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Quantification of net exudation for the Plant Microbial Fuel Cell

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Objective

The amount of exudates released by the plant is one of the limiting processes of the plant-MFC. Methods to sample non-sterile and sterilized root environments turned out to be not suitable to study the difference in net exudation between and within plant species. The objective is to develop a simple procedure to estimate net root exudation to study genetic and environmental effects on exudation.

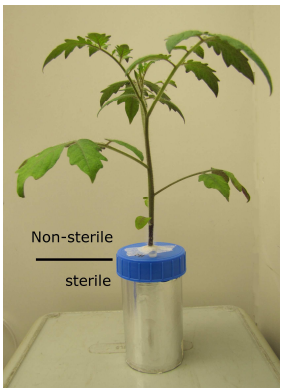

Figure 1. Experimental system

Materials & Methods

Seeds of tomato were surface sterilized and grown sterile. After development of the first true leaf, the plants were transferred to sterile 180 ml tubes with sterile nutrient solution (Figure 1) in a laminar flow cabinet. At the fourth true leaf stage, 100 ml of 300 µM artificial acetic acid solution was added to the root environment.

Results & Discussion

In our system exudation leads to an increase in the concentrations of oxalic acid (A) and citric acid (B), with the strongest exudation showed by *S. cheesmanii* (Figure 2). After spiking the plants with acetate, within 7h (*Solanum lycopersicon* cv Moneymaker and Plaisance) and 11h (*S. cheesmanii*) half of the acetate added at t=0 disappeared (Figure 3). This decrease in acetate is probably due to microbial breakdown, but uptake by the plant roots cannot yet be excluded. There is no reason to assume that the metabolic effect of bacteria on exudates will be much different than the effect on externally applied organic acids. For accurate determination of net root exudation and large scale screening the use of a sterile system is inevitable. Current methods to grow adult plants with a sterile root zone are not suitable for high-throughput. An approach as presented in this paper requires little effort for plant cultivation and is suitable for studying genetic and environmental effects on root exudation.

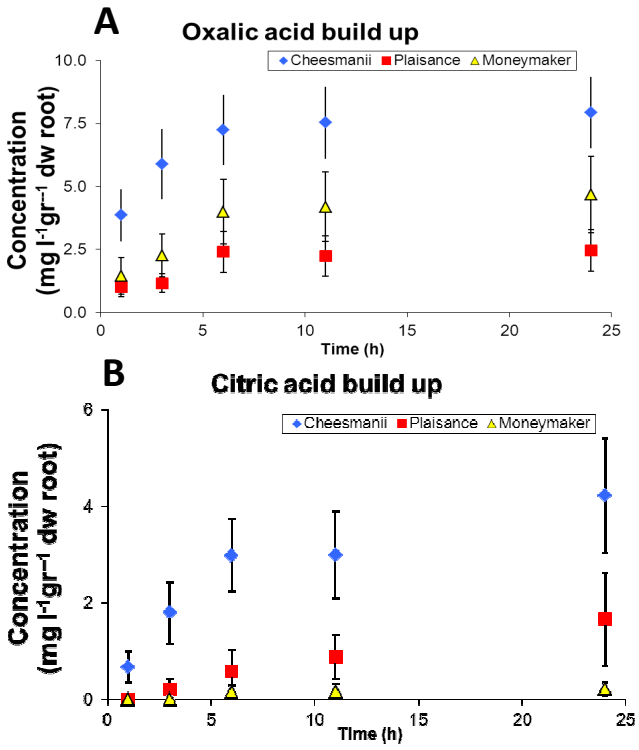

Figure 2: Time-course of oxalate **(A)** and citrate **(B)** in the root environments of three tomato cultivars. The amount of anions at the different time points is presented as the concentration in mg L^{-1} g^{-1} (root DW)

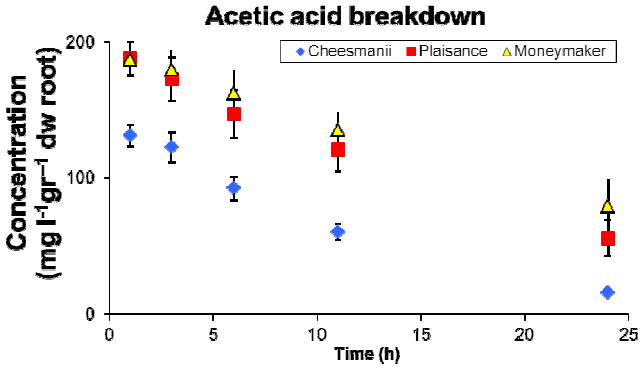

Figure 3: Time course of externally applied acetate in the root environments of three tomato cultivars. Concentrations are presented in mg L^{-1} g^{-1} (root DW). All starting concentrations at time point 0h were similar at 300 µM.

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