

High-quality bread wheat – new insights

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In Germany arable land comprises approximately 12 million hectares, where winter wheat was grown on 3.1 million hectares in the 2017 season, yielding a total harvest of 24.2 million tons of wheat. This figure is very close to the six year average yield of 24.3 million tons of winter wheat obtained in the seasons from 2011 to 2016. Approximately 30 %, i. e. 7.2 million tons, of the total wheat harvest is milled for baking purposes. The per-capita consumption of bread and fine baked goods amounts to 84 kg/year.

In Germany wheat varieties are graded according to baking performance in elite wheat (E class), blending wheat (A class), bread wheat (B class), EU varieties and varieties, not suitable to produce leavened bread, but fit for production of biscuits (C class). Examination of wheat quality in trade and food science is based on numerous parameters, comprising sensorial, physical, chemical and rheological characteristics. Total crude protein content and sedimentation value according to Zeleny are relatively easy to obtain parameters, allowing to predict the baking performance of a wheat variety to a certain degree. However, to establish baking performance with high accuracy, it is necessary to perform a standardised baking test. The most commonly used standardised baking test in Germany is called Rapid-Mix-Test.

Long-term evaluation of indirect baking quality parameters of wheat is obtained within a representative analysis of the yearly German wheat harvest, the so called Specific Determination of Crop and Quality (BEE). Analyses of BEE data show that crude protein content and sedimentation value of wheat increased in parallel during the years from 1965 to 1992. From 1992 onwards until present, crude protein content has reached a plateau, whereas an increase in sedimentation value was still observable. These results indicate that in recent years newly bred wheat varieties might have been able to realise a higher baking performance at stable crude protein content.

Analyses of baking parameters of newly bred wheat varieties are available in great detail from German official variety trials. Here, selected data are presented, originating from a statistical evaluation of performance data of altogether 316 approved wheat varieties spanning the years from 1983 to 2014. Key results were a strong increase in grain yield, a moderate decrease in crude protein content and almost stable results for loaf volume, as obtained with the Rapid-Mix-Test. Strong to very strong relations were found for protein content, sedimentation value and loaf volume. Further, the two parameters indicating baking performance, sedimentation value and loaf volume, were strongly influenced by genotype, in other words environmental effects had relatively less influence on baking performance. Taken together, these data indicate that breeding efforts in wheat has made significant

progress in yield parameters, while at the same time maintaining baking performance. The strong genetic influence on the baking parameters sedimentation value and loaf volume is seen as an advantage for further breeding efforts with the aim of maintaining baking performance and yield at lower fertilisation levels. Reduction of nitrogen based fertilizers is an urgent task in Germany, because contamination of drinking water reservoirs and ground water by nitrogen fertilizers from agriculture is causing serious environmental and health concerns.

For further details regarding the presented results of German official variety trials the reader is referred to the following publication.

Laidig F, Piepho H-P, Rentel D, Drobek T, Meyer U, Huesken A (2017) Breeding progress, environmental variation and correlation of winter wheat yield and quality traits in German official variety trials and on-farm during 1983–2014. *Theor. Appl. Genet.* 130, 223-245. doi: 10.1007/s00122-016-2810-3