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Rooting characteristics of lettuce grown in irrigated sand beds

D. Schwarz[1], M. Heinen[2,4] and M. Van Noordwijk[2,3]
[1]*Institute for Vegetable and Ornamental Plant Growth, Großbeeren/Erfurt e. V., Theodor-Echtermeyer-Weg 1, D-14979 Großbeeren, Germany and* [2]*Agricultural Research Department Research Institute for Agrobiology and Soil Fertility (AB-DLO), P.O. Box 129, 9750 AC Haren, The Netherlands.* [3]*Present address: ICRAF, P.O. Box 161, Bogor, 16001, Indonesia.* [4]*Corresponding author**

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Abstract

To avoid the current water pollution from intensive glasshouse horticulture, closed systems have to be developed with recirculating drainage water. For crops with a high planting density, such as lettuce, shallow beds of coarse sand may be used if water and nutrient supply can be regulated adequately. The aim of the present study was to determine the rooting characteristics and root distribution of lettuce in sand beds, as affected by substrate depth, the distance to a drain, drip lines and drip points, and the excess of nutrient solution applied. The hypothesis was tested that a small excess and a large distance between drip points leads to local salt accumulations in the root environment and thus to a less homogeneous root distribution.

The data confirmed both parts of the hypothesis: spatial patterns in salt distribution were found. Detailed measurements in a sand bed with only one drip line per two crop rows and an amount of fertigation solution added of 2 times the estimated evapotranspiration, showed that root length density was negatively correlated with salt content when comparisons were made within the same layer. Crop yield per row was influenced in the extreme treatment, i.e. one drip line per two crop rows and an amount of fertigation solution added of 1.3 times the estimated evapotranspiration, but yield per bed was still unaffected. The increased heterogeneity of the crop will cause problems at harvest and indicates that the most extreme treatment included in the comparison is just beyond the limit of acceptable heterogeneity in the root medium. Lettuce can be grown on sand beds with a recirculating nutrient solution provided that drip lines are well distributed in the bed and the daily nutrient solution excess is more than 30% of demand.

Introduction

Over the last two decades a large part of the Dutch commercial horticultural growers changed from soil-based systems to the use of artificial substrates. The smaller rooted volume and the lower chemical buffering capacity of the root environment offer better opportunities to control plant growth. Nutrient use efficiencies in the presently used open-drain systems are low, however, and result in unacceptable pollution of groundwater and surface water (Van Noordwijk, 1990). In the Netherlands growers are obliged to change to closed growing systems, with drainage water collection and recirculation, before the end of this century. In these closed systems the rooted volume and therefore the depth of the substrates is kept small to maintain the options for rapid change of the root environment to control plant growth. This means that natural soils with a fine texture cannot be used, since conditions that are too wet will occur and oxygen supply to the roots will be a problem for most crops because of their limited ability to make aerenchyma in their roots (Van Noordwijk and Brouwer, 1993). Therefore, coarser substrates have to be used. The choice of substrates, the design

* Fax no: + 3150337291