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Evaluation of aeroponics, hydroponics and vermiculite systems for greenhouse tomato production in the Antarctic and for long-duration spaceflight

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The nutrient delivery system is one of the most important hardware components in hydroponic tomato (Lycopersicon esculentum Mill.) production for both space, such as Bio-regenerative Life Support Systems (BLSS), and unbans agriculture fields. To simulate the requirements of proposed space missions, Antarctic stations are often selected as analog test facilities due to representative logistical, infrastructural and environmental factors. The objective of this study was to investigate the influences of different nutrient delivery systems (aeroponics, hydroponics and vermiculite) on the growth, photosynthetic characteristics, antioxidant capacity, biomass yield and quality of tomato during its life cycle. The results showed that the chlorophyll a content of tomato plants grown in the aeroponics system had the top advantages from initial stage 1.47 mg/g to late stage 1.21 mg/g. Both tomato photosynthesis and stomatal conductance maximized at the development stage and then decreased later in senescent leaves. At the initial stage and the development stage, POD activities in the aeroponics treatment were higher than other two treatments, reached 3.6 U/mg prot and 4.6 U/mg prot, respectively. The fresh yield 431.3 g/plant of hydroponics treatment group was significantly lower than others. At the same time, there were no significant differences among nutrient delivery systems in the per fruit fresh mass, which was 14.2-17.5 g/fruit.

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