

Development of a high-throughput phenotyping screening system for drought tolerance in barley

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Barley is the second most important crop species next to wheat in Europe. Barley yields have substantially increased during the last decades, but in recent years the linear trend decreased which is believed to be associated with drought periods in spring and summer. Climate models predict for Germany an increase in drought periods, therefore drought tolerance will be an important goal in barley breeding in the future. Because of its importance drought tolerance is included in the project BARSELECT that deals with the implementation of genomic selection in barley breeding. As a prerequisite to include this trait in the genomic selection procedure a reliable high-throughput screening system for drought tolerance has to be developed.

To achieve this, in a first step 63 six-rowed winter barley cultivars, which have been analysed in association genetics studies (GABI-GENOBAR), already, are grown under controlled conditions in a growth chamber up to the four leaf stage. Stress is applied by wilting single leaves or leaf disks or by putting leaf disks on a PEG medium for 48h. On wilting leaves the relative water content as well as the chlorophyll fluorescence is estimated.

On leaf disks the osmotic adjustment, the content of soluble sugars and free proline is analysed as well as the cell membrane stability which is determined by measuring the electrical conductivity of ions leaching in double distilled water.

For these six physiological parameters significant differences between the stressed and non stressed plants were detected indicating a successful stress application. The results also revealed significant differences between the GABI-GENOBAR genotypes after stress application which is a prerequisite to score the traits as indicator for drought tolerance.

Results now will be correlated to data obtained on these genotypes in two years rain-out shelter trials for drought tolerance and in two years pot experiments for early leaf senescence that are received in two additional projects funded by the BMELV and the IZN. Based on the correlations, three out of these six traits will be selected, and subsequently 750 six-rowed winter barley breeding lines and varieties and 750 DH lines derived from crossings between selected genotypes will be analysed for these traits.