Proceedings of the LXVI SIGA Annual Congress
Bari, 5/8 September, 2023
ISBN: **978-88-944843-4-2**

Poster Communication Abstract – 2.21

NON-PHOTOCHEMICAL QUENCHING (NPQ) BARLEY MUTANTS: A VALUABLE SOURCE OF ALLELIC VARIANTS TO IMPROVE PHOTOSYNTHESIS EFFICIENCY AND YIELD IN CROPS

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crop yield, barley mutants, photoprotection, Non Photochemical Quencing (NPQ), photosynthesis

Increasing crop yield is one of the main challenges for ensuring food supply in a context where the global population is growing, and climate change threatens crop productivity. The manipulation of photosynthetic traits is still a widely unexplored field and shows great potential for crop improvement. When sunlight is absorbed in excess by leaves, defensive mechanisms against photodamage are activated. The non-photochemical quenching of chlorophylls (NPQ) is the faster photoprotective pathway that dissipates excess energy in the form of heat. Since the kinetics of NPQ activation/deactivation are not as prompt as fluctuations in light, the optimization of this process could lead to the increase of CO_2 fixation rate by minimizing the waste of energy through heat. One of the main components of NPQ is the xanthophyll cycle, where energy dissipation involves two special carotenoids named Violaxanthin and Zeaxanthin. The interconversion reaction between Violaxanthin and Zeaxanthin is catalyzed by two enzymes: Violaxanthin de-epoxidase (VDE), located in the thylakoid lumen, and Zeaxanthin epoxidase (ZEP), located in the chloroplast stroma. Allelic variants of these two genes could potentially lead to a faster adaptation to light changes.

Here, we report on the characterization of five barley mutants, isolated from the HorTillus mutant population, carrying SNPs in the *VDE* and *ZEP*

genes. Mutated lines show no differences in growth and protein accumulation compared to the wild type, while changes in NPQ kinetics and CO_2 uptake were detected using a PAM fluorometer and IRGA gas analyzer. Furthermore, three of these mutants were tested in an automated growth chamber system which can simulate light fluctuations, while measuring the canopy CO_2 assimilation. With this system, we were able to detect differences in light use efficiency under changing light conditions. Furthermore, *in vitro* assays to test the enzymatic activity of the different allelic variants are currently set up to support physiological data, with the final aim to identify novel alleles able to optimize photoprotection and photosynthesis efficiency in crops.