PROJECT TITLE

CO2 regulation of stomatal conductance as a tool for generation of water-saving plants

CONSORTIUM

P 1	Dmitry Yarmolinsky		
P 2	Olena Zamora		
P 3	Hannes Kollist		

SUMMARY OF THE REPORT

Drought is an important environmental factor affecting crop productivity. Stomata, the microscopic pores on plant leaves, play an important role in drought resistance as they control water loss by transpiration. Although the connection between stomatal functioning and drought resistance has been studied before, we used an opportunity to thoroughly study an influence of stomatal behavior on plant development and performance under mild drought combined with high light. The project was performed in cooperation with the National Plant Phenotyping Infrastructure (NaPPI) of the University of Helsinki. *Arabidopsis thaliana* lines with mutations in different signaling pathways of guard cells were grown under various watering and light conditions. Lines with reduced (*ht1-2*, *aha1-6*) and elevated (*ost1-3*, *ghr1-3*, a transgenic line over-expressing $HT1^{A109V}$) stomatal conductance were compared with each other and with the wild type plants (Col-0). Plants were imaged by using RGB, thermal, and FluorCam cameras in order to characterize morphological parameters, leaf temperature, and photosynthetic performance. Our results demonstrate that inactivation of protein kinase HT1, a negative regulator of CO_2 signaling in guard cells, resulted in an improved growth under limited watering due to reduced stomatal conductance. Unexpectedly, stomatal conductance correlated with some morphological parameters in plants. Lines with reduced and elevated stomatal conductance demonstrated lowered and enhanced roundness and compactness of plant rosettes, respectively, compared with the wild type plants. We also noticed that some photosynthetic parameters, including non-photochemical quenching (NPQ), depended on stomatal conductance in the plants which were grown under high light. For example, the lines with enhanced stomatal conductance showed reduced levels of instantaneous NPQ during light adaptation, compared with the wild type and the lines with reduced stomatal conductance. Leaf temperature corresponded to the previous information about stomatal performance in the studied mutants and was increased in the drought-treated plants. In general, our results provide detailed information about plant performance under limited watering and high light conditions. The drought resistance of the mutants with reduced stomatal conductance due to inactivation of HT1 can be especially interesting as it provides a tool for breeding of drought tolerant crop varieties.