BREWING AND MALTING
BARLEY RESEARCH INSTITUTE

1510 – One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3
Phone: 204-927-1401 www.bmbri.ca

Desirable Quality Traits in Malting Barley for BMBRI Member Companies

This list represents the quality traits of particular importance to the member companies of the Brewing and Malting Barley Research Institute. These traits are separated into those which specifically need to be considered in the development of new varieties, and those on which research is required to gain a better understanding. Both sets of quality characteristics are of importance to processors.

This list is meant to be a reference both for malting barley breeders and for researchers working in areas intended to expand our understanding of malting barley quality traits and to ultimately support and contribute to breeding efforts.

Characteristic (Not prioritized)	**Breeding Target**	**Research Target** (New knowledge/method required)
Arabinoxylan measurement		✓
Balanced Modification	✓	
Consistency in barley quality across growing conditions	✓	
Dimethyl Sulphide (DMS) and its Precursors		✓
Enzyme Activities	See below	
Extract	✓	
Fermentability		✓
FHB Resistance	✓	
Hull Adherence	✓	
Long Term Germination	✓	
Pre-Harvest Sprout Tolerance		✓
Protein	See below	
Varietal Identification		✓

There are four main malt quality profiles which are used, as malt, for blending to produce commercial malts:

- Moderate protein / Moderate enzymes – high demand e.g. AC Metcalfe,
- Moderate protein / High enzymes – high demand e.g. CDC Kendall, Legacy
- Moderate protein / Low enzymes – moderate demand e.g. CDC Copeland
- Low protein / Low enzymes – limited demand e.g. no current example

Protein Ranges:

Low = < 11% Moderate = 11 – 12.5%

Enzyme Ranges:

DP:	Low = <125	Moderate = 125 – 150	High = >150
Alpha Amylase:	Low = <53	Moderate & High = >53	

BREWING AND MALTING
BARLEY RESEARCH INSTITUTE

1510 – One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3
Phone: 204-927-1401 www.bmbri.ca

Explanations:

Arabinoxylans measurement: One type of non-starch polysaccharide found in the cell walls of the starchy endosperm and aleurone layer are arabinoxylans. If the cell walls are insufficiently degraded during the malting process, these molecules may have adverse effects during filtration in the brewing process and may contribute to haze formation. At the same time, arabinoxylans may have positive effects in regards to the sensory profile and foam stability in beers. In order to have a better understanding of arabinoxylans role in beer production and quality, a universal measurement technique would be useful to end users.

Balanced Modification: The term “modification” encompasses all the changes which happen within a barley kernel as it becomes malt. Two key measures of these changes are the breakdown of beta glucan molecules into smaller molecules, and the partial degradation of the barley protein. Ideally varieties would deliver low beta glucan levels, for optimum lautering and filtration during brewing, without excessive breakdown of the protein fraction, which can be detrimental to beer characteristics such as foam stability. “Balanced” refers not to a mid level for both beta glucan and soluble protein, but to an ideal level of each without compromising the level of the other.

Consistency in barley quality across growing conditions: Some malting barley varieties have acceptable malt quality when grown across diverse growing areas and across crop years. Varieties which give consistent malt quality have a better chance of becoming widely grown and accepted for malting and brewing purposes. For example, Harrington has been grown in several countries under varying conditions and has been consistently selected for malting. Consistency across all malting barley quality traits is an important characteristic in itself.

Dimethyl Sulphide (DMS) and DMS Precursors: DMS adds a characteristic flavour in beers. It arises from precursors that are formed during grain germination. These can be controlled to the desired level during kilning of the malt or during boiling in the brew house. DMS at the required levels in kilned malt would be desirable. This may allow for energy cost savings at the boiling stage in the brewery. Research is needed to examine if there is tendency for DMS variability between varieties. A tool for breeders to identify any such variability is also desirable.

Enzyme Activities: Typical North American malts have relatively high enzyme levels when compared with European and Australian malts. This is one of the advantages of our malting barley varieties. The enzymes active during the malting process ensure the appropriate levels of beta glucan and protein breakdown. The enzymes in finished malt ensure that the starch from both malt and any adjuncts which may be used in the brewing process are broken down into fermentable sugars. Enzyme levels can be too high, however, leading to a lack of control in the brewing process. Current levels are appropriate for meeting most malt specifications. There may be some interest in malting barley varieties which have lower enzyme levels for some malt markets, but there is not a significant demand at this time. In addition to measurement of Alpha Amylase (AA) overall Diastatic Power (DP), it would be desirable to provide information on the levels of Limit Dextrinase (LD) in breeding lines currently under development.

Extract: When brewers buy malt they are buying extract. It contains all the soluble components of the malt, primarily carbohydrates and proteins and their breakdown products, as well as colour and flavour compounds. The extract provides the source of fermentable sugars, the enzymes necessary for starch conversion, and proteins needed for yeast nutrition. Extract levels in current commercial varieties are at acceptable levels. Increases beyond the current levels which are derived from increased soluble protein are not desirable.

BREWING AND MALTING
BARLEY RESEARCH INSTITUTE

1510 – One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3
Phone: 204-927-1401 www.bmbri.ca

Fermentability: While extract refers to all components of a malt which are solubilized during the mashing stage of brewing, only the fermentable sugars in the wort can be converted into alcohol by the yeast. Not all of the starch in malt gets broken down into fermentable sugars and not all starch breakdown products can be used by the yeast. A variety of processing parameters can affect fermentability, but there also appear to be varietal differences. Increased fermentability means getting more out of the malt during the brewing process, in a controlled and predictable way. The development

of a measurement for fermentability that is accepted by end users is required to better understand this dynamic phenomenon.

FHB Resistance: Agronomic performance in general, including disease resistance, is recognized as being as important as malting quality in new malting barley lines; however, it is particularly urgent that lines with improved FHB resistance be developed. Susceptibility to FHB and the presence of DON in barley directly impacts the quality of both the malt and the beer which can be made. It is also of critical importance in terms of maintaining and regaining production acres in the Red River Valley and, increasingly, across the Prairies.

Hull Adherence: This remains an important target for improvement in Canadian malting barley varieties. Hull adherence in both malting barley and the resulting malt impacts the quality of the malt and the beer produced from it in several ways: the hull physically protects the embryo end of the kernel and, in doing so, helps to ensure vigorous germination; the hull also provides some degree of insulation during the kilning stage of the malting process, moderating the effect of the heat on the enzymes in the green malt; the hulls are also important during the brewing process as a filter bed during lautering. For all these reasons, hulls that adhere firmly during the handling of barley and malt are important contributors to overall quality.

Long Term Germination: The problems associated with germination of Canadian malting barley has gained considerable attention over the past couple of years, in particular with respect to the performance of Canadian malting barley overseas. Reliable germination is just as important to the production of malt domestically. While it is clear that pre-harvest sprouting and storage conditions have a significant effect on germination behaviour, it is not yet clear to what extent different varieties are susceptible to these problems. The challenge is to ensure that malting barley maintains its germination, but without introducing prolonged dormancy.

Pre-Harvest Sprout Tolerance: Some malting barley varieties have a greater propensity to germinate than others under wet conditions during crop maturation through harvest. This compromises the likelihood of this crop being selected for malting purposes. Although the barley is still alive, once pre-harvest germination has occurred, the barley will never perform optimally in the malt house, compromising malt quality. While long term dormancy is not desirable, it is recognized that some resistance to pre-harvest sprouting is required to ensure barley quality under a wide range of harvest conditions. A procedure to determine a variety's propensity to sprout would be very beneficial to the development of new barley lines.

Protein: The protein content of malting barley is affected by many factors, especially the growing conditions. Fertilizer application may also impact the final protein level. The protein level of new lines is measured relative to standard check varieties grown at the same location under the same conditions, and lines which have a tendency to regularly have higher or lower protein than the checks are noted. The protein level is important because it will affect the rate of water uptake during the steeping stage of malting, affect the extract level in the finished malt (higher protein dilutes the starch available for conversion to fermentable sugars), and provide the enzymes and soluble proteins needed in the finished

BREWING AND MALTING
BARLEY RESEARCH INSTITUTE

1510 – One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3
Phone: 204-927-1401 www.bmbri.ca

malt. Protein levels can be too low (inadequate enzymes) and too high (inadequate extract; excessive enzymes and soluble protein). Varieties which tend to maintain a moderate protein level under a range of growing conditions are desirable.

Varietal Identification: Malting is done on a varietal basis, with conditions particular to each variety being used during processing to produce malt with the required specifications. Blending is only done with finished malt, and is done to a brewer's specifications. There is a very real need for the means by which to accurately, quickly and affordably determine the varietal composition of barley samples, using a subjective method. This is becoming increasingly important as the number of registered varieties proliferates. Visual identification of varieties is no longer adequate.