



Tropentag, September 20-22, 2023, hybrid conference
“Competing pathways for equitable food systems transformation:
Trade-offs and synergies”

The effect of vapour pressure deficit on genotypic nutrient uptake and biomass production of hydroponically grown tomato

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Abstract

Controlled environment farming that reduces the risks of pests, diseases and climate shocks based on hydroponics, a method of growing plants without soil, is becoming increasingly important in resource-efficient crop production. Hydroponic plant production potentially draws on a multitude of water sources including treated municipal wastewater as basis for nutrient solutions. However, reconciling the required nutrient solution quality with consistently high yields still presents a major challenge, since crop varieties may vary in their nutrient uptake dynamics as a function of water quality and environmental conditions. In order to assess the potential of wastewater in a water and nutrient management strategy, the chemical composition of the water needs to be known and the phenologically nutrient requirements of the crop under varying environments need to be understood. In a greenhouse experiment in humidity-controlled growth chambers at the University of Hohenheim, we investigated the dynamics of nutrient uptake, plant growth, and plant morphology of four tomato varieties (cv's Moneymaker, Reddery, Saluoso, and Sweeterno) grown at different vapour pressure deficits (VPD) in low concentration nutrient solution. The nitrogen concentration in the nutrient solution was kept at a level as expected in anaerobically-aerobically treated wastewater. At high VPD, cv “Saluoso” took up from the nutrient solution about 43 % more total nitrogen than “Reddery”. This varietal difference increased to 64 % under low VPD. These situational responses indicate that choice of variety, adequate setting of atmospheric conditions and any combination thereof constitute important aspects for optimising nutrient uptake, plant growth, and ultimately yield for growing tomatoes hydroponically in controlled environment farming systems.

Keywords: Controlled farming, hydroponics, nutrient uptake, tomato, vapour pressure deficit, varietal difference