



## **Evaluation of new European Malting Barley Varieties.**

Jørgen Larsen

Carlsberg Research Laboratory, Gamle Carlsberg Vej 10, DK-2500 Valby,  
Copenhagen, Denmark

### **Abstract**

The European malting barley production covers nearly 50% of the world's requirement. Over nine mill. tons barley are used for malting within the European area and a considerable amount of malting barley is each year exported to South America, China and Africa.

Malting barley is produced in about 20 different countries. Each country has an official system for the evaluation of agronomic and industrial value of new varieties. Within the EU a common variety testing system is gradually being introduced. No generally accepted systems exist for the evaluation of malting quality of new varieties. The most advanced quality testing system has been set up in France, where the breeders, official testing authorizes, malsters and brewers have a close cooperation. Less efficient systems to document the malting qualities are used in the other major malting barley producing countries such as UK, Germany and Denmark. Within the European Brewing Convention a Barley & Malt Committee is responsible for the testing of malting quality of all the new barley varieties of interest for the brewing industry. The committee will give their recommendations to the malting and brewing industry concerning promising new varieties to be grown in the different European areas.

Some of the bigger malting and brewing companies will perform their own malting and brewing pilot-trials to select varieties most suitable for their production. Some brewers make a positive list of varieties accepted for their production. The Carlsberg testing system is described.

### **Introduction**

More than 200 new barley varieties will each year enter the official variety testing system in the various European countries. Of these new varieties 2/3 will be spring types, and 1/3 winter types. About 1/2 of the varieties will be claimed to possess malting and brewing quality. Only about 80 varieties will reach the acceptance for entering the National Lists, and around 40 of those will end up as candidates as new malting barley varieties. Only 10 to 20 varieties will be used in the malting barley production.

Therefore we have a very large number of accepted malting barley varieties, see table

1, but less than 10 varieties give a yearly yield larger than ½ mill. tons. Most of the varieties will only be grown in the country of origin, whereas the generally accepted varieties will be grown in several countries depending on how well they tolerate the local climatic conditions.

The testing systems today varies between the different countries, but the official trailing systems will become more and more homogeneous within the EU and surrounding countries, so the requirements for reaching the National Lists are getting more and more equal. However the testing for malting qualities is very different between the countries. The most efficient system has been set up in France, where the breeders, the official testing authorities and the malting and brewing industries have organised a close co-operation concerning the testing and acceptance of new varieties for the brewing industries. Less critical systems are used in the other major malting barley producing countries as UK, Germany and Denmark.

The most promising new varieties will enter the trial system set up by the EBC (European Brewing Convention) Barley & Malt Committee, (Home, 1999).

The international brewing companies will perform their own variety quality tests, which consist of pilot and production scale malting followed by brewing trials. As an example, the Carlsberg way of testing new varieties is shown.

**Table 1. European barley for malting purpose**

	<b>Spring barley</b>	<b>Winter barley</b>
No. of producing countries	18	8
Total no. of varieties	138	29
No. of varieties yielding > ½ mill. Tons/year	5	3
No. of varieties yielding > 200.000 mill. Tons/year	18	8
No. of varieties yielding < 50.000 mill. Tons/year	77	13
No. of varieties only grown in one country	84	22
No. of varieties grown in 3 or more countries	14	3
"Mill. Tons used for malting each year"	7	2

### ***Official variety testing systems (examples)***

A complete survey of the official testing systems in the different European countries is not carried out, but some typical examples for the systems used in France, UK and Denmark are given, see table 2 and 3.

In general all countries use a two-year's trailing system at several locations to gain all the agronomic information on new varieties. But the information on grain quality in the new varieties, and especially the malting quality, vary a lot between the countries.

**France** has the most critical and also most efficient system for the evaluation of new malting barley varieties, (<http://perso.wanadoo.fr/ste.ifbm>). Each year 30-40 new spring and 40-45 new winter barley varieties will enter the official trials. After 2 years of trailing more than 50% of the varieties are discarded due to unwanted characters and only 10-15 varieties of both spring and winter types will be accepted to enter the National List. Results from micromaltings during the first two years are used to give the varieties a malting quality index, and only 5 - 6 varieties will be accepted by CBMO (Comité Bière Malt Orge), to enter a third year of recommended malting barley lists trials. The varieties will be tested in a 600-kg pilot malting and followed by brewing trials paid by the malting and brewing industry. It is named the "Technical Evaluation". Typically 3 - 5 varieties will each year be accepted by CBMO to undergo a two years commercial evaluation, which include several commercial malt productions and brews. Only the varieties which fully meet the industrial needs in the productions, will be accepted by CBMO and enter the "Official Malteurs De France List of Malting Barley" (Malteurs de France). The malting industry will follow the list very close, to ensure a high reputation for French malt worldwide. The varieties are kept on the list as long as the quality and commercial value can keep up with newer varieties.

Also in **UK** about 40 spring and 40 winter barley varieties will enter the official trials each year. Only 5 - 6 varieties of each type will after two years testing qualify for the recommended list trials. To qualify for the recommended list trials the agronomic performance must show an improvement, and the malting barley candidates must have shown promising results in micromaltings the two first years. Although the micromalts only will be analyzed for "% hot water extract", it gives some indications on the malting quality, and is serving as a basis for selecting varieties which can be accepted for pilot malting and brewing trials at IoB (The Institute of Brewing). The results from the pilot malting and brewing at IoB together with the agronomic results from the recommended trials are evaluated by CTAC (Cereal Technical Advisory Committee), which then gives the recommendations to the malting industry concerning candidates. After two years of commercial scale testing with promising results, the varieties can finally enter the fully recommended malting barley list, (NIAB, 2001).

As performed today, the UK malting quality testing system demands too many years to accept new varieties, and a new set up with more quality testing in the first trial years will soon come into force, so a more rapid change to improved varieties will be possible.

**Table 2. Normal numbers of varieties in the official trials in France, UK and Denmark.**

Country	Type	Year of testing				
		1	2	3	4 and 5	6
France	Spring	30 – 40	25	10 – 15	3 – 4	4
France	Winter	40 - 45	25	10 - 20	1 - 2	1
UK	Spring	40	20	4 – 6	4 - 5	3 – 4
UK	Winter	40	20	4 - 6	4 - 5	3 - 4
Denmark	Spring	40	15	8 – 10	6 – 8	3 - 4
Denmark	Winter	20	8	2 - 4	2 - 3	1 - 2

National List Trials	Provisional Recommended Trials	Commercial observation Trials	Fully Recommended Trials	Agricultural Advisory Trials
----------------------	--------------------------------	-------------------------------	--------------------------	------------------------------

In **Denmark** the official testing authorities are receiving about 40 new spring and 20 new winter barley varieties each year. After two years of trailing, 8 - 10 spring and 2 - 4 winter barley varieties will qualify for the National List, (Jensen, 2001). The varieties, which are applied for as malting barley candidates, are micromalted both years, but only the results on extract yield and viscosity of wort are reported as the official malting quality data for new varieties. After the two years of official testing no more organized quality evaluation will be performed. Only the agronomic characteristics will be followed and reported each year as long the variety is sold. Therefore only private company trials will follow up on the malting and brewing quality.

**Table 3. Malting quality tests of new varieties in France, UK and Denmark**

Country	Year of test			Recommended by
	1 & 2	3	4 & 5	
<b>France</b>	Micromaltings % Extract Kolbach Index Diastatic Power Viscosity of wort Final attenuation "Quality Index"	<b>Pilot malting and brewing</b>	<b>Industrial Malting and Brewing Trials</b>	CBMO Comité Bière Malt Orge
<b>UK</b>	Micromaltings % Hot water extract	<b>Pilot malting and brewing</b>	<b>Industrial Malting and Brewing Trials</b>	CTAC Cereal Technical Advisory Committee
<b>Denmark</b>	Micromaltings % Extract Viscosity of wort	<b>PRIVATE TRIALS</b>		No official recommendation

## ***EBC Barley & Malt Committee variety tests system.***

The objective of the EBC Barley Trials is to supply reliable data for the performance of novel barley varieties grown under different conditions. Due to the great variation in the weather conditions barley trials are executed in four separate regions: North (FIN, S, DK, EST), West (UK, IRL, F, NL, B), Central (H, D, SK, A, SLO, CZ) and South (P, E, I, BG).

Varieties, which have completed the D.U.S. test and have been accepted as a malting barley varieties in one of the participating EBC countries and have had a minimum of two years in National List Trials, can enter the test system. When included in the testing, the varieties will become known to the malting and brewing industries in all the EBC-countries, which indeed was the main purpose when the committee was formed in 1948. It is still one of the tasks, but targets are also recommendation concerning varieties for malting barley production in specific regions and generally to widen the new knowledge about barley and malt qualities in the member states. Varieties will be tested for two years.

Some countries, which not are a member of EBC, have been accepted to participate in the trial system. It is especially some of the East European countries, but also North America, New Zealand and Zimbabwe. No cooperation with Australia exists, which probably is due to the very strict regulation you have for import of seed samples.

The data collected from the EBC trials are shown in table 4.

**Table 4. Data collected from the EBC Trials.**

<b>Agronomic performance</b>	<b>Barley quality</b>	<b>Malt Quality</b>
Grain yield	Grading > 2,8 mm	Extract yield
Relative yield	Grading > 2,5 mm	Total N content
	Grading < 2,2 mm	Soluble N
	1000 kernel weight	Kolbach index
	Protein content	Viscosity of wort
	Germination energy after 3 days 1. 3 weeks after harvest 2. Before the malting	$\beta$ -glucans in wort
		Friability
		Apparent final attenuation
		Diastatic power

The Committee reports each year the results, (EBC, Barley & Malt Committee, 2001). A compressed press release containing the main results are printed in several of the brewing journals, see etc (King, 2001). For details about the activities in the Committee, see (Home, 1999).

## ***Private company evaluation. - The Carlsberg system.***

The bigger brewing companies will normally have a list of accepted or preferred barley varieties to be allowed in the purchased malt. At the Carlsberg Breweries we are continuously updating a worldwide list of acceptable varieties, containing varieties from all the regions of importance to Carlsberg.

Before the acceptance of a new variety, we will perform several internal pilot tests on the barley and malt quality, as well as we follow the brewing performance in production scale.

Only new varieties with an expected good quality and a guaranteed increasing production area in the coming years will be included in our evaluation. All tests are performed in comparison to a known standard variety cultivated under the same circumstances.

**a. Pilot testing.**

In the pilot tests we focus on the quality parameters listed in table 5.

The red printed characters are the most important for the malting barley quality.

Depending on the pilot malting results it will be decided whether a variety also can be accepted to undergo a production scale tests.

Discriminating observations in the pilot tests will often be the hours needed to reach 95% modification, the level of soluble N in wort, diastatic power in malt, homogeneity of the germination and hush losses of barley.

**Table 5: Data collected from the Carlsberg pilot tests.**

<b>BARLEY</b>	<b>Malting</b>	<b>Malt</b>
Protein content	Total hours to reach 95%modification Different steeping degree Different temperatures in steeping and germination	Extract yield
<b>Grading &gt; 2,5 mm</b>		Wort colour
$\beta$ -glucan content		<b>Soluble N</b>
<b>Germination energy</b>		<b><math>\beta</math>-glucan in wort</b>
<b>Germination index</b>		Friability
<b><math>\beta</math>-amylase content</b>		Modification
<b>Fusarium infection</b>		<b>Homogeneity</b>
<b>Husk loss</b>		<b>Diastatic power</b>
		$\alpha$ -amylase

**b. Production scale tests.**

Malt will be produced at malt houses within Carlsberg or at one of the external malting plants. The malt quality has to meet our specifications for lager malt.

Brewing and fermentation will be performed at two separate breweries following the normal procedures. The production will be compared with a reference beer production.

Discriminating observations in the production will often be slow lautering, slow wort and beer filtration, wort quality, fermentation length, beer taste, beer flavor stability and beer foam.

If no discriminating observations have been made during the production of malt and beer, the variety will enter our list of acceptable varieties and so be allowed in the malt deliveries to Carlsberg Breweries.

## References.

1. Home, S. (1999), Proceedings of the Australian Barley Technical Symposium, 1999. (<http://perso.wanadoo.fr/ste.ifbm>): The French qualification system for new malting barley varieties. Malteurs de France: Yearly report: Qualité des orges de brasserie.
  2. NIAB, (2001), UK Recommended List of Cereals.
  3. Jensen, J.W. (2001), Varieties of Cereals, Pulse Crops and Oil Seed Crops 2001, Danish Institute of Agricultural Sciences.
  4. EBC, Barley & Malt Committee, (2001), Results Field Trials Harvest 2000.
  5. King, R.C.S. (2001), Scandinavian Brewers Review, 58 (4), 55
-