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Greenhouse tomato production with nutrient solution recycling

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INTRODUCTION

- The soilless systems **allow the use of brackish** water and can help to **decrease the consumption of water** in greenhouses (more accurate management of fertigation – Bradley and Marulanda, 2000; Montesano *et al.*, 2015).
- The **environmental sustainability of open soilless systems** has been questioned (drainage is discharged into the environment).
- Closed soilless systems: **accumulation of ions in the recycled NS**, in particular the unabsorbed (or the poorly absorbed ones).
- Automated sensing and mathematical models have been developed (they need **a lot of variables** in order to work**; only a few models are suitable for greenhouse** environments – Bacci *et al*., 2012; their **implementation is laborious** because need to be adapted to the current situation of a crop – Gallardo *et al*., 2009, Bacci *et al*., 2012)

OBJECTIVES

Develop a NS (the "recovery solution") that fits the real needs of the crop (with respect to water and nutrients) without negative effects on yield and quality.

- **Save** water and nutrients.
- **Reduce** environmental impact of soilless systems.

WHAT WAS USED/MEASURED

- **Nutrient Film Technique (NFT)** – closed soilless system
- **Cherry type tomato**

WHAT WAS USED/MEASURED

- Replenishment of NS every two days.
  - **Transpiration** of the crop.
- Growth analysis.
  - **Crop Growth Rate** (CGR) of the crop.
- Inorganic ions in the NS and into the plant tissues.
  - **Mineral composition** of the plant.

WHAT WAS USED/MEASURED

Transpiration

NS added to the system

Total biomass (dry weight)

Crop Growth Rate (CGR)

Mineral composition

Concentration of the main elements (N, P, K^+, Ca^{2+}, Mg^{2+}) and Na^+ in the plant tissues.

Transpiration/biomass

[the amount of water required (g) to produce the unit of dry matter (g)], is calculated as **transpiration/CGR**.

Recovery solution

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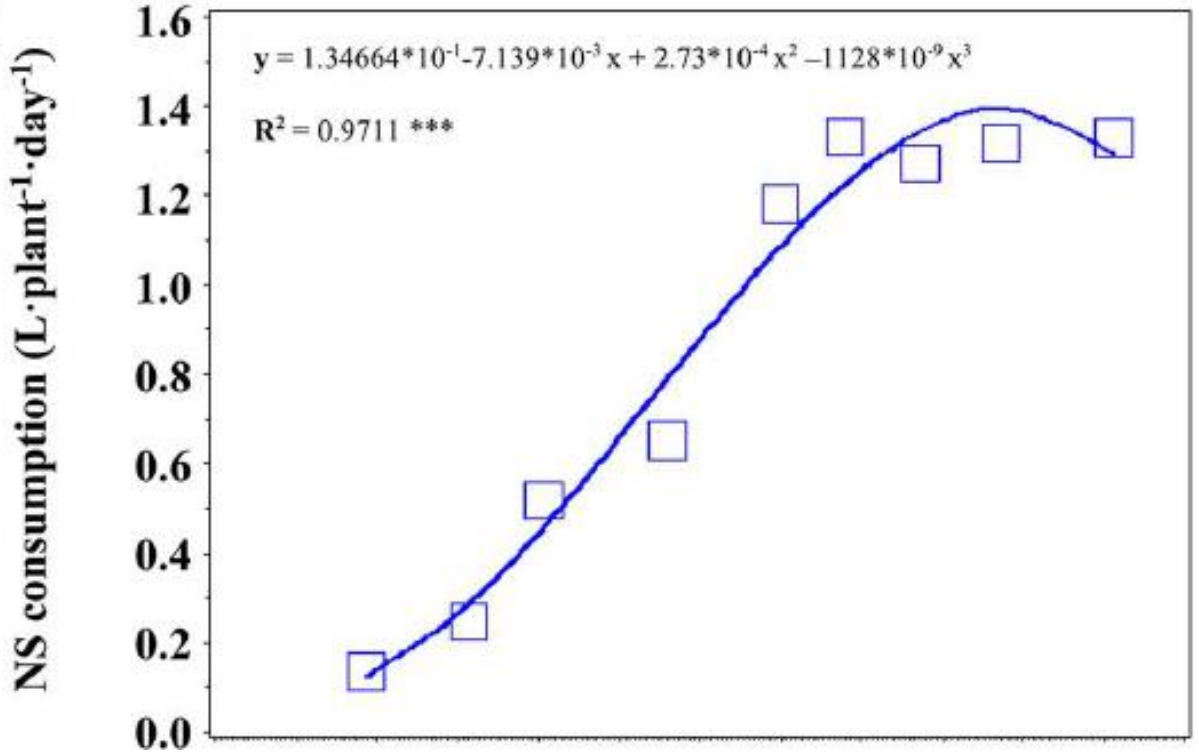
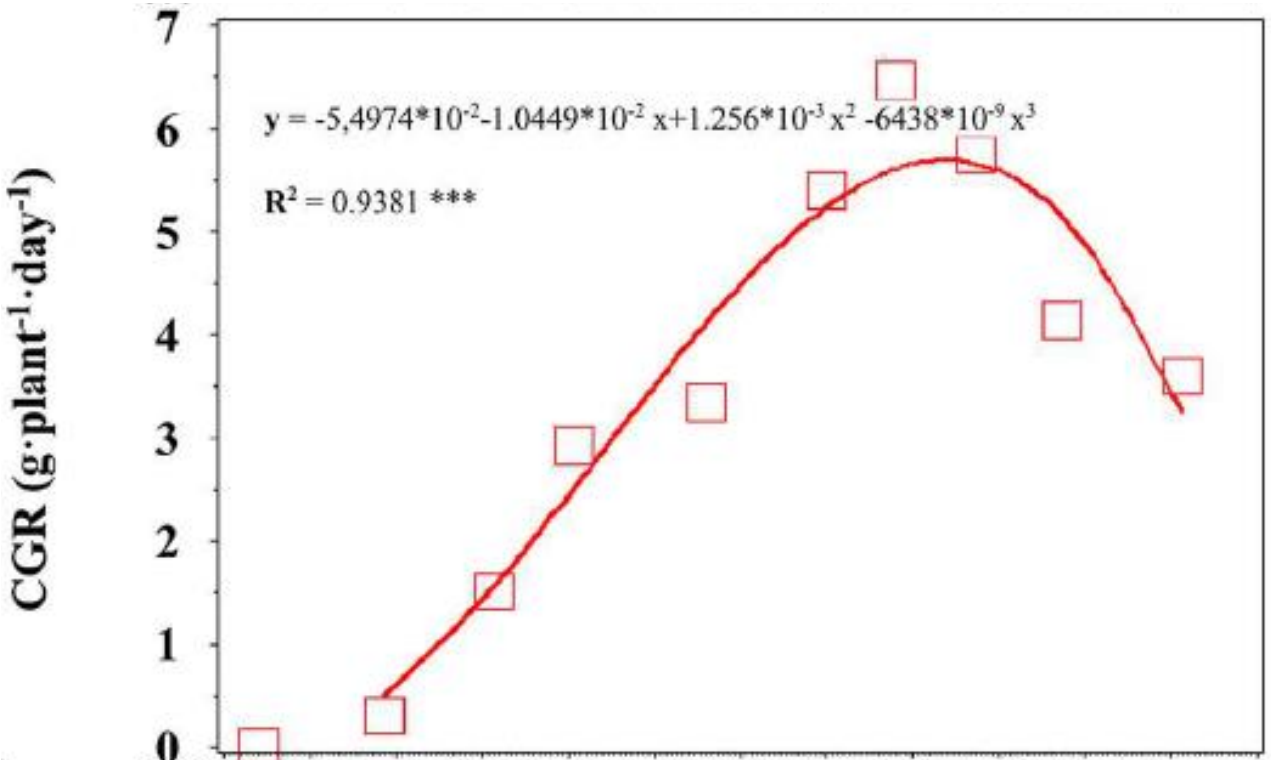
MAIN OBSERVATIONS





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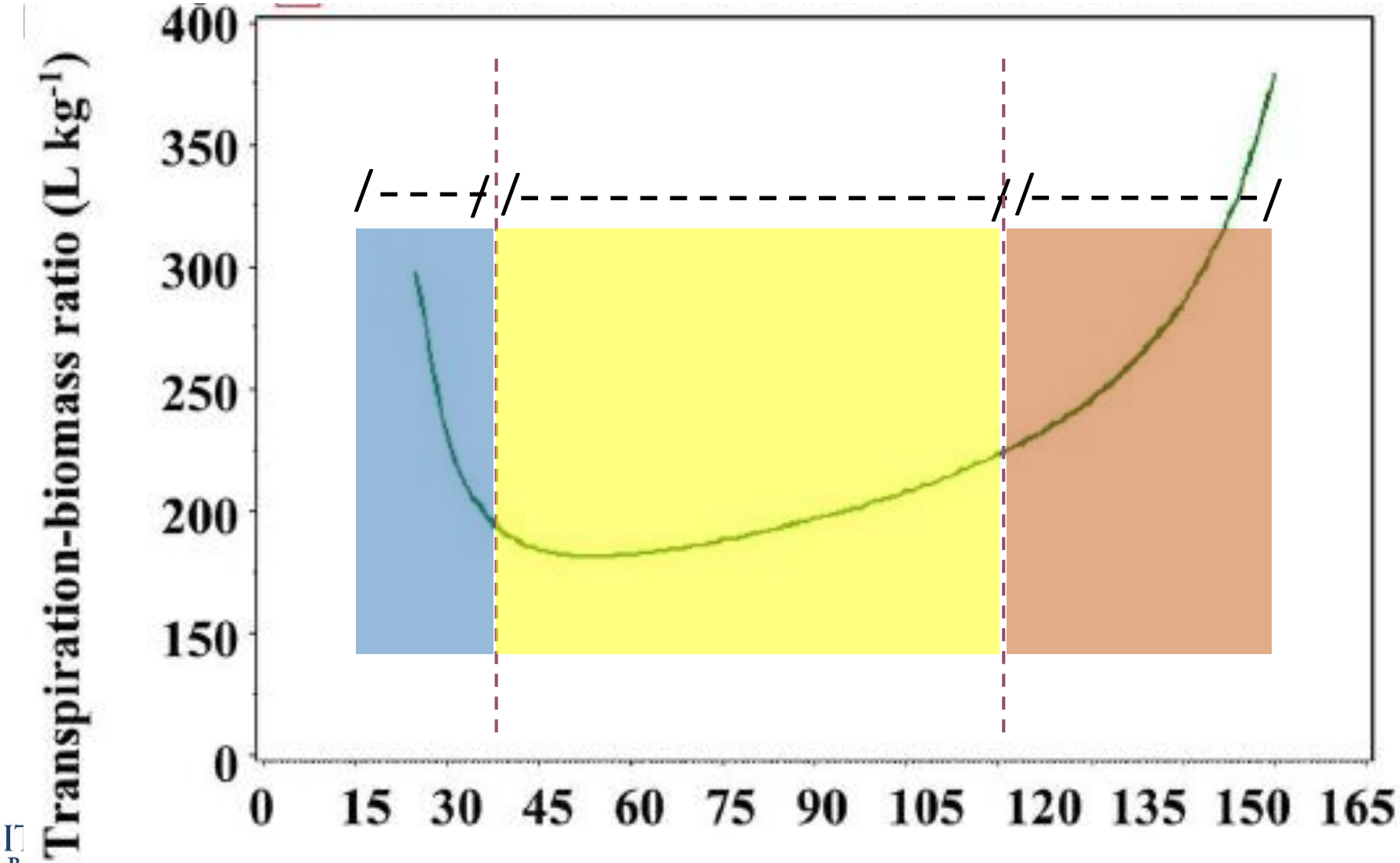
MAIN OBSERVATIONS



MAIN OBSERVATIONS

TABLE 3 | Nutrient levels into the recovery NS calculated in function of the real needs of the crop.

DAT	Phenological phases	N	K^+	P	Ca^{2+}	Mg^{2+}	Na^+	EC*
		(mM)						dS m^{-1}
28	Beginning of flowering of first truss	8.0	4.4	1.0	1.9	1.2	0.3	1.2
47	Beginning of flowering of second truss	11.0	6.4	1.4	2.8	1.4	0.9	1.7
61	Beginning of flowering of fourth truss	10.5	4.1	1.0	2.1	0.9	1.0	1.3
84	Beginning of flowering of sixth – seventh truss + fruits	9.1	4.2	0.9	2.2	1.1	1.4	1.3
105	Beginning of flowering of 9th – 10th truss + fruits	7.5	3.4	0.8	1.6	1.0	1.0	1.1
117	First harvest	6.9	3.0	0.8	1.1	0.8	0.8	0.9
131	Second harvest	5.8	2.9	0.7	0.9	0.6	0.7	0.8
146	Sixth harvest	4.9	2.3	0.7	1.0	0.6	0.7	0.8
167	10th harvest	3.4	2.0	0.6	0.9	0.6	0.6	0.7

*DAT, days after transplant. *Theoretical EC calculated using the formula proposed by Sonneveld and de Kreij (1999): EC = 0.095 + 0.19 Ct, where Ct is the total concentration of anions or cations present in the NS (in meq·L^{-1}).*

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LIMITATIONS/ISSUES

- Applicable on "cherry" tomato type: the plant has to be stressed to obtain "cherry" tasty fruits.
- The transpiration/biomass and the mineral composition should be determined for every kind of tomato, also considering the crop cycles (short/long, spring/summer, autumn/winter, etc.)
- Not related to the climate of the greenhouse
- Attention should be paid to the recirculation of NS (sanitary problems)

MORE INFORMATION

frontiers in Plant Science

ORIGINAL RESEARCH
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A Targeted Management of the Nutrient Solution in a Soilless Tomato Crop According to Plant Needs

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The adoption of closed soilless systems is useful in minimizing the environmental impact of the greenhouse crops. Instead, a significant problem in closed soilless systems is represented by the accumulation of ions in the recycled nutrient solution (NS), in particular the unabsorbed or poorly absorbed ones. To overcome such problem, we: (1) studied the effect of several values of the electrical conductivity (EC) of NS in a NFT (Nutrient Film Technique) system on a cherry type tomato crop, and (2) define a NS (called recovery solution), based on the concept of "uptake concentration" and

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