Adoption of malting barley varieties in malt barley supply chains

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Executive Summary

The malting barley industry worldwide has experienced continuous growth over the last four years, with increased barley yields, malt and beer production and consumption. Growth is particularly evident in EU countries and emerging Asian and Latin American markets. It is apparent that some of the largest malting barley and malt producers, such as Germany, France, Australia and the United Kingdom have developed a shorter cycle for the adoption of new varieties than is the case in Canada. In these countries, newly registered varieties (i.e. in the last ten years) have been actively grown and used in malt production.

In contrast, current trends in the Canadian malting barley industry indicate a decrease in production and seeded areas of malting barley. Despite new varieties being registered every year, only two varieties that were registered twenty years ago have an established demand and still account for almost 80% of all malting barley grown in Canada. The problem of ‘varietal lock-in’ within the western Canadian barley market has slowed the adoption of newer varieties with enhanced agronomic traits, reducing the competitiveness of malting barley, and contributing to the downward trend in barley acres. In the long-run, the decrease in production, and reluctance by farmers to grow new malting barley varieties, may reduce the international competitiveness of Canadian malt barley.

The primary goal of this research was to conduct an exploratory analysis of the process of varietal introduction and diffusion in the Canadian malting industry and in selected malting barley producing countries. A comparative analysis of the Canadian barley-malt-beer supply chain with selected EU countries (Germany, France, and the United Kingdom) and Australia was conducted. Differences in the structure and organization of supply chains and the role of industry institutions in facilitating the adoption of new varieties are identified. Implications for the Canadian malting barley industry are developed.

Interviews with industry stakeholders confirmed a problem of varietal “lock-in” in Canada, where new malting barley varieties have not achieved a significant market share for many years. In comparison, interviews with industry stakeholders in the European Union and Australia indicated that the average life of new varieties is currently five to ten years in the United Kingdom, and five to seven years in France, Germany, and Australia.

The analysis suggests possible areas in the Canadian malting barley supply chain that may impede the adoption of new varieties. First, seed availability for the industry varietal trials plays a significant role in the adoption process. A considerable time gap exists between registration at the Variety Registration Office (VRO) and the commercial availability of new varieties in Canada. Furthermore, the Canadian maltsters and brewers conduct macro-scale trials only after a few years from the start of varietal diffusion. Due to the auctioning of varieties to seed companies after VRO approval, public breeders are not responsible for varietal marketing to the end-users, per se. In contrast, all barley breeding in the UK, France, and Germany is conducted
by private seed companies. Because of a high level of competition, the breeders appear willing to take a risk with early seed multiplication. This results in the availability of seed to conduct, not only micro-trials, but also commercial (i.e. macro-scale) trials by maltsters and brewers at early stages of the varietal evaluation and registration process. The competitive environment provides an incentive to the EU breeders to actively promote the variety to end-users directly. In Australia, breeders similarly start seed multiplication early at the stage of National Variety Trials (NVT) and are responsible for providing a large bulk of barley for malting barley recommendation evaluation by the first year of trials through Barley Australia (an industry organization).

Second, with the removal of the single desk selling authority of the Canadian Wheat Board (CWB) in 2012, responsibility for international market development within the Canadian malt barley sector appears to be somewhat diffuse. Many industry members appear to believe that the Canadian Malting Barley Technical Centre (CMBTC) conducts international market development. However, as a small non-for-profit organization the CMBTC has limited resources to undertake these types of activities.

In the EU, international market development is a shared responsibility among all supply chain members (e.g. breeders, grain companies, maltsters). For instance, grain traders in the UK play an active role in the development of domestic and international markets. To a large extent, this can be explained by a high degree of supply chain integration and coordination. Similarly, in France, some of the large maltsters are highly integrated upstream via grower cooperatives, joint grain trading companies, and collaborative breeding programs. This results in the facilitation of information exchange, mutual interest in the further success of new varieties, and a faster turnover of new varieties. In Australia, grain traders also play a very active role in market development domestically and internationally. In contrast, malting barley supply chain members in Canada tend to work relatively independently. For example, the grain traders tend to be less proactive in the development of international markets for malting barley and wait for the acceptance of new varieties first by the domestic market. Also, with higher yielding crops like canola or wheat, and segregation capacity with these crops, grain companies tend to have fewer incentives to become involved in the malting barley industry.

Third, end-users, through their industry organizations, are closely involved in varietal evaluation at an earlier stage. In the European Union, the Recommendation List (RL) trials of new varieties are overseen and assisted by the industry organizations that represent most of the maltsters and beer producers. In the United Kingdom, this is done by the Malting Association of Great Britain (MAGB) that involves the largest maltsters, brewers, and distillers in the country. Similarly, in Germany, this role is performed by the German Malting Barley Association (Braugersten-Gemeinschaft e.V) that includes the largest brewers, regional and national industry organizations and associations. In France, the Association of Maltsters of France (Malteurs de France), in collaboration with the Association of the Brewers of France (Association des Brasseurs de France), performs this role. In Australia, malting barley evaluation is conducted by Barley
Australia, the organization that represents large maltsters and beer producers in the country. It seems that participation of the end-users in the Recommendation List trials sends a strong message to the rest of the members in the malting barley supply chain about the acceptance of new varieties. In Canada, the Collaborative trials for the national registration of the varieties are conducted by the Brewing and Malting Barley Research Institute (BMBRI), and the Recommendation List trials and results publication are overseen by the Canadian Malting Barley Technical Centre (CMBTC).

Insights from the project have implications for the Canadian malting barley industry in three areas. First, one of the reasons for the successful adoption of new varieties in other malt producing countries appears to be not only the involvement of the end-users in early stages of the varietal tests, but also a provision of significant amount of seeds for large-scale trials. The beer industry is highly dependent on an established reputation among beer consumers and will be hesitant to accept new varieties until they can be tested at a macro-scale level. If public breeders have limited capacities to produce the required bulk of seeds, barley supply chain members could look for other ways to assure that the end-users (e.g. maltsters and brewers) have access to a sufficient bulk of new varieties to enable commercial testing earlier in the registration process.

Second, domestic and international market development activities for malting barley play a crucial role in the successful adoption of new varieties. Considering that the Canadian Wheat Board had over 400 employees back in 2012 (albeit across a spectrum of roles), it is important to clarify who is responsible for the market development functions previously performed by the CWB, and to what extent. Other malt producing countries clearly benefit from the active role of breeders and grain companies in varietal promotion domestically and internationally. Further discussions within the Canadian malting barley industry could explore a more encompassing involvement of supply chain members into market development for new varieties and establish what industry procedures or coordinating mechanisms might help facilitate market development.

Finally, transparency and information exchange top-down and bottom-up is central to an industry's development. In the EU member states examined and in Australia, supply chain members are engaged in collaborative efforts to develop and agree upon effective, yet different, systems of self-regulation and procedures. These institutional frameworks facilitate a transparent and clear information exchange along the supply chain, ease the process of decision making, and assure that all sectors of the industry can contribute and benefit in the long run.

A clear understanding of the direction in which the industry is moving allows every member of the supply chain to prepare for change. The end-users of malting barley play a significant and often the final role in the decision-making process, but it is not only up to them to assure progress in the industry. An evaluation of the extent to which links along the value chain for the Canadian malting barley sector could be improved through improved communication, coordination and collaboration between industry members would be beneficial.
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1. Introduction

The malting barley industry worldwide has experienced continuous growth over the last four years, with increased barley yields and growing malt and beer production and consumption. Growth is particularly evident in EU countries and emerging Asian and Latin American markets. Some of the largest malting barley producers, such as Germany, France, the UK, and Australia have developed a shorter cycle for the adoption of new varieties. In these countries, newly registered varieties (i.e. in the last ten years) have been actively grown and used in malt production.

In contrast, current trends in the Canadian malting barley industry indicate a decrease in production and exports of malting barley and, despite new varieties being registered every year, only two varieties, “AC Metcalfe” and “CDC Copeland”, that were registered twenty years ago have an established demand and still account for almost 80% of all malting barley grown in Canada. The problem of ‘varietal lock-in’ in the western Canadian barley market may have slowed the adoption of newer varieties with enhanced agronomic traits, reducing the competitiveness of malting barley in a producer’s rotation and contributing to the downward trend in barley acres.

The process of varietal introduction and diffusion in the malting industry is examined in this report. A comparative analysis of the Canadian barley-malt-beer supply chain with selected EU countries and Australia is conducted. The report is organized into separate sections on each malt producing country (see sections on Canada, the United Kingdom, and Australia), with the discussion of France and Germany combined into one section. The discussion section (section 6) examines differences in the structure and organizational aspects of these supply chains, and the role of industry institutions in facilitating the adoption of new varieties, a comparison table highlights key differences across the five countries. The report concludes in section 7 with a discussion of recommendations and suggestions for further research.

The exploratory analysis included primary and secondary data. Primary data were collected over the period of February-May 2017 through semi-structured interviews with malting barley supply chain members in North America, the UK, Germany, France, and Australia. The list of 43 interviewed companies and organizations is provided in Appendix A. Secondary data included web-resources, and data provided by Canadian Grain Commission, Canadian Malting Barley Technical Centre (CMBTC), and Agriculture and Agri-Food Canada (AAFC).

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2. Canada

Malting barley in Canada

In the global picture, Canada is one of the world’s largest exporters of agricultural products, with major grain and meat producers located in the four western provinces (Manitoba, Saskatchewan, Alberta, and British Columbia). Further, Canada is the fourth largest producer of barley and second in global malt supply\(^5\). The average annual production of barley in western Canada was estimated at 8.5 million tonnes from 2006 to 2016\(^4\). Approximately 2.2 million tonnes of barley is accepted for the value-added production of malt domestically and for export.

Nevertheless, the last decade has shown a decline in not only seeded areas, but also in the production of barley (Figure 1), with an estimated average decrease of 3% annually since 1994\(^6\).

![Figure 1. Production and seeded areas of barley in western Canada from 2006 until 2016](image)

There is a noticeable trend towards higher yielding crops, like canola or lentils\(^6,7\) that also have improved agronomic characteristics (e.g. disease resistance), which may explain the decrease in barley production. Over the last 20 years, average canola, corn and spring wheat yielding
characteristics have shown an improvement by 30-50%, while barley has experienced approximately a 20% increase in yield\(^7\). Considering that intensively funded breeding programs\(^6\) have increased the availability of improved varieties for other crops, barley may not be perceived as the first choice for farmers. Weather conditions and fertilizer applications have a direct impact on varietal quality, which increases the risk for growers that grain that is not accepted as malting barley. In this case, a producer has an option to sell the grain as feed barley to grain traders or directly to feedlots at a lower price than malting barley.

The malting barley market in Canada has experienced varietal concentration, even though there were over thirty varieties grown in 2016. Two-row varieties “AC Metcalfe” and “CDC Copeland” account for 78% of all malting barley grown in the 2016 crop year\(^8\), and this trend has not changed significantly for the last ten years (see Figure 2). Recent changes show a growing demand for “AAC Synergy”, which achieved a 5% growth in 2016 and is predicted to reach 10-15% in the next year or two\(^9\). The remainder of the varieties barely account for 15% of total barley production\(^4\).

The long life of AC Metcalfe and CDC Copeland has been an increasing concern for the industry. Both varieties were registered at the end of the 1990s (AC Metcalfe in 1997 and CDC Copeland in 1999). Newly registered varieties often have better yield and disease resistance characteristics in comparison with older varieties, yet it seems that the progression of the adoption of many new varieties has been rather slow and unsuccessful. In the long-run, the decrease in production and lack of adoption of new malting barley varieties by farmers could have a negative impact on Canadian competitiveness in global barley production and export.
Registration and evaluation of malting barley varieties in Canada

Before commercialization, each new barley variety in Canada has to pass through the National Variety Registration system, which is overseen by the Variety Registration Office (VRO) of the Canadian Food Inspection Agency (CFIA). There are several trials through which new varieties pass before the recommendation for registration. The Prairie Recommending Committee for Oat and Barley (PRCOB) conducts and oversees Cooperative (Coops) and Collaborative (Collabs) trials\textsuperscript{10}. The committee includes a number of public and private representatives from the industry: public institutions (CDC University of Saskatchewan, AAFC Brandon, FCDC Lacombe); private companies involved in plant breeding (e.g. Syngenta, Bayer, etc.); seed companies (e.g. Canterra Seeds, SeCan, etc.); maltsters (e.g. Canada Malting, Prairie Malt, Rahr, etc.); large beer producing companies (e.g. ABInBev and Molson Coors); representatives of farmers’ groups (e.g. Alberta Barley Commission, Saskatchewan Barley Development Commission etc.) and non-profit organizations (e.g. The Brewing and Malting Barley Research Institute (BMBRI), Canadian Malting Barley Technical Centre (CMBTC), etc.)\textsuperscript{10}.

Usually, Cooperative trials focus on the evaluation of varietal agronomic characteristics (e.g. yield, disease resistance, etc.), while Collaborative trials test the quality characteristics that are
significant for malting and brewing processes. Cooperative trials are run over a period of two years and organized by members of PRCOB (Figure 3).

![Timeline for the evaluation and registration trials in Canada](image)

**5-6 years in total to pass PRCOB and RL trials**

*Figure 3. Timeline for the evaluation and registration trials in Canada* \(^9,10\)

If the variety passes Year 1 of the Cooperative trials, it enters Year 2 of the Coops and automatically begins Year 1 of Collaborative trials. The BRMBI oversees Collabs trials because downstream supply chain members can have access to the data from micro-scale trials at an early stage, and can participate in the discussion at the annual meetings of PRCOB. The number of seeds required for the Coop and Collabs trials ranges from 10 kg in the first year to one metric tonne in the last year of trials. In total, it takes three years for the variety to pass the recommendation for registration at the VRO \(^9\).

There is also a Recommended List (RL) process of varietal evaluation that tests malting barley by performance characteristics for malting and brewing. It is overseen and results are published by the CMBTC. The research facility can conduct not only micro-scale trials with 500 grams of seeds, but also pilot-scale trials in malting and micro-brewing with 100 kg batches of barley.

The RL trials usually start after the variety has passed CFIA registration, especially because of the limited amount of seeds available during PRCOB trials \(^11\). There is usually a limited seed distributional capacity in public breeding programs. A large portion of barley breeding in Canada is conducted at public breeding programs (see next section). Breeders must auction the varieties to private seed companies that do the multiplication and the distribution of seed to growers. The auction sale is only possible after the registration at the VRO, and not every variety that has undergone registration trials is chosen for further commercialization.
Typically, there is not enough seed for immediate commercial use which restrains growers and end-users and adds an additional waiting period until sufficient seeds of the new variety are available. For instance, the variety AAC Synergy was registered at the VRO in 2012. The private seed company Syngenta bought the rights for commercialization, and the seeds were available to growers only in 2015. Also, after a seed company for the variety is chosen, it is a common notion that public breeding institutions do not participate in the further promotion of the variety in the supply chain.

Maltsters and brewers often perform internal industrial-scale trials, but those can be difficult to conduct because it requires a significant amount of malting barley. As indicated, if the seed company starts multiplication after registration at the CFIA, it takes several additional years for the industry to be able to run industrial trials of malting and brewing. Thus, it might take five to six years in total for the variety to pass PRCOBI and RL trials in Canada.

**Canadian R&D in malting barley and its role in the varietal adoption**

All of the R&D programs in western Canada in barley varietal development are conducted within public sector institutions, including Agriculture and Agri-Food Canada in Brandon, Manitoba (AAFC), Field Crop Development Centre in Alberta (FCDC), and Crop Development Centre at the University of Saskatchewan (CDC). Research funding comes from a number of different sources, including the Barley Council of Canada, BMBRI, Western Grain Research Foundation (WGRF), private companies, and producer organizations (Saskatchewan Barley Development Commission, Alberta Barley Commission, Manitoba Wheat and Barley Growers Association, British Columbia Grain Producers Association).

Private sector funding for barley breeding that comes from the industry (e.g. SeCan, Viterra, MolsonCoors, Anheiser Busch, Sapporo) contributes to public breeding programs. In general, the breeding industry in Canada is relatively highly concentrated. There are breeding programs overseen by Molson Coors and ABInBev, but they are located in the US. To be released in Canada, barley varieties from other countries have to go through the same pipeline of registration procedures as any new barley variety in Canada.

After the registration of new varieties at the CFIA, plant breeders can apply for Plant Breeders Rights (PBR) and collect royalties. There is a variation in the distribution of the collected royalties. In the case of AAFC, generated revenues flow back to the government of Canada, and not directly to fund breeding. Royalties from the varieties developed in CDC or FCDC go back to the funding of breeding programs, in addition, some of the funds return via check-offs from the grain trade. Usually, the royalty capture happens at the point of sale of certified seeds to growers by seed companies. Farm-saved seeds do not generate royalties in Canada. Even
though discussions on the implementation of end-point royalties\textsuperscript{iii} has been happening\textsuperscript{9}, there are no predictions as to whether, when or how the system may be implemented.

Further, public breeders do not participate in varietal commercialization per se. Since seed companies purchase the rights for the varieties after registration, they do not start active promotion of a new variety to growers and downstream firms until after National Registration. The inefficiencies in the current royalty system have been linked to low incentives of the private sector to invest in breeding programs\textsuperscript{6}. This, and the limited scope for public breeders to be involved in seed production and promotion, appears to have a negative impact on varietal development and the adoption of new varieties.

\textit{International and domestic trade of malting barley}

Because of the value-added characteristics of malting barley (i.e. the ability to produce malt, which is the main ingredient in alcohol and used by the food industry), grain handling requires that varietals are not mixed and certain storage requirements are needed to keep the grain germination rate over 95%. This adds additional pressure and costs for grain handlers. Large grain trading companies in Canada operate a bulk-handling transportation system, and an accumulation of a large amount of seed for each malting variety is required. When there is not enough bulk available for new varieties, it is inevitable that preference is given within the bulk grain handling system to varieties that minimize costs and risks in handling.

Canadian maltsters consume approximately 50\% of the malting barley produced in Canada that meets malting specifications\textsuperscript{5}. A stylized supply chain for malting barley is provided in Figure 4.

The most preferred option between Canadian growers and maltsters is direct contracting. Every year contracts can be renewed, but many growers tend to work consistently with the same malting company for many years. Certified seeds are preferred by the maltsters because of varietal purity concerns, but it is usually not required in the contracts. Also, maltsters typically allow one year of farm-saved seeds to be used for seeding.

To diversify supply risks, maltsters also purchase malting barley from major grain traders (Richardson, Viterra, Cargill, and G3). However, as mentioned, the bulk handling transportation system in Canada does not allow an easy switch between varieties if a new variety is introduced. Discussions with industry members suggest that grain traders tend to wait for the domestic and international demand to establish and enough grain being grown before they switch to a new variety\textsuperscript{9}.

\textsuperscript{iii} Currently, royalties in Canada are collected at the point of seed sales to farmers. End-point royalties (ERP’s) would be collected at the point of the first grain sale (i.e. royalties on commodity).
Figure 4. Malting barley supply chain in Canada

The remaining 50% of Canadian malting barley goes for export. The biggest importers of malting barley from Canada are China (60%), USA (31%) and Japan (7.3%). The main competitors for Canada in China are the EU and Australia, which take first and second place respectively as the largest barley producers and exporters in the world\textsuperscript{5,13}. In the United States malting barley from Canada has to compete with grain from Argentina. Recent devaluations of the Argentinian peso and the removal of export taxes on some agricultural products resulted in an increase in the competitiveness of Argentinian malting and feed barley on the global market\textsuperscript{14}.

Discussions with industry stakeholders suggested that it is common for international customers to be resistant toward change, and an extra effort is required to convince them to switch to new malting barley varieties. Also, it is common for international customers to wait until a domestic market has accepted a new variety.

Often grain trading companies are the main information source for many international customers regarding available varieties. Discussions with industry stakeholders in Canada, however, suggest that grain companies do not participate actively in the promotion of new varieties. There are some exceptions, such as the cooperative work of Viterra with CMBTC in international market development. Nevertheless, generally, some level of reluctance can be observed\textsuperscript{9}.

A major part of international market development for malting barley was overseen by the Canadian Wheat Board (CWB) until 2012. After the removal of the single desk authority of the CWB, international market development responsibilities were taken over by different members
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of the supply chain. Some of the varietal promotion has been attempted by the Canadian Malting Barley Technical Centre (CMBTC), with samples sent to major malting barley importing countries. The CMBTC is a small non-profit research facility that contributes to the research in malting barley and actively participates during varietal registration and trials. The CMBTC is funded via membership fees and currently has 24 members comprised of representatives from the malting and brewing industry, producers’ groups, provincial government(s) and seed distributors. Also, some portion of the funding comes from the Western Wheat and Barley Checkoff program and the Federal Government.\textsuperscript{9,11}

The Malting Industry Association of Canada (MIAC) represents four Canadian malting companies (Canada Malting, Rahr, Prairie Malt and Malteurop). The Barley Council works with the whole barley supply chain, promoting barley usage domestically and internationally, and represents the industry to government. Both organizations conduct some of the functions of domestic and international market development and actively contribute input to the discussions in international trade negotiations. Finally, producer groups such as SaskBarley, Alberta Barley, Manitoba Wheat and Barley Growers Association, and British Columbia Grain Producers Association also conduct market development activities, working closely with Canadian farmers in efforts to increase the global competitiveness of Canadian barley.

\textbf{The competitive structure of the malting and brewing sectors in Canada}

The malting industry in Canada is represented by four main companies.\textsuperscript{9,15–18}:

- **Canada Malting Co.** with a production capacity of 450,000t. This is the largest malting company in Canada and includes three plant locations in Calgary, Montreal and Thunder Bay. They also own nine country elevators across the country. The company works with both domestic and international brewing companies, distillers and food industries. The main shareholder is GrainCorp, a multinational grain trading company with headquarters in Australia.

- **Prairie Malt Ltd.** With a 220,000t production capacity located in Biggar, SK. The company was created as a joint venture between Cargill and Viterra. It primarily works with international customers: Japan and Korea take 60% of the business and 35% is exported to the US market.

- **Rahr Malting Canada Ltd.** with 140,000t of production capacity located in Alix, AB. There is also the Shakopee production facility in Minnesota, US with a production capacity of 460,000t. The company mainly works in the North American region, with both large and craft brewers. Recently, Rahr acquired a specialty malt production plant in British Columbia, with a particular interest in strengthening their position in the craft brewing market.
- **Malteurop North America Inc.** with 90,000t annual production capacity. The company entered the Canadian market after the acquisition of ADM Malting in 2008, and mainly works with the domestic and international brewers. Headquarters location is in France.

Approximately 65% of Canadian malt is exported \(^5\). The largest importers are the United States, Japan, South Korea and Mexico. Similarly to malting barley exports, the outlook for the malt competition is somewhat similar, and Canada is competing with the top malt producing countries (e.g. EU member-states, Australia)\(^9\).

The Canadian beer industry generates $5.8 billion dollars in provincial and federal taxes annually\(^5\) and consumes 35% of Canadian malt. Large beer producers are represented by two main companies: Anheuser-Busch InBev (AbInBev) and Molson Coors with 26.8% and 31.7% market shares in Canada respectively \(^20\). Both companies work internationally and have strong connections to supply chains in the USA.

Craft breweries have been on the rise in North America and consume a growing portion of domestically produced malt (i.e. around 30% of Canadian malt is consumed by Canadian craft-breweries). Over the period of five years since 2010 the number of licensed breweries doubled in Canada and is expected to keep growing (Figure 5).

![Licensed Breweries, 2010-2015](image)

*Figure 5. Number of licensed breweries in North America, 2010-2015* \(^21\)
ABInBev and MolsonCoors in the US have integrated supply chains between breeders, growers, maltsters, and brewers. In contrast, the Canadian malting and brewing industry works independently and has a low level of vertical integration.

In Canada, there is a limited degree of vertical integration on the grain handling side of malting barley: Canada Malting owns nine grain elevators, and its parent company Grain Corp plans to expand their grain handling divisions in Canada within the next couple of years. Rahr has one elevator in the area of Fargo and Grand Forks in North Dakota, US, while Prairie Malt has the access to the Cargill and Viterra operations. Other than that, the supply chain for malt in Canada is fairly independent, and downstream firms in the supply chain (e.g. maltsters and brewers) do not own breeding programs or grain trading companies in Canada.
3. The United Kingdom

*Maltling barley varieties in the UK*

Over the last ten years, the production of barley in the United Kingdom (UK) has been showing a positive trend in acres and production output (Figure 6). Malting barley varieties have a relatively quick turnover, although the varieties that are suitable for both brewing and distilling tend to stay on the market longer.

![Figure 6. Production and seeded area of barley in the UK, 2006-2016](image)

Typically, the UK malting barley industry is separated into two regions - England and Scotland. Geographically they have different agronomic growing conditions and have had a distinct differentiation in industrial development: whisky and grain distilling production prevails in Scotland, and beer production is mainly located in England. This has resulted in variation in end-users’ preferences for malting barley varieties (see Figures 7 and 8). Malting barley for brewing is mainly grown in England (east of England, southern and northern regions of England), while Scotland produces most of the malting barley suitable for whisky and grain distilling.
Figure 7. English malting barley purchases, 1991-2014

Across the UK the top three varieties of spring malting barley in 2016 were: Concerto with 54% of the market share, Propino and Odyssey with a growing demand of 18% and 10% respectively. Among winter varieties, Venture achieved 44% of the market share for winter varieties since 2012. Another winter variety, Flagon, has been showing a constant decrease in seeded area and had a 12% market share in 2016.

Based on the data from 1991 to 2014, and confirmed in conversations with industry stakeholders, - on average it takes five to ten years for varieties to be replaced by new varieties. One of the exceptions can be observed for Maris Otter, an old winter variety, which has had a small but constant demand for many decades, preferred mainly in the craft brewing industry worldwide.  

9
Malting barley in the UK is classified by the nitrogen content that reflects the protein content of the grain\textsuperscript{23}. Typically, grain in the band below 1.65% nitrogen is demanded by the malt distillers in whisky production. Barley with a nitrogen content in the range of 1.65% to 1.85% is suitable for the brewing industry, and everything above it goes to grain distilling\textsuperscript{24}.

Every year the Malting Association of Great Britain (MAGB) publishes a forecast of the next year’s purchases by nitrogen band in north England, south England and Scotland to help farmers understand the expected market demand for the next crop year (see Figure 2.3).

\textsuperscript{23} The amount of nitrogen indicates the crude protein content. To convert into protein indicators multiply the nitrogen bands by 6.25 \textsuperscript{24}
The information is collated by MAGB from purchases provided by maltsters in previous years and is available on the MAGB website. The rejection rate of barley at the maltster’s delivery points is also published and the average rejection rate was between 2.5 and 3% in the last 10 years for all malting barley delivered\textsuperscript{v} \textsuperscript{24}.

\textbf{Registration and evaluation of malting barley varieties in the UK}

In the UK new varieties go through the National List (NL) registration trials that are overseen by the Agriculture and Horticulture Development Board (AHDB), which is a levy body that represents agricultural producers in the crops and livestock sectors. The DUS and VCU\textsuperscript{vi} trials

\textsuperscript{v} It is worth noting that many of the deliveries to maltsters are not directly from farmers, as such grain traders or co-ops operating in the supply chain between farmers and maltsters conduct in-house screening to ensure grain meets malt specifications before delivering to maltsters.

\textsuperscript{vi} DUS - Distinctness, Uniformity and Stability Test. VCU - Testing for the Value for Cultivation and Use.
for NL are contracted to the British Society of Plant Breeders (BSPB) and The National Institute of Agricultural Botany (NIAB), and it takes two years to register the variety in NL (see Figure 10).  

The additional approval for Recommendation List (RL) is done via The Institute of Brewing and Distilling (IBD) and AHDB and coordinated by MAGB.  

![Diagram of varietal evaluation trials in the UK](image)

**Figure 10. The timeframe of varietal evaluation trials in the UK**

The Recommendation List Year 1 starts when the variety passes NL Year 1 trials. Afterwards, the variety goes through commercial trials (i.e. macro-scale) that are conducted by the members of MAGB and funded from AHDB levy funds. Every maltster or brewer has one new variety to test out of the maximum of 5 varieties chosen for macro-scale tests. Later, the data is submitted to AHDB and shared among members in MAGB. There is a requirement for breeders to provide enough seeds for the industrial scale tests and it should be at least 1000t to 2000t. Often, it is also a responsibility of the breeders to find a maltster to conduct the malting trials, and MAGB plays an assisting role in the process.

The results from NL1, NL2, and RL1 trials are used to determine which variety obtains Provisional Approval 1 in the AHDB Recommendation List. To achieve Full Approval, the variety has a maximum of two years of macro-scale testing. If a variety shows promising results after Provisional Approval 1, it can be accredited Full Approval in the next year. If there are
some questions regarding the variety, a Provisional Approval 2 can be granted. If the variety does not get Full approval in 2 years of macro-scale trials, it is dropped from the Recommendation List. In total it takes four to five years for the variety to pass all trials in NL and RL. The AHDB Recommendation List is updated annually, and the varieties that show poor agronomic performance, low purchases or lack of seed can be a reason for dropping a variety from the list\(^\text{24}\).

The members of MAGB are major malting companies in the UK, in addition, different working parties within MAGB can consist of experts and representatives from the breeding industry (e.g. KWS, Limagrain, Syngenta)\(^\text{vii}\), brewers (e.g. Molson, Heineken, Carlsberg etc.), distilling companies (e.g. Diageo, Chivas etc.), and different industry organizations. The organizational structure of malting barley evaluation in the UK is provided in Figure 11 below.

![Organisation Structure of Malting Barley Evaluation in the UK](image)

**Figure 11. Organizational structure of Malting Barley Evaluation in the UK\(^\text{24}\)**

Many malting companies and large breweries have quality control laboratories to conduct micro-malting and micro-brewing. Small breweries typically have limited capacities to conduct

\(^{\text{vii}}\) See the next section for a discussion of barley breeding in the United Kingdom
Members of MAGB meet twice a year. The purpose of meetings in the fall is to discuss varietal growing performance, seed availability and to confirm the varieties for micro-scale trials in malting, brewing and distilling, and candidates for macro-scale trials in malting and brewing (macro-scale distilling trials are not possible). The main aim of the meetings in the spring is to discuss the results of trial data and decide which candidates move forward in the evaluation process. The varieties that have a significant improvement in yield, disease resistance and show a high level of commercial potential are the main reasons for the variety to be recommended. Many industry members indicated that agronomic improvements in new varieties have one of the strongest impacts on the decision process.

The simplified results of the RL trials and recommendations to AHDB are publicly available on the webpage of MAGB for farmers and other industry members to use as a reference point. The varieties that went through NL systems in other European Union countries are allowed to enter RL trials in the UK immediately, with a sufficient amount of satisfactory micro-scale trial data. However, because of the climatic differences with the rest of EU, some of the varieties first go through NL trials in the UK.

**R&D in the UK**

All barley breeding programs in the UK are private, and primarily owned by the seed companies. Currently, the varieties of eight companies are listed in the AHDB Recommendation List. The breeding market can be described as highly competitive. The largest breeding programs belong to Limagrain, Agrii, RAGT, KWS, Syngenta, Secobra and Saaten. Except for Agrii, many of them are multinational companies, with headquarters located in France and Germany, which means that in addition to the domestic breeding companies and research stations, there are malting barley varieties from other European Union countries that compete with the local UK varieties in RL trials. Further, Limagrain, RAGT and Secobra have been originally created by the co-operatives in France, which means a close integrational link between breeders and growers.

Breeders obtain Plant Breeder’s Rights (PBR) after passing NL2, and the process is overseen by the British Society of Plant Breeders (BSPB). The system of royalty collection applies to both certified seed sales and farm-saved seed and follows the regulatory framework of the International Union for the Protection of New Varieties of Plants (UPOV). For farm-saved seeds, farmers are legally required to claim how much farm-saved seed they have and pay 50% on average of the full royalty price. Approximately half of the malting barley grown in the UK is from farm-saved seeds, and there is no specific requirement in contracts to use only certified seeds.

Conversations with industry members confirmed a high level of participation and involvement of the breeders in the adoption process of new varieties – from the evaluation process to the chemical analysis and testing. Thus, it is easier for large companies to participate in the MAGB evaluation system.
promotion of the varieties directly to maltsters and brewers. At the malting barley evaluation stages, breeders are responsible for seed multiplication and provision of a sufficient amount for micro-and macro-scale trials. Also, perhaps because of the highly competitive environment, interviews confirmed that seed companies try to have a communication channel, whether with maltsters or with brewers, to increase the chance of varietal acceptance by end-users.

In general, the information about new varieties in different stages of the NL and RL trials gets to maltsters and brewers through multiple channels, which also includes grain cooperatives and grain traders. Many seed companies have regular communication with grain companies, maltsters, and brewers in person, over the phone or via email monthly.

The UK malting, brewing and distilling industries

The malting industry in the UK is dominated by six large maltsters and also some relatively small maltsters. The largest are:

- **Boortmalt UK** with 300,000t of annual production capacity. The company is the largest maltster in the UK and holds a 25% market share. The company works with the distilling and brewing industry domestically and also on international markets.

- **Bairds Malt Ltd.** with an annual production capacity of 255,000t. The main production is focused on malt for whisky distilling and the brewing industry. The company is actively involved in the last stages of the RL trials, and employees sit on the working groups within MAGB, and other organizations involved in the evaluation of malting barley varieties. Bairds Malt has 15% of the market share in the UK.

- **Simpsons Malt Ltd** is another large malt producing company, with a total capacity of 303,000t. In addition to working with the large brewers and distillers, the company is active in the supply of malt for craft breweries and owns a craft-malting facility. The share of the market is 15%.

- **Crisp Malting Group Ltd.** with an annual capacity of 240,000t and market share of 15%. The company works on the domestic and international markets, and supplies to the brewing, distilling and food industries.

- **Muntons plc** has a capacity of 210,000t. The company has 12% of the market share in the UK. The company specializes in producing malt extract and works actively in brewing, distilling and food supply chains.

- **Soufflet Malting UK** has 128,000t of annual production capacity and covers 8% of the market share. The Soufflet Group purchased a malting facility in the UK from Molson Coors in 2015 as a part of the strategy to enter the British market. The company works mainly with the largest brewers in the UK.
The distilling and brewing industries play a significant role\textsuperscript{viii} in the overall economy of the United Kingdom. The Scottish whisky industry alone contributed over £4 billion to total UK exports (approximately 7% of total UK exports) in 2016\textsuperscript{22,33}.

There are over 1800 registered breweries in the UK (Brewers of Europe, 2017), with a wide range of beer styles offered. The four largest beer producers are ABInBev, Molson Coors, Heineken, and Carlsberg\textsuperscript{ix}. These companies participate in the evaluation trials for new malting barley varieties and have a voice in the decision process on the approval of new varieties for the AHDB Recommendation List. The Scotch Whisky Association (SWA) and British Beer & Pub Association (BBPA) also contribute to the discussion on approval of new varieties at the MAGB working parties.

It should be noted that large maltsters and beer producers have plants across Europe. New varieties that were developed outside of the UK tend to be accepted faster on the end-user side. Industry members confirmed that varieties that enter the UK varietal evaluation having already been tested in France or Germany tended to be adopted faster in the supply chain. First, there is usually enough seed for commercial trials and growing trials in the UK. Second, the results from the macro-scale trials in other EU sites allow a faster process for varietal acceptance because of the easier process of information exchange between companies and their subsidiaries\textsuperscript{9}.

**Malting barley and malt trade in the UK**

In 2016 the major part of UK malt was consumed by the distilling (49%) and brewing (32%) industries. The remaining malt was either exported (14%) or used in the domestic food industry (5%) (Figure 12).
Since the vast proportion of malt goes to the distilling industry, the varieties with lower levels of nitrogen (i.e. low protein) dominate the market. Typically, maltsters prefer working with multiple supply sources (e.g. grain traders, spot market transactions and contracting directly with farmers) because it helps to minimize the risks of an unstable supply.

There are many storage and grain trade options available to UK farmers because of a large number of cooperatives or grain traders that offer these services. Also, maltsters can work with multiple varieties at the same time because of the wide range of storage capacities on their premises. Usually, maltsters prefer dealing with five to six varieties at most.

Quality control is conducted by a number of bodies that oversee quality schemes for malting barley and malt production in the UK. For instance, the Assured UK Malt (AUKM) program is overseen by MAGB and is followed by four major maltsters: Bairds Malt, Crisp Malt, Muntons and Simpsons Malt. The quality scheme includes a regulatory framework for product quality and traceability, and is used as a quality assurance for brewers and distillers.

Exported malt from the UK goes to EU countries, North America, Latin America, Australia, Russia and Middle East countries (Figure 13).
According to recent statistics, intra-EU trade of malt accounted for approximately 9,580 tonnes of malt from the UK, while non-EU countries consumed 155,467 tonnes of UK malt. In general, the EU countries cumulatively export over 2 million tonnes of malt annually\textsuperscript{34}, and the share of UK malt in total EU exports is relatively small\textsuperscript{35}.

Imported malt to the UK comes from Ireland, Sweden, The Czech Republic, Belgium, and Germany. However, import volumes are not significantly large compared with domestic production and consumption, and less by half than the total malt exports from the UK worldwide\textsuperscript{36}.

**Cooperatives in the UK supply chain**

The grain industry in the UK has a fairly high level of involvement by farmer-owned cooperatives. A large number of different producer cooperatives provide storage capabilities, input materials and trade grain on behalf of the farmers.

Some cooperatives also closely work with plant breeders. For instance, Openfield UK, a multipurpose cooperative, is involved in input supply and grain storage and marketing. The company cooperates with breeders on early stages of varietal development and has access to barley samples years before the variety enters the NL trials. Openfield also contracts to carry out...
Adoption of malting barley varieties in malt barley supply chains

seed multiplication for the NL and RL trials, and has distributional rights on some of the malting barley varieties. The company provides inputs to farmers and conducts grain trade domestically and internationally. As a part of their communication strategy, they often conduct field trips when they bring brewers and maltsters to farmers’ fields to facilitate the exchange of information and to build stronger connections within their supply chain \(^9,^{37}\).

Similarly, one of the largest cooperatives, Fram Farmers Coop, plays a major role in barley trade in the UK and internationally. FramFarmers Coop provides farm (e.g. seed, inputs, machinery, and crop insurances) and grain trading services to its members. Grain handling is done through a long-term partnership agreement with ADM (Archer Daniel Midlands). ADM is also a shareholder, together with InVivo, of Gleadell Agriculture Ltd, another malting barley trade company that used to be a maltster back in the 19th and 20th centuries. Relationships built over that time transferred into a number of partnership agreements for Gleadell with different breeders, maltsters, and brewers \(^{38,39}\).

Collaborative and cooperative agreements among supply chain members in the UK allow new varieties to be adopted relatively quickly. In the case of Openfield, because of the early access to new barley samples they can regularly communicate to the end-users about upcoming varieties, which allows maltsters and brewers to prepare for the varietal switch. When maltsters and brewers want to conduct additional internal trials before accepting the variety, it is relatively easy for Openfield and FramFarmers to arrange grain supply through contracts with members of the coop. Similarly, grain trading companies, whether through long-term agreements with the maltsters or with parenting companies, change to new varieties with relatively little resistance \(^9\).
4. France and Germany

Malting barley in Germany and France

France is one of the largest barley producers and exporters in the world. Over the last decade, some variability in barley production is observed, mainly due to inconsistent weather patterns. With respect to the acreage of barley grown, in contrast to the situation in western Canada there is a fairly stable trend (Figure 14), which may be attributed to the active turnover of varieties in the supply chain, along with a constant international market demand for malting barley that keeps growers interested in growing barley.

![Graph showing barley production and seeded area in France, 2006-2016](image)

**Figure 14. Barley production and seeded area in France, 2006-2016**

On the other hand, seeded areas of malting barley in Germany have been decreasing over the past decade (Figure 15), which has been a concern to the end-users, particularly because of the high dependence of the beer industry in Germany on the stability of the domestic and imported malt supply.
Figure 15. Barley production and seeded area in Germany, 2006-2016

The discussions with industry stakeholders confirmed that the average lifespan of new malting barley varieties in France and Germany is around 5 to 7 years. For Germany, the varieties that are suitable for all-malt production prevail on the market. For France, since the majority of malting barley is exported, the varietal portfolio has a higher level of variation in the suitability of those varieties (i.e. for all-malt, adjunct brewing or distilling). 9.

Barley breeding in France and Germany

Barley breeding in France and Germany is dominated by private companies, mainly large seed companies. Similarly to the situation in the UK barley industry, Limagrain, RAGT, KWS, Syngenta, Secobra and Saaten are the largest seed companies in France and Germany that own breeding programs or work in partnership with the private breeders. For instance, the varieties developed by Ackermann Saatzucht GmbH in Germany are distributed worldwide via the seed company Saaten, and the agricultural cooperative BayWa AG in Germany. Another example of the close work of the breeders and the end-users is a breeding company Secobra Recherches, which is owned by maltsters Soufflet, Malteurop, and by brewing companies. Public breeding in France and Germany is also present, yet it does not appear to play a crucial role in varietal introduction in malting barley. Stakeholder interviews suggested that the majority of actively grown varieties were registered by private industry stakeholders. Such a large number of competing companies has led to the extensive marketing of new malting barley varieties by the

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9 Further details of the malting and brewing sectors in France and Germany is provided later in this section.
seed companies to the growers and end-users. Seed companies aim to achieve at least a 15% market share for the new varieties, which is difficult to do while working within the borders of one country. Thus, many seed companies attempt to have their barley varieties accepted in the Recommended List evaluation programs in other countries. The EU single market space allows varieties that have undergone National Registration in one country to be accepted directly to RL trials in another country with sufficient micro and macro-malting data.

Furthermore, the implementation of the UPOV framework that regulates royalty collections in France and Germany has led to stronger assurances of a return on investments. France implemented an end-point royalty system with uniform payment on every barley variety, which is considered as a highly efficient system with over 90% of the available royalty returned to the breeders. Also, only a small amount of farm-saved seeds in France is exempt from the royalty collection system. On the other hand, royalties in Germany are collected on certified seed sales, with all available royalties on certified seed sales returned to breeders. At the same time, there is a certain level of loss in royalties on farm-saved seeds.

**Registration and evaluation of malting barley varieties in France**

In France, new crop varieties go through registration in the Official Catalogue in the Ministry of Agriculture, and the recommendation for the national registration is done by the Permanent Technical Committee for Selection (CTPS) based on the trial data from GEVES.

After two years of the trials for DUS and VCU tests, if successful, the variety passes registration and plant breeders apply for PBRs. After the National registration, the industry chooses approximately five varieties with promising malting and brewing results for the pilot and macro-scale trials (see Figure 16 for the timeline of the trials). The end-users are represented by the Association of Maltsters of France (Malteurs de France) in collaboration with the Association of the Brewers of France (Association des Brasseurs de France). For the first year of the Recommendation List trials, breeders are required to provide approximately 3t of barley (approximately 600kg for each variety) for the pilot malting and brewing trials. For the second year, breeders are expected to provide 100t of barley for the macro-scale trials.
In total it takes four years for the registration and evaluation of new malting barley varieties. Usually, the varieties with the higher yield or disease resistance are preferred by the industry, which recognizes that varieties with improved agronomic characteristics are necessary to induce farmers to grow malting barley. The results of the pilot and macro-scale trials are returned to the breeders, but not shared in detail among end-users.

**Registration and evaluation of malting barley varieties in Germany**

The German evaluation system is considered as one of the strictest systems among top malt producing countries. New barley varieties go through trials at the Federal level at the BundesSortenAmt (BSA) office. It takes 3 years of VCU and DUS tests after which successful barley varieties pass the registration and breeders obtain Plant Breeders Rights (PBRs). Only the varieties that go through BSA are considered by the industry for the macro-scale trials. The industrial level trials are overseen by the Braugersten-Gemeinschaft e.V., Deutschland (Association of Maltsters and Brewers of Germany) that was created at the Federal level to bring together all members of the supply chain and ensure a transparent and unbiased process for malting barley recommendations by the industry.

At the end of the last year at the BSA the industry chooses one or two varieties that have promising malting and brewing characteristics and funds breeders for the additional plots to
create a bulk of 150t of barley seed for the macro-scale trials (see Figure 17 for the timeline of varietal evaluation trials).

Figure 17. Registration and evaluation timeline of barley varieties in Germany\textsuperscript{9,42}

If the variety is approved by the industry, it typically means that all of the largest beer producers in Germany internally approved the variety. This sends a strong message upstream in the supply chain about the commercial potential of new malting barley varieties. Due to the recent negative trends in barley acres, preference is given toward the varieties that have higher yielding capabilities and contribute to the sustainability of agriculture. Unlike in the UK or France, the result of trials are shared among all members of the industry, to ensure that the process is transparent free from bias.

Malting and brewing supply chains in France

France is a one of the largest malt producing countries, providing 30% of global malt supply, with approximately 80% of its malt being exported. There are four major players in the French malt industry\textsuperscript{9,17,18,27,32,43}:
- **Soufflet Malterie** with 809,900t of production capacity. The company has nine plants located in France, and is one of the largest malt suppliers in the world. Soufflet is also a shareholder of the private breeding company Secobra Recherches.

- **Malteurop** is a second largest maltster in France and has a capacity of 420,000t. The company owns four production plants in the country. It is owned by one of the largest farmer’s cooperatives in France, VIVESCIA, which provides agricultural (e.g. seed, supplies, advising) and grain trading services. The company is also a shareholder of the breeding company Secobra Recherches.

- **Boortmalt** has an annual capacity of 160,000t at its French division, and it is a subsidiary of the largest French farmers’ cooperative Axéréal.

- **Cargill** with a production capacity in France of 75,000t. The company works in a relatively independent supply chain (compared with the cooperatively-owned and vertically integrated competitors).

The French brewing industry is the third largest in the European Union, and has over 700 active breweries of different sizes. An extensive growth in the number of breweries has been observed over the last five years due to the growing popularity of craft beers. However, the majority of beer production in France still lies within the large beer producers, like Carlsberg Group, Heineken N.V and Anheuser-Busch InBev.

The leading malting and beer players on the market are shareholders of the breeding company Secobra, or have had a long history of working closely with barley breeding programs within their respective supply chains. Such close involvement of maltsters and brewers in barley varietal development has made it relatively easy for the industry to accept new varieties. Also, the cooperative structure of the major maltsters on the market (two of the four largest maltsters – Boortmalt and Malteurop – are owned by farmer cooperatives) contributes to the fast turnover of new varieties by facilitating the flow of information within the supply chain.

**Malting, brewing industries and the role of grain cooperatives in Germany**

The malting industry in Germany has been showing a shift towards a higher degree of concentration, with many small malting houses acquired by the major players. While the industry still has a small number of privately owned malting houses that are owned by the breweries, this has been changing over the last few years. The major maltsters are:

- **Avangard** with 340,000t of total production capacity in four locations in Germany. The Russian company operates 3 more plants in Russia.

- **Malteurop** with three locations in Germany and 260,000t of the production capacity. As a subsidiary of the largest cooperative in France, the company has the advantage of being able to share the results of varietal trials in other countries and have seed multiplied in other growing regions.
- **Hanse-Malz** with three production locations and 245,000t of annual capacity. The company is German based, with no other production facilities in another countries.
- **Soufflet Malteries** with a production capacity of 200,000t annually at their three plants. Similarly to Malteeurop the company has the advantage of multiple locations in different countries that facilitates information transfer.
- **Ireks** with 163,000t of production capacity at three locations in Germany. The company also has production plants in Austria.
- **GrainCorp Malt** with 156,000t of annual capacity in three locations. The parent company merged with the large maltster GermanMalt GmbH & Co. in 2011 to achieve a strong market position in the European region.
- **Cargill Malt** with 85,000t production capacity at one location in Germany. The company is a subsidiary of the Cargill Group that provides grain trading and agricultural services in Germany and other countries.

A large portion of German malt is consumed by domestic brewers. The beer industry has been largely focusing on the all-malt beer production that requires significantly more malt than Germany can produce. Usually, the malt imports come from France, The Netherlands, Czech Republic and Poland. The beer industry in Germany has a large number of breweries (over 1000), with approximately 60% of beer produced by the large brewers. The largest market share of 15% belongs to Raderberger Group, and the remaining large beer producers have 10% or less of the market share.

Cooperatives have had a long history of involvement in German agricultural supply chains. The largest, BayWa and Agravis, provide services in the agricultural sector (e.g. input supplies, grain storage and trading) and work closely with the breeding companies. For instance, BayWa has the exclusive distributional rights for some of the barley varieties, and tends to collaborate with the breeders to get access to small samples even before the varieties start the process of the Federal State Registration.
5. Australia

**Malting barley industry in Australia**

The barley industry in Australia is the second most significant grain industry after the wheat (Figure 18) and contributed more than 4% annually to the overall gross value of Australian agriculture in the period between 2014 and 2015.\(^{51}\)

![Diagram of Australian grains industry](image)

**Figure 18. The contribution of the Australian grains industry to Australian agriculture in 2014–15**\(^{52}\)

The total production of barley averaged over 8 million tonnes annually in the period 2010-2016, of which 2.3 million tonnes on average annually was accepted as malting barley. More than 60% of produced barley goes for export, with malting barley exports averaging 1.3 million tonnes annually over the same time period. The remaining 1 million tonnes of malting barley is used for domestic consumption.\(^{53}\)
The 2016 crop year was particularly productive because of favourable weather conditions, with barley production estimated at more than 13 million tonnes, with 2.7 million tonnes produced in the New South Wales region, 3.2 million tonnes in Victoria, 3 million tonnes in South Australia, and 4.2 million tonnes in Western Australia.

Even though a large portion of barley goes for feed (over 60-70% annually), it is common for Australian growers to seed malting barley varieties. The production and seeded area trends for barley in Australia have been stable over the last 10 years (Figure 19), with some fluctuations due to weather conditions.

![Figure 19. Barley production and seeded area in Australia, 2006-2016](image)

The available data on the Western Australia growing region indicates that, out of the current dominant malting barley varieties (i.e., Bass, Baudin, Flinders, Granger, Scope CL and La Trobe), only Baudin is a relatively old variety that was registered in 2003, and has shown a significant decrease over the last few production years (see Figures 20 and 21). The remaining malting barley varieties that prevail on the market are new varieties that were registered over the period of 2012-2015.
In general, the feed and malting barley varieties that were registered before 2009 have been “outclassed”, which means that newer varieties with superior agronomic or malt characteristics
have replaced older varieties, and it is unlikely that grain traders will accept them\textsuperscript{xi}. The data for other growing regions of Australia also indicates a high degree of variability in produced varieties\textsuperscript{56}.

\textbf{Registration and evaluation of new malting barley varieties in Australia}

The process of evaluation and registration of new barley varieties in Australia can be separated into two parts. First, there is the National Variety Trials (NVT) program that was established in 2005 by the Grains Research and Development Corporation (GRDC) and is managed by the Australian Crop Accreditation System Limited (ACAS). The ACAS was created as a not-for-profit organization to organize and manage crop varietal accreditation processes, and the trustees include the Australian Seed Federation, Grains Council of Australia and GRDC. The NVT program is completely funded by GRDC\textsuperscript{xii} and its budget is about AUS$5.5 million (just over CAD$5.5 million), which is used for seed production for commercial trials and NVT management. The only exemption is for the state of Western Australia, where the State Department of Agriculture shares the financing of the NVT trials with GRDC.

Only the varieties that are close to commercial release go through the NVT program, and require a prior nomination decision (breeders have to decide which varieties to nominate to NVT) and a sufficient supply of seeds by the breeders. The program takes two years for the new barley variety to pass all the trials, and follows strict deadlines for nomination and seed availability requirements of the candidate lines. The lines that do not meet standards or deadlines do not proceed in the evaluation process. The database of the trial results is maintained online to assure consistency and uniformity of the results, and is publically available\textsuperscript{57}.

For the commercial lines like barley, the seed bulk for trials is produced at two nurseries in Western Australia and New South Wales, which provide backup to one another that helps to manage Western Australian Quarantine and Inspection Service (WAQIS) issues (e.g. pest control). The common seed is used for all trials within each year at the NVT. The varieties in the NVT program, if successful, should achieve the status of “available to growers” within two years from nomination for the trials.

The second part of the accreditation process is overseen by Barley Australia (BA), which is responsible for accreditation of new barley varieties and produces the Recommended varieties List. The organization is funded by its members that include major end-users of malting barley.

\textsuperscript{xi} Figures 20 and 21 display two different periods to show how some varieties, even though maintaining a respectable market share, were discontinued over a short period of time. For instance, the variety “Buloke” had a market share of over 25% in Western Australia. The industry decided to replace it with newer varieties (plans to do so were actively communicated to the sector through various industry and government publications). As a result, Buloke in Figure 21 is considered as “old malt” and completely disappeared by the year 2016. The varieties Bass and La Trobe were registered in 2012 and 2015 respectively, thus they appear only in Figure 21.

\textsuperscript{xii} The role of GRDC in R&D is discussed in the next section.
Adoption of malting barley varieties in malt barley supply chains

(malting, brewing, and grain trading companies) and research organizations: Australian Export Grains Innovation Centre (AEGIC), Australian Grain Technologies, Barrett Burston Malting, Cargill Malt, Carlton and United Breweries, CBH Grain GrainCorp Operations Ltd, Intergrain, Lion - Beer, Spirits and Wine Australia, Malteurop, Syngenta and The University of Adelaide 53. The process of the accreditation through Barley Australia is presented in Figure 22.

The application for malting barley accreditation is submitted to Barley Australia by breeders on an annual basis and only after passing NVT. Typically, when there are many applications for malting barley accreditation; Barley Australia can limit accepted varieties for the evaluation to five or six lines maximum. The decision on acceptance into the trials and on malting barley accreditation for domestic and exporting markets is made by the Malting and Brewing Industry Barley Technical Committee (MBIBBTC), which it is comprised of the largest malting and brewing industry members (Barrett Burston Malting, Cargill Malt, Carlton & United Breweries, Coopers Brewery, Lion Brewing, Malteurop Australia) 9.

![Diagram of the process of barley accreditation through Barley Australia](image)

**Figure 22. The process of barley accreditation through Barley Australia**

In the first year of the evaluation, the data from micro-scale and commercial malting trials is used to determine barley lines that will be forwarded to the Pilot Brewing Australia (PBA) stage. The PBA is a co-funded industry project that is supported by the members of Barley Australia and GRDC and conducts pilot-brewing trials (batches of 100 kg) with the commercially malted lines of barley (batches of 100 tonnes). New barley varieties that do not proceed to Year 2 (Stage
2) of malting barley evaluation can be granted feed or food accreditation by the Barley Australia Board. Typically, the results from the two growing seasons and successful malting and brewing trials are sufficient for the variety to obtain a malting barley accreditation by Barley Australia. In total, it takes four years for new malting barley varieties to pass NVT and malting barley accreditation trials and be recommended for commercial growing by the industry (Figure 23).

![Timeline for new malting barley variety registration in Australia](image)

**Figure 23. Timeline for new malting barley variety registration in Australia**

Barley Australia continuously updates a list of the accredited malting, feed, and food barley varieties, and the market demand status for each variety. The Recommendation List is used as guidance for the industry about upcoming or discontinued lines of barley.

**Barley breeding in Australia**

Barley breeding programs in Australia have shown a noticeable trend towards a privately funded structure. The main organization that oversees R&D in the grain sector is The Grains Research and Development Corporation (GRDC). The organization was founded as a corporation that included Government of Australia and is funded by grower levies and a governmental contribution.
A large number of the industry stakeholders contribute private funding towards barley breeding programs, including not only private seed companies like Limagrain, Syngenta or Secobra, but also large grain traders and other industry members. Public sector funding comes via InterGrain’s shareholders (State of Western Australia and GRDC), as well as AGT’s shareholders (which include GTRDC, the South Australian government and the University of Adelaide). Until 2016 barley breeding in Australia was conducted at both publicly and privately funded breeding programs. However, the University of Adelaide decided to focus on the pre-breeding rather than breeding side of the research, and starting from the end of June 2016 barley breeding in Australia is now conducted privately 58.

The two major private breeders in Australia are InterGrain Pty Ltd and Agricultural Grain Technologies (AGT), and GRDC has a minor ownership share in both. Other shareholders in these companies include the governments of Western Australia and South Australia, Limagrain, Syngenta, Secobra, and other members of the industry 59.

The royalty system in Australia switched to an end-point royalty system in 1994, which has led to significant changes in crop development and R&D in Australia overall. Unlike in France, the end-point royalties differ for each variety, and require growers to claim grown varieties. There are two ways to collect royalties, either grain traders deduct it at the point of sale from the farmer, or they report to the variety owner the purchased amounts and the PBR holder can invoice the farmer directly 59,60.

**International and domestic trade of the Australian malting barley**

The Australian grain industry operates a bulk grain handling system and the main transportation means for the movement of grain across the country to the port terminals are railways. Typically, the grain is segregated at the delivery points per crop variety. Also, there has been a noticeable increase in on-farm grain storage in the recent years.

The grain trading industry consists of 10 large marketers, around 24 medium-sized traders and a group of 200 small grain traders that do not always export consistently 52. The largest are the Cooperative Bulk Handling Limited (CBH), grain company GrainCorp, and marketers such as Glencore Grain Pty Ltd, Cargill Australia Limited, Emerald Grain Pty Limited, Nidera Australia Pty Ltd, CHS Trading Company Australia, Louis Dreyfus Company Australia Pty Ltd and Bunge Agribusiness Australia Pty Ltd. 52 Three out of the four main regional players in grain handling and storage services, GrainCorp, Viterra and Cargill’s Grainflow, are characterized by international ownership, while CBH is the largest farmer-owned cooperative in Australia 52.

The introduction of the Port Access Code in 2014 61 that regulates the competition level in port terminals requiring ports to give terminal access to every grain company in Australia led to a change in the competitive environment for grain trading. An exemption on some of the Port Access Code clauses can be granted to the ports if they can prove a healthy level of competition
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to the Australian Competition and Consumer Commission (ACCC). Indeed, half of the port
terminals have gained an exemption from the port code competition requirements since 2014,
suggesting that grain traders and shipment operators may have adjusted their practices and
shipping routes to diffuse loading to ships in different ports rather than monopolizing a single
port - a process of ‘self-regulation’ within the grain handling industry. Nevertheless, the port
terminals are required to publicly report expected capacities and grain segregation preferences by
variety in each port terminal loading zone. This provides a signal as to which varieties are
becoming more popular, allowing growers and grain traders to observe the expected demand
trends for malting barley and improving their abilities to plan.

Often, marketers and State Departments of Agriculture in different regions provide
complementary information that informs growers, and other members of the industry on the
current state of the barley industry (including malting barley), and guides which varieties are
likely to be preferred by international markets, or may be outclassed in the next few years, and
which varieties have the potential for segregation (storage capacities) at the delivery points.

The choice of exporting region is often driven by freight costs and long-term established
relationships. The substantial portion of barley (feed, food and malting) is exported to Asian
markets (e.g. China and Japan), Middle East and Africa. Over the last 10 years Australia has
gained a significant advantage over many exporting countries because of a marked decrease in
the differential for freight costs relative to North America, efficiencies in bulk grain handling,
and quality improvements, all of which contribute to a stronger competitive position for
Australia on the global market.

**Malting and brewing supply chain in Australia**

The malting industry in Australia produces approximately 900,000 tonnes of malt, out of which
200,000 tonnes are consumed domestically, and around 700,000 tonnes goes for export.

The Australian malting industry is comprised of three large malting companies:

- **Barrett Burston Malting** with a production capacity of 260,000t. The parent company is
  GrainCorp which also operates as the largest grain trader in Australia. Two malt plants
  out of four are located on the premises of the GrainCorp export grain elevator and the
  territory of GrainCorp port terminal. Malt goes to the domestic brewing sector and key
  Asian export markets.

- **Cargill Malt** with a capacity of 455,000t. Cargill Malt’s Asia Pacific division has 6
  plants located in Australia, and exports to the domestic and international markets, Asia
  Pacific and Africa in particular.

- **Malteurop Australia** with 78,000t of production capacity. The plant in Australia is
  located in close proximity to the port terminal and produces malt for domestic and Asian
  markets. The company plans to increase capacity by 2018.
The beer industry in Australia is the most profitable industry within the Australian alcohol sector (accounting for 60% of the profit accruing to the beer, wine, cider and spirits sector) and is mainly represented by Carlton & United Breweries and Lion Brewing, with market shares of 40.7% and 43% respectively. Carlton & United Breweries was acquired by SABMiller Beverages Investments Pty Limited in 2011, and then went through another acquisition by Anheuser-Busch InBev in 2016. Lion Brewing is a part of the Lion family that produces alcoholic (beer, spirits, and wine) and non-alcoholic beverages in Australia and New Zealand, and also operates in the dairy industry. The company focuses on the craft and traditional brewing sectors and consumes half of the total domestically consumed malt (approximately 100,000t). The third beer company in Australia is Coopers Brewery with a 5% market share. The company is the largest Australian-owned brewery with a portfolio of its own beer lines, and it also produces or has a right for sale of internationally recognized brands like Carlsberg, Sapporo and some brands from North America.

There is a distinct difference between the brewing industry in Australia and beer production in many other countries. A substantial portion of the domestic brewing in Australia is conducted with the addition of sugar directly into the brewing process, which is not the same as the addition of adjuncts or all-malt brewing. For the sugar-added beer production, the enzymatic activity of malting barley is required to be low (i.e. low protein content). However, there is a noticeable trend towards more traditional all-malt beer production, which still requires low protein malting barley. For instance, although Lion Brewing used sugar in its production in 2011, in 2017 the company specifically claimed that sugar is not included in their production process. At the same time, the major importing countries for Australian malting barley and malt typically prefer varieties that have a high protein content and can be used in adjunct beer production.

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xiii The addition of other grains or ingredients (e.g. sugar, spices) during the brewing process.
Coordination, Communication, and Collaboration

The varietal adoption process for malting barley differs in each malt producing country, and it often relies on the supply chain structure and the degree of collaboration and communication within those supply chains.

Compared to the Canadian malt barley supply chain, one competitive advantage of the malting barley supply chains in the UK, France, and Germany appears to be their relatively high degree of coordination, which is partially a result of the supply chain structure (e.g. cooperatives or the establishment of long-term supply chain partnerships). The breeders, grain traders, maltsters and malt end-users take an active part in the organizational process of varietal evaluation, and the promotion of new varieties. Similarly, Australian supply chain members contribute to the varietal diffusion via a set of accepted procedures and guidelines for varietal evaluation with a high level of involvement of many sectors of the industry and a clear assignment of responsibilities.

Further, the United Kingdom, Germany, and France currently have the advantage of being within the single market of the European Union that allows a relatively easy transition of new varieties from one country to another. Most of the large beer producers and malting companies conduct commercial trials in one country and know exactly what to expect when the same variety goes through NL and RL trials in other EU member states.

Second, the Recommended List (RL) system exists in each top malt producing country and, in most cases, it is administered by the representatives of the industry. In the EU countries examined (France, Germany and the UK) and Australia, the RL trials for new varieties are overseen and assisted by the industry organizations that represent most of the maltsters and beer producers. In the United Kingdom, this is done by the Malting Association of Great Britain (MAGB) that involves the largest maltsters, brewers, and distillers in the country. Similarly, in Germany, the German Malting Barley Association (Braugersten-Gemeinschaft e.V) that includes largest brewers, regional and national industry organizations and associations perform this role. In France, the Association of Maltsters of France (Malteurs de France) in collaboration with the Association of the Brewers of France (Association des Brasseurs de France) are involved in overseeing new varietal trials. In Australia, malting barley evaluation is conducted by Barley Australia, the organization that represents large maltsters and beer producers in the country.

It seems that participation of the end-users in the Recommendation List trials sends a strong message to other members in the malting barley supply chain about the acceptability of new varieties. In Canada, Collaborative trials (related to end-user characteristics) for the national registration of varieties are conducted by the Brewing and Malting Barley Research Institute (BMBRI), and the Recommendation List trials and publication of results are overseen by the
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Canadian Malting Barley Technical Centre (CMBTC). The lack of confirmation from the end-users about new varieties may result in increased uncertainty for growers regarding which varieties to grow.

Brewers, by nature, have a tendency to be conservative and are reluctant to change their recipes. Considering that they have long-established reputations that depend highly on the flavour profile of their brands, it is no surprise that beer producers require additional time and additional trials to accept change. Discussions with industry stakeholders in other countries, however, suggest a strong understanding of the responsibility of the end-users to take into consideration barley growers when determining the future of new varieties so that agronomic characteristics are considered alongside good malting and brewing characteristics. An unstable supply of malting barley can impact end-users drastically, and they have a strong incentive to assure that farmers are still interested in growing malting barley varieties instead of switching to other crops.

Nevertheless, the communication link between maltster and brewer plays one of the most significant roles in varietal adoption. In most of the malt producing countries examined for this report, the maltsters take responsibility to arrange macro-scale trials with brewing participants and pass the information on new varieties to the end-users. Also, a large number of cooperatives and collaborative supply chain agreements, hand in hand with a set of coordination procedures in the overall supply chain, allow for a smooth process of varietal adoption. Multiple opportunities for information exchange, well-coordinated arrangements for trials and a high level of involvement of all industry players for the mutually aligned goals of industry development contribute to efficient and effective supply chain partnerships in the EU, and Australia. Coordination, communication and collaboration appear to characterize malt barley supply chains in these countries and help to explain the more rapid adoption of new malting barley varieties.

**Bottlenecks in the Canadian varietal evaluation and registration system**

The intensive private breeding systems in the EU countries examined and in Australia, resulting in a highly competitive environment, appear to have led to a more active involvement of breeders in varietal promotion and adoption. The production of large amounts of seed is costly and most importantly, highly risky. However, because of a more direct interest in the success of the new varieties (e.g. investments in breeding, integration along the supply chains), there is a stronger incentive for seed companies to take more risk and start seed multiplication earlier in the process. In cases when breeders have a limited capacity or are reluctant to produce the necessary seed bulk, the supply chain members share the expenses and costs for the seed production and trials. In Germany, the brewers pay for seed multiplication; in Australia, France, and the UK the costs are spread among the members of the value chain.

For Germany, a vast portion of malting barley and malt is consumed domestically, and there is a high reliance on malt imports from other EU countries. The private seed companies with their breeding programs work in a competitive environment similar to other EU member states and
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thus, exhibit pro-activeness in the promotion and the adoption of new varieties. Even though France exports 80% of its malting barley to EU countries and other international markets, the high rate of varietal turnover intensified the need for the supply chain stakeholders, especially breeders, to actively exchange information and samples on a constant basis. Similarly, in the UK and Australia seed companies take the risk of seed multiplication at early stages of the national trials or even before that, because of a clear understanding that micro and macro-scale trials play an essential role in varietal acceptance by end-users.

Not all varieties achieve the desired market share of at least 15%, and not all varieties are accepted or recommended by the end-users. Nevertheless, European and Australian seed companies understand that without macro-scale trials there is a lower chance for the variety to be accepted by large beer producers and maltsters. It was noted that in the Canadian system of varietal evaluation often there is not enough seed to conduct large-scale trials (see Table 1). This lack of seed also slows or halts immediate commercialization after registration at the CFIA. Public breeding programs are reluctant to risk their limited funds on seed multiplication of uncertain varieties, and seed companies cannot start multiplication process because they do not know which varieties will pass CFIA registration and will be offered for auction.

**International market development**

According to discussions with industry stakeholders in EU and Australia - there are two types of international consumers. A first type gladly accepts new varieties as long as the variety went through the NL and RL stages. A second type requires additional time and samples to conduct additional malting trials, and to adjust their beer recipes.

After the removal of the single desk selling authority of the Canadian Wheat Board (CWB) in Canada, a portion of the CWB’s previous responsibilities for international market development fell on the shoulders of various supply chain members. It was often pointed out in conversations with the industry that CMBTC conducts international development, which is true to some degree. Although, taking into consideration that the CWB had a working staff of over 400 people in 2012 (albeit across a variety of functions), the work of CMBTC may be limited by human capital constraints.

In other malt producing countries, the grain trading companies and maltsters that work with international customers actively promote the new varieties. International and domestic brewers conduct multiple visits to the malting plants on an annual basis. The breeders, maltsters and grain traders send barley samples to their consumers continuously, and discussions on upcoming changes in malting barley production trends happen throughout the year. In Australia, a large number of grain marketers work on market development, and have built effective information exchange ties with the end-users. Table 1 offers a summary of the key characteristics of malting barley supply chains in the five countries examined for this study.
Table 1. A comparison of malting barley supply chains in Canada and in other malt producing countries

<table>
<thead>
<tr>
<th></th>
<th>Canada</th>
<th>The UK</th>
<th>France</th>
<th>Germany</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifecycle of new varieties</td>
<td>Decades for the dominating varieties. Many new varieties never achieve a 5-10% market share.</td>
<td>5 to 10 years lifecycle. Variation in market shares (can range between 5 to 50%)</td>
<td>5-7 years lifecycle. Variation in market shares (can range between 5 to 50%)</td>
<td>5-7 years lifecycle. Variation in market shares (can range between 5 to 30%)</td>
<td>5-7 years lifecycle. Variation in market shares (can range between 5 to 30%)</td>
</tr>
<tr>
<td>Evaluation and registration of malting barley varieties</td>
<td>- 3 years for the National Registration. - 1-3 years for the Recommended List trials. <em>4-6 years in total</em> depending on seed availability</td>
<td>- 2 years for the National List Registration. - 2-3 years for the Recommended List trials. <em>4-5 years in total</em></td>
<td>- 2 years for the National List Registration. - 2 years for the Recommended List trials. <em>4 years in total</em></td>
<td>- 3 years for the Federal Registration. - 2 years for the Recommended List trials. <em>4-5 years in total</em></td>
<td>- 2 years for the National Varietal Trials. - 2 years for the Recommended List trials. <em>4 years in total</em></td>
</tr>
<tr>
<td>Macro-scale trials</td>
<td>No. Pilot scale for RL.</td>
<td>Yes. 1000t seed requirement.</td>
<td>Yes. 100t seed requirement.</td>
<td>Yes. 150t seed requirement.</td>
<td>Yes. 100t seed requirement.</td>
</tr>
<tr>
<td>Involvement of the end-users in the evaluation trials</td>
<td>Maltsters and brewers participate in the Collaborative trials for National Registration, and contribute to the discussion in the Recommended List (RL) trials but are not involved directly in RL trials.</td>
<td>Maltsters, brewers and distillers participate directly in the Recommended List trials, and contribute to the discussion during National Registration.</td>
<td>Maltsters and brewers participate directly in the Recommended List trials, and contribute to the discussion during National Registration.</td>
<td>Maltsters and brewers participate directly in the Recommended List trials, and contribute to the discussion during Federal Registration.</td>
<td>Maltsters and brewers participate directly in the Recommended List trials, grain traders participate in the discussion and coordination of RL trials; maltsters, brewers and grain traders contribute to the discussion during National Registration.</td>
</tr>
<tr>
<td>Characteristics of supply chain structure</td>
<td>Relatively independent supply chain. Brewing and malting industries are relatively concentrated. Maltsters have linkages with the grain handlers (via ownership or parent companies).</td>
<td>Malting and brewing industries have some degree of concentration.</td>
<td>A high number of cooperatives and vertically integrated supply chain links (breeder-grower-grain trader-maltster). Malting and brewing industries are relatively concentrated.</td>
<td>Malting and brewing industries have quite a number of firms, with a limited degree of concentration.</td>
<td>Relatively independent supply chain, with a few large cooperatives working in the grain sector. Malting and brewing sector is relatively concentrated.</td>
</tr>
<tr>
<td>R&amp;D in malting barley varieties</td>
<td>Public breeding prevails. Royalties collected on certified seeds.</td>
<td>Private breeding prevails. Royalties collected on certified seeds, and a % on farm saved seeds.</td>
<td>Private breeding prevails. Uniform end-point royalties.</td>
<td>Private breeding prevails. Royalties collected on certified seeds, and a % on farm saved seeds.</td>
<td>Private breeding prevails. End-point royalties.</td>
</tr>
<tr>
<td>Market development</td>
<td>The functions are somewhat diffused along the supply chain and among multiple industry organizations.</td>
<td>The breeders, grain companies and maltsters play an active role in varietal promotion to the maltsters, brewers and distillers.</td>
<td>Everyone in the supply chain actively promotes new varieties to the end-users.</td>
<td>Everyone in the supply chain actively promotes new varieties to the end-users.</td>
<td>Many grain traders participate in the domestic and international markets development.</td>
</tr>
</tbody>
</table>
Adoption of malting barley varieties in malt barley supply chains

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Canada</th>
<th>The UK</th>
<th>France</th>
<th>Germany</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The industry has had a reputation for the production of high quality malting barley.</td>
<td>- The supply chain benefits from relationships and partnerships developed over many decades of collaboration. Established trust and linkages allow a relatively easy exchange of information and communication.</td>
<td>-Closely integrated supply chain links facilitate a quick information exchange and relatively smooth coordination for the varietal introduction into the system.</td>
<td>- A mutual acceptance of the varieties by end-users sends a strong message to the rest of the supply chain.</td>
<td>- An open exchange of the information among key supply chain members assures transparency and unbiased decisions in the varietal approval process.</td>
<td>- A high involvement of grain traders into market development facilitates the introduction of new varieties into the market.</td>
</tr>
<tr>
<td>- A high involvement of industry organizations (e.g. SaskBarley, Alberta Barley, MIAC, CMBTC etc.) can contribute to the strong connectivity and ease of information exchange among supply chain members.</td>
<td>- A set of industry-accepted protocols and procedures for evaluation of new varieties clearly defines the responsibilities of members in the supply chain.</td>
<td>- A mutual acceptance of the varieties by end-users sends a strong message to the rest of the supply chain.</td>
<td>- A rigorous process of evaluation limits the diversity in accepted varieties.</td>
<td>- A fast turnover of new varieties can help to mitigate the outbreaks of crop diseases, or unstable weather patterns, which is advantageous to the growers, and to the downstream supply chain members.</td>
<td></td>
</tr>
<tr>
<td>Disadvantages</td>
<td>- A large number of the varieties never achieve a profitable market share, leading to inefficiencies in the allocation of funds to breeding activities (i.e. sunk costs not recouped).</td>
<td>- Substantial long-term investments in close supply chain partnerships and vertical integration may lead to a higher level of co-dependency, whereby established relationships dominate and limit the capacity to form relationships with new breeders or switch to improved varieties from different companies.</td>
<td>- A significant amount of investments (capital requirements, dedicated assets) into the development of vertically integrated supply chain links.</td>
<td>- A high level of integration limits the possibility for the varieties that were developed outside of the supply chain to be accepted by the end-users.</td>
<td>- A fast varietal adoption results in the loss of some portion of profits from breeding (if new varieties do not have time to achieve high market shares).</td>
</tr>
<tr>
<td>- A lack of macro-scale trials at early stages of the evaluation process prevents early buy-in by end-users in new malting barley varieties.</td>
<td>- A low involvement of grain traders and breeders in market development results in potential losses in international markets and stagnates varietal introduction.</td>
<td>- Additional sources of risk that come from being vertically integrated across multiple parts of the supply chain.</td>
<td>- An open exchange of information among supply chain members during varietal trials puts end-users in a vulnerable position with respect to potential leakage of commercially sensitive information.</td>
<td>- A fast varietal turnover increases the costs and uncertainty among end-users, and might lead to reluctance to change in the long-run.</td>
<td></td>
</tr>
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<td>- A low involvement of grain traders and breeders in market development results in potential losses in international markets and stagnates varietal introduction.</td>
<td>- Potential for a higher degree of duplication of functions and coordination challenges when there are a large number of organizations involved in the sector.</td>
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7. Conclusions and further research

The goals of this research project were to conduct an exploratory analysis of malting barley supply chains in major malt producing countries and determine how different supply chain structures and varietal approval processes contributed to differences in the rate at which new varieties are commercialized and adopted. The analysis suggests that varietal “lock-in” has become an issue in Canada when new varieties often fail to gain a significant market share for long periods of time. Varieties that were registered twenty years ago still dominate the market. In contrast, the interviews with industry stakeholders elsewhere revealed a shorter average lifespan for new varieties, for example, five to ten years in the UK and five to seven years in France, Germany, and Australia.

Breeders in the EU and Australia appear willing to take a risk with early seed multiplication, and this is one of the reasons why the process of evaluation and adoption of new varieties is quite efficient. In Canada, seed multiplication often starts after National Registration is complete, especially because of some level of resistance to risk from seed companies who were not directly involved in breeding. This results in a considerable time gap before Canadian maltsters and brewers can conduct macro-scale trials and increases the lag in the overall varietal acceptance process.

Further, after the changes to the role of the Canadian Wheat Board in grain marketing, it is not clear who is taking over the responsibilities in international market development, and whether it is the responsibility of one organization in Canada or a shared responsibility of the industry. In the EU and Australia, grain traders play an active role in the development of domestic and international markets because of a high degree of collaboration and partnerships within the supply chain. In France, where some of the large maltsters are highly integrated upstream via growers’ cooperatives, grain trading and shared ownership of barley breeding programs, a greater degree of coordination and collaboration within and across supply chains facilitates the introduction of new varieties and their promotion to end-users.

In comparison, supply chains for malting barley in Canada feature much looser vertical coordination, and grain traders tend to be less proactive in international market development for malting barley. Crops like canola or wheat are easier to handle in bulk, and because of the additional requirements of malting barley varieties, grain companies may have less interest in malting barley market development.

An evaluation of the previous functions of the CWB related to market development and establishing to what extent and which of these functions were positively contributing to the strong global position of Canada in malting barley and malt production would be advantageous.
This would facilitate a discussion of appropriate strategies to address any gaps in market development activities across the sector where a more coordinated approach would be beneficial.

It is rather unclear what the “perfect lifecycle” might be for new varieties. Turnover and adoption of new varieties too quickly might lead to increased uncertainty and adaptation costs among end-users, and a loss of the returns on investments for breeding companies simply because the varieties do not have time to achieve a significant market share. The long life of the barley varieties weakens their agronomic potential such that, as time progresses, disease resistance and yield of available varieties may be compromised. With a large number of varieties being registered over the last 20 years but few reaching a sufficient market saturation to generate a return on the breeding investment, these investments becomes a sunk cost to the sector. Further research into the benefits of different lifecycles for new barley varieties can assist long-term strategic planning with respect to the industry’s development, including strategies to assist a more sustainable uptake of improved varieties.

Insights from the project have implications for the Canadian malting barley industry in three areas. First, one of the reasons for the successful adoption of new varieties in other malt producing countries appears to be not only involvement of the end-users in early stages of the varietal tests, but also a provision of a significant amount of seeds for the large-scale trials. The beer industry is highly dependent on an established reputation among beer consumers and will be hesitant to accept new varieties until they can be tested on a macro-scale level. If public breeders have limited capacities to produce the required bulk of seeds, barley supply chain members could look for other ways to assure that the end-users (e.g. maltsters and brewers) have access to a sufficient bulk of new varieties to enable commercial testing earlier in the registration process.

Second, domestic and international market development for malting barley plays a crucial role in the successful adoption of new varieties. It is important to clarify who is responsible for the market development functions previously performed by the CWB, and to what extent. Other malt producing countries clearly benefit from the active role of the breeders and grain companies in varietal promotion, both domestically and internationally. Further discussions within the Canadian malting barley industry could explore a more encompassing involvement of supply chain members into market development for new varieties and establish what industry procedures might help facilitate market development.

Finally, transparency and information exchange top-down and bottom-up is the key to an industry's development. In the EU and Australia, supply chain members engaged in collaborative efforts to develop and agree upon effective, yet different, systems of procedures for varietal development and evaluation. These institutional frameworks facilitate a transparent and clear information exchange along the supply chain, ease the process of decision making, and assure that all sectors of the industry can contribute and benefit in the long run. Further research could examine in greater detail the extent which the industry institutional environment and
organization of supply chains reduces transaction costs and improves coordination and communication, facilitating the development and adoption of new varieties.

A clear understanding of the direction in which the industry is headed allows every member of the supply chain to prepare for the changes. The end-users of malting barley play a significant and often the final role in the decision-making process, but it is not only up to them to assure progress in the industry. An evaluation of the extent to which links along the value chain for the Canadian malting barley sector could be improved through improved communication, coordination and collaboration between industry members would be beneficial.
References


9. Interviews with the supply-chain members. See Appendix A. The list of the interview participants. 2017.


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35. Statista. Volume of malt exported to EU countries from the United Kingdom (UK) from
Adoption of malting barley varieties in malt barley supply chains


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58. Heards G. Uni of Adelaide exits commercial barley breeding space. Farmweekly AU.

59. Giovanoli SM. Farm Saved Seed (FSS) and Royalty Generation for Wheat in France, United Kingdom, and Australia – Policy Implications for Canada. 2014.


# Appendix A. List of interview participants

## North America – 17 interviews

<table>
<thead>
<tr>
<th>#</th>
<th>Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Canadian Malting Barley Technical Centre (CMBTC)</td>
<td>Non-profit organization and research centre</td>
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<td>2</td>
<td>Paddockwood brewery</td>
<td>Craft brewer</td>
</tr>
<tr>
<td>3</td>
<td>Canada Malting</td>
<td>Maltster</td>
</tr>
<tr>
<td>4</td>
<td>Anheuser-Busch InBev (ABInBev) North America– 2 interviews</td>
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<tr>
<td>5</td>
<td>Moslon Coors North America- 2 interviews</td>
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<tr>
<td>6</td>
<td>Syngenta</td>
<td>Private seed company</td>
</tr>
<tr>
<td>7</td>
<td>Brewing and Malting Barley Research Institute (BMBRI)</td>
<td>Industry organization (maltsters, brewers)</td>
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<tr>
<td>8</td>
<td>Rahr Malting</td>
<td>Maltster</td>
</tr>
<tr>
<td>9</td>
<td>Prairie Malt (Cargill)</td>
<td>Maltster</td>
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<td>10</td>
<td>Field Crop Development Centre, Lacombe (FCDC)</td>
<td>Public breeding program</td>
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<td>11</td>
<td>Crop Development Centre University of Saskatchewan (CDC UofS)</td>
<td>Public breeding program</td>
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<td>12</td>
<td>GrainCorp</td>
<td>Grain trader</td>
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<td>13</td>
<td>Agriculture and Agri-Food Canada, Brandon (AAFC, Brandon)</td>
<td>Public breeding program</td>
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<td>14</td>
<td>BarleyCouncil/Malting Industry Association of Canada (MIAC)</td>
<td>Non-profit/Industry organizations</td>
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<td>15</td>
<td>Viterra</td>
<td>Grain trader</td>
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The United Kingdom – 12 interviews

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<td>The National Institute of Agricultural Botany (NIAB)</td>
<td>Research non-profit organization</td>
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<td>2</td>
<td>Soufflet UK</td>
<td>Maltster</td>
</tr>
<tr>
<td>3</td>
<td>British Society of Plant Breeders (BSPB)</td>
<td>Industry organization (breeders)</td>
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<td>4</td>
<td>Malting Association of Great Britain (MAGB)</td>
<td>Non-profit/Industry organization (malting, brewing and distilling)</td>
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<td>Openfield UK – 2 interviews</td>
<td>Seed company</td>
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France – 6 interviews

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<td>3</td>
<td>Secobra Recherches</td>
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<td>Limagrain France</td>
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<td>5</td>
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<td>Beer producer in the EU region</td>
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<td>6</td>
<td>Syngenta EU</td>
<td>Private seed company/Breeder in the EU region</td>
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Germany – 4 interviews

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<td>2</td>
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<td>Industry organization (maltsters and brewers)</td>
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<td>3</td>
<td>Maltzfabrik</td>
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<td>4</td>
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Australia – 4 interviews

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<td>Barley Australia AU</td>
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