Use of non-optimal quality water in closed soilless growing systems

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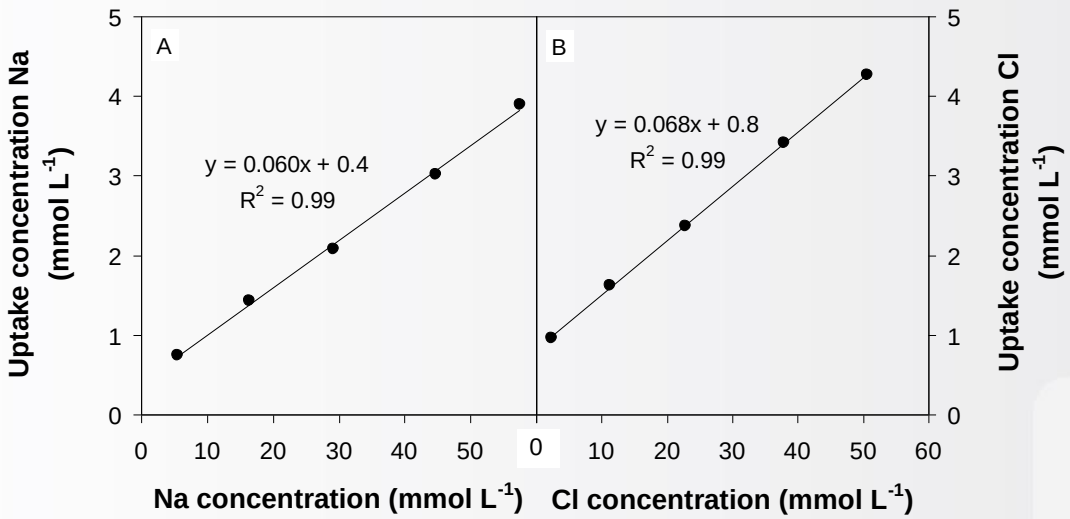
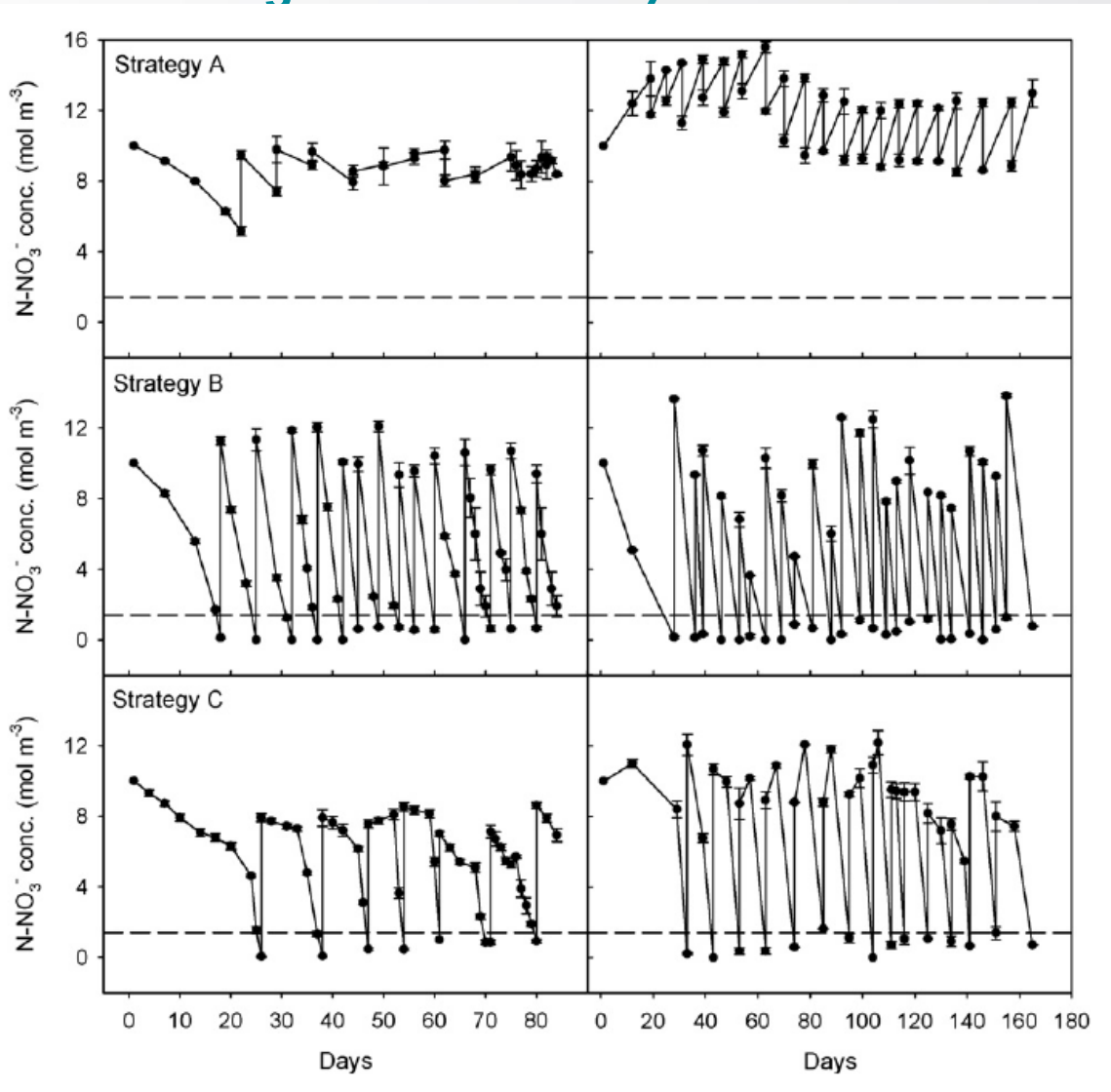
Introduction

- Poor quality of the irrigation water is one of the most important factors limiting the implementation of closed soilless growing systems in the Mediterranean area.
- An excess of salts in the irrigation water provokes their accumulation in the recirculating solution until a level promoting an uptake concentration equal to the concentration in the water.
- However, an excessive saline accumulation is frequently necessary to achieve this steady state, thereby being compulsory to discharge part of the recirculating solution in order to avoid yield reduction.
- This discharge can promote significant loss of nutrients.



Magán *et al.*, Acta Hortic. 697: 365–369

Evolution of N-NO_3^- concentration in the recirculating solution with different management strategies in semi-closed system (Massa *et al*., Agric. Water Manage. 97: 971–980)



Objective

To evaluate a combined strategy from those proposed by Massa et al. (2010), controlling pH of the recirculating solution by using nitric acid instead of sulfuric acid.

Materials and methods

- Growing system: NGS
- Crop: tomato ‘Valkirias’ grafted on ‘Multifort’, from September 16th 2014 to May 25th 2015, 1.56 plantas m^{-2} with two stems per plant (one every three stems was topped on November 17th)

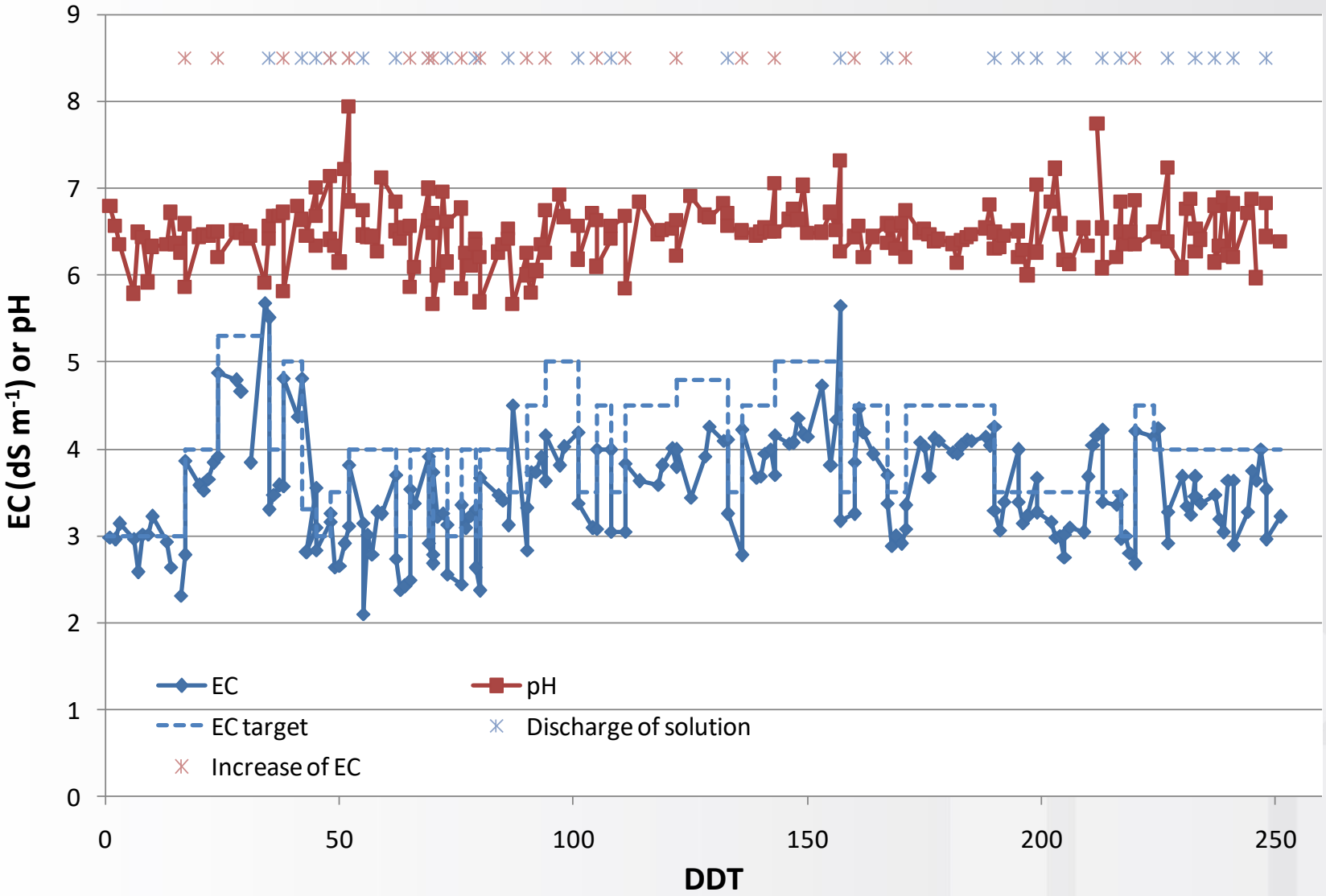
Materials and methods

- Irrigation water used in the experiment: EC = 1.6 dS m^{-1}

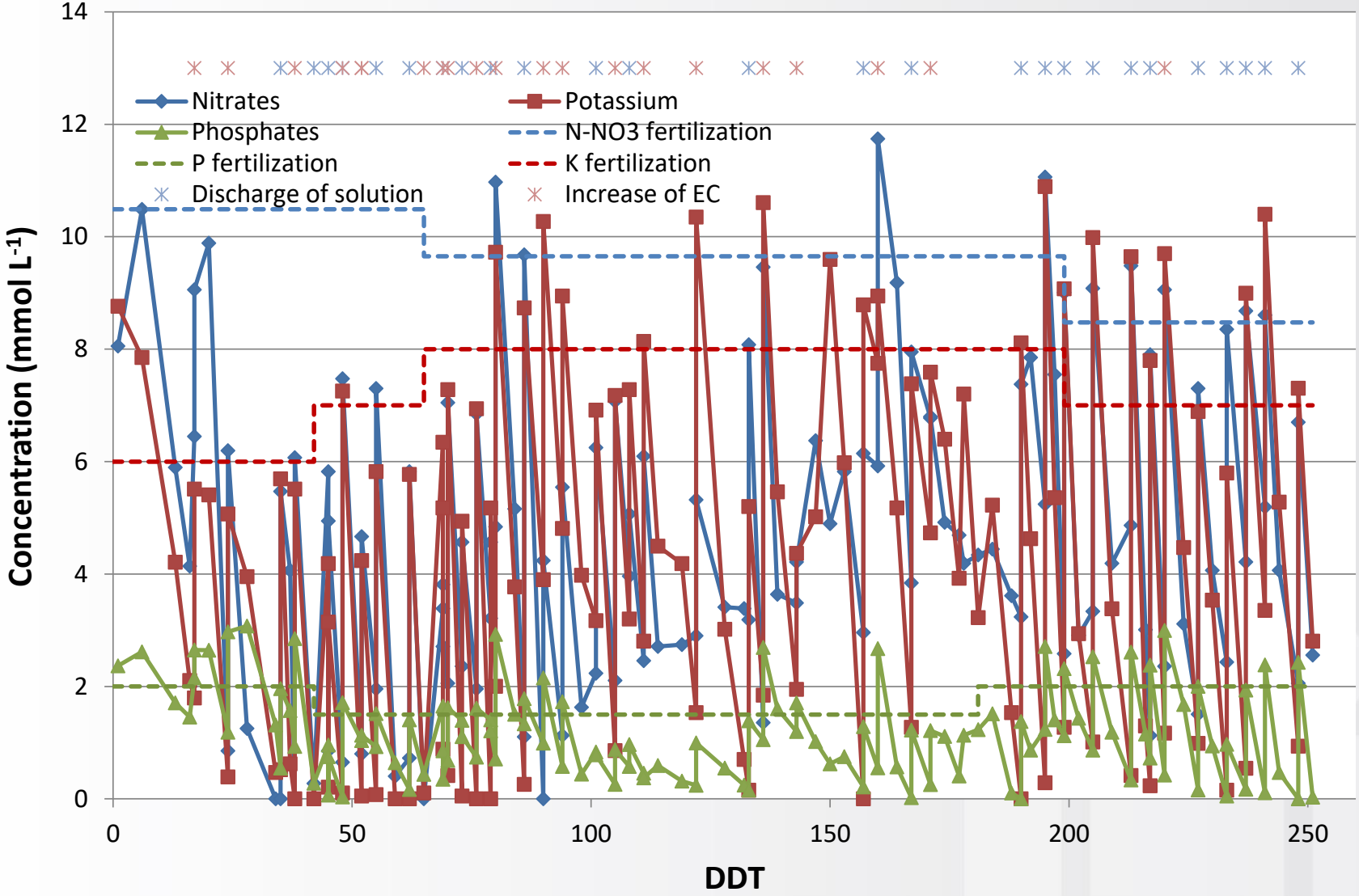
ION	NO_3^-	$H2PO_4^-$	$SO_4^=$	HCO_3^-	Cl^-	K^+	Ca^{++}	Mg^{++}	Na^+
Concentration (mM L^{-1})	0.2	0	0.4	3.0	12.3	0.1	2.2	2.9	5.9

- Daily measurement of nitrates and potassium concentration by using rapid selective electrodes (LaquaTwin, Horiba). An EC of 3 dS m^{-1} was established when starting with new recirculating solution; that target was increased to 4 dS m^{-1} when the concentration of one of the two ions reached a value around 15 ppm. The recirculating solution was discharged when the nutrient concentration decreased again.

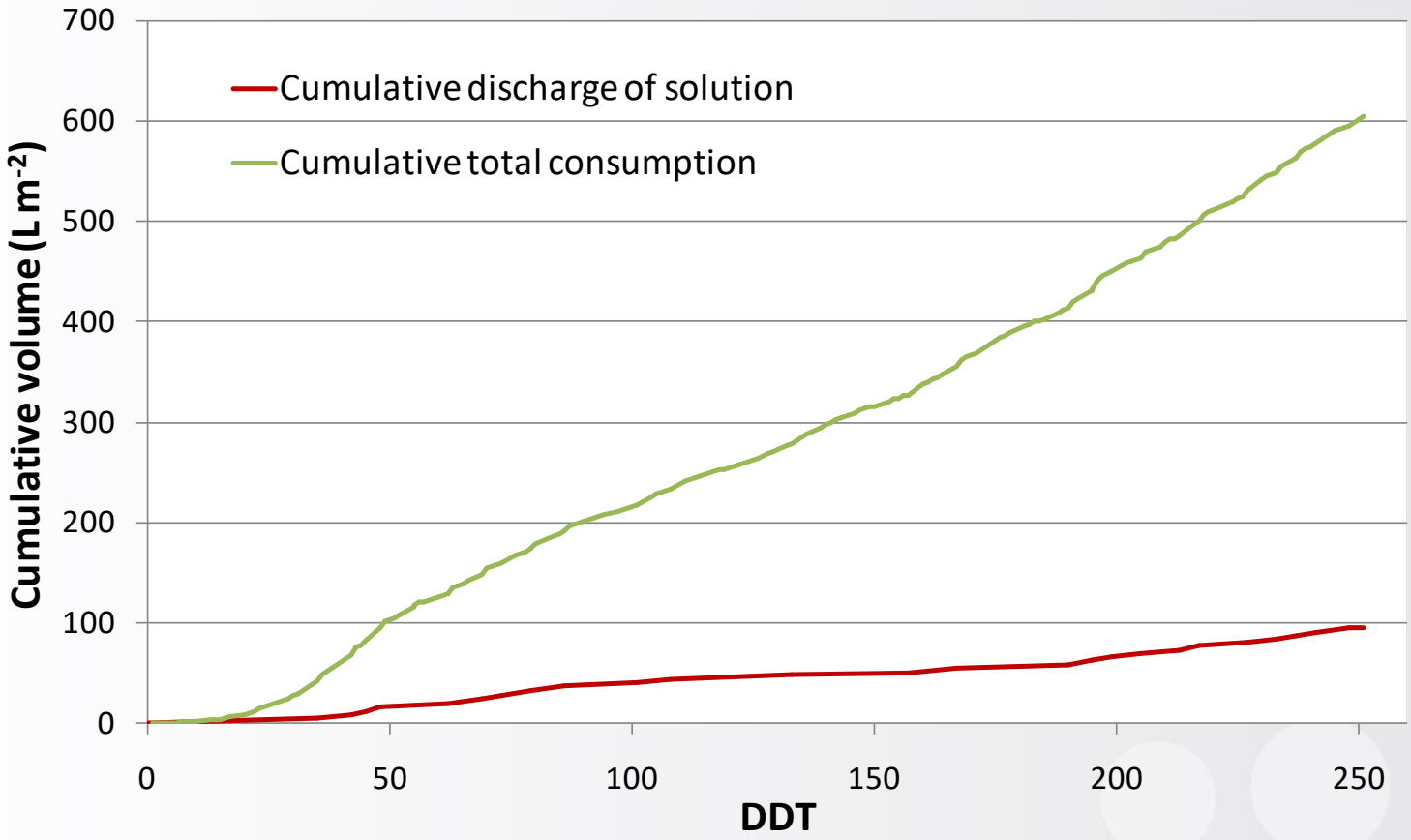
Evolution of EC in the recirculating solution



Evolution of nitrates, phosphates and potassium concentration in the recirculating solution



Evolution of cumulative water use



Total water use: 605 L m^{-2}

Discharged solution: 95 L m^{-2} (15.6%)

Water use efficiency: 37.5 g L^{-1}

Supply of macronutrients and use efficiency

NUTRIENT	N	P_2O_5	K_2O
Total supply of macronutrients (UF ha^{-1})	764	426	1194
Ratio between macronutrients (in relation to N)	1.00	0.56	1.56
Discharge of nutrients (%)	4.4	7.8	2.7
NUTRIENT USE EFFICIENCY (kg UF^{-1})	297	533	190
Efficiency in Magán *et al*. (1999) with recirculation (kg UF^{-1})	276	400	154
Efficiency in Magán *et al*. (1999) without recirculation (kg UF^{-1})	156	278	98
Efficiency in Magán *et al*. (2001) with recirculation good water (kg UF^{-1})	304	404	174
Efficiency in Magán *et al*. (2001) with recirculation non-optimal quality water (kg UF^{-1})	248	373	152

Conclusion

The strategy applied for the management of the nutrient solution allows an excelent water and nutrient use to be achieved when non-optimal quality water is used in recirculation, although it requires the daily measurement of the nutrient concentration. The development of technology enabling automatic measurements will facilitate the adoption of that strategy by growers.

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Thank you very much