PROJECT: METABO-DURUM-OA-1

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PROJECT TITLE

Metabolome profiling of durum wheat leaves from field-grown accessions differing for their osmotic adjustment capacity at flowering under drought conditions

CONSORTIUM

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SUMMARY OF THE REPORT

Drought is the major abiotic stress limiting wheat yield worldwide. Global climate warming models predict a substantial mean temperature increase in the next decades coupled with more severe heat waves and droughts, especially in the Mediterranean Basin. These predictions underline the importance and urgency to better understand the genetic and functional basis of the adaptive response of wheat to heat stress, particularly when associated to drought stress. The study of osmotic adjustment (OA) and relative water content (RWC) is of major importance in wheat in order to understand the genetic and molecular dynamics of stress tolerance among different genotypes/varieties. UNIBO, in collaboration with University of Arizona in Maricopa (USA) tested 189 durum panel varieties in the field for drought stress resistance during 2018 and 2019. All accessions were measured for RWC and OA and 14 genotypes were selected based upon their contrasting OA capacity (7 with high OA (HOA) and 7 with low OA (LOA)). In order to compare results obtained in the field also in a controlled environment, in collaboration with Dr. Kerstin Neumann and Dr. John C. D'Auria (IPK-Gatersleben), the 14 accessions were evaluated on the APPP-B platform (medium sized phenotyping platform). This facility allowed to plan the drought stress for every accession under a controlled water regime for 6 weeks.

Each accession was represented by 15 replicates for the stress treatment as well as 15 non-stress induced control plants. Plant available water (PAW) content was kept at 90% in control plants, whilst the drought experimental plants flag leaves were sampled at 4 time points under different stress levels: 50%, 30%, 10% and 5%. During every time point, a part of the leaf was sampled for metabolite analysis via GC-TOF MS. Therefore, samples were frozen in liquid nitrogen and kept at -80 °C until the sample preparation and analysis are completed.

At the time of this submission, more than two thirds of the 680 total samples for the project have been processed. The remaining third is awaiting injection and raw data collection due to several hardware-related issues that require technical assistance from the manufacturer. However, phytormone analysis was recently completed in order to search for differences in hormones that could be linked to drought response. In particular, abscisic acid, jasmonic acid (Wang et al., 2020) and salicydic acid (Sharma et al., 2016) were of particular interest. Our initial review of the results revealed a significant difference in phytormone concentration between stressed and control plants, otherwise not maintained between the HOA and LOA selection made in Maricopa, as also pointed out by Relative water content and Osmoitic adjustment data monitored in this experiment as well.

Samples for metabolite analysis were collected also in Maricopa during 2018 and 2019 field experiment under strong stress conditions. However, due to sampling problems, this analysis was not performed and focus was placed on samples from the APPP-B phenotyping platform.