



Water management strategies for lettuce cultivation in soil and soilless systems under controlled conditions

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The growing demand for sustainable food production requires innovative farming techniques that optimise water use and minimise environmental impacts. This experiment tested the cultivation of lettuce (*Lactuca sativa* L.) in a greenhouse environment. Two cropping systems were tested, a soil-based system with a humus-sand soil and a perlite system. Two different levels of water management were applied for the soil-based system, these were 70% and 90% of the minimum water capacity (WC_{min}). Both the soil and perlite systems were irrigated daily to ensure adequate water supply. The nutrient supply methods included nutrient solution and compost treatments in addition to the control group.

Key growth parameters including plant height, leaf number, head diameter, Fv/Fm fluorescence ratio and SPAD values were monitored weekly for five weeks. In addition, biomass (shoot and root mass), root length, and chlorophyll and carotenoid content were determined at the end of the experiment to evaluate the overall productivity and physiological status of the plants.

The results showed that in perlite-based systems, plant growth was faster, while soil-based cultivation showed more stable growth, especially the 70% WC_{min} treatment resulted in a more balanced growth compared to the 90% WC_{min} treatment. Based on nutrient replenishment, it can be said that nutrient-based treatments significantly increased plant biomass, especially wet head weight and chlorophyll content. Statistical analyses confirmed the differences between treatments, highlighting the effects of both nutrient supply and water management strategies on plant growth.

The results underline the importance of optimising water use in closed environment cropping systems. By contributing to the development of sustainable water management strategies for lettuce production, this study is in line with the main objectives of the EU Green Deal and the UN Sustainable Development Goals. These results provide practical insights into efficient water use, nutrient use and plant physiological responses under different growing conditions, pointing the way towards more sustainable, resilient food production systems.

The research presented in the article was carried out within the framework of the Széchenyi Plan Plus program with the support of the RRF 2.3.1 21 2022 00008 project.