PROJECT TITLE

TRIticum Photosynthesis Under Drought and fluctuating Irradiance: Use of Mutants phenotyping to approach crop photosynthetic regulation

CONSORTIUM

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SUMMARY OF THE REPORT

TriPUDIUM is a high-throughput project exploring the effect of fluctuating irradiance on wheat plants deficient in chlorophyll synthesis, with emphasis on the effect of a reduced photosystems antenna complement on plant performance. Moreover, the project approaches the cogent problem of combined drought stress and fluctuating light on crop plants.

The plant material used for phenotyping was a set of chlorophyll-depleted isogenic *chlorina* mutants of *Triticum aestivum* and *T. durum*, together with their parental wild-type lines, for a total of eight genotypes. Experiment was set up at the Slovak PlantScreen Phenotyping Unit of Nitra (Slovak Republic) to compare plants grown under either a fluctuating (FL) or a non-fluctuating light regime (CL), both providing the same amount of photons on a daily base. Starting from the 4th week after sowing, the automated phenotyping routine included shoot chlorophyll fluorescence imaging (saturation pulse method and quenching analysis), RGB imaging for advanced morphometrics and green hues analyses, hyperspectral imaging (VNIR and SWIR). Manual measurements were performed in parallel to evaluate specific photosynthesis-related plant properties (chlorophyll meters, fast chlorophyll fluorescence transients, comparative activity of PSI and PSII, electrochemical thylakoid potential, carbon assimilation). At the end of the experiment, leaf segments were sampled for photosynthetic pigment analyses and for electron microscopy examinations of chloroplasts. Starting from the 8th week after sowing, the plants of both FL and CL were further divided into two subgroups, one of which was exposed to a progressive water shortage down to a stable 30% field capacity. The effect of drought was then analysed using automated phenotyping and manual measurements, including osmotic potential determinations, porometry and thermal imaging. Biomass determinations concluded the experiment.

The amount of data collected during the automated phenotyping corresponds to 17.010 images, with an information volume of 2.78 TB. Combining the statistical power of automated phenotyping with manual photosynthesis measurements, TriPUDIUM will help identify main regulatory processes compensating for a defective chlorophyll synthesis under the naturally relevant condition of FL. TriPUDIUM outputs can help understand the relevance of different genetic backgrounds (hexaploid in bread wheat, tetraploid in durum wheat) in determining the severity of chlorina mutation under FL or CL. Exploiting a set of thoroughly characterized phenotypes ranging from wild-type to severe chlorina, the results of TriPUDIUM can put to test several hyperspectral reflectance indexes used for vegetation analysis. Analysing the concomitant effect of drought and FL, TriPUDIUM can meaningfully contribute to the debated issue of a reduced antenna size as being beneficial or not to increase crop productivity.