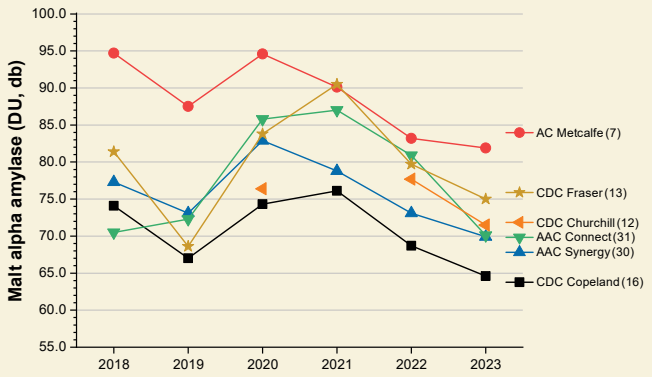


Figure 3.17 Comparison of the average activity of α-amylase in the malt of selected barley varieties from 2018 to 2023.

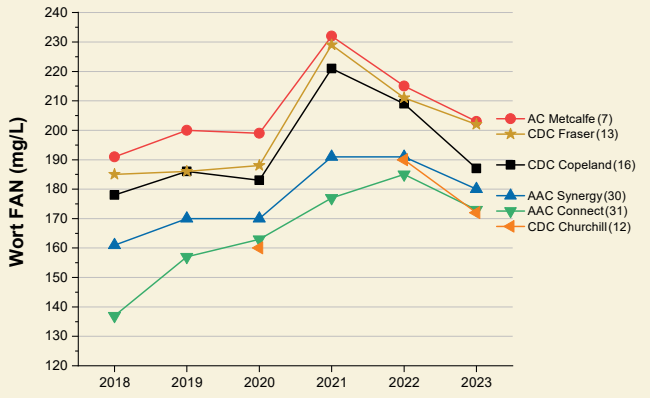


Figure 3.18 Comparison of the average FAN level in wort produced from the malt of selected barley varieties from 2018 to 2023.

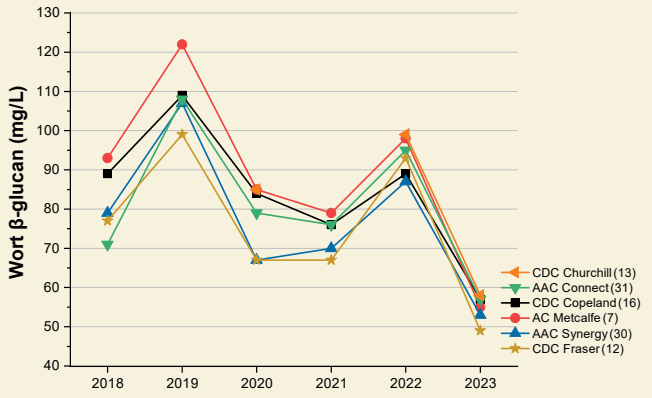


Figure 3.19 Comparison of the average β-glucan concentration in wort produced from the malt of selected barley varieties from 2018 to 2023.

3.7 Highlights of malting barley quality in 2023

- The hot and dry conditions at the beginning of the growing season negatively affected the yield of barley in 2023. Despite a 4% increase in the area seeded with barley, the production of barley was approximately 10% lower than last year.
- In 2023, AAC Synergy was the most popular malting barley variety seeded in western Canada. The area seeded with CDC Copeland continued to decline. The popularity of newer varieties, such as AAC Connect, CDC Fraser and CDC Churchill, increased noticeably. The area seeded with AC Metcalfe declined to approximately 4% of the area seeded with malting barley.
- The hot and dry growing conditions had some effect on the physical characteristics and composition of barley grain in 2023 but the malting quality of this year's barley was generally good. The average barley protein content was 12.3% in 2023, which is the same as last year's but slightly higher than the 10-year average (11.9%).
- The average test weight was 65.0 kg/hL, which is lower than last year's average (66.7 kg/hL)
- The rainy conditions in August caused some pre-harvest sprouting in this year's barley. However, in the fall of 2023, barley exhibited an excellent average germination energy (98%) with no water sensitivity.
- The combination of lower test weight, lower grain density and lower kernel hardness in 2023 barley contributed to easy and quick water absorption during steeping.
- Well-modified malt was obtained from 2023 barley with high friability and adequate levels of enzymes (diastatic power and α-amylase), soluble proteins and free amino nitrogen (FAN). Wort was characterized by low levels of β-glucans and very good (low) viscosity values.
- Malt made from 2023 barley resulted in average levels of extract with expected differences in extract levels among different Canadian malting varieties.

Part 4: Quality data for individual varieties

AAC Synergy

In 2023, AAC Synergy became the most popular malting barley variety seeded in western Canada. 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 qualities makes it a desirable two-rowed malting barley variety for western Canadian producers and the malting and brewing industry.

CDC Copeland

Although the area seeded with CDC Copeland drastically decreased in 2023 compared to previous years, CDC Copeland remained one of the predominant varieties selected for malting. Its excellent brewing characteristics, combined with protein and enzyme levels that are lower than AC Metcalfe, provides an excellent balance among malting barley varieties.

AAC Connect

The area seeded with AAC Connect increased substantially in 2023. AAC Connect, registered in 2016, has excellent agronomic traits and disease resistance. AAC Connect has very good yield potential: 11% higher than AC Metcalfe and 5% higher than CDC Copeland. Compared to AC Metcalfe and CDC Copeland, it has shorter and stronger straw as well as heavier and plumper kernels. Its maturity date is similar to that of AC Metcalfe. It is resistant to spotted net blotch, surface-borne smuts and stem rust, and moderately resistant 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.

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. Its maturity date is similar to that of 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, high enzyme activity and high FAN levels.

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 (3% higher than AAC Synergy). Its maturity date is comparable to CDC Copeland. It has shorter and stronger straw with good lodging resistance. It is a low grain protein variety with low to moderate levels of malt enzymes, and high extract potential. CDC Churchill is moderately resistant to spot form net blotch, net form net blotch and is moderately susceptible to FHB.

AC Metcalfe

In 2023, the production of AC Metcalfe declined to 3.7% of the area seeded with malting barley. With high levels of starch-degrading enzymes, however, AC Metcalfe exhibits excellent brewing 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 content and malt enzymatic activity similar to that of CDC Copeland. It has a high extract potential.

Newdale

Newdale is an older malting variety that continues to represent a small, but consistent, share of barley selected for malting each year. With good friability and low levels of β-glucan, it performs well in the brewhouse. Its moderate levels of enzymes, soluble protein and FAN make Newdale well suited for all-malt brewing.

AAC Prairie

AAC Prairie is the newly registered (2022) two-row malting barley that is currently being developed for the market. It has a malting profile similar to that of AC Metcalfe. The western Cooperative and Collaborative registration trials indicated that this variety has moderate protein content, very high enzymatic activity, high FAN and low wort β-glucan. It has a good yield potential, shorter straw and good lodging resistance. AAC Prairie is moderately resistant to surface-borne smuts, stem rust and net-form net blotch.

Sirish

Sirish is a two-row barley variety with good yield potential, very short plant height and excellent standability. It was registered in 2017. Sirish has excellent plumpness and test weight and its low height and structure offer great harvestability and easy straw management for both feed and malt producers. Sirish is moderately resistant to scald and common root rot; moderately resistant to moderately susceptible to FHB and spot blotch; moderately susceptible to net blotch spot-form; and susceptible to stem rust. Sirish is a European style, low protein variety with a quality profile well suited to the craft brewing market. Sirish is characterized by relatively low levels of malt enzymes, low wort β-glucans, low levels of soluble proteins and FAN, and good extract.

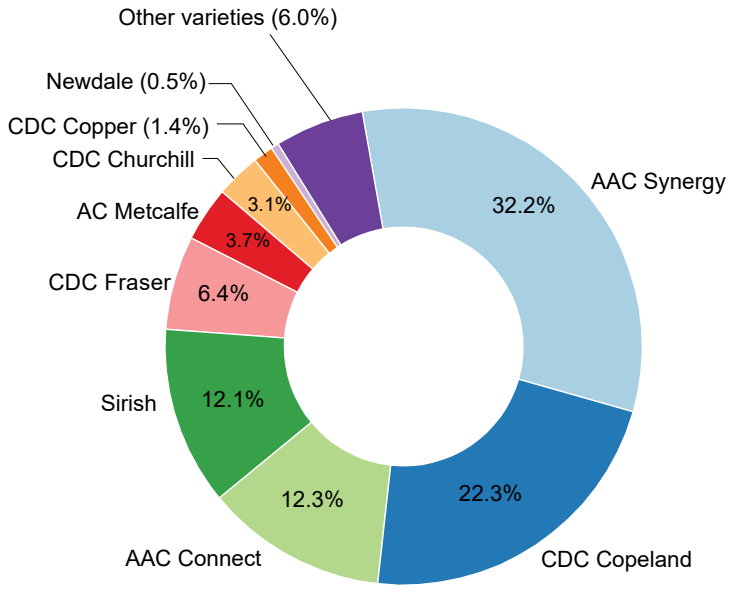


Figure 4.1 Distribution of malting barley varieties as a percentage (%) of area seeded with malting barley in western Canada in 2023.

AAC Synergy

Table 4.1 Quality data for AAC Synergy malting barley

Origin of selected samples	Alberta	Saskatchewan	Manitoba	Western Canada		
Year	**2023**	**2023**	**2023**	**2023**		2018-2022
Number of samples	18	15	4	37		-
Tonnage represented by samples (thousands of tonnes)[a]	348	396	37	781		-
Barley	**Avg_w**[b]	**Avg_w**	**Avg_w**	**Avg_w**	**Range**	**5-year avg**
Test weight (kg/hL)	65.7	64.9	65.6	**65.3**	64.1-68.9	67.1
1000 kernel weight (g)	47.3	47.2	47.5	**47.3**	45.1-53.3	47.5
Plump, over 6/64" sieve (%)	95.4	94.9	94.6	**95.1**	90.6-98.0	95.7
Intermediate, over 5/64" sieve (%)	3.5	4.0	4.0	**3.7**	1.0-8.1	3.2
Moisture[c] (%)	11.7	12.0	11.6	**11.8**	10.4-14.7	12.1
Protein (%, db)	12.1	12.5	12.0	**12.3**	10.7-13.5	11.8
Germination, 4 ml (%)	98	98	99	**98**	95-100	98
Germination, 8 ml (%)	95	94	96	**94**	85-99	92
Malt						
Yield (%)	90.7	90.3	90.9	**90.5**	89.2-92.4	90.6
Steep-out moisture (%)	46.1	46.2	45.3	**46.1**	44.4-48.2	46.2
Friability (%)	76.0	74.8	78.3	**75.5**	59.7-87.1	72.1
Moisture (%)	5.0	5.0	4.8	**5.0**	4.6-6.0	4.9
Protein (%, db)	11.8	12.1	11.6	**11.9**	9.8-13.5	11.7
Diastatic power (°, db)	164	165	151	**164**	135-202	163
α-Amylase (DU, db)	71.6	71.2	69.3	**71.3**	53.0-80.9	78.0
Wort						
Fine grind extract (F) (%, db)	80.7	80.0	80.4	**80.5**	78.9-82.4	80.8
Coarse grind extract (C) (%, db)	80.2	79.6	80.1	**80.0**	77.5-82.1	80.3
F-C difference (%, db)	0.5	0.4	0.3	**0.5**	0-1.7	0.5
ß-Glucan (mg/L)	51	49	54	**49**	43-108	82
Viscosity (cP)	1.41	1.41	1.42	**1.41**	1.39-1.43	1.42
Soluble protein (%, db)	4.70	4.65	4.48	**4.66**	3.99-5.36	4.77
Ratio S/T (%)	40.0	38.3	38.4	**39.1**	33.2-46.6	40.9
FAN (mg/L)	182	182	169	**181**	134-210	176
Colour (°)	1.9	1.9	1.8	**1.9**	1.5-2.6	1.8

[a] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[b] Values represent weighted averages (avg_w) based on tonnage of composite samples received.
[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 protein/total protein; cP =centipoise

CDC Copeland

Table 4.2 Quality data for CDC Copeland malting barley

Origin of selected samples	Alberta	Saskatchewan	Manitoba	Western Canada		
Year	**2023**	**2023**	**2023**	**2023**		2018-2022
Number of samples	10	13	3	26		-
Tonnage represented by samples (thousands of tonnes)[a]	151	196	21	368		-
Barley	**Avg_w**[b]	**Avg_w**	**Avg_w**	**Avg_w**	**Range**	**5-year avg**
Test weight (kg/hL)	65.2	64.7	64.2	**64.8**	60.9-67.8	66.2
1000 kernel weight (g)	44.9	44.6	45.4	**44.8**	40.6-50.6	44.7
Plump, over 6/64" sieve (%)	93.9	93.8	92.9	**93.8**	86.7-97.9	93.6
Intermediate, over 5/64" sieve (%)	4.6	4.9	4.8	**4.8**	1.8-11.7	5.1
Moisture[c] (%)	11.5	12.0	12.9	**11.8**	9.6-15.5	12.0
Protein (%, db)	12.1	12.7	11.9	**12.4**	10.9-13.6	12.1
Germination, 4 ml (%)	99	99	98	**99**	97-100	99
Germination, 8 ml (%)	96	94	95	**95**	81-100	94
Malt						
Yield (%)	90.6	90.3	91.3	**90.5**	89.0-92.4	90.6
Steep-out moisture (%)	45.8	46.1	45.2	**45.9**	44.2-48.0	45.8
Friability (%)	78.3	76.2	80.5	**77.3**	67.9-87.8	76.6
Moisture (%)	4.7	4.8	4.7	**4.7**	4.2-6.1	4.6
Protein (%, db)	11.8	12.4	11.5	**12.1**	10.9-13.2	12.2
Diastatic power (°, db)	160	165	153	**162**	152-207	166
α-Amylase (DU, db)	66.6	67.9	64.5	**67.2**	49.5-73.7	73.0
Wort						
Fine grind extract (F) (%, db)	79.9	79.4	79.9	**79.6**	78.5-81.6	80.2
Coarse grind extract (C) (%, db)	79.4	79.0	79.6	**79.2**	78.0-80.5	79.5
F-C difference (%, db)	0.5	0.4	0.3	**0.4**	0-1.5	0.8
ß-Glucan (mg/L)	56	53	69	**55**	42-86	91
Viscosity (cP)	1.42	1.43	1.44	**1.43**	1.40-1.46	1.43
Soluble protein (%, db)	4.80	4.79	4.70	**4.79**	3.34-4.93	5.02
Ratio S/T (%)	40.5	38.8	40.8	**39.6**	27.7-43.0	41.0
FAN (mg/L)	190	191	188	**191**	163-209	196
Colour (º)	1.9	1.9	2.0	**1.9**	1.5-2.6	2.0

[a] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[b] Values represent weighted averages (avg_w) based on tonnage of composite samples received.
[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 protein/total protein; cP =centipoise

AAC Connect

Table 4.3 Quality data for AAC Connect malting barley

Origin of selected samples	Alberta	Saskatchewan	Manitoba	Western Canada		
Year	**2023**	**2023**	**2023**	**2023**		2018-2022
Number of samples	10	14	13	37		-
Tonnage represented by samples (thousands of tonnes)[a]	90	141	33	264		-
Barley	**Avg_w**[b]	**Avg_w**	**Avg_w**	**Avg_w**	**Range**	**5-year avg**
Test weight (kg/hL)	65.2	64.8	63.7	**64.8**	62.1-67.4	67.2
1000 kernel weight (g)	48.4	48.9	49.5	**48.8**	43.1-55.6	49.6
Plump, over 6/64" sieve (%)	94.4	94.3	94.5	**94.4**	83.8-97.7	95.6
Intermediate, over 5/64" sieve (%)	4.3	4.3	3.6	**4.2**	1.4-13.0	3.4
Moisture[c] (%)	11.7	12.3	12.6	**12.1**	10.6-14.4	12.8
Protein (%, db)	12.2	12.8	12.0	**12.5**	10.9-13.5	11.9
Germination, 4 ml (%)	99	97	98	**98**	96-100	99
Germination, 8 ml (%)	96	92	96	**94**	83-100	94
Malt						
Yield (%)	90.6	90.4	91.2	**90.6**	88.9-93.2	90.7
Steep-out moisture (%)	46.1	46.3	46.6	**46.3**	43.9-48.1	45.5
Friability (%)	79.1	74.1	80.5	**76.6**	58.9-87.7	78.4
Moisture (%)	5.1	5.2	5.3	**5.2**	4.5-6.4	4.8
Protein (%, db)	12.0	12.4	11.8	**12.2**	10.8-13.3	11.9
Diastatic power (°, db)	185	182	170	**182**	146-223	179
α-Amylase (DU, db)	77.9	74.1	69.9	**74.9**	62.4-83.7	81.2
Wort						
Fine grind extract (F) (%, db)	81.0	80.9	81.0	**81.0**	79.8-82.5	81.5
Coarse grind extract (C) (%, db)	80.5	80.1	80.3	**80.3**	78.8-82.9	80.9
F-C difference (%, db)	0.5	0.8	0.7	**0.7**	0-1.4	0.6
ß-Glucan (mg/L)	52	50	56	**51**	44-128	86
Viscosity (cP)	1.41	1.41	1.40	**1.41**	1.39-1.43	1.42
Soluble protein (%, db)	4.69	4.72	4.42	**4.67**	4.06-4.82	4.71
Ratio S/T (%)	39.2	37.9	37.6	**38.3**	34.7-44.3	39.7
FAN (mg/L)	171	176	164	**173**	137-189	168
Colour (°)	1.9	1.9	2.0	**1.9**	1.6-2.2	1.9

[a] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[b] Values represent weighted averages (avg_w) based on tonnage of composite samples received.
[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 protein/total protein; cP =centipoise

CDC Fraser

Table 4.4 Quality data for CDC Fraser malting barley

Origin of selected samples	**Western Canada**		
Year	**2023**		2018-2022
Number of samples	13		-
Tonnage represented by samples (thousands of tonnes)[a]	83.1		-
Barley	**Avg$_w$**[b]	**Range**	**5-year avg**
Test weight (kg/hL)	64.1	62.3-68.3	66.7
1000 kernel weight (g)	45.8	43.6-52.5	49.2
Plump, over 6/64" sieve (%)	93.9	91.5-98.2	96.9
Intermediate, over 5/64" sieve (%)	4.6	0.9-7.0	2.0
Moisture[c] (%)	12.0	11.1-14.9	12.6
Protein (%, db)	12.8	9.9-13.6	11.6
Germination, 4 ml (%)	97	94-100	99
Germination, 8 ml (%)	94	56-99	90
Malt			
Yield (%)	89.0	88.0-91.0	89.7
Steep-out moisture (%)	47.2	44.7-47.9	46.5
Friability (%)	83.8	79.8-94.4	83.1
Moisture (%)	4.9	4.4-5.5	5.0
Protein (%, db)	12.5	9.4-13.2	11.6
Diastatic power (°, db)	189	162-214	178
α-Amylase (DU, db)	75.6	66.0-92.5	81.0
Wort			
Fine grind extract (F) (%, db)	80.7	79.3-83.1	81.4
Coarse grind extract (C) (%, db)	80.5	79.0-82.8	81.0
F-C difference (%, db)	0.2	0.0-0.8	0.4
ß-Glucan (mg/L)	46	43-64	82
Viscosity (cP)	1.41	1.39-1.43	1.42
Soluble protein (%, db)	5.13	4.30-5.40	4.99
Ratio S/T (%)	41.2	38.7-47.7	43.3
FAN (mg/L)	202	168-238	200
Colour (º)	2.2	1.8-2.4	2.2

[a] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[b] Values represent weighted averages (avg$_w$) based on tonnage of composite samples received.
[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 protein/total protein; cP =centipoise

CDC Churchill

Table 4.5 Quality data for CDC Churchill malting barley

Origin of selected samples	**Western Canada**		
Year	**2023**		2020-2022
Number of samples	14		-
Tonnage represented by samples (thousands of tonnes)[a]	48.7		-
Barley	**Avg$_w$**[b]	**Range**	**3-year avg**
Test weight (kg/hL)	66.1	64.3-67.8	67.4
1000 kernel weight (g)	46.1	42.3-53.5	46.0
Plump, over 6/64" sieve (%)	95.2	87.7-99.2	93.8
Intermediate, over 5/64" sieve (%)	3.4	0.3-9.6	4.9
Moisture[c] (%)	12.3	10.1-13.9	11.7
Protein (%, db)	11.8	9.9-13.5	12.1
Germination, 4 ml (%)	99	97-100	99
Germination, 8 ml (%)	92	82-98	89
Malt			
Yield (%)	91.4	90.4-92.7	90.5
Steep-out moisture (%)	45.7	44.3-47.4	45.5
Friability (%)	78.3	65.6-92.9	79.2
Moisture (%)	5.0	4.5-5.8	4.7
Protein (%, db)	11.5	9.2-13.7	12.1
Diastatic power (°, db)	151	132-174	165
α-Amylase (DU, db)	72.7	65.1-95.3	80.4
Wort			
Fine grind extract (F) (%, db)	81.1	78.6-83.3	80.8
Coarse grind extract (C) (%, db)	80.4	77.1-83.0	80.2
F-C difference (%, db)	0.7	0-3.7	0.6
ß-Glucan (mg/L)	58	46-88	94
Viscosity (cP)	1.41	1.40-1.45	1.42
Soluble protein (%, db)	4.45	4.00-4.86	4.91
Ratio S/T (%)	39.0	31.6-47.9	41.0
FAN (mg/L)	175	151-195	173
Colour (°)	1.9	1.4-2.2	1.9

[a] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[b] Values represent weighted averages (avg$_w$) based on tonnage of composite samples received.
[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 protein/total protein; cP =centipoise

AC Metcalfe

Table 4.6 Quality data for AC Metcalfe malting barley

Origin of selected samples	**Western Canada**		
Year	**2023**		2018-2022
Number of samples	8		-
Tonnage represented by samples (thousands of tonnes)[a]	16.3		-
Barley	**Avg$_w$**[b]	**Range**	**5-year avg**
Test weight (kg/hL)	**66.6**	63.6-69.7	68.1
1000 kernel weight (g)	**43.0**	36.8-49.3	43.8
Plump, over 6/64" sieve (%)	**94.2**	86.4-98.6	93.0
Intermediate, over 5/64" sieve (%)	**4.8**	1.0-9.0	5.4
Moisture[c] (%)	**10.5**	9.5-13.5	12.0
Protein (%, db)	**13.0**	10.7-13.6	12.6
Germination, 4 ml (%)	**99**	97-100	99
Germination, 8 ml (%)	**89**	77-99	92
Malt			
Yield (%)	**90.1**	89.4-90.8	90.6
Steep-out moisture (%)	**45.7**	44.8-46.9	45.8
Friability (%)	**71.4**	62.8-89.7	67.0
Moisture (%)	**4.7**	4.5-5.4	4.8
Protein (%, db)	**12.4**	10.4-13.8	12.5
Diastatic power (°, db)	**187**	148-202	190
α-Amylase (DU, db)	**80.7**	76.8-85.7	90.0
Wort			
Fine grind extract (F) (%, db)	**80.0**	78.7-81.7	80.5
Coarse grind extract (C) (%, db)	**79.6**	78.0-81.0	79.9
F-C difference (%, db)	**0.4**	0.3-1.0	0.7
ß-Glucan (mg/L)	**68**	41-93	98
Viscosity (cP)	**1.44**	1.39-1.45	1.43
Soluble protein (%, db)	**5.00**	4.26-5.24	5.12
Ratio S/T (%)	**40.3**	36.2-44.0	40.9
FAN (mg/L)	**205**	182-225	206
Colour (°)	**2.0**	1.6-2.2	2.0

[a] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[b] Values represent weighted averages (avg$_w$) based on tonnage of composite samples received.
[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 protein/total protein; cP =centipoise

CDC Copper

Table 4.7 Quality data for CDC Copper malting barley

Origin of selected samples	**Western Canada**		
Year	**2023**		2020-2022
Number of samples	4		-
Barley	**Avg**[a]	**Range**	**3-year avg**
Test weight (kg/hL)	**66.0**	65.7-66.1	65.9
1000 kernel weight (g)	**47.3**	45.8-49.6	44.6
Plump, over 6/64" sieve (%)	**96.7**	95.7-98.3	92.8
Intermediate, over 5/64" sieve (%)	**2.6**	1.5-3.7	5.8
Moisture[b] (%)	**12.4**	10.5-13.5	12.6
Protein (%, db)	**11.5**	9.2-13.6	12.1
Germination, 4 ml (%)	**98**	96-100	98
Germination, 8 ml (%)	**78**	72-84	86
Malt			
Yield (%)	**91.0**	89.6-93.1	88.7
Steep-out moisture (%)	**46.7**	45.9-47.1	47.4
Friability (%)	**72.1**	43.9-91.1	76.5
Moisture (%)	**5.2**	4.4-5.7	4.8
Protein (%, db)	**11.2**	8.7-13.5	11.8
Diastatic power (°, db)	**160**	131-178	166
α-Amylase (DU, db)	**65.8**	51.2-86.8	72.2
Wort			
Fine grind extract (F) (%, db)	**80.9**	78.8-83.0	80.0
Coarse grind extract (C) (%, db)	**80.6**	78.6-81.9	79.3
F-C difference (%, db)	**0.3**	0-1.1	0.6
ß-Glucan (mg/L)	**53**	46-59	79
Viscosity (cP)	**1.43**	1.42-1.44	1.44
Soluble protein (%, db)	**4.30**	3.88-4.54	4.71
Ratio S/T (%)	**39.1**	33.3-44.5	40.3
FAN (mg/L)	**158**	139-179	162
Colour (°)	**2.5**	1.8-2.9	2.7

[a] Values represent the arithmetic averages (avg) 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 protein/total protein; cP =centipoise

Newdale

Table 4.8 Quality data for Newdale malting barley

Origin of selected samples	**Western Canada**		
Year	**2023**		2018-2022
Number of samples	6		-
Barley	**Avg**[a]	**Range**	**5-year avg**
Test weight (kg/hL)	65.1	62.1-66.9	65.7
1000 kernel weight (g)	45.8	44.4-46.7	46.6
Plump, over 6/64" sieve (%)	94.6	93.4-95.9	94.8
Intermediate, over 5/64" sieve (%)	4.0	2.5-4.7	4.0
Moisture[b] (%)	13.2	12.3-14.1	13.2
Protein (%, db)	12.1	11.5-13.1	11.8
Germination, 4 ml (%)	99	98-100	98
Germination, 8 ml (%)	96	91-100	83
Malt			
Yield (%)	91.3	90.0-92.5	90.0
Steep-out moisture (%)	46.2	44.9-48.6	46.6
Friability (%)	76.2	65.3-86.3	76.3
Moisture (%)	5.0	4.9-5.2	5.0
Protein (%, db)	11.9	11.4-12.5	11.7
Diastatic power (°, db)	156	149-164	162
α-Amylase (DU, db)	63.7	60.1-68.0	75.7
Wort			
Fine grind extract (F) (%, db)	79.8	79.1-80.7	80.3
Coarse grind extract (C) (%, db)	79.1	77.9-80.1	79.6
F-C difference (%, db)	0.7	0.1-1.2	0.7
ß-Glucan (mg/L)	59	44-77	98
Viscosity (cP)	1.41	1.40-1.41	1.42
Soluble protein (%, db)	4.34	4.19-4.49	4.60
Ratio S/T (%)	36.6	36.0-37.0	39.4
FAN (mg/L)	158	149-173	171
Colour (°)	1.8	1.7-2.2	2.0

[a] Values represent the arithmetic averages (avg) 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 protein/total protein; cP =centipoise

AAC Prairie[a]

Table 4.9 Quality data for AAC Prairie malting barley

Origin of selected samples	**Western Canada**	
Year	**2023**	
Number of samples	3	
Barley	**Avg[b]**	**Range**
Test weight (kg/hL)	**70.5**	70.2-71.0
1000 kernel weight (g)	**49.4**	48.2-50.3
Plump, over 6/64" sieve (%)	**98.3**	98.0-98.6
Intermediate, over 5/64" sieve (%)	**1.2**	1.2-1.3
Moisture[c] (%)	**12.1**	10.9-12.8
Protein (%, db)	**11.6**	10.9-12.7
Germination, 4 ml (%)	**99**	97-100
Germination, 8 ml (%)	**90**	79-99
Malt		
Yield (%)	**88.8**	88.3-89.7
Steep-out moisture (%)	**45.1**	43.8-47.0
Friability (%)	**85.4**	79.9-89.6
Moisture (%)	**5.6**	5.4-5.9
Protein (%, db)	**11.9**	11.1-13.3
Diastatic power (°, db)	**232**	222-248
α-Amylase (DU, db)	**103.1**	96.3-109.9
Wort		
Fine grind extract (F) (%, db)	**81.8**	81.0-82.4
Coarse grind extract (C) (%, db)	**81.3**	80.5-81.9
F-C difference (%, db)	**0.5**	0-0.9
ß-Glucan (mg/L)	**43**	42-44
Viscosity (cP)	**1.41**	1.40-1.42
Soluble protein (%, db)	**5.32**	5.19-5.41
Ratio S/T (%)	**45.0**	40.7-48.2
FAN (mg/L)	**242**	233-253
Colour (°)	**2.0**	1.9-2.2

[a] AAC Prairie is currently being developed for the market and is not yet commercially produced. The number of samples analyzed in this survey is limited and may not accurately represent the characteristics of this variety.
[b] Values represent arithmetic averages (avg) of samples analyzed.
[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 protein/total protein; cP =centipoise

Sirish[a]

Table 4.10 Quality data for Sirish malting barley

Origin of selected samples	Western Canada	
Year	**2023**	
Number of samples	6	
Barley	**Avg[b]**	**Range**
Test weight (kg/hL)	**65.5**	64.5-67.8
1000 kernel weight (g)	**47.8**	43.0-50.3
Plump, over 6/64" sieve (%)	**97.4**	96.0-98.7
Intermediate, over 5/64" sieve (%)	**1.8**	1.0-2.6
Moisture[c] (%)	**12.9**	11.9-13.8
Protein (%, db)	**11.3**	10.3-12.9
Germination, 4 ml (%)	**98**	97-99
Germination, 8 ml (%)	**71**	56-96
Malt		
Yield (%)	**93.8**	93.0-94.3
Steep-out moisture (%)	**45.0**	42.4-46.0
Friability (%)	**81.5**	67.7-91.8
Moisture (%)	**5.2**	4.9-5.7
Protein (%, db)	**10.6**	8.7-12.0
Diastatic power (°, db)	**135**	118-145
α-Amylase (DU, db)	**50.4**	39.3-60.8
Wort		
Fine grind extract (F) (%, db)	**81.4**	80.3-82.9
Coarse grind extract (C) (%, db)	**80.5**	79.1-82.0
F-C difference (%, db)	**0.9**	0.3-1.5
ß-Glucan (mg/L)	**75**	44-199
Viscosity (cP)	**1.43**	1.40-1.51
Soluble protein (%, db)	**3.85**	3.29-4.30
Ratio S/T (%)	**36.6**	29.5-42.3
FAN (mg/L)	**143**	110-158
Colour (°)	**1.8**	1.6-2.0

[a] Samples of Sirish barley were obtained exclusively through the Canadian Grain Commission's Harvest Sample Program.
[b] Values represent arithmetic averages (avg) of samples analyzed.
[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 protein/total protein; cP =centipoise

Appendix I - Methods

This section describes the analytical methods used at the Grain Research Laboratory. Unless otherwise specified, 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.

Arabinoxylan content
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 barley 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 that is calibrated using malt standards analyzed 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 were 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 (S/T)
Kolbach index was calculated using (% soluble protein / % total 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 using 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 sample (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 104ºC for 3 h (ASBC Malt-3).

Protein content (nitrogen x 6.25)
Protein content was predicted on dockage-free barley using the Foss Infratec™ 1241 whole grain near-infrared analyzer. The 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 ethylenediaminetetraacetic acid (EDTA). Samples were ground on a UDY Cyclone Sample Mill fitted with a 1.0 mm screen. A moisture analysis was also performed with results 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 with the PerkinElmer RVA 4500 Rapid Visco Analyzer using the Stirring Number method. 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 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 using a mechanical divider to obtain one representative sub-sample that weighed 40 g. All foreign material and broken kernels were removed from the 40 g portion and the net weight determined. The number of kernels were counted with a mechanical counter and the thousand kernel weight 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 colour was determined spectrophotometrically using ASBC methods Wort-9 and Beer-10.

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