
## Precision Agriculture

# Methodology for quality validation of the plant culture & final product using metabolomics and systems biology

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## ABSTRACT

**Introduction:** A major objective of modern agro-biotechnology is to achieve consistent crops of high productivity and quality independently of where and when they are grown. In sequence, we present the value of metabolomic analysis in systems biology for studying the effect of abiotic stresses in plants in the context of a collaborative project of our laboratory. We investigated whether metabolic profiling analysis could diagnose salinity stress effects in tomato plants (*Solanum lycopersicum*), much earlier than the standard physiological measurements. High water salinity can have a negative effect on crop productivity and quality. We are in need of accurate and sensitive methodologies for the monitoring of plant molecular physiology that will enable the identification of deviations from normal growth before they have become observable at the macroscopic level and irreversible for the quality of the culture and the products. In addition, they can provide information regarding the status of recovery of the plant cultures if alleviating factors have been implemented to the growth environment of the plants, as it is for example, the elevated $CO_2$ for the high salinity effect on the plants [1,2].

**Materials and Methods:** Hereby, we present a systems agro-biotechnology study, in which we used metabolomics and metabolic network reconstruction analysis to monitor the growth of tomato plant hydroponic cultures through their leaf molecular physiology under high water salinity conditions in a large-scale growth chamber and a commercial greenhouse. The leaf metabolic profiles were acquired through combined application of gas and liquid chromatography-mass spectrometry. Data were appropriately normalized, filtered and quality controlled.

**Results:** Significant patterns were detected through multivariate statistical analysis methods and they were interpreted in the context of the tomato plant known physiology and reconstructed metabolic network. The salinity stress is harsher than the elevated CO2 perturbation and becomes apparent at the molecular level from the first day of treatment, enhancing thus conventional physiological measurements. Furthermore, our results validated the alleviating effect of elevated CO2 in the growth environment of salinity-stressed plants.

**Conclusions:** Systems agrobiotechnology in the context of Precision Agriculture is the new research and development area that emerges from the implementation of systems and network biology methods in the monitoring, treatment and practice of plant cultures and crop development.

**Acknowledgments:** ΒΙΤΑΔ-ΔΕ (MIS_5002469), "Phytoalatotita" ( NSRF 2007-2013), ΙΚΥ (ΙΚΥ-Siemens Post-doctoral Scholarship to Georgia Tooulakou).

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