Canadian Grain Commission | Commission canadienne des grains

Barley Production, Barley Nutrient Content, and Quality of Malting Barley in Western Canada

2020

Annual Barley Harvest Report

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Summary

Total barley production in Western Canada in 2020 is estimated at 10,416,300 tonnes, and the total area planted with barley is estimated at 2,994,200 hectares. These figures are higher than those from 2019 when 9,996,300 tonnes of barley was produced from 2,878,00 hectares of seeded area. The 2020 average yield for barley in Western Canada is estimated at 71.8 bushels per acre, an increase from 71.1 bushels per acre in 2019.

In 2020, CDC Copeland dominated the portfolio of malting barley cultivars in Western Canada at 42.4% of the total area seeded with malting barley. For the first time, the area seeded with AAC Synergy (22.5%) exceeded that seeded with AC Metcalfe (17.7%). The area planted with recently registered two-rowed cultivars, especially AAC Connect, CDC Bow, CDC Fraser, and Sirish continued to grow. Together they accounted for approximately 11.2% of total area seeded with malting barley varieties in Western Canada, up from 4.9% in 2019.

During the early part of the growing season in 2020 much of the Prairies experienced below average temperatures that delayed emergence and slowed crop growth. In late May and June, rains in many areas allowed the crops to get well established. Adequate moisture and heat during the growing season in a large part of the Prairies, coupled with a relatively dry harvest, allowed Canadian farmers to produce one of the best malting barley crops in a decade.

The 2020 barley crop can be characterized by good yields, few issues with pre-harvest sprouting and disease, as well as high test weights and plump kernels. Overall, protein content in barley grain had an average of 11.8% dry basis (db) in 2020 compared to 11.5% (db) in 2019. The 1000 kernel weight of this year's barley had an average of 45.5 grams (g) compared to 45.1 g last year. The average kernel weight of the newer Canadian malting barley varieties, such as AAC Synergy, AAC Connect, CDC Bow, CDC Fraser, CDC Churchill, and CDC Copper, were noticeably higher than that of CDC Copeland and AC Metcalfe.

Barley had an average germination energy of 99%, higher than the 10-year average (98%), and little water sensitivity. Very good quality malt was obtained from 2020 barley with adequate levels of enzymes (diastatic power and α-amylase), soluble proteins, and free amino nitrogen (FAN). Slightly higher concentration of grain proteins in 2020 barley likely contributed to somewhat lower malt extract levels compared to those in 2019.

Overall, favorable growing and harvest conditions allowed Canadian farmers to produce a very good quality malting barley crop in 2020 with ample supply for both the domestic and international markets.

In 2020, we also began analysis of nutritional components in barley to obtain a better understanding of nutrient levels in various genotypes and barley classes, and to increase awareness and appreciation of the nutritional and health values of barley grain.

Part 1: Growing and harvest conditions in 2020

The spring of 2020, with its cool temperatures and late season snow, delayed seeding by one to three weeks compared to the average seeding dates across the Prairies (Figure 1.1). The first seeding started around April 15 in southern Alberta but in much of the three prairie provinces general seeding did not get underway until the second week of May.

Southern Alberta, which had suffered through three consecutive droughts (2017-2019), received widespread rains in late May and June (Figure 1.2). These were perfectly timed with the arrival of warm weather to stimulate crop development. This rain also fell on northern Alberta, which was suffering from excessive moisture, and delayed seeding in the region. Much of the Prairies experienced below average temperatures which delayed emergence and slowed crop development.

By mid-July there was a stark contrast between the prevailing conditions in Northern Alberta and southern Saskatchewan. Crops suffered from below normal seasonal temperatures and excessive moisture in the Edmonton and surrounding areas, with numerous fields being drowned out. Meanwhile, dry areas in southeast and south-central Saskatchewan desperately needed rain. Rains fell on these dry areas in mid-July, just in time to limit crop damage, but the northern tiers of Alberta remained cool and wet throughout the summer and harvest.

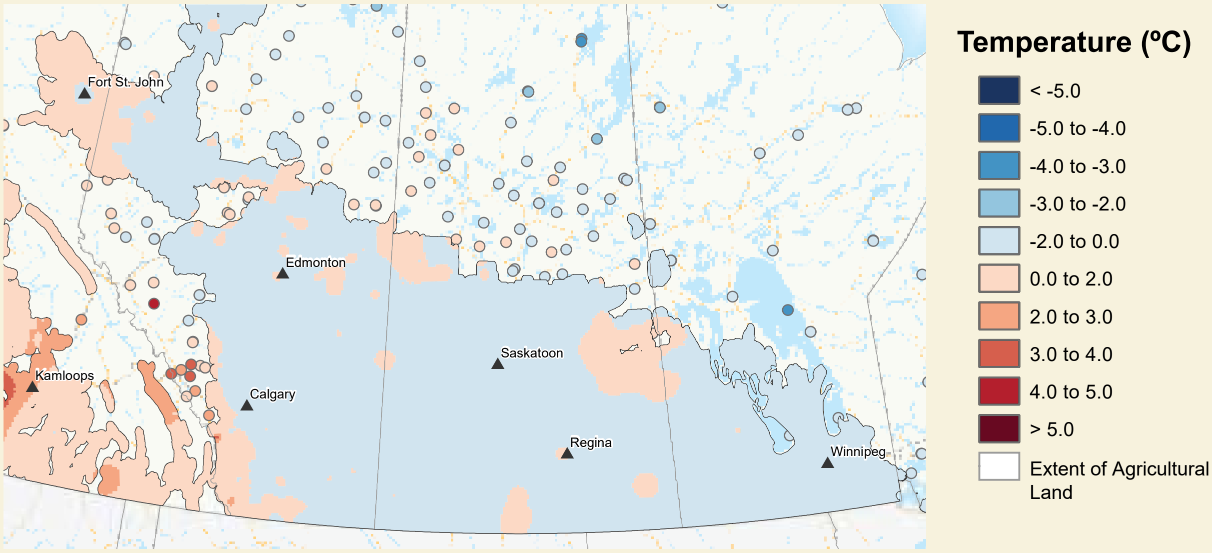

Figure 1.1 Mean temperature differences from normal for May 2020.

By late July, the Prairies had warmed up significantly and this greatly advanced crop development. Warm and dry conditions persisted to the end of August and September, permitting the crop to ripen and allowing harvest to begin. By the end of August, harvest was well underway in the southern prairies. Generally, dry conditions allowed farmers to make rapid progress (Figure 1.3) and by mid-September 75% of the barley was harvested. The majority of the barley was of very good quality.

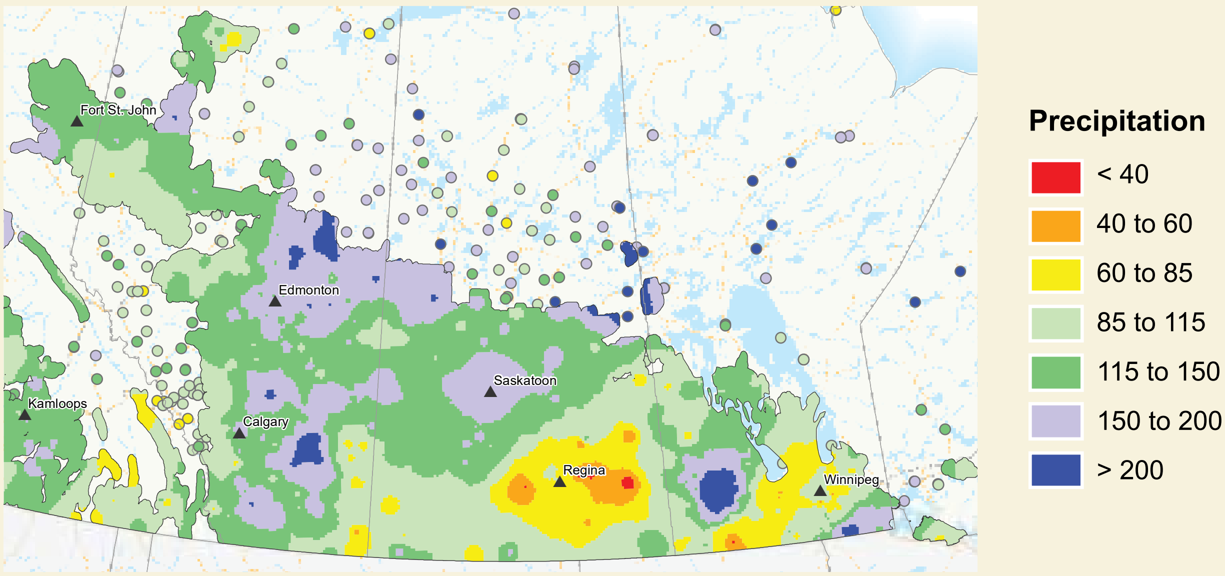

Figure 1.2 Percent of average precipitation in June 2020.

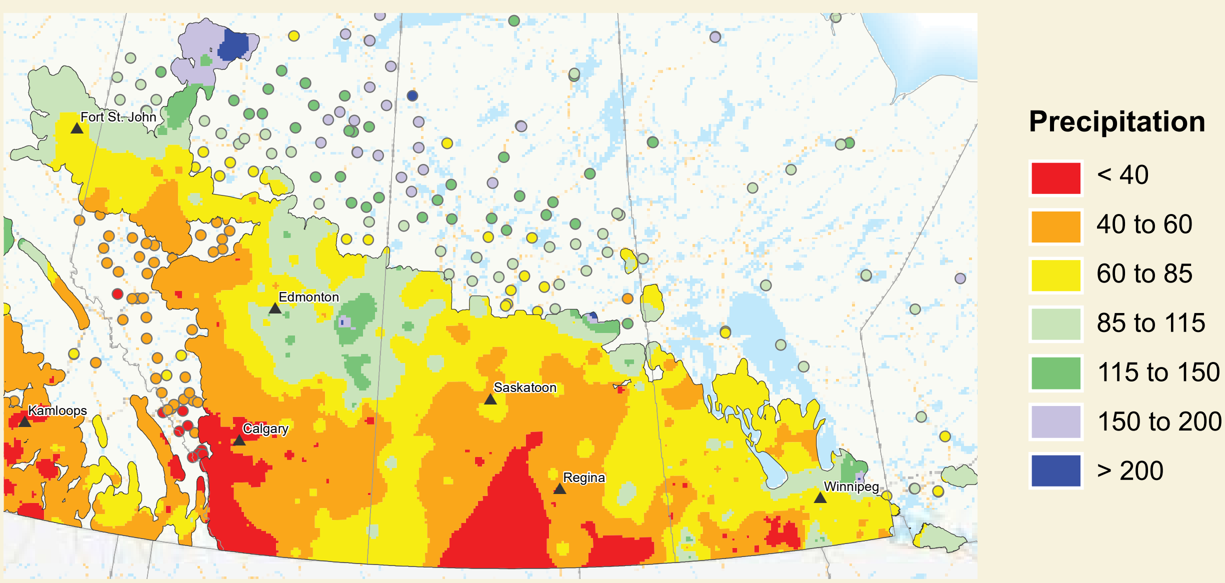

Figure 1.3 Percent of average precipitation from August 1 to September 30, 2020.

Part 2: Barley production in 2020

2.1 Annual production statistics

The total area planted with barley in Western Canada in 2020 was 2.944 million hectares, slightly higher than in 2019 (Table 2.1). Barley production in Western Canada in 2020, estimated at about 10.416 million tonnes, was approximately 4.2% higher than in 2019 (Table 2.2). The average yield for barley in Western Canada is estimated at 71.8 bushels per acre in 2020, compared to 71.1 bushels per acre in 2019 (Table 2.3 and Figure 2.3).

Compared to last year, 2020 barley seeded area decreased in Saskatchewan by 0.9% and increased in Alberta and Manitoba by 3.1% and 23.5%, respectively (Table 2.1 and Figure 2.1). In 2020, barley production in Manitoba and Alberta (including the northeastern part of British Columbia) increased by 29.7% and 6.5%, respectively, and decreased in Saskatchewan by 1.4% compared to last year (Table 2.2 and Figure 2.2).

Table 2.1 Total barley seeded area in Canada

	Seeded area (million hectares)			
	2018	2019	10-year average*	2020**
Manitoba	0.131	0.136	0.158	0.168
Saskatchewan	1.089	1.275	0.989	1.264
Alberta & British Columbia	1.280	1.467	1.412	1.512
Western Canada	**2.501**	**2.878**	**2.563**	**2.944**
Canada	**2.628**	**2.996**	**2.707**	**3.060**

Source: Statistics Canada
*10-year average from 2010 to 2019
** Estimated as of December 2020

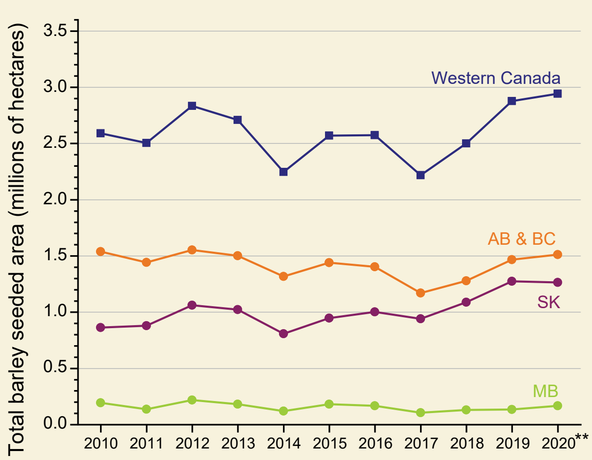

Figure 2.1 Yearly comparison of total barley seeded area in Western Canada.

Table 2.2 Total barley production in Canada

	Production (millions of tonnes)			
	2018	2019	10-year average*	2020**
Manitoba	0.501	0.529	0.508	0.686
Saskatchewan	3.439	4.449	2.957	4.385
Alberta & BC	4.057	5.018	4.532	5.345
Western Canada	**7.997**	**9.996**	**8.010**	**10.416**
Canada	**8.380**	**10.383**	**8.461**	**10.741**

Table 2.3 Average barley yield

	Average barley yield (bushels per acre)			
	2018	2019	10-year average*	2020**
Manitoba	75.3	76.9	66.1	79.9
Saskatchewan	62.7	69.3	59.6	68.7
Alberta	66.8	72.4	69.1	74.0
Western Canada	**65.4**	**71.1**	**65.2**	**71.8**
Canada	**65.0**	**70.8**	**64.9**	**71.1**

Source: Statistics Canada, Table 32-10-0359-01
*10 year average calculated from 2010 to 2019.
** Estimated as of December 2020.

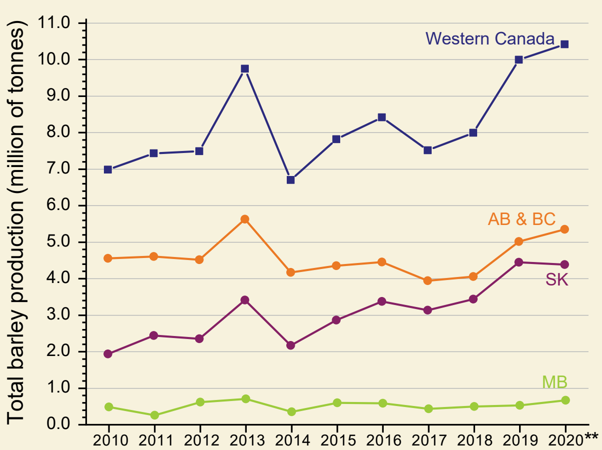

Figure 2.2 Yearly comparison of total barley production in Western Canada.

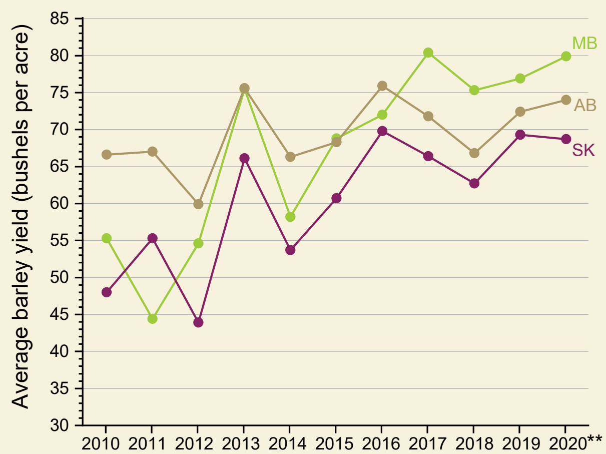

Figure 2.3 Yearly comparison of average barley yield in the Prairie Provinces.

2.2 Distribution of barley classes and varieties

Barley is a versatile crop grown for malting, food, and general purposes (feed and forage) across the Canadian Prairies. Based on insured commercial acres in 2020, general purpose barley accounted for 49.7% of total barley seeded area in Alberta while malting barley accounted for 46.1% (Figure 2.4, left). In Saskatchewan the majority of barley seeded area (65.4%) was planted with malting barley varieties (Figure 2.4, left). In Manitoba approximately 42.7% of barley seeded area was allocated to malting varieties and 51.7% to general purpose varieties (Figure 2.4, left). Overall, in Western Canada in 2020, barley seeded area was comprised of 53.7% malting barley, 38.5% general purpose barley, and 2.4% food barley (Figure 2.4, right).

In 2020, CDC Copeland, AAC Synergy, and AC Metcalfe dominated the portfolio of malting barley cultivars grown in Western Canada (Table 2.4). The area seeded with CDC Copeland (42.44%) was slightly lower than last year (44.03%). The area seeded with AAC Synergy has been steadily increasing since 2014 and in 2020 it exceeded (22.54%) that of AC Metcalfe (17.66%) for the first time (Figure 2.5). The area planted with recently registered two-rowed cultivars, especially AAC Connect, CDC Bow, CDC Fraser, and Sirish, continued to grow (Figure 2.6). Together they accounted for approximately 11.15% of the total area seeded with malting barley varieties in Western Canada (Table 2.4).

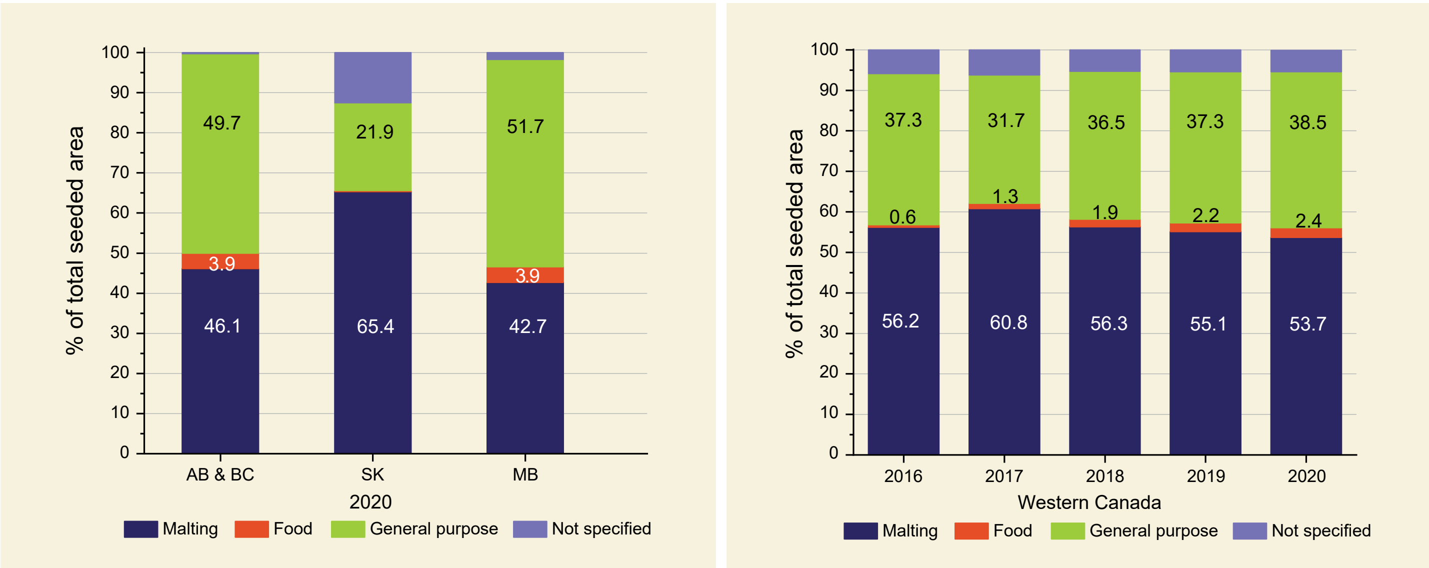

Figure 2.4 Distribution of barley classes as a percentage of total area seeded with barley in each province in 2020 (left) and overall in Western Canada from 2016-2020 (right).

The production of six-rowed malting barley continued to decline. In 2020, the six-rowed cultivars occupied only about 3.32% of the total area seeded with malting barley, compared to 4.01% in 2019. Legacy, Celebration and Tradition remained the top three six-rowed varieties (Table 2.4).

The production of two-rowed cultivars dominated in each province (Table 2.4). In Alberta and British Columbia (BC), CDC Copeland and AAC Synergy were the top two varieties. In Saskatchewan CDC Copeland, followed by AC Metcalfe and AAC Synergy, dominated the area seeded with malting barley. Compared to Alberta and Saskatchewan, the area seeded with malting barley in Manitoba was relatively low. In 2020, the most popular cultivars seeded in Manitoba were AAC Synergy, CDC Copeland, AAC Connect, and AC Metcalfe, followed by Celebration (Table 2.4).

Based on the 2020 insured acreage in Western Canada, food and general purpose barley varieties accounted for 40.9% of total barley seeded area (Figure 2.4 right). CDC Austenson, followed by Brahma, dominated the portfolio of general purpose barley cultivars grown in Western Canada (Table 2.5 and Figure 2.7). CDC Austenson was the top variety grown in every western province in 2020. The area seeded with Champion and Xena continued to decrease in 2020. Canmore, a new variety that can be used for food and feed purposes, has experienced steady growth since 2014 (Figure 2.7).

Table 2.4 Distribution of malting barley cultivars as a percentage of total area seeded with malting barley in Western Canada in 2020

Percentage (%) of area seeded with malting barley in Western Canada 2020				
Malting barley cultivars	**Alberta & BC**	**Saskatchewan**	**Manitoba**	**Western Canada**
2-rowed	%	%	%	%
CDC Copeland	19.08	22.15	1.21	42.44
AAC Synergy	10.50	10.63	1.41	22.54
AC Metcalfe	5.89	11.00	0.77	17.66
AAC Connect	2.66	1.61	0.93	5.19
CDC Bow	1.64	0.91	0.15	2.71
CDC Fraser	0.78	0.48	0.41	1.67
Sirish	1.56	0.00	0.01	1.58
Newdale	0.28	0.46	0.41	1.15
CDC PlatinumStar	0.00	0.45	0.00	0.46
Bentley	0.30	0.03	0.03	0.36
Cerveza	0.25	0.00	0.00	0.25
Bill Coors 100	0.15	0.00	0.00	0.15
CDC Meredith	0.04	0.09	0.00	0.13
CDC Copper	0.10	0.00	0.01	0.12
CDC Kindersley	0.04	0.02	0.02	0.07
Major	0.04	0.00	0.00	0.04
CDC Churchill	0.02	0.00	0.00	0.02
Lowe	0.02	0.00	0.00	0.02
Harrington	0.01	0.00	0.00	0.01
Merit 57	0.01	0.00	0.00	0.01
AB Brewnet	0.00	0.00	0.00	0.00
AAC Goldman	0.00	0.00	0.00	0.00
CDC Aurora Nijo	0.04	0.00	0.00	0.04
CDC Stratus	0.02	0.00	0.00	0.02
Other	0.02	0.02	0.00	0.04
Total 2-rowed	**43.45**	**47.86**	**5.37**	**96.68**
6-rowed	**%**	**%**	**%**	**%**
Legacy	0.54	1.49	0.08	2.11
Celebration	0.00	0.15	0.53	0.69
Tradition	0.01	0.03	0.21	0.25
Other	0.14	0.00	0.14	0.28
Total 6-rowed	**0.69**	**1.67**	**0.96**	**3.32**

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

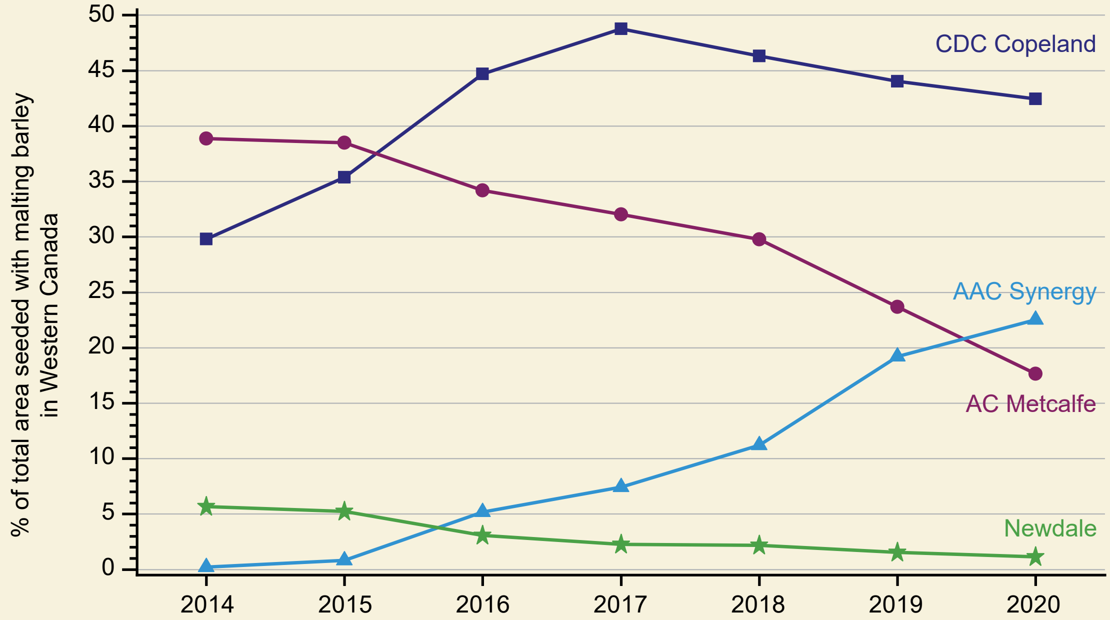

Figure 2.5 Comparison of areas seeded with top malting barley cultivars in Western Canada from 2014 to 2020. Source: Sask Crop Insurance, Alberta Ag Financial Services Corp., Manitoba Agricultural Services Corporation, BC Crop Insurance.

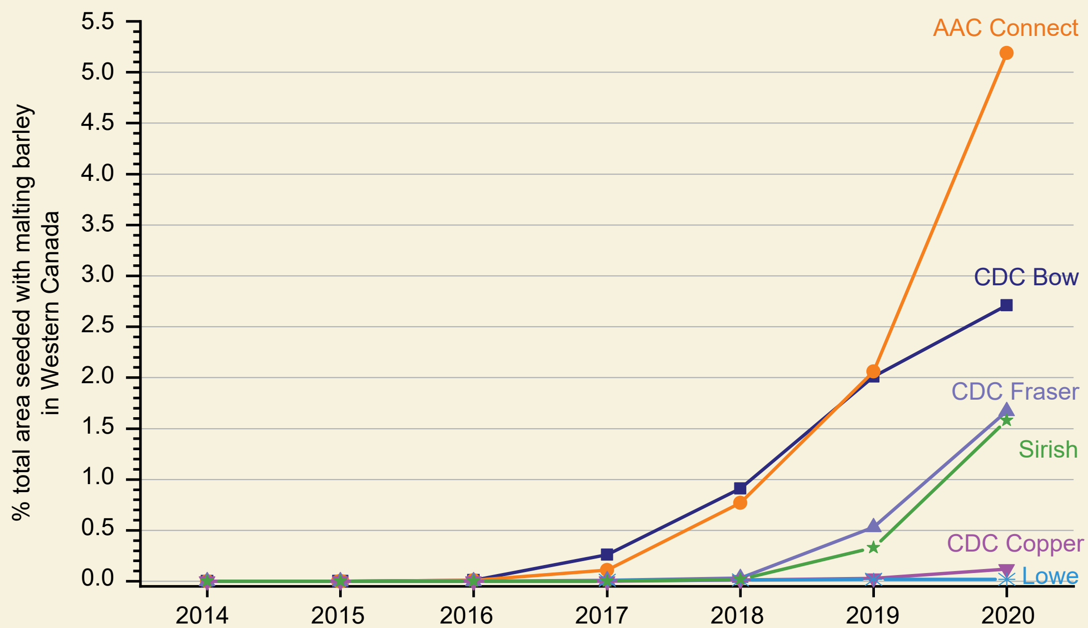

Figure 2.6 Comparison of areas seeded with the recently registered malting barley cultivars: AAC Connect (2016), CDC Bow (2015), CDC Fraser (2016), Lowe (2016), Sirish (2017), and CDC Copper (2018) in Western Canada from 2014 to 2020. The numbers in brackets indicate the year of variety registration. 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 (F) barley in Western Canada in 2020

	% of total area seeded with general purpose and food barley in 2020			
General purpose and food barley cultivars	**Alberta & BC**	**Saskatchewan**	**Manitoba**	**Western Canada**
CDC Austenson	22.96	13.94	5.98	42.89
Brahma	10.85	0.14	0.00	10.98
Canmore (F)	4.92	0.11	0.72	5.74
Champion	4.18	0.95	0.21	5.34
Xena	5.03	0.19	0.00	5.22
CDC Coalition	4.50	0.21	0.00	4.70
Claymore	2.41	2.05	0.22	4.69
Conlon	1.15	0.13	3.04	4.32
Oreana	3.49	0.51	0.09	4.10
CDC Maverick	1.51	2.11	0.24	3.86
CDC Cowboy	1.05	0.72	0.09	1.86
AB Cattlelac	0.57	0.10	0.08	0.75
CDC Thompson	0.62	0.00	0.00	0.62
Amisk	0.58	0.00	0.00	0.58
Seebe	0.54	0.00	0.00	0.54
CDC Trey	0.36	0.00	0.00	0.36
AC Rosser	0.10	0.24	0.00	0.34
Sundre	0.20	0.13	0.00	0.32
Ponoka	0.26	0.00	0.00	0.26
AC Ranger	0.15	0.08	0.01	0.24
CDC Bold	0.21	0.00	0.00	0.21
CDC McGwire (F)	0.02	0.14	0.04	0.20
Gadsby	0.13	0.05	0.00	0.19
Busby	0.18	0.00	0.00	0.18
Otal	0.16	0.00	0.00	0.16
AC Albright	0.15	0.00	0.00	0.15
Falcon	0.12	0.02	0.00	0.15
Stander	0.12	0.00	0.00	0.12
CDC Helgason	0.10	0.00	0.00	0.10
Bridge	0.09	0.00	0.00	0.09
Trochu	0.07	0.00	0.00	0.07
AC Lacombe	0.07	0.00	0.00	0.07
AB Advantage	0.07	0.00	0.00	0.07
Other	0.30	0.15	0.00	0.53
Total general purpose and food	**67.2**	**22.0**	**10.80**	**100.00**

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

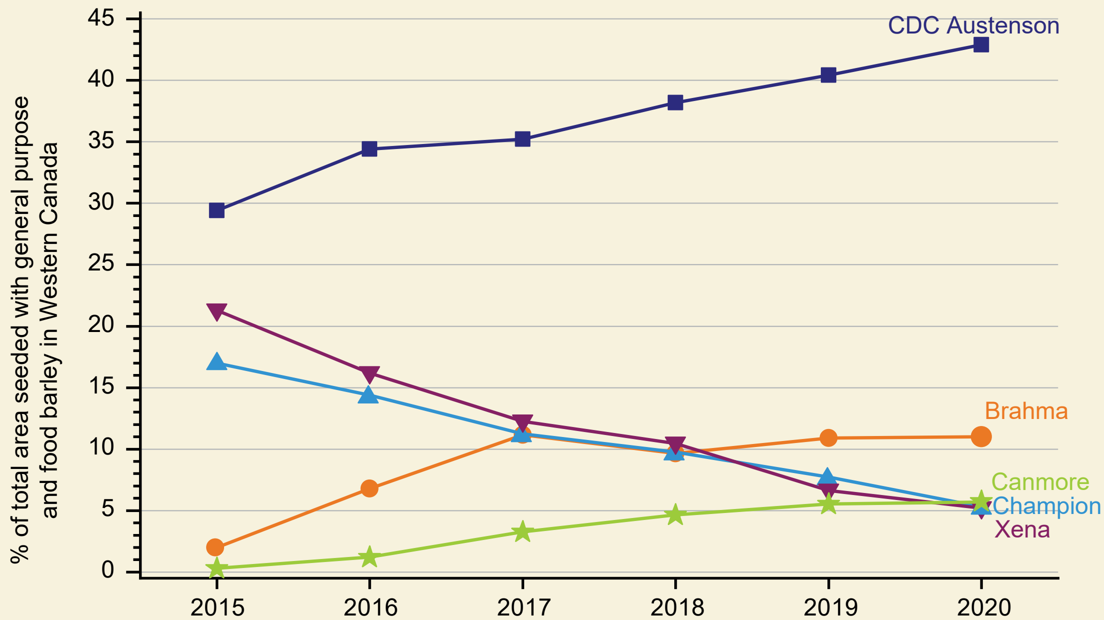

Figure 2.7 Comparison of areas seeded with the top five general purpose and food barley cultivars in Western Canada from 2015 to 2020.

Canmore

AB Wrangler

TR18262 line

Part 3: Nutritional components in barley grain

Barley is a versatile crop that can be used for animal feed, human food, the production of malt and beer, and forage. Selective breeding practices in recent decades have resulted in the development of barley genotypes with distinctive traits targeted for specific end uses. Examples of such traits include the ability to produce ample amounts of hydrolytic enzymes needed for malting or a high content of soluble fibre in grain to combat heart disease. In Canada, barley varieties are classified into three major types based on their intended end use: food, general purpose, and malting barley. Even though nutrient levels in barley are controlled by genotype, environmental growing conditions, and the interactions between these two factors, barley is generally a wholesome and nutritious cereal grain. Many health benefits are derived from its high levels of soluble β-glucans, total dietary fibre, tocols, vitamin B, and phenolic compounds. While specialty food barley can deliver exceptionally high levels of β-glucan and starch with altered characteristics (waxy or high amylose), any type of barley can be made into convenient food ingredients such as pearled grain, steel-cut, flakes and flour. Barley can also be blended into various food products to add texture, flavor, and nutritional value to the product. As a food grain, however, barley is still awaiting greater utilization by the food industry and better recognition and acceptance by consumers.

In 2020, we began an analysis of the nutritional components in barley in order to obtain a better understanding of the nutrient levels in various genotypes and barley classes. Covered barley genotypes were dehulled to determine the level of nutrients in the edible portion of the grain. Since the hull is firmly attached to the caryopsis it is usually difficult to remove and some parts of the outer layer, such as the pericarp or testa, may be unintentionally lost during the dehulling process. In hulless barley genotypes, the dry hulls are easily detached from the rest of the kernel during combining at harvest. Hulless barley may contain remnants of adhering hulls, however, and these also need to be removed mechanically before the grain is suitable for consumption. For comparison purposes we are reporting the level of nutrients before and after dehulling. The values for malting varieties represent averages for samples grown in two different locations in 2020. Other varieties were grown in a single location. Specialty food barley includes hulless, high β-glucan varieties with waxy (CDC Fibar, CDC Marlina, CDC Valdres) or high amylose starch (CDC Hilose).

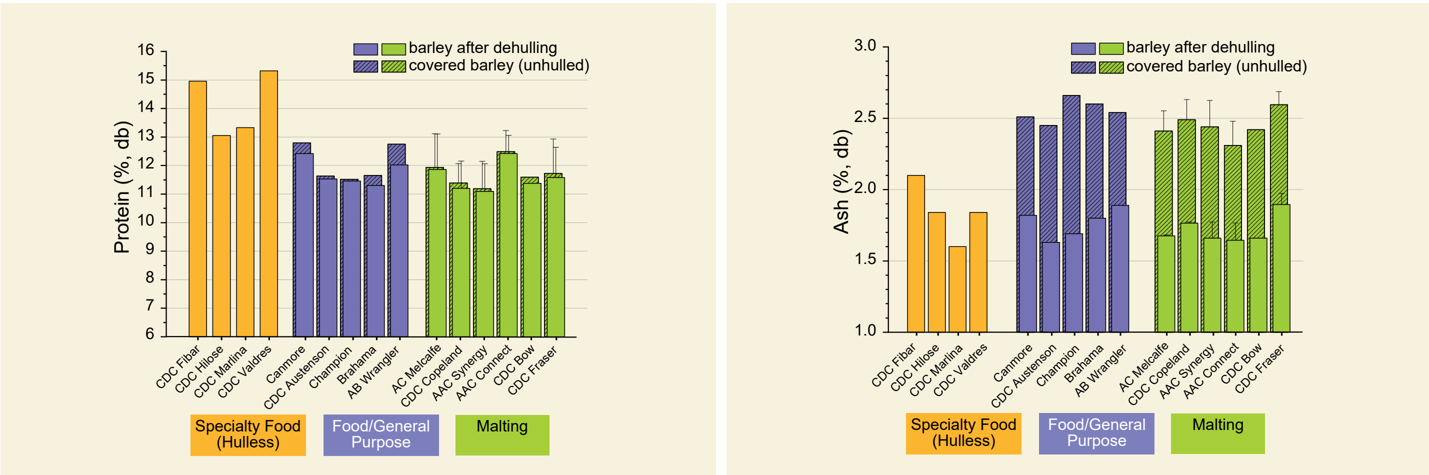

Figure 3.1 Content of proteins (left) and ash (right) in various genotypes of specialty food (hulless), food/general purpose, and malting barley before and after dehulling. The values for malting varieties represent averages for samples grown in two different locations.

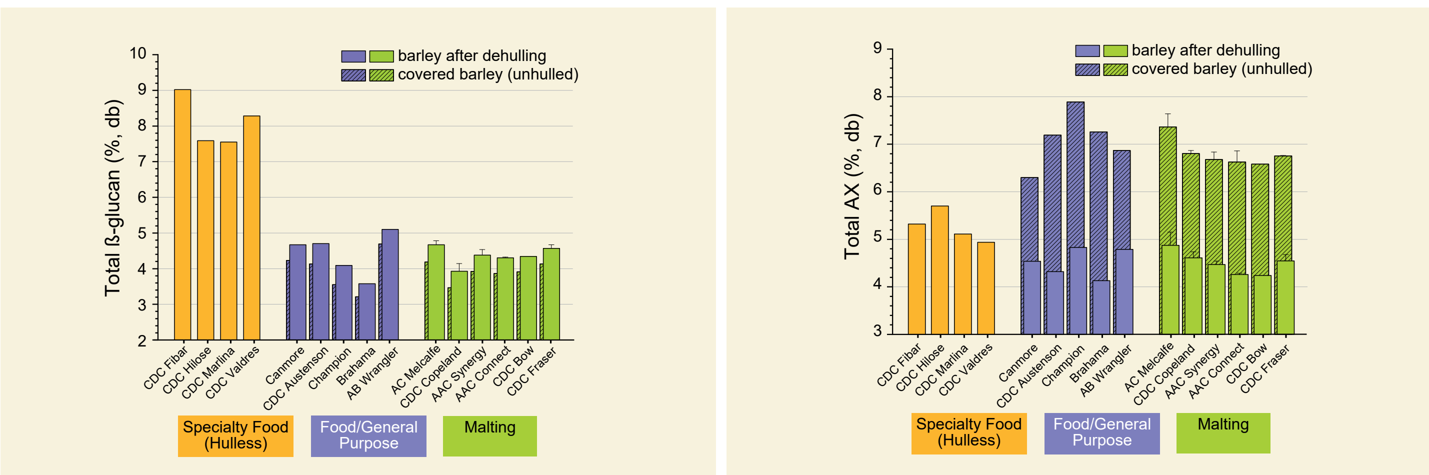

Figure 3.2 Content of β-glucans (left) and arabinoxylans (AX) (right) in various genotypes of specialty food (hulless), food/general purpose and malting barley before and after dehulling. The values for malting varieties represent averages for samples grown in two different locations.

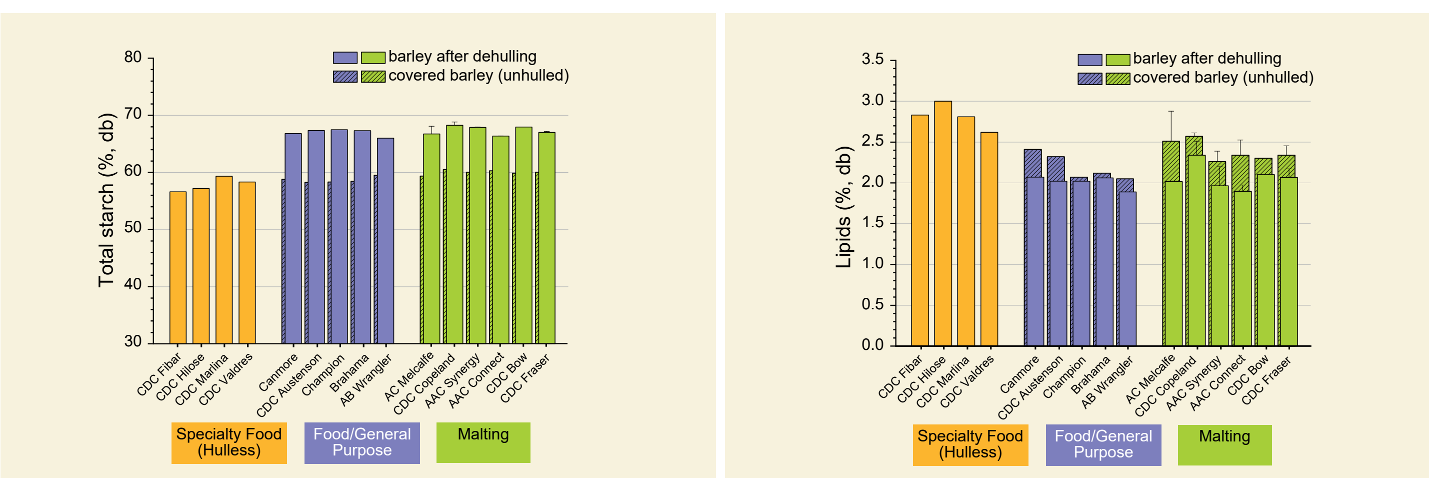

Figure 3.3 Content of starch (left) and lipids (right) in various genotypes of specialty food (hulless), food/general purpose and malting barley before and after dehulling. The values for malting varieties represent averages for samples grown in two different locations.

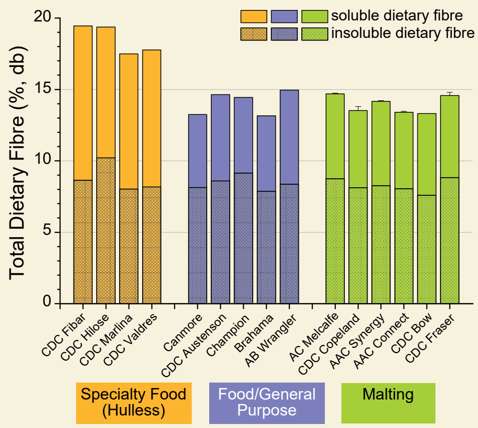

Figure 3.4 Content of soluble, insoluble, and total dietary in hulless specialty food and in dehulled food/general purpose and malting barley genotypes.

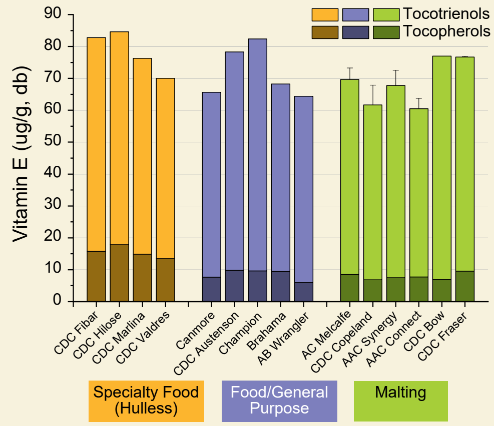

Figure 3.5 Tocopherols, tocotrienols, and total vitamin E in hulless specialty food and in dehulled food/general purpose and malting barley genotypes.

Table 3.1 Content of essential minerals in selected genotypes of specially food (hulless) barley (CDC Hilose and CDC Valdres), in dehulled food/general purpose barley (Canmore and AB Wrangler), and in dehulled malting barley (CDC Copeland and AAC Synergy).

	CDC Hilose	CDC Valdres	Canmore[a]	AB Wrangler[a]	CDC Copeland[a]	AAC Synergy[a]
Ca (mg/kg)	307	437	287	272	319	289
Fe (mg/kg)	39.8	71.0	37.6	28.3	37.5	37.4
K (mg/kg)	4530	4310	4470	4910	4030	4180
Mg (mg/kg)	1220	1390	1250	1210	1240	1140
Mn (mg/kg)	14.4	10.8	9.24	8.29	14.3	13.1
P (mg/kg)	3190	3520	3200	3150	3130	3030
Zn (mg/kg)	25.8	34.2	22.6	22.4	23.2	19.4

[a] dehulled grain

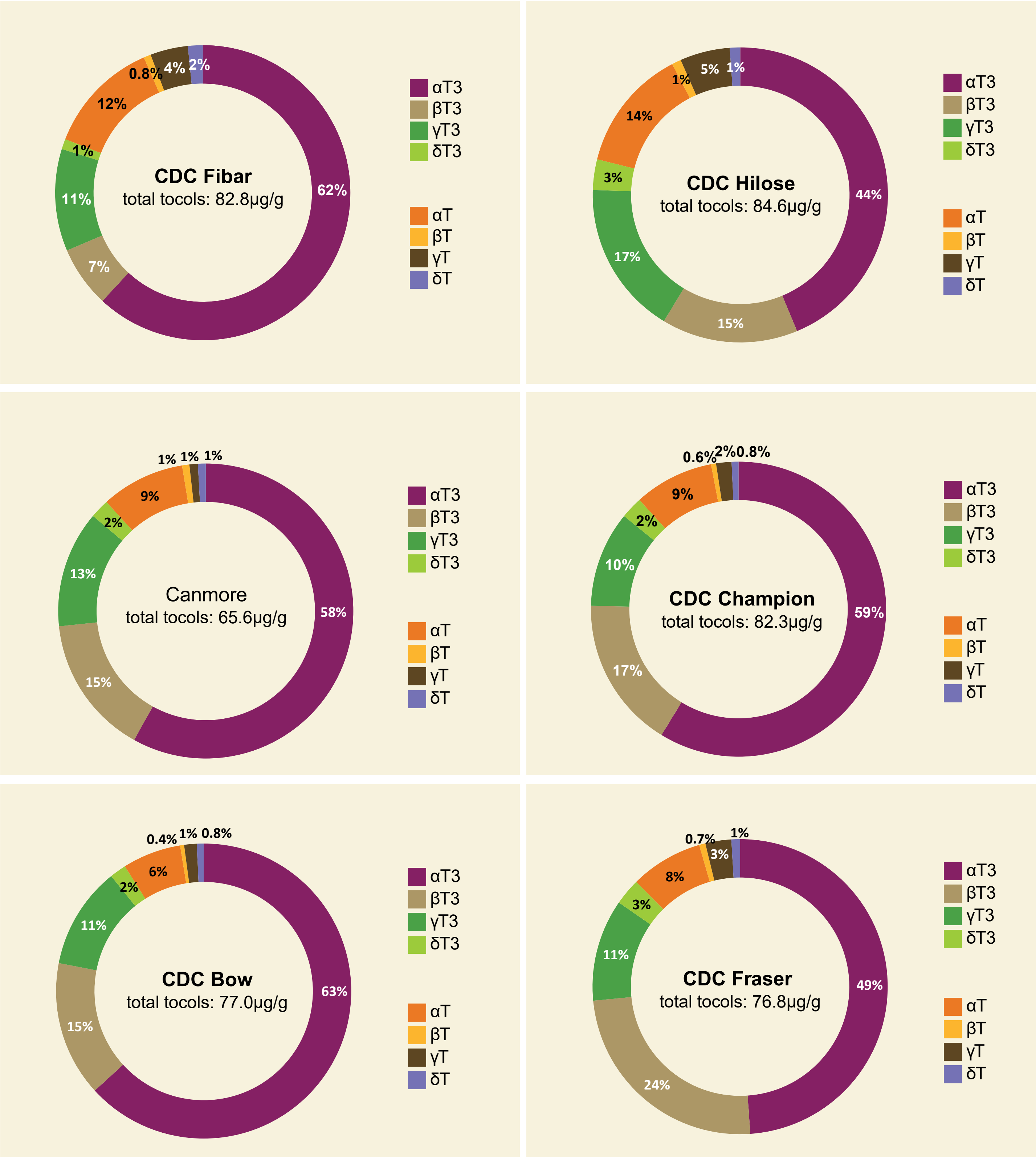

Figure 3.6 Relative amount of vitamin E constituents expressed as a percentage of the total tocols content in grain of selected genotypes of specialty food (hulless) barley (CDC Fibar and CDC Hilose), dehulled food/general purpose barley (Canmore and CDC Champion), and malting barley (CDC Bow and CDC Fraser). (αT = α-tocopherol, βT = β-tocopherol, γT = γ-tocopherol, δT = δ-tocopherol, αT3 = α-tocotrienol, βT3 = β-tocotrienol, γT3 = γ-tocotrienol, δT3 = δ-tocotrienol).

Part 4: Annual harvest survey of malting barley

4.1 Sampling and survey methodology

The 2020 malting barley survey was based on varietal composites that represented about 2.0 million tonnes of barley selected for domestic malt processing or for export as malting barley. The grain handling and malting companies involved in the selection process were Cargill Ltd., Canada Malting Co. Ltd., Rahr Malting Canada Ltd., Richardson International Ltd., Viterra Inc, Boortmalt, and Malteurop Canada Ltd. The tonnage included in this survey represents a portion of the total volume of malting barley selected in Western Canada and does not reflect the actual amounts selected. Some samples included in this report came from the Canadian Grain Commission Harvest Sample Program. Samples were received from the beginning of harvest until November 15, 2020. All results (unless otherwise stated) presented in this report represent weighted averages based on tonnage of composite samples received and analysed.

4.2 Quality of barley selected for malting in 2020: general trends and annual statistics

The average level of barley proteins (11.8%) in 2020 was slightly higher than last year (11.5%) and higher than the 10-year average (11.6%) (Figure 4.1). 2020 barley exhibited excellent average germination energy (99%), higher than the 10-year average (Figure 4.2), and very little water sensitivity. This year's average 1000 kernel weight (45.5 g) was slightly higher than last year's average value (45.0 g), and higher than the 10-year average value (44.8 g) (Figure 4.3). Kernel plumpness, a measure of kernels remaining on the 6/64" slotted screen, had an average of 92.4%, which was lower than last year (92.7%) and lower than the 10-year average (93.0%) (Figure 4.4).

The kernel hardness and kernel diameter were determined for individual varieties using a Single Kernel Characterization System. The results indicated some differences among barley varieties (Figure 4.5). The yearly variations in 1000 kernel weight and grain protein level in several established and new malting barley varieties are presented in Figure 4.6 and Figure 4.7.

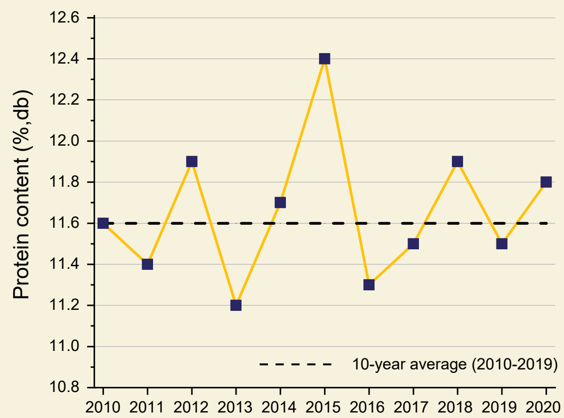

Figure 4.1 Average protein content in barley selected for malting from 2010 to 2020.

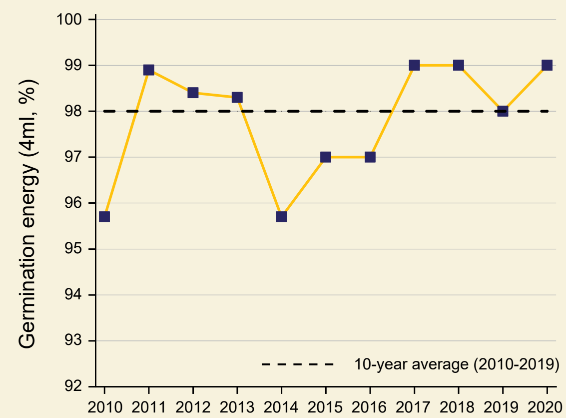

Figure 4.2 Average germination energy of barley selected for malting from 2010 to 2020.

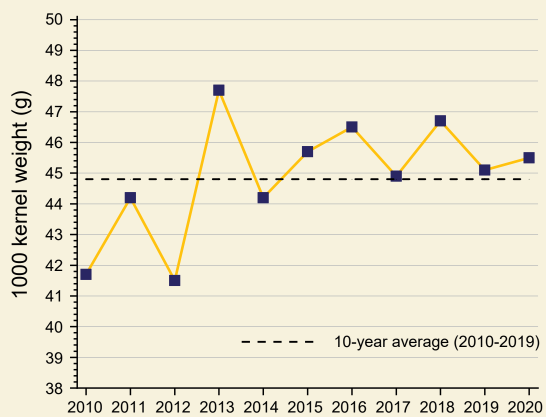

Figure 4.3 Average 1000 kernel weight of barley selected for malting from 2010 to 2020.

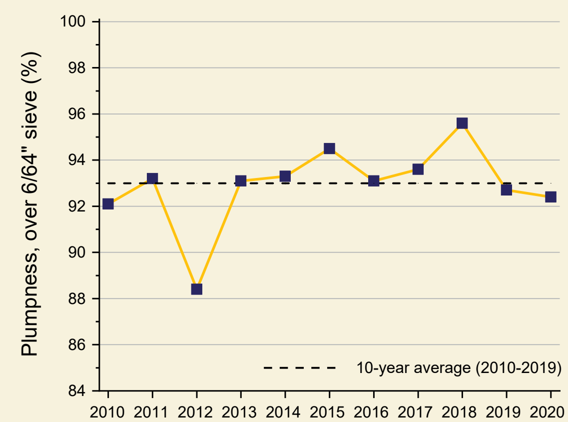

Figure 4.4 Average plumpness of barley selected for malting from 2010 to 2020.

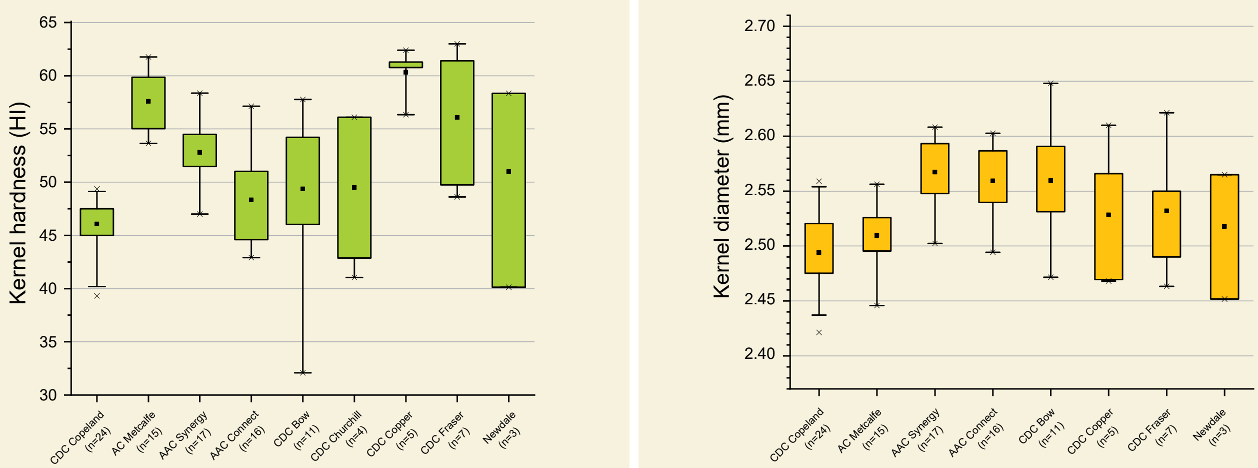

Figure 4.5 Kernel hardness index (HI) (left) and kernel diameter (right) for barley cultivars selected for malting in 2020. HI and kernel diameters values were determined using a Single Kernel Characterization System.

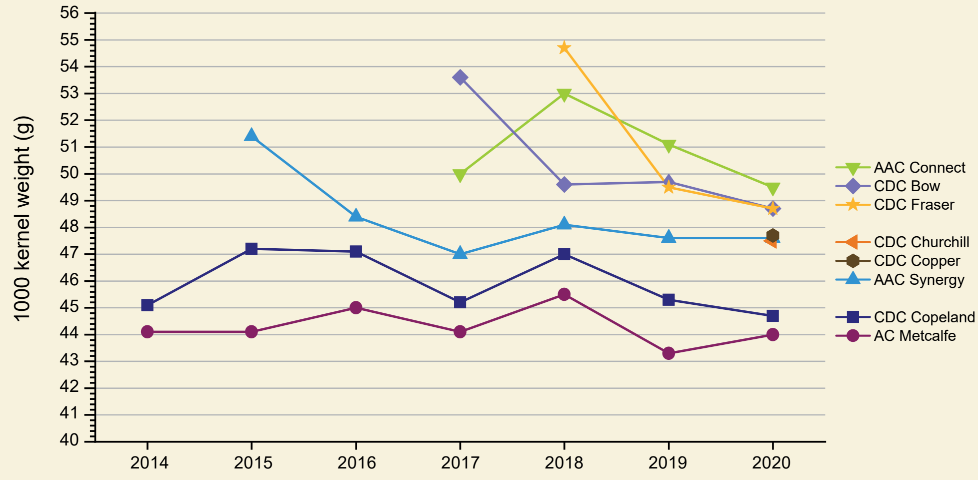

Figure 4.6 Comparison of the average 1000 kernel weight of selected barley varieties from 2014 to 2020.

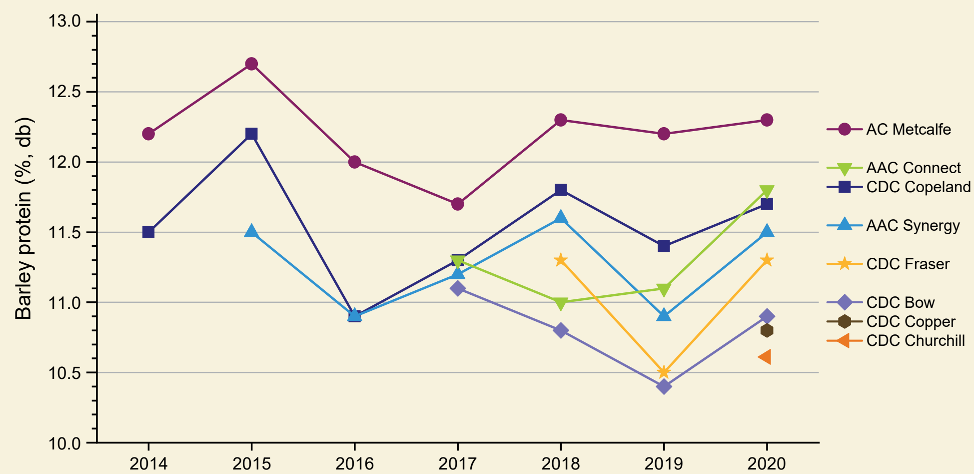

Figure 4.7 Comparison of the average protein content in selected barley varieties from 2014 to 2020.

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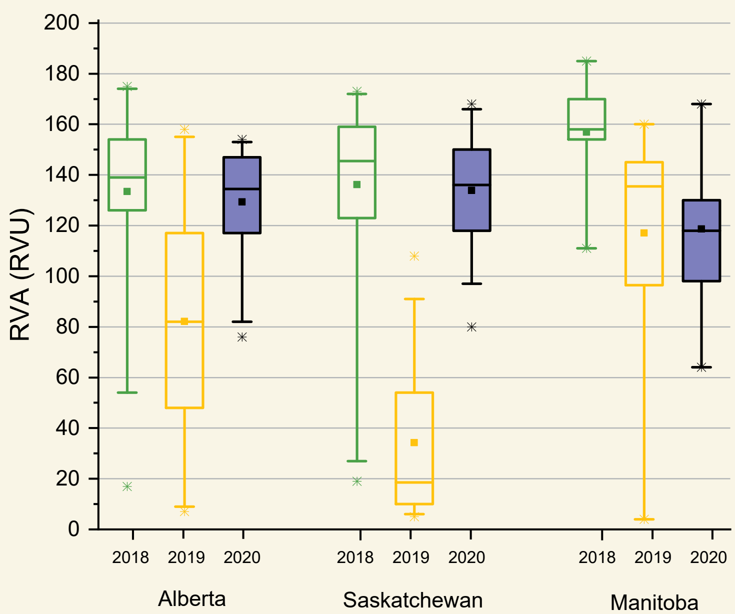
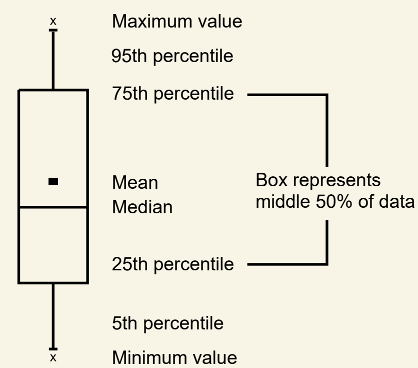
The premature sprouting of grain occurs when mature grain remains unharvested in the field during prolonged periods of wet weather. This event is called pre-harvest sprouting. One of the enzymes produced very early during germination is α-amylase. Since the level of α-amylase in sound grain is very low compared to the level 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 50-120 (RVU) are moderately pre-germinated and 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 have to be taken into account, as well as the RVA values.

The majority of barley samples tested in the 2020 survey were sound as indicated by high RVA values (>120 RVU) shown in Figure 4.8. Favourable and dry harvest conditions, especially in August and September, contributed to this year's high RVA values.





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

Figure 4.8 RVA results for barley selected for malting in 2020 in comparison with previous years.

4.3 Malting conditions and methodologies

Initial malting trials indicated that this year's barley needed slightly longer wet steep cycles to achieve adequate hydration levels. Consequently, the second steep cycle was increased to 11 hours compared to 8 hours in 2019 and the temperature of steeping was increased to 15ºC from 14ºC used in 2019. The germination step was initially conducted at 15ºC for 48 hours and at 16ºC for the remaining 48 hours. The kilning steps were conducted according to the same schedules as last year. All analytical methods used to assess barley, malt and wort quality in this survey are listed in Appendix I.

Table 4.1 Malting conditions used with Grain Research Laboratory Micro-malting System in 2020

Steeping	10 hours wet steep, 14 hours air rest, 11 hours wet steep, 13 hours air rest at 15°C
Germination	48 hours at 15ºC; 48 hours at 16ºC
Kilning	12 hours at 60-65°C, 6 hours at 65°C, 2 hours at 75°C, 5 hours at 83-85°C

4.4 Malting quality in 2020: varietal and yearly comparison

Figures 4.9 to 4.14 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 evaluated annually in our survey since 2014. Values for the newest varieties, CDC Churchill and CDC Copper, are reported for the first time and are based on a limited number of samples.

Grain Research Laboratory Segmented Flow Analyzer

Preparing grain for the germination test

Grain Research Laboratory Phoenix Micro-malting System

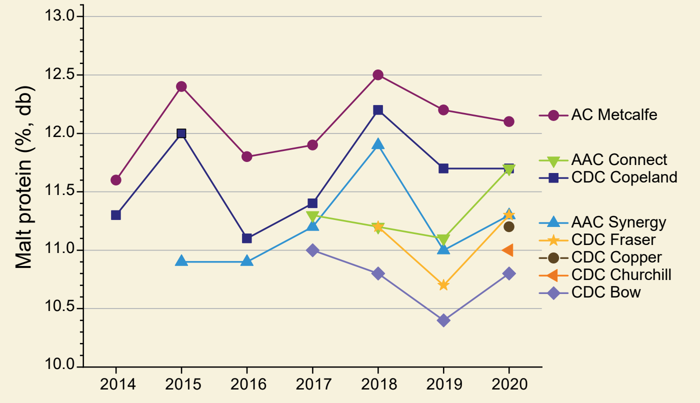


Figure 4.9 Comparison of the average concentration of proteins in malt for selected barley varieties from 2014 to 2020.

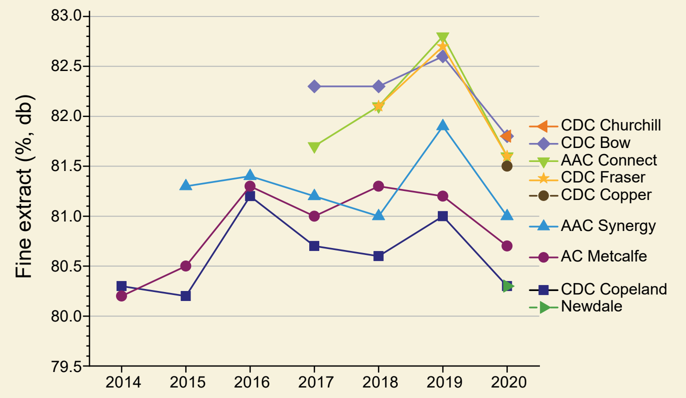


Figure 4.10 Comparison of the average extract levels from malt for selected barley varieties from 2014 to 2020.

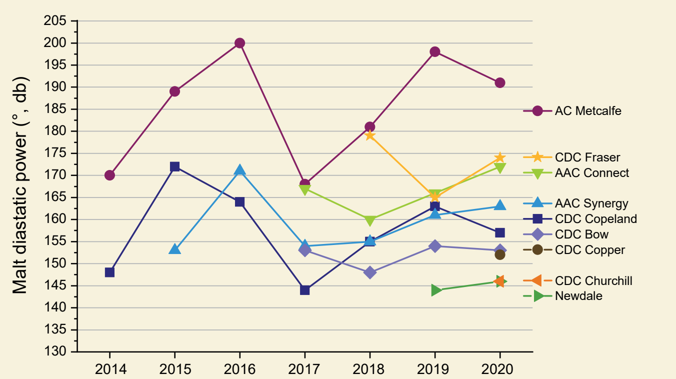


Figure 4.11 Comparison of the average diastatic power in malt for selected barley varieties from 2014 to 2020.

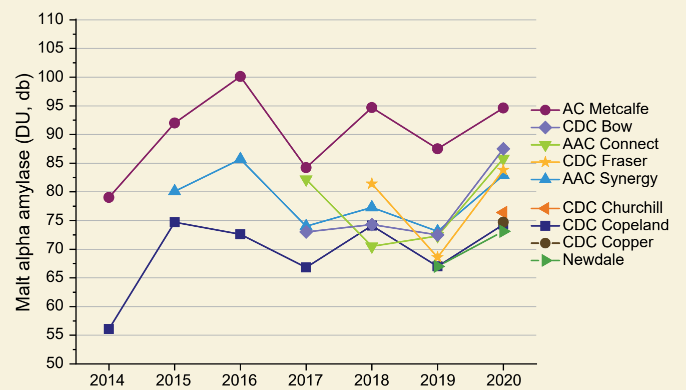


Figure 4.12 Comparison of the average activity of α-amylase in malt for selected barley varieties from 2014 to 2020.

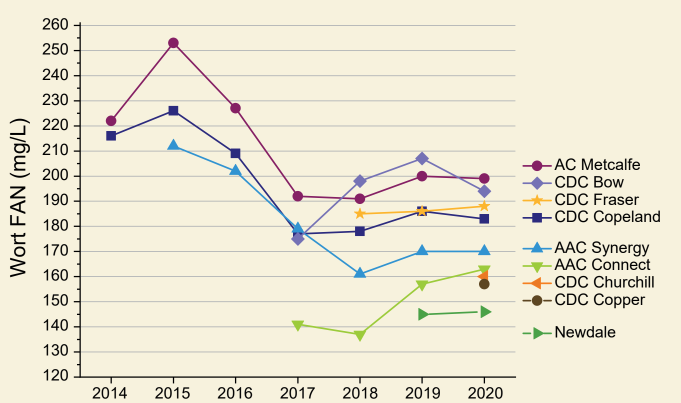


Figure 4.13 Comparison of the average FAN level in wort produced from malt for selected barley varieties from 2014 to 2020.

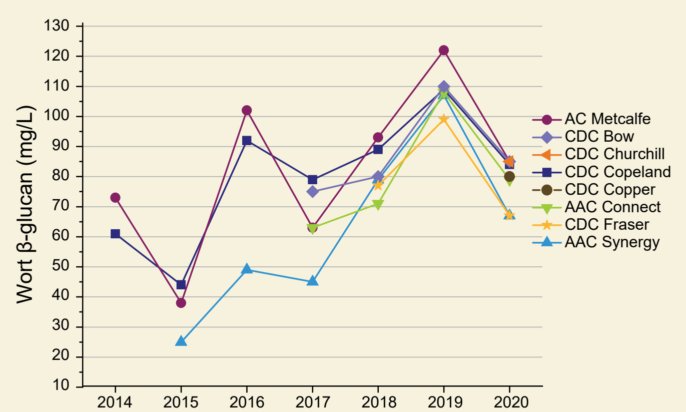


Figure 4.14 Comparison of the average β-glucan concentration in wort produced from malt for selected barley varieties from 2014 to 2020.

4.5 Quality of malting barley in 2020: highlights

- Favourable growing and harvest conditions allowed Canadian farmers to produce a very good quality malting barley crop in 2020 with ample supply for both the domestic and international markets.
- The average level of barley proteins (11.8%) in 2020 was slightly higher than last year (11.5%).
- This year’s average 1000 kernel weight (45.5 g) was slightly higher than last year’s average value (45.0 g), and higher than the 10-year average value (44.8 g).
- The rapid visco analysis (RVA) test indicated that the majority of barley samples tested in 2020 survey were sound, with no evidence of pre-harvest sprouting.
- This year's barley exhibited an excellent average germination energy (99%) which was higher than the 10-year average, and very little water sensitivity.
- A slightly higher concentration of grain proteins in 2020 barley likely contributed to somewhat lower malt extract levels than in 2019 and to relatively high levels of malt enzymes (diastatic power and α-amylase). Low levels of β-glucans and adequate levels of soluble proteins and free amino nitrogen (FAN) characterized wort produced from 2020 malt.

Part 5: Quality data for individual varieties

CDC Copeland

CDC Copeland has remained the dominant malting barley variety grown in Western Canada in 2020. Its excellent brewing characteristics, combined with protein and enzyme levels lower than AC Metcalfe, provides an excellent balance within the portfolio of malting barley varieties.

AC Metcalfe

In 2020, the production of AC Metcalfe continued its steady decline. With high levels of starch-degrading enzymes, however, AC Metcalfe exhibits excellent brewing performance and still generates demand from both domestic and export markets.

AAC Synergy

The popularity of AAC Synergy on the Prairies significantly increased in 2020 with acreage exceeding that of AC Metcalfe. AAC Synergy is a newer high-yielding variety that is characterized by relatively high kernel weight and plumpness, and relatively low grain protein content. 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, is a high-yielding malting barley variety with excellent agronomic traits and disease resistance. Production of this cultivar is steadily increasing. This variety offers high extract, moderate to high enzymes and relatively low FAN levels, as well as good brewhouse performance and fermentability.

CDC Bow

CDC Bow, registered in 2015, is a high-yielding malting barley variety with excellent agronomic traits and disease resistance. Production of this cultivar is slowly increasing. CDC Bow offers high extract, moderate to high enzymes, high FAN levels, high fermentability and good overall brewhouse performance.

CDC Fraser

CDC Fraser, registered in 2016, is a high yielding variety with excellent lodging resistance. This variety offers high extract, as well as moderate to high enzyme and FAN levels.

Newdale

The area seeded with Newdale continues to occupy a relatively small percentage of the total area seeded with malting barley in 2020. Its low to moderate levels of enzymes, soluble proteins and FAN make this variety well suited for all-malt brewing.

CDC Churchill

CDC Churchill, recently registered in 2019, is a high yielding variety with low grain protein, low to moderate levels of malt enzymes, low wort β-glucans, and high extract potential.

CDC Copper

CDC Copper, recently registered in 2018, is a high yielding variety with a strong leaf disease package. It is a low grain protein variety with malt enzymatic activity similar to CDC Copeland and high extract potential.

CDC Copeland

Table 5.1 Quality data for CDC Copeland malting barley[a]

Origin of selected samples	**Alberta**		**Saskatchewan**		**Manitoba**		**Prairie Provinces**		
Crop year	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	2015-2019 average
Number of samples	**12**	16	**17**	14	**4**	2	**33**	32	
Tonnage represented by samples (thousands of tonnes)[b]	**324**	357	**655**	448	**53**	18	**1,032**	823	916
Barley									
Test Weight (kg/hL)	**67.1**	66.0	**66.5**	66.1	**66.6**	66.4	**66.7**	66.1	66.8
1000 kernel weight (g)	**44.1**	44.1	**44.9**	46.3	**45.4**	44.4	**44.7**	45.3	46.4
Plump, over 6/64" sieve (%)	**90.5**	91.5	**91.7**	93.7	**91.6**	92.4	**91.3**	92.7	94.1
Intermediate, over 5/64" sieve (%)	**7.9**	7.0	**6.9**	5.0	**6.8**	6.4	**7.2**	5.9	4.5
Moisture[c] (%)	**10.8**	12.7	**11.8**	13.3	**10.6**	11.9	**11.4**	13.1	12.2
Protein (%, db)	**11.6**	11.5	**11.8**	11.3	**11.5**	11.3	**11.7**	11.4	11.5
Germination, 4 ml (%)	**100**	98	**99**	99	**99**	99	**99**	98	98
Germination, 8 ml (%)	**98**	93	**98**	93	**96**	95	**98**	93	93
Malt									
Yield (%)	**91.5**	91.6	**90.5**	90.9	**91.0**	91.3	**90.8**	91.2	91.1
Steep-out moisture (%)	**45.1**	45.1	**45.6**	45.6	**45.4**	44.7	**45.4**	45.4	44.9
Friability (%)	**78.6**	72.0	**78.2**	74.8	**80.1**	76.3	**78.4**	73.6	76.3
Moisture (%)	**4.2**	5.2	**4.5**	5.1	**4.1**	5.4	**4.4**	5.1	5.2
Protein (%, db)	**11.5**	11.7	**11.8**	11.7	**11.4**	11.7	**11.7**	11.7	11.7
Diastatic power (°, db)	**146**	169	**156**	158	**148**	168	**157**	163	160
α-Amylase (DU, db)	**73.1**	68.4	**74.7**	65.7	**75.8**	69.9	**74.3**	67.0	71.0
Wort									
Fine grind extract (F) (%, db)	**80.5**	81.0	**80.2**	81.0	**80.8**	81.2	**80.3**	81.0	80.7
Coarse grind extract (C) (%, db)	**79.8**	80.3	**79.7**	80.6	**79.8**	80.7	**79.7**	80.5	80.0
F-C difference (%, db)	**0.7**	0.7	**0.6**	0.4	**1.0**	0.5	**0.6**	0.6	0.7
ß-Glucan (mg/L)	**85**	118	**83**	102	**90**	102	**84**	109	83
Viscosity (cP)	**1.45**	1.44	**1.43**	1.43	**1.44**	1.42	**1.44**	1.44	1.43
Soluble protein (%, db)	**5.12**	4.71	**5.15**	4.81	**5.15**	4.74	**5.14**	4.77	4.58
Ratio S/T (%)	**44.5**	40.3	**43.8**	41.2	**45.2**	40.5	**44.1**	40.8	39.2
FAN (mg/L)	**179**	184	**185**	188	**182**	189	**183**	186	195
Colour (°)	**2.0**	1.7	**2.0**	1.9	**2.3**	1.8	**2.0**	1.8	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 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

AC Metcalfe

Table 5.2 Quality data for AC Metcalfe malting barley[a]

Origin of selected samples	Alberta		Saskatchewan		Manitoba		Prairie Provinces		
Crop year	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	2015-2019 average
Number of samples	**4**	6	**13**	8	**2**	2	**19**	16	
Tonnage represented by samples (thousands of tonnes)[b]	**95**	113	**254**	268	**16.4**	9.6	**365**	390	614
Barley									
Test Weight (kg/hL)	**68.6**	66.7	**68.3**	67.1	**68.3**	66.3	**68.4**	66.9	68.4
1000 kernel weight (g)	**43.7**	42.2	**44.1**	43.8	**43.8**	41.7	**44.0**	43.3	44.4
Plump, over 6/64" sieve (%)	**91.4**	90.3	**91.7**	91.2	**91.4**	88.7	**91.6**	90.8	92.9
Intermediate, over 5/64" sieve (%)	**6.9**	8.0	**6.7**	7.2	**6.6**	9.3	**6.7**	7.5	5.4
Moisture[c] (%)	**11.1**	12.9	**12.2**	13.3	**10.8**	12.7	**11.9**	13.2	12.0
Protein (%, db)	**12.3**	12.2	**12.3**	12.1	**12.2**	12.3	**12.3**	12.2	12.2
Germination, 4 ml (%)	**99**	98	**99**	97	**99**	100	**99**	97	98
Germination, 8 ml (%)	**91**	87	**94**	89	**89**	95	**93**	89	90
Malt									
Yield (%)	**89.4**	91.2	**90.5**	91.4	**89.4**	90.9	**90.1**	91.3	90.7
Steep-out moisture (%)	**46.0**	45.7	**46.1**	46.1	**46.1**	45.9	**46.1**	45.9	45.2
Friability (%)	**65.7**	59.1	**66.0**	58.5	**66.6**	58.4	**65.9**	58.7	64.2
Moisture (%)	**4.9**	5.4	**4.8**	5.3	**4.9**	5.5	**4.8**	5.3	5.4
Protein (%, db)	**12.1**	12.3	**12.2**	12.1	**12.1**	12.4	**12.1**	12.2	12.2
Diastatic power (°, db)	**192**	202	**190**	197	**194**	200	**191**	198	187
α-Amylase (DU, db)	**96.1**	90.0	**93.9**	86.3	**95.5**	91.8	**94.6**	87.5	91.7
Wort									
Fine grind extract (F) (%, db)	**80.6**	81.1	**80.7**	81.2	**80.6**	81.0	**80.7**	81.2	81.1
Coarse grind extract (C) (%, db)	**80.2**	80.5	**80.2**	80.6	**80.3**	80.5	**80.2**	80.6	80.4
F-C difference (%, db)	**0.4**	0.6	**0.5**	0.6	**0.3**	0.4	**0.5**	0.6	0.7
ß-Glucan (mg/L)	**82**	120	**87**	123	**83**	117	**85**	122	84
Viscosity (cP)	**1.43**	1.44	**1.43**	1.44	**1.43**	1.43	**1.43**	1.44	1.43
Soluble protein (%, db)	**5.23**	4.94	**5.32**	5.04	**5.21**	5.07	**5.29**	5.02	4.82
Ratio S/T (%)	**43.3**	40.2	**43.8**	41.5	**43.2**	40.7	**43.6**	41.1	39.7
FAN (mg/L)	**204**	198	**196**	200	**206**	205	**199**	200	213
Colour (°)	**2.0**	1.8	**1.9**	1.9	**2.0**	1.9	**2.0**	1.9	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 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 Synergy

Table 5.3 Quality data for AAC Synergy malting barley[a]

Origin of selected samples	Alberta		Saskatchewan		Manitoba		Prairie Provinces		
Crop year	**2020**	2019	**2020**	2019	**2020**	2019	**2020**	2019	2015-2019 average
Number of samples	**11**	12	**11**	4	**5**	0	**27**	16	
Tonnage represented by samples (thousands of tonnes)[b]	**237**	125	**225**	72	**18**	-	**480**	197	136
Barley									
Test Weight (kg/hL)	**67.6**	66.4	**67.4**	65.7	**66.6**	-	**67.5**	66.1	66.9
1000 kernel weight (g)	**47.6**	47.4	**47.6**	47.8	**47.6**	-	**47.6**	47.6	48.5
Plump, over 6/64" sieve (%)	**95.3**	95.7	**94.6**	95.2	**94.3**	-	**95.0**	95.5	96.4
Intermediate, over 5/64" sieve (%)	**3.6**	3.2	**4.3**	3.6	**4.5**	-	**3.9**	3.4	2.5
Moisture[c] (%)	**11.8**	13.4	**11.6**	12.2	**10.5**	-	**11.7**	13.0	12.4
Protein (%, db)	**11.2**	10.8	**11.9**	11.2	**11.9**	-	**11.5**	10.9	11.2
Germination, 4 ml (%)	**99**	98	**99**	99	**98**	-	**99**	98	99
Germination, 8 ml (%)	**93**	85	**96**	92	**93**	-	**94**	86	92
Malt									
Yield (%)	**89.5**	91.5	**90.2**	92.0	**89.7**	-	**89.8**	91.6	90.9
Steep-out moisture (%)	**46.5**	46.2	**46.2**	46.4	**46.7**	-	**46.4**	46.3	45.6
Friability (%)	**77.7**	69.1	**73.9**	67.6	**72.3**	-	**75.7**	68.5	73.5
Moisture (%)	**4.7**	5.1	**4.7**	5.2	**4.9**	-	**4.7**	5.2	5.2
Protein (%, db)	**11.0**	10.7	**11.7**	11.4	**11.7**	-	**11.3**	11.0	11.2
Diastatic power (°, db)	**158**	146	**167**	184	**173**	-	**163**	161	159
α-Amylase (DU, db)	**82.1**	68.2	**83.5**	80.3	**87.6**	-	**82.9**	73.1	78.0
Wort									
Fine grind extract (F) (%, db)	**81.1**	81.8	**80.9**	82.0	**81.0**	-	**81.0**	81.9	81.4
Coarse grind extract (C) (%, db)	**80.8**	81.4	**80.4**	81.9	**80.4**	-	**80.6**	81.6	80.8
F-C difference (%, db)	**0.2**	0.4	**0.5**	0.1	**0.6**	-	**0.4**	0.3	0.5
ß-Glucan (mg/L)	**68**	109	**66**	102	**69**	-	**67**	107	61
Viscosity (cP)	**1.42**	1.43	**1.41**	1.43	**1.41**	-	**1.42**	1.43	1.42
Soluble protein (%, db)	**4.99**	4.48	**5.03**	4.73	**5.12**	-	**5.01**	4.58	4.42
Ratio S/T (%)	**45.6**	42.0	**43.2**	41.5	**43.9**	-	**44.4**	41.8	39.8
FAN (mg/L)	**169**	167	**170**	176	**176**	-	**170**	170	185
Colour (°)	**1.9**	1.8	**1.8**	1.8	**1.9**	-	**1.9**	1.8	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 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 5.4 Quality data for AAC Connect malting barley[a]

Origin of selected samples	**Prairie Provinces**			
Crop year	**2020**	2019	2018	2017-2019 average
Number of samples	**21**	8	6	
Tonnage represented by samples (thousands of tonnes)[b]	**72.2**	8.8	7.7	6.0
Barley				
Test Weight (kg/hL)	**67.9**	67.9	67.8	67.3
1000 kernel weight (g)	**49.5**	51.1	52.2	51.4
Plump, over 6/64" sieve (%)	**94.4**	97.2	96.7	96.2
Intermediate, over 5/64" sieve (%)	**4.4**	2.2	2.4	2.9
Moisture[c] (%)	**11.8**	14.0	12.9	13.6
Protein (%, db)	**11.8**	11.1	11.3	11.1
Germination, 4 ml (%)	**98**	99	99	99
Germination, 8 ml (%)	**95**	89	97	93
Malt				
Yield (%)	**89.8**	91.8	92.2	91.7
Steep-out moisture (%)	**46.0**	44.4	45.6	44.6
Friability (%)	**80.5**	73.3	83.0	80.1
Moisture (%)	**4.7**	5.1	4.7	5.0
Protein (%, db)	**11.7**	11.1	11.2	11.2
Diastatic power (°, db)	**172**	166	160	164
α-Amylase (DU, db)	**85.8**	72.3	70.5	75.0
Wort				
Fine grind extract (F) (%, db)	**81.6**	82.8	82.1	82.2
Coarse grind extract (C) (%, db)	**81.3**	82.0	81.4	81.6
F-C difference (%, db)	**0.3**	0.8	0.7	0.6
ß-Glucan (mg/L)	**79**	108	71	81
Viscosity (cP)	**1.42**	1.43	1.43	1.43
Soluble protein (%, db)	**5.05**	4.36	3.77	4.00
Ratio S/T (%)	**43.2**	39.3	33.9	35.9
FAN (mg/L)	**163**	157	137	145
Colour (º)	**2.0**	1.8	1.6	1.7

[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 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 Bow

Table 5.5 Quality data for CDC Bow malting barley[a]

Origin of selected samples	**Prairie Provinces**			
Crop year	**2020**	2019	2018	2017-2019 average
Number of samples	**17**	12	2	
Tonnage represented by samples (thousands of tonnes)[b]	**11.2**	6.0	2.0	3.3
Barley				
Test Weight (kg/hL)	**68.5**	67.9	67.8	68.9
1000 kernel weight (g)	**48.7**	49.7	49.6	51.0
Plump, over 6/64" sieve (%)	**95.8**	97.8	96.4	97.3
Intermediate, over 5/64" sieve (%)	**2.9**	1.6	2.6	1.9
Moisture[c] (%)	**11.7**	13.8	12.0	12.9
Protein (%, db)	**10.9**	10.4	10.8	10.8
Germination, 4 ml (%)	**98**	98	100	99
Germination, 8 ml (%)	**88**	89	98	95
Malt				
Yield (%)	**89.8**	91.1	90.6	91.1
Steep-out moisture (%)	**46.1**	46.1	46.1	45.2
Friability (%)	**83.0**	76.8	83.7	78.5
Moisture (%)	**4.6**	5.0	4.5	4.8
Protein (%, db)	**10.8**	10.4	10.8	10.7
Diastatic power (°, db)	**153**	154	155	154
α-Amylase (DU, db)	**87.5**	72.5	74.3	73.3
Wort				
Fine grind extract (F) (%, db)	**81.8**	82.6	82.3	82.4
Coarse grind extract (C) (%, db)	**81.6**	82.2	82.2	82.1
F-C difference (%, db)	**0.2**	0.4	0.1	0.3
ß-Glucan (mg/L)	**85**	110	80	88
Viscosity (cP)	**1.42**	1.45	1.42	1.44
Soluble protein (%, db)	**5.37**	4.90	4.82	4.65
Ratio S/T (%)	**50.0**	46.0	44.8	43.1
FAN (mg/L)	**194**	207	198	193
Colour (º)	**2.3**	2.0	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 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 5.6 Quality data for CDC Fraser malting barley[a]

Origin of selected samples	Prairie Provinces			
Crop year	**2020**	2019	2018	2017-2019 average
Number of samples	**13**	4	2	
Tonnage represented by samples (thousands of tonnes)[b]	**7.7**	2.2	0.9	1.6
Barley				
Test Weight (kg/hL)	**66.7**	66.5	69.2	67.9
1000 kernel weight (g)	**48.7**	49.5	54.7	52.1
Plump, over 6/64" sieve (%)	**95.6**	97.0	99.5	98.3
Intermediate, over 5/64" sieve (%)	**3.3**	1.8	0.1	1.0
Moisture[c] (%)	**12.5**	14.3	12.2	13.3
Protein (%, db)	**11.3**	10.5	11.3	10.9
Germination, 4 ml (%)	**98**	99	99	99
Germination, 8 ml (%)	**84**	89	99	94
Malt				
Yield (%)	**88.9**	90.2	91.1	90.7
Steep-out moisture (%)	**47.4**	46.2	45.5	45.9
Friability (%)	**87.7**	83.6	77.2	80.4
Moisture (%)	**4.7**	5.4	5.5	5.5
Protein (%, db)	**11.2**	10.7	11.2	11.0
Diastatic power (°, db)	**174**	165	179	172
α-Amylase (DU, db)	**83.8**	68.6	81.4	75.0
Wort				
Fine grind extract (F) (%, db)	**81.6**	82.7	82.1	82.4
Coarse grind extract (C) (%, db)	**81.2**	82.4	82.1	82.3
F-C difference (%, db)	**0.4**	0.3	0.0	0.2
ß-Glucan (mg/L)	**67**	99	77	88
Viscosity (cP)	**1.43**	1.42	1.42	1.42
Soluble protein (%, db)	**5.44**	4.61	4.27	4.44
Ratio S/T (%)	**48.8**	43.3	38.1	40.7
FAN (mg/L)	**188**	186	185	186
Colour (º)	**2.5**	2.0	1.8	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 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

Newdale

Table 5.7 Quality data for Newdale malting barley[a]

Origin of selected samples	**Prairie Provinces**			
Crop year[b]	**2020**	2019	2018	2013-2019 average
Number of samples	**9**	2	4	
Tonnage represented by samples (thousands of tonnes)[c]	**22.4**	4.8	9.3	17
Barley				
Test Weight (kg/hL)	**66.4**	67.9	68.5	67.3
1000 kernel weight (g)	**45.4**	50.4	48.6	47.4
Plump, over 6/64" sieve (%)	**93.0**	96.0	96.0	94.9
Intermediate, over 5/64" sieve (%)	**5.4**	3.0	3.2	3.8
Moisture[d] (%)	**13.0**	13.7	13.2	13.0
Protein (%, db)	**11.3**	10.5	11.9	11.7
Germination, 4 ml (%)	**99**	99	99	98
Germination, 8 ml (%)	**84**	65	92	86
Malt				
Yield (%)	**90.4**	91.6	90.7	90.9
Steep-out moisture (%)	**46.4**	43.9	45.6	44.8
Friability (%)	**82.3**	77.8	70.6	73.4
Moisture (%)	**4.7**	4.9	4.8	5.1
Protein (%, db)	**11.1**	10.6	12.1	11.6
Diastatic power (°, db)	**146**	144	153	150
α-Amylase (DU, db)	**73.1**	67.0	76.0	70.5
Wort				
Fine grind extract (F) (%, db)	**80.3**	81.9	80.7	80.6
Coarse grind extract (C) (%, db)	**79.7**	81.3	79.6	79.8
F-C difference (%, db)	**0.6**	0.6	1.2	0.8
ß-Glucan (mg/L)	**91**	174	67	87
Viscosity (cP)	**1.42**	1.47	1.42	1.43
Soluble protein (%, db)	**4.59**	4.29	3.97	4.29
Ratio S/T (%)	**41.5**	40.6	33.0	36.8
FAN (mg/L)	**146**	145	156	166
Colour (º)	**1.9**	1.7	1.8	1.8

[a] Values represent weighted averages based on tonnage of composite samples received.
[b] Newdale was not included in the 2014 and 2016 Harvest Survey due to an insufficient number of samples.
[c] Indicates weight of selected barley represented in this survey; does not represent amounts commercially selected.
[d] Moisture 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 5.8 Quality data for CDC Churchill malting barley[a]

Origin of selected samples	Prairie Provinces
Crop year	**2020**
Number of samples	**5**
Barley	
Test Weight (kg/hL)	**69.5**
1000 kernel weight (g)	**47.5**
Plump, over 6/64" sieve (%)	**93.4**
Intermediate, over 5/64" sieve (%)	**5.3**
Moisture[b] (%)	**12.0**
Protein (%, db)	**10.6**
Germination, 4 ml (%)	**99**
Germination, 8 ml (%)	**82**
Malt	
Yield (%)	**90.0**
Steep-out moisture (%)	**45.4**
Friability (%)	**83.0**
Moisture (%)	**4.6**
Protein (%, db)	**11.0**
Diastatic power (°, db)	**146**
α-Amylase (DU, db)	**76.4**
Wort	
Fine grind extract (F) (%, db)	**81.8**
Coarse grind extract (C) (%, db)	**81.4**
F-C difference (%, db)	**0.4**
ß-Glucan (mg/L)	**85**
Viscosity (cP)	**1.43**
Soluble protein (%, db)	**4.82**
Ratio S/T (%)	**43.9**
FAN (mg/L)	**160**
Colour (°)	**2.0**

CDC Copper

Table 5.9 Quality data for CDC Copper malting barley[a]

Origin of selected samples	Prairie Provinces
Crop year	**2020**
Number of samples	**6**
Barley	
Test Weight (kg/hL)	**66.8**
1000 kernel weight (g)	**47.7**
Plump, over 6/64" sieve (%)	**94.3**
Intermediate, over 5/64" sieve (%)	**4.6**
Moisture[b] (%)	**12.8**
Protein (%, db)	**10.8**
Germination, 4 ml (%)	**97**
Germination, 8 ml (%)	**63**
Malt	
Yield (%)	**88.3**
Steep-out moisture (%)	**47.6**
Friability (%)	**80.8**
Moisture (%)	**4.7**
Protein (%, db)	**11.0**
Diastatic power (°, db)	**152**
α-Amylase (DU, db)	**74.7**
Wort	
Fine grind extract (F) (%, db)	**81.5**
Coarse grind extract (C) (%, db)	**81.0**
F-C difference (%, db)	**0.5**
ß-Glucan (mg/L)	**80**
Viscosity (cP)	**1.45**
Soluble protein (%, db)	**4.98**
Ratio S/T (%)	**45.6**
FAN (mg/L)	**157**
Colour (°)	**3.2**

[a] Values represent arithmetic averages for samples analysed.
[b] Moisture 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

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.

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

Ash
Ash content in barley was determined following the American Association for Clinical Chemists (AACC) International Method 08.01.01 by incinerating the ground barley sample in a muffle furnace at 590ºC. Ash content is reported as a percentage on dry matter basis.

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 Grade 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 according to 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, 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).

Dietary Fiber
Dietary fiber content in grain was determined by quantitative recovery of insoluble dietary fiber (IDF) and soluble dietary fiber (SDF) fractions in ground barley using an ANKOMTDF Dietary Fiber Analyzer (AOAC Method 991.43). Results were corrected for protein and ash content and reported on a dry matter basis.

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 the fine extract according to the official ASBC method Wort-12 by segmented flow analysis.

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 20ºC and 90% relative humidity in a germination chamber. Germinated kernels were removed after 24 and 48 hours and a final count was made at 72 hours (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 twenty-four 500 g samples of barley or forty-eight 250 g samples of barley 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 using Near-Infrared Reflectance (NIR) equipment that has been calibrated by the standard ASBC method (ASBC Barley 5C). Moisture content in grain was also determined by drying the ground barley in the oven for 65 min. at 130ºC (AACC International Method 44-15.02, one-stage, air-oven).

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

Protein content (N x 6.25)
Barley protein content was predicted on dockage-free barley using NIR equipment that had been calibrated by Combustion Nitrogen Analysis (CNA). Malt protein was measured by CAN 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 are reported on a dry matter basis (ASBC Barley 7C).

Rapid Viscometric 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-4 (Newport Scientific) and the Stirring Number Program. Final viscosity values are reported in Rapid Visco Units (RVU).

Starch
Starch content in grain was determined in ground barley according to the Megazyme Amyloglucosidase / α-Amylase Method – assay procedure for determination of total starch content in cereals and food products not containing resistant starch, D-Glucose and/or maltodextrins (AOAC Method 996.11, AACC International Method 76-13.01).

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

Vitamin E
The content of tocopherols and tocotrienols in barley was determined by reverse phase high performance liquid chromatography (RP-HPLC) using a fluorescent detector. Tocols were extracted from barley after saponification with hexane:ethyl acetate (8:2, volume / volume).

Water sensitivity
Water sensitivity was determined exactly as described for germination energy, except that 8.0 ml of purified water is added to each petri dish (ASBC 3C, IOB and EBC procedure). The water sensitivity value is the numerical difference between the 4ml and 8ml 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 one 40 g portion and the net weight determined. The number of kernels was then counted with a mechanical counter and the thousand 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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