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Aeroponics as Potential System for Fully Controlled Staple Food Production

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Abstract

Staple food crops such as rice or wheat constitute the most land intensive production systems. Urban food supply could profit from fully controlled vertical farming systems as the required space and the competition for fertile soils would be considerably reduced. Aeroponic systems will be required to reduce the weight of the vertically stacked production units. Aeroponics are soil-less production systems in which plant roots are supplied permanently or periodically with a fine mist of nutrient solution. These systems have been successfully established for commercial production of horticultural plants (*i.e. Brassica oleracea* var. *italica*, *Lactuca sativa*), medicinal and herbal plants (*i.e. Zingiber officinale*, *Scutellaria minor*) and for several scientific approaches (*i.e.* plant nutrition, plant physiology) showing that higher and less variable yields per unit area can be achieved. Little is known on aeroponic cultivation of staple food crops such as rice and the related genotypic, plant nutritional and technical challenges for future intensive food production.

An aeroponic system was developed for cultivating rice seedlings in a greenhouse. High end ultrasonic nebulizers with glass membranes combined with newly developed water proof ventilators were used to nebulize and distribute the nutrient solution. With the aim to find optimal irrigation frequencies, different duty-cycles of nebulizers and ventilators were adjusted and the effects on root and shoot growth rates of two different lowland rice varieties were determined.

As the maximum root length of the plants determines the outer dimensions of the aeroponic cultivation system and thus the economic efficiency the effects of different pH-levels of the nutrient solution on root-length, biomass accumulation, and leaf gas exchange were measured and compared to plants simultaneously cultivated in a classic hydroponic system comprising the same treatments. The effects of different nebulizing frequencies (irrigation intensity) and pH-levels on growth rates, root length and leaf gas exchange of the two genotypes as well as the differences between aeroponic and hydroponic systems will be illustrated and conclusions on design and implementation of the aeroponic system will be discussed.

Keywords: Multi-storey food production, *Oryza sativa*, urban farming, rice

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