Universität Basel

Research Project

Plant growth in a changing environment: Effect of biotic stress on plant growth

Third-party funded project

Project title Plant growth in a changing environment: Effect of biotic stress on plant growth
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Plant growth is affected by climate change in major ways. Higher temperatures and CO2 levels have a direct and dramatic effect of photosynthesis. Rising temperatures are also predicted to increase the potential for damage inflicted to plants by insects. An in-depth understanding of the underlying mo-lecular events leading to a quantitative modeling of growth processes will lead to the development of improved agricultural strategies. In this subproject, we will establish in situ techniques to meas-ure overall plant growth (including roots) non-invasively, in realistic conditions and with high tem-poral resolution. Growth will be described with several morphological parameters concomitantly with the determination of global gene expression signatures. By studying Arabidopsis growth in di-verse environmental conditions (and mutants) we anticipate identifying molecular signatures of the growth process. This will be achieved by performing a meta-analysis of micro-array data generated from plants harvested at various times of the day (with distinct growth rates); mutants with altered growth rates, and plants exposed to various biotic and abiotic stresses leading to growth alterations. Common molecular patterns emerging from such a study will enable us to identify the underlying gene regulatory network. This will allow us to construct quantitative models of growth control at the whole plant level. 3.2.4.2

Specific Aims

1) Develop a mathematical model that captures the hypocotyl elongation pattern based on “ex-ternal coincidence” controlled abundance of growth-promoting bHLH transcription factors. Further develop this model to the whole plant level. See also SP1.

2) Measure leaf growth quantitatively through the development of an imaging platform that enables us to monitor rosette growth day and night with high spatial and temporal resolu-tion.

3) Obtain quantitative data on the intimate links between shoot and root growth. Develop novel imaging techniques to monitor root growth in the soil and identify more easily monitorable traits that correlate with root growth.

4) Test the consequences of changes in the environment (biotic and abiotic) on plant growth. This will be determined at the morphological level implementing the techniques developed in points 1 & 2 and at the global gene expression level.

5) Identify sets of genes which are co-regulated and correlate quantitatively with growth rates. By com-bining network inference from transcriptome analysis with high-resolution imaging of growth we will be able to identify its molecular signatures. We will identify “transcrip-tion modules” from large sets of

micro-array data (1) (2) (3), whose function can then be analyzed. Iteration of such cycles will lead to the establishment of a robust model, which will initially be determined in Specific Aim 1.

Keywords Plant growth, elicitors, MAMPs (microbe-associated molecular patterns)
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