



## Arabidopsis Roots and Shoots Show Distinct Temporal Adaptation Patterns toward Nitrogen Starvation

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### Résumé en anglais

Nitrogen (N) is an essential macronutrient for plants. N levels in soil vary widely, and plants have developed strategies to cope with N deficiency. However, the regulation of these adaptive responses and the coordinating signals that underlie them are still poorly understood. The aim of this study was to characterize N starvation in adult *Arabidopsis* (*Arabidopsis thaliana*) plants in a spatiotemporal manner by an integrative, multilevel global approach analyzing growth, metabolites, enzyme activities, and transcript levels. We determined that the remobilization of N and carbon compounds to the growing roots occurred long before the internal N stores became depleted. A global metabolite analysis by gas chromatography-mass spectrometry revealed organ-specific differences in the metabolic adaptation to complete N starvation, for example, for several tricarboxylic acid cycle intermediates, but also for carbohydrates, secondary products, and phosphate. The activities of central N metabolism enzymes and the capacity for nitrate uptake adapted to N starvation by favoring N remobilization and by increasing the high-affinity nitrate uptake capacity after long-term starvation. Changes in the transcriptome confirmed earlier studies and added a new dimension by revealing specific spatiotemporal patterns and several unknown N starvation-regulated genes, including new predicted small RNA genes. No global correlation between metabolites, enzyme activities, and transcripts was evident. However, this multilevel spatiotemporal global study revealed numerous new patterns of adaptation mechanisms to N starvation. In the context of a sustainable agriculture, this work will give new insight for the production of crops with increased N use efficiency.

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