Identification of the genetic traits responsible for 'Stabilstroh' phenotype.

Muszynska A., Börner A., Melz G., Röder M. S., Rutten T., Hoffie K., Benecke M., Melzer M.

1Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK), D-06466 Gatersleben,
2Monsanto Saaten GmbH Zweigniederlassung Nienstädt, D-31688 Nienstädt

Email of the presenting author: muszynska@ipk-gatersleben.de

Lodging, the state of permanent displacement of tillers from their upright position, decreases grain quality and increases the costs of harvesting, qualifying this phenomenon as one of the most serious problems in cereal crop production. Therefore lodging resistance is an important agronomic trait, especially in rye (*Secale cereale* L.), where yield losses due to lodging can be as high as 75%. 'Stabilstroh', a recently identified genotype of rye, not only has the best lodging resistance, but simultaneously it is characterized by the longest tillers among the German cultivars of rye hybrids.

In order to identify the genetic traits responsible for the 'Stabilstroh' phenotype histological and ultrastructural investigations were focused on the most prone to lodging basal internodes of segregating F2 population ('304/1') and its parental lines: 'ms135' ('Stabilstroh') and 'R1124' (wild type). Analyses of tissue distribution, cell size, and cell wall thickness using Light Microscopy, Scanning Electron Microscopy, and Transmission Electron Microscopy revealed sclerenchymal and inner periclinal cell walls of epidermis to be thicker, more lignified, and more structured in the 'Stabilstroh' genotype as compared to the wild type. 'Stabilstroh' is also morphologically characterized by many pronounced stem invaginations and a significantly higher ratio of sclerenchyma to parenchyma tissues (sc/pa ratio), important factors enhancing mechanical stability of the crop stem. Not only do these features improve mechanical properties of lodging resistant genotype, but they are also responsible for increased biomass production.

The quest for QTLs (Quantitative Trait Loci) for improved lodging resistance is based on the inheritance of microsatellite (SSR) markers linked to the traits affecting mechanical stability of tillers, including stalk invaginations, thickness of cell walls, lignin content, and sc/pa ratio.
Fig. 1: A standard phloroglucinol staining of lignin in wild type (A) and ‘Stabilstroh’ (B). Hand cross-sections of wild type (C) and ‘Stabilstroh’ (D) under SEM. Basic fuchsin staining of cell walls in: wildtype (E) and ‘Stabilstroh’ (F). SI- stem invagination; Vb –vascular bundle; Pa- parenchyma; Sc- sclerenchyma