PROJECT TITLE

Exploiting the seedling root vigour and drought tolerance of Th. intermedium to improve ecological adaptability of wheat

CONSORTIUM

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SUMMARY OF THE REPORT

Bread wheat is the second highest production cereal crop globally, with 752 million tonnes produced each year. To fulfil calorie requirements for a predicted 9.6 billion people by 2050, production will need to increase to 858 million tonnes per annuum (Gupta and Vasistha, 2018). Yields are greatly affected by abiotic stresses, such as drought, heat and nutrient deficiency, which are increasingly likely due to climate change and resource depletion. Root system architecture is key for efficient water and nutrient uptake, and thus is an important component of yield.

In wheat, few studies have identified favourable exotic QTL alleles for root traits and there is limited knowledge on the QTLs in wheat/wild relative introgression lines. Many agronomically important QTLs and genes have been mapped to the wheat 7D chromosome, including seedling root traits and genes for the accumulation of water-soluble carbohydrates which correlate with drought resistance (Acuña-Galindo et al., 2015; Atkinson et al., 2015; Hou et al., 2018).

In this project, we phenotyped the seedling root architecture of a new wheat/*Thinopyrum intermedium*7D.7St recombinant line using the 2D-RSAT system. We determined the seedling root traits (Total Length - All Roots, Total Length - Primary Roots, Total Length - Lateral Roots, Lateral Root Count, Primary Root Count, Convex Hull, Average Tortuosity, Maximum Width, Maximum Depth, Ratio Centre of Mass and Convex Hull Centroid) of the 7D.7St recombinant line and control wheat lines ('Chinese Spring' and 'Paragon'). We identified differences in the root system architecture between the three genotypes (Figure 1, 2) . Significant differences were detected for all measured parameters, however, the 7D.7St recombinant line was similar to the Paragon parental line. Total Length of Lateral Roots and Lateral Root Count revealed the biggest differences between Paragon and the 7D.7St introgression line. During the osmotic stress treatment, we used 18% w/v poly-ethylene glycol (PEG) 6000 solution. The recombinant line showed ~80% germination rate in contrast to the wheat lines (~15-20%). The growth of the root system could not be identified because the high viscosity PEG solution was found to be incompatible with the pouch system. The pouches rely on the nutrient solution being able to wick up the paper to support plant growth. 18% w/v PEG (a higher concentration than used in preliminary tests) was found to prevent this, leading to seedling death 2-4 days following the start of the experiment. According to the results of the germination test under osmotic stress, the newly developed 7D.7St introgression line represents valuable pre-breeding material by introducing new allelic variation into chromosome 7D, improving the osmotic stress tolerance of wheat. We propose further evaluation of the salinity and drought tolerance of the 7D.7St introgression line by using the presented results.