Evaluating an Aeroponic System for Water and Nutrient Use Efficiency of Tomato (*Solanum lycopersicum*)

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Introduction

Conventional agriculture usually suffers from over-use of nutrients and water which may result in waste of water and nutrients, accumulation of toxic substances in the soil and the contamination of ground water. Alternative plant growing systems for optimal delivery of nutrient and water could help to address such problems.

Aeroponics, a plant growing system in which roots are suspended in air and nutrient solution is directly applied onto the roots in the form of mist, could be an alternative method. The objective of this study was to examine a unique aeroponic system for nutrient uptake and water use efficiency in comparison with the soil and hydroponics systems.

Materials and Methods

The experiment was conducted in a controlled greenhouse at the Jacob Blaustein Institutes for Desert Research, Sede Boqer, Israel.

Three growing systems (aeroponics, hydroponics and soil) were used as treatments. The aeroponics system was comprised of four aeroponics chambers each with misters, pipes and buckets. All aeroponic chambers were connected to a reservoir tank for nutrient solution, a buster pump to draw solution from the tank and an automatic timer to control the rate of misting. The aeroponics system was a closed system in which the nutrient solution was re-cycling until the nutrients were depleted and refreshed.

Similarly four containers, each with a capacity of carrying four plants, were used for soil and hydroponics. Half Hoagland's nutrient solution was used for all treatments and the solution was refreshed once every ten days for aeroponics and hydroponics.

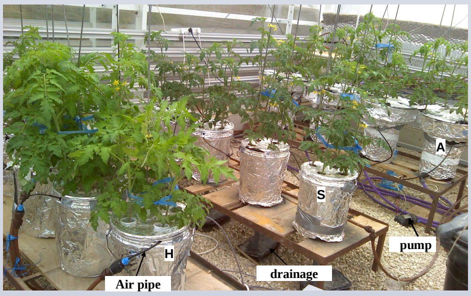

Figure 1. Experiment set up of hydroponics (H), soil (S) and aeroponics (A) growing systems.

Results

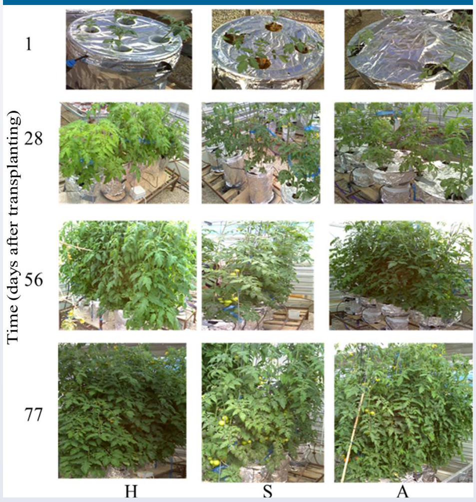

Figure 2. tomato plants grown in hydroponics (H), soil (S) and aeroponic (A) growing systems at different growth stage

Figure 3. roots of the tomato plants grown in hydroponics (H) , soil (S) and aeroponics (A)

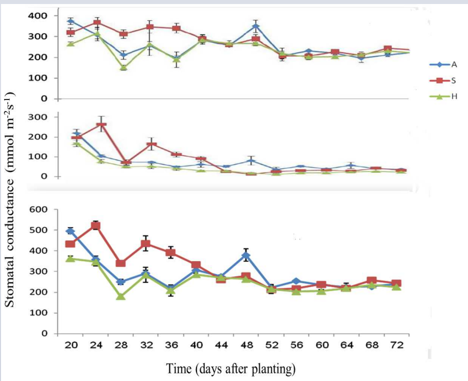

Figure 4. Stomatal conductance of tomato plants grown in the three growing systems. Error bars are standard errors. n=4

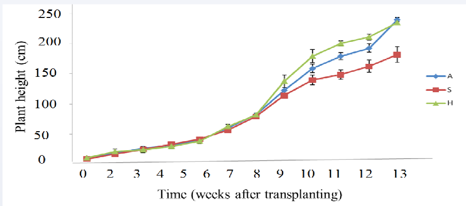

Figure 5. average plant height increase of tomato plants grown in the three growing systems. Error bars are standard errors. n=4

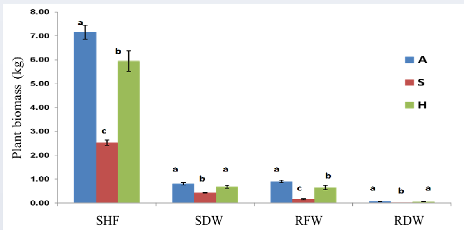

Figure 6. shoot fresh weight (SFW), shoot dry weight (SDW), root fresh weight (RFW) and root dry weight (RDW) of tomato plants gown aeroponics (A), soil (S) and hydroponics (H). Different letters represent significant differences. Error bars are standard errors. n=4

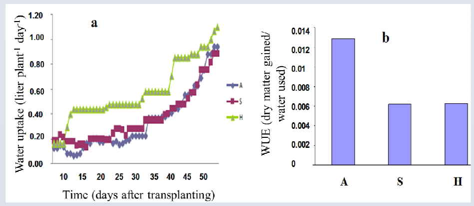

Figure 7. water uptake per plant per day in liter (a) and water use efficiency (WUE) (b) of tomato plants grown in in aeroponics (A), soil (S) and hydroponics (H) growing systems

Conclusion and Future Works

According to our results, aeroponics showed better performance on plant growth, total biomass production and WUE than hydroponics and soil under optimal conditions.

The potential benefit of aeroponics under stress conditions such as salt and nutrient stress is not well addressed. The future work is therefore, to investigate the roles of aeroponics on nutrient uptake, WUE and growth of tomato under different stress conditions.

Acknowledgements

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