Breeding for the future: Generation of wheat plants resistant to powdery mildew by tilling

Johanna Acevedo-Garcia¹, Hannah Thieron¹, David Spencer¹, Kim Hammond-Kosack², Andy Phillips² & Ralph Panstruga¹

¹RWTH Aachen University, Institute for Biology I, Unit of Plant Molecular Cell Biology, 52056 Aachen, Germany
²Rothamsted Research, Plant Biology and Crop Science, West Common, Harpenden, Hertfordshire, AL5 2JQ, United Kingdom

Bread wheat (Triticum aestivum) is the third largest cereal cultivated in the world and the second in terms of dietary intakes. In 2012 its production reached 670 million tons. However, yield can be severely affected by the powdery mildew disease caused by the fungus Blumeria graminis f. sp. tritici. Loss-of-function alleles of Mlo (Mildew resistance locus o) gene(s) in barley, tomato, pea and Arabidopsis confer non-race specific resistance against their causing powdery mildew disease fungus. In hexaploid wheat, three orthologs (wheat homoeologs) of barley Mlo (TaMlo-A1, TaMlo-B1, TaMlo-D1) have been identified. TaMlo-B1 was previously shown to complement barley mlo mutants at the single-cell level, indicating functional equivalence of these wheat and barley Mlo genes. Therefore, we propose to take advantage of the non-transgenic TILLING (Targeted Induced Local Lesions IN Genomes) technology to identify mutants in the respective Mlo homoeologs to ultimately generate a wheat mlo triple mutant. A mutagenized population of the spring bread wheat cultivar Cadenza was screened for the exon encoding the third cytoplasmic loop of the Mlo protein. Several missense mutations were identified for the three genomes (Fig. 1) and were functionally tested by transient gene expression in barley single cells. Only mutant variants that showed significant reduction of host cell entry compared to the wild-type Mlo were selected for further crosses. Currently, several combinations of mlo triple heterozygous mutants are in propagation. The resulting wheat homozygous lines are expected to provide durable broad-spectrum powdery mildew resistance.

Figure 1. Different spikes from wheat plants with mutations in one of the three Mlo homoeologs TaMlo-A1, TaMlo-B1, TaMlo-D1.