ABSTRACT

TOWARDS IDENTIFYING GENES INVOLVED IN PHOTOSYNTHETIC ACCLIMATION TO LOW

TEMPERATURES

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This thesis describes the use of the Dynamic Environmental Phenotype Imaging (DEPI) system – an imaging system that allows for dynamic environmental control and continuous monitoring of multiple photosynthetic parameters, including photosynthetic efficiency (□II) and non-photochemical quenching (NPQ), to probe the responses and acclimation of photosynthesis in Arabidopsis thaliana (hereafter referred to as Arabidopsis) to low temperature. Acute (minutes to hours) exposure to low, non-freezing temperatures dramatically decreased □II and increased NPQ. Under these conditions, qE – the energydependent quenching mechanism – decreased with increasing light, indicating a breakdown of the normal regulation of the light reactions. The photosynthetic processes recovered progressively during acclimation over a period of weeks. The effects of cold and subsequent acclimation responses were highly heterogeneous. Also, there was natural variation in photosynthetic acclimation among five Arabidopsis accessions tested. Altered photosynthetic acclimation to low temperatures was also observed in transgenic Arabidopsis lines overexpressing three transcription factors – HSFC1, CRF3, and AS1 – and in Arabidopsis mutant lines carrying knock out mutations of the CAMTA1, CAMTA2, and CAMTA3 transcription factors. Taken together, the results presented in this thesis provide strong evidence that the DEPI technology can be used in combination with Arabidopsis genetic variation to identify genes that condition the fundamental process of photosynthetic acclimation to low temperatures.