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Subsurface irrigation of tomato with saline water using an exudation textile pipeline: an option with risks

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Context

By 2040 Chile is forecasted to be among the 30 countries having more water stress if current conditions are maintained (Luo *et al*., 2015).

Forecasted as the more affected regions by climate change

Pp/ETo → salinity problems

Introduction

Subsurface drip irrigation (SDI) is an effective alternative for improving the behaviour of crops irrigated with saline water.

Frequently, yield and quality improvement are mentioned with this technique associated to a decrease of salts at the root level (Phene *et al*., (1991; Hanson & May, 2004).

However, known evaluations use drip emitters but the behaviour of tomato crop irrigated with SDI using an exudation textile pipeline (EP) was unknown.

Our background

Early results in SDI (Kahlaoui *et al*., 2011) and our previous hydraulic evaluations of an exudation textile pipeline (2012) were the basis for the current experiment.

Our evaluations on EP as DI in 2012 revealed an acceptable Christiansen's uniformity coefficient (0.85 at 0.3 bar).

Flow of EP in hydraulic test unit: 16.8 $L.h^{-1}.m^{-1}$ (0.3 bar). (data not published)

But…

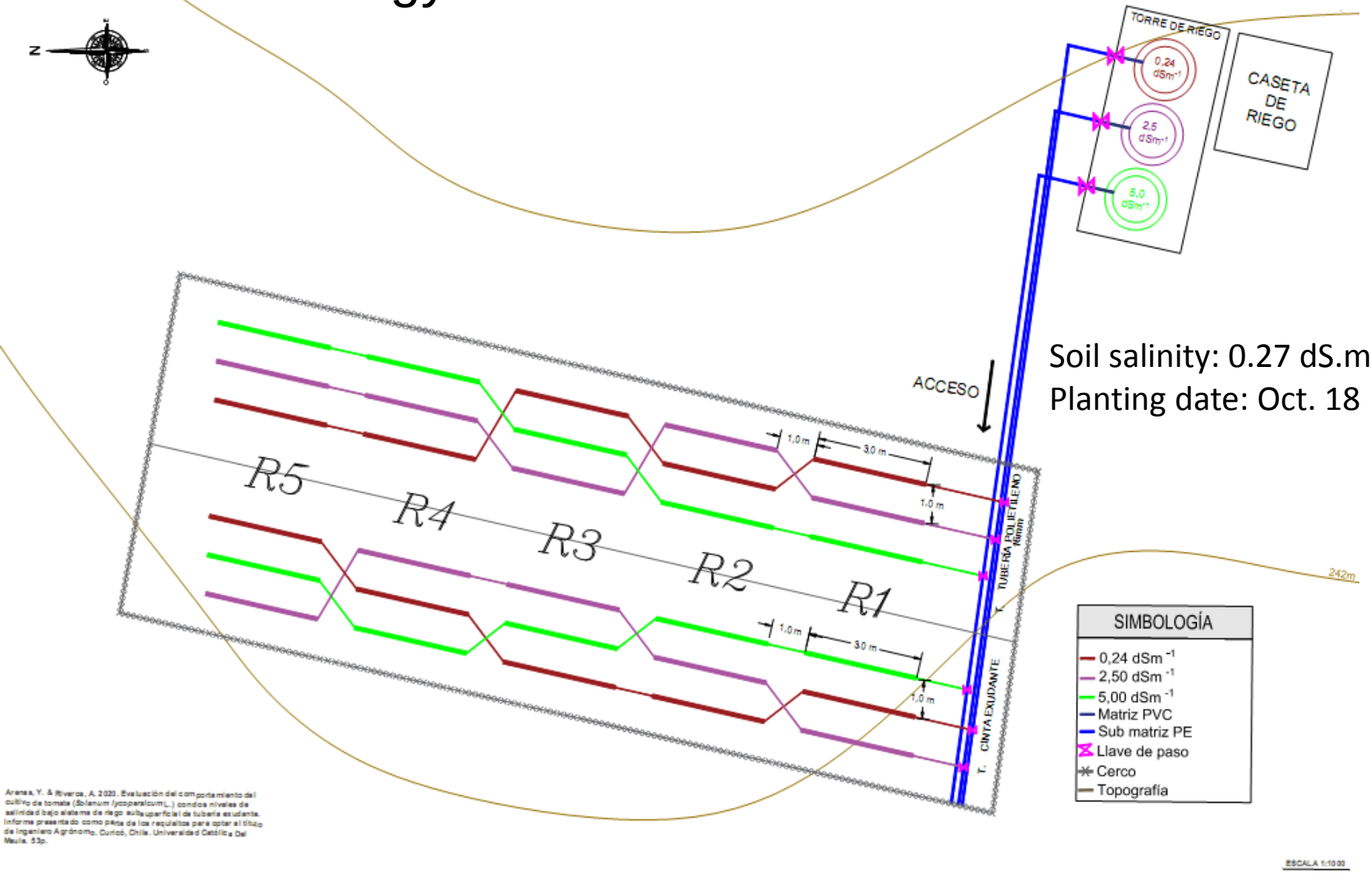
We tested the flow decrease of two irrigation materials in tomato crop during the season 2012/13 at the end of the season. Both **as surface irrigation and without chemicals** (data not published):

Flow decrease (%)	
Drip tape	Exudation textile pipeline
29.77	**73.39**

(2.5 fold approx.)

So, the **general objective** was to evaluate tomato crop irrigated with SDI using an exudating textile pipeline (compared to a drip tape) and three salinity levels (2.5 and 5 $dS.m^{-1}$ and a control, 0.24 $dS.m^{-1}$).

Methodology



Soil salinity: 0.27 dS.m^{-1}

Planting date: Oct. 18

Arenas, Y. & Riveros, A. 2020. Evaluación del comportamiento del cultivo de tomate (Solanum lycopersicum L.) condos niveles de salinidad bajo sistema de riego subsuperficial de tubería exudante. Informe presentado como parte de los requisitos para optar al título de Ingeniero Agrónomo. Curicó, Chile. Universidad Católica Del Maule. 53p.

Water conductivities defined at **2.5 and 5 dS.m^{-1}** for saline irrigation treatments, were set as convenient levels for evaluating tomato based on Ayers & Westcot (1985) and Misle & Kahlaoui (2015).

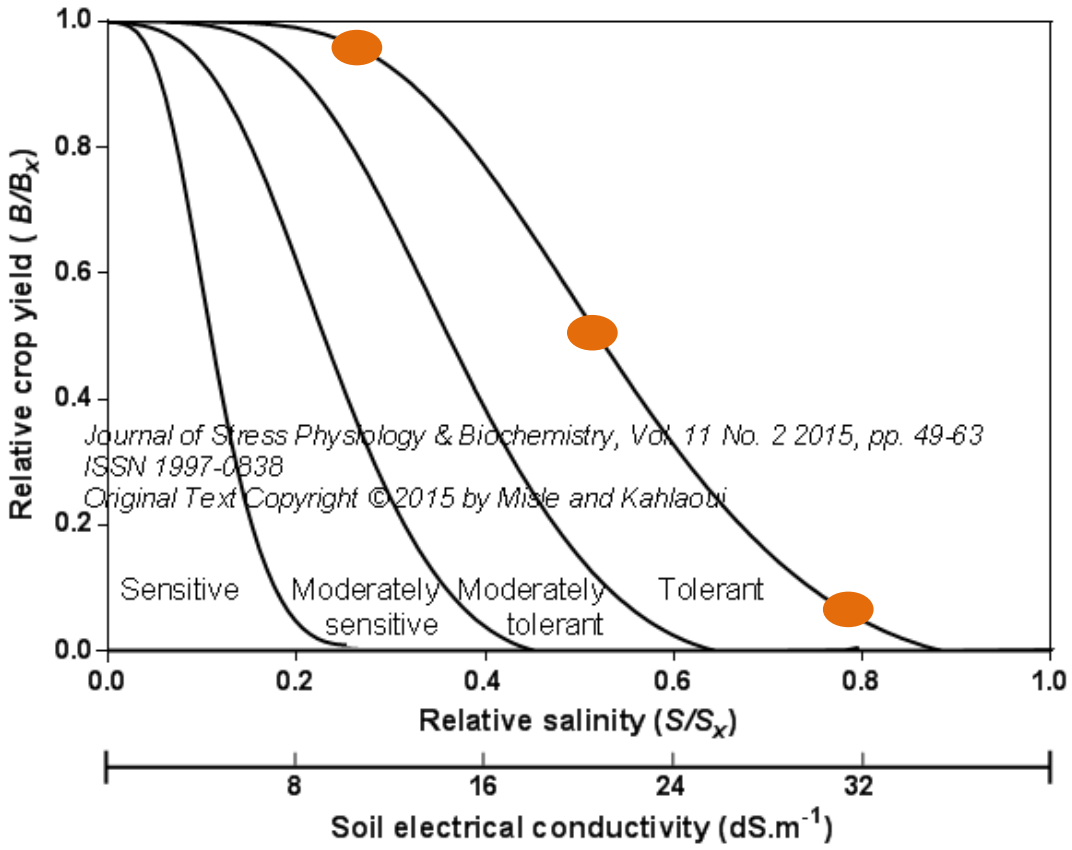


Figure 1. Nonlinear Allometric Equation for Crop Response to Soil Salinity

Non saline water for the control treatment came from a well (0.24 $dS.m^{-1}$).

EP 16 mm was installed 20 cm depth and each experimental unit of 3 m length was randomized accordingly. 5 rep.

Soil density was 1.31 $g.cm^3$, field capacity 0.33 and permanent wilt point 0.184. Irrigation was carried out according to Allen *et al*. (1998). A weather station for the necessary data was beside the experiment.

Measurements, calculations and evaluation

Leaf area was evaluated at 20, 40, 60, 80, 100 and 120 days after transplant, measuring leaf width and length for further calculation by an allometric function (Schwarz & Kläring, 2001).

Soluble solids, **titratable acidity**, **diameter** and **weight** were determined for fruits. **Total yield** and **aerial biomass** was also measured. Two way anova and Tukey ($p < 0.05$) test when corresponding and correlation analysis were used for statistical analyses.

Results

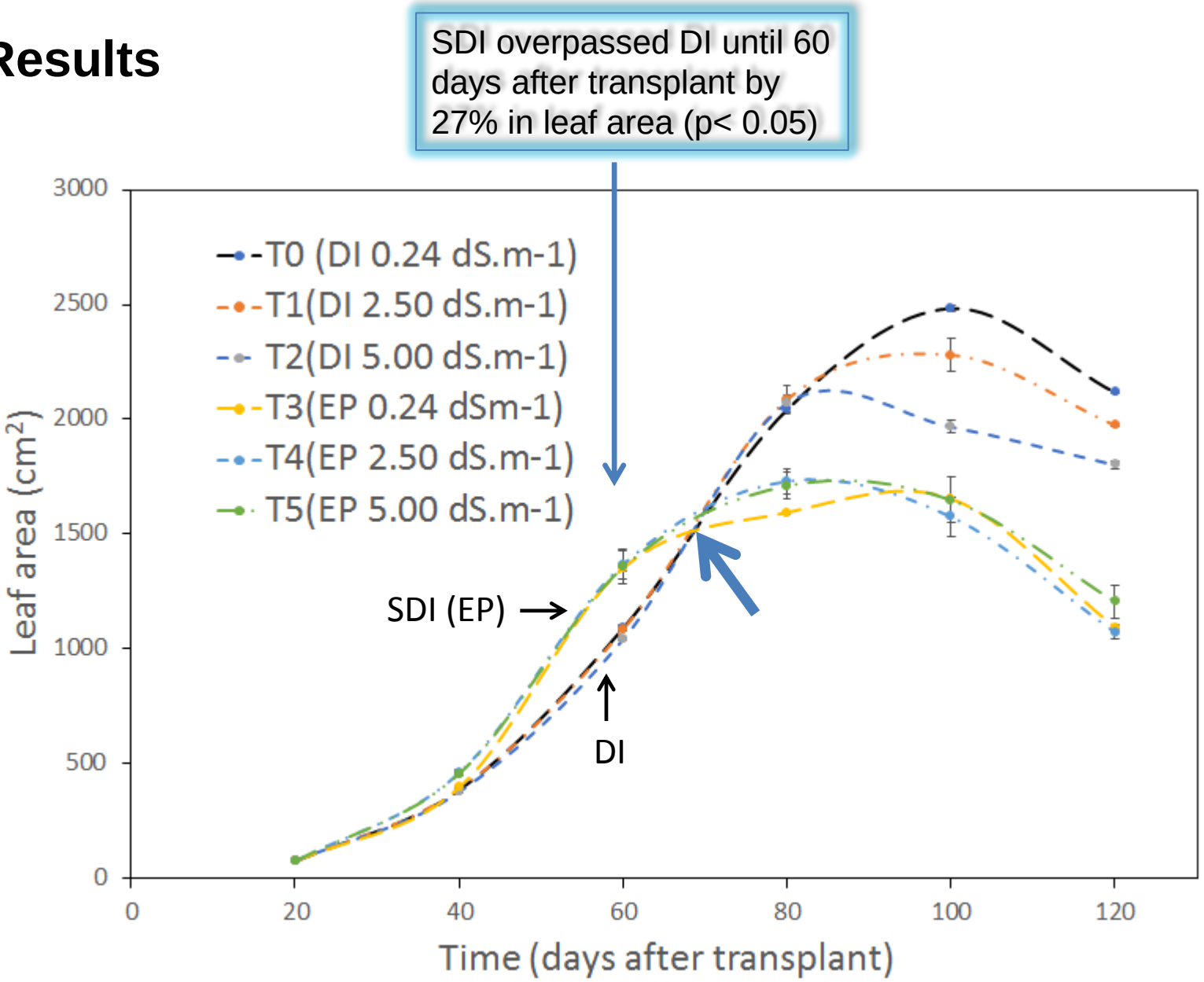


Figure 2. Evolution of leaf area of tomato crop according to irrigation method and water quality

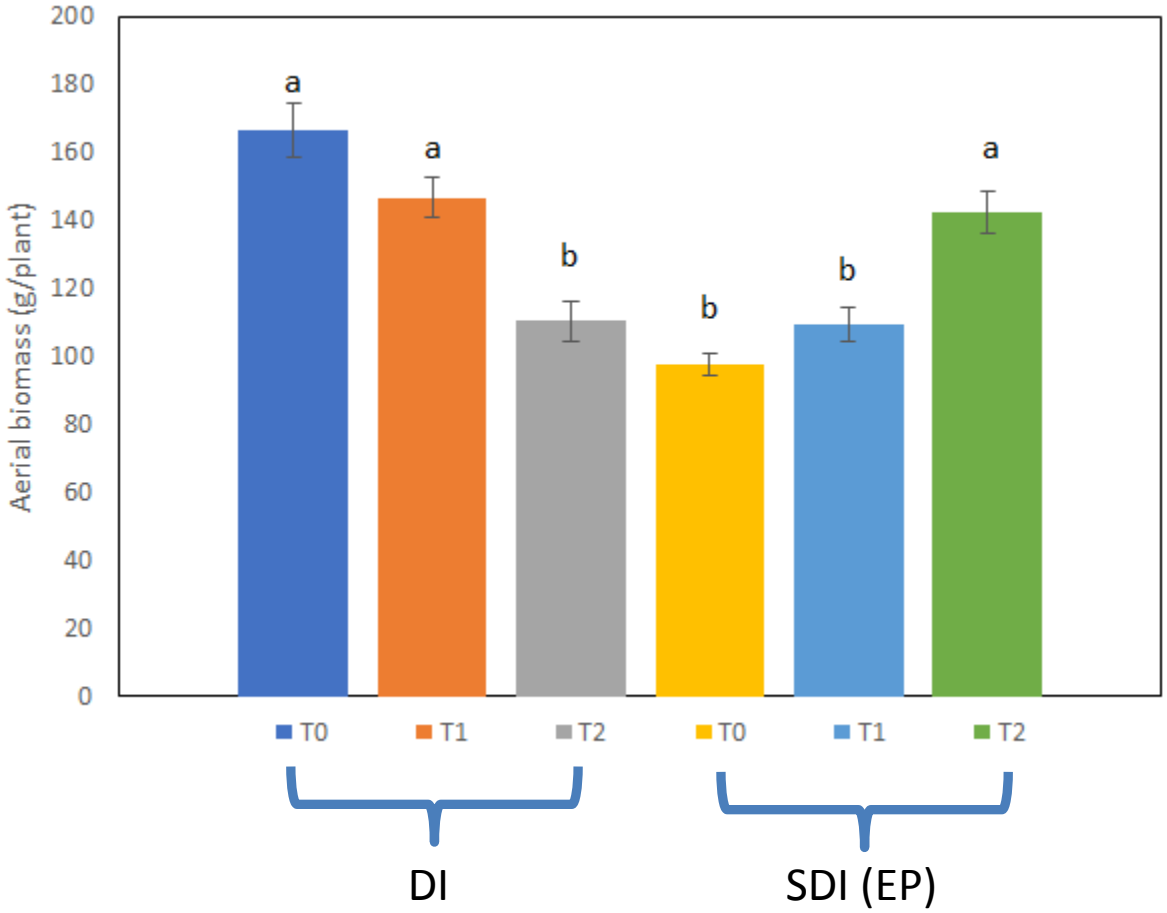


Figure 3. Plant biomass of tomato crop according to irrigation method and water quality

Externally

Internally

Figure 4. External and internal aspect of the exudation textile pipeline at the end of the experiment.

and significantly correlated (α = 0.05) different parameters with root biomass into pipelines:

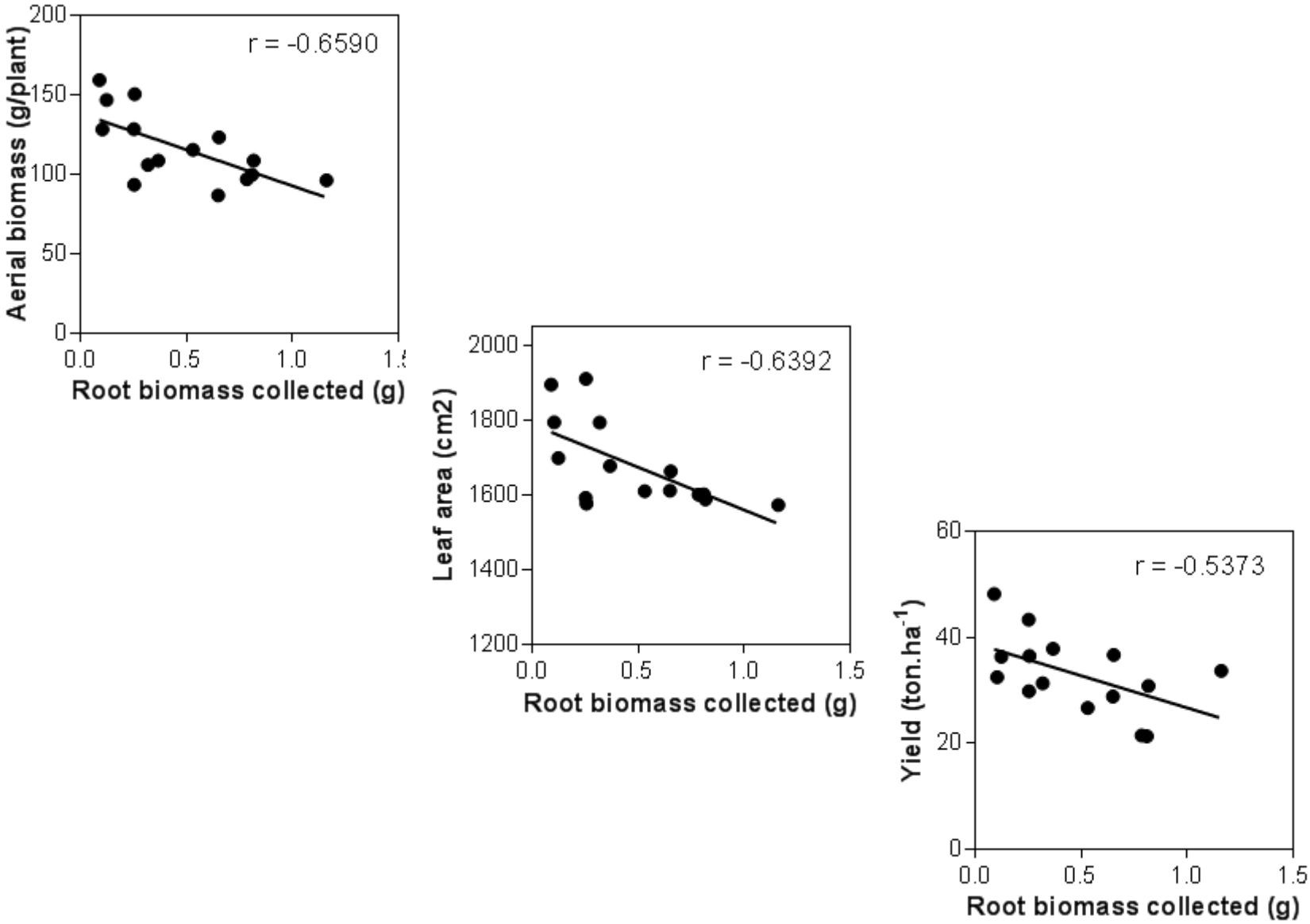


Figure 6. Correlation of aerial biomass, leaf area and yield with root biomass into pipelines of each experimental unit (3m).

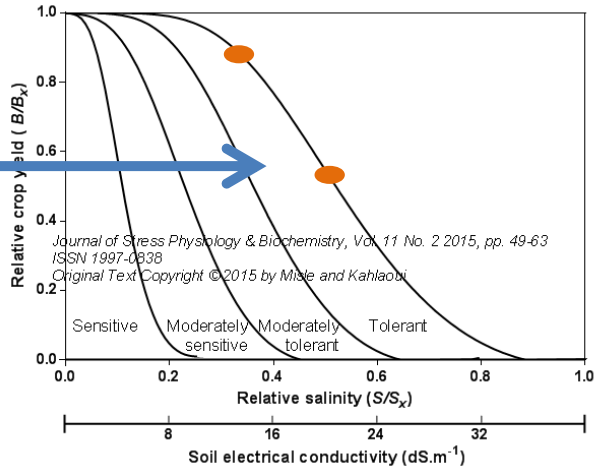
At harvest total soluble solids, titratable acidity, fruit diameter and weight, aerial biomass as well as yield, revealed significant differences in EP not attributable to salinity effects but to water deficit caused by pipeline clogging with roots.

Final soil salinity was not possible to be measured due to the closing of the lab by the COVID contingence but the last evaluation in 16 December was:

T0: 1.54 dS.m^{-1}

T1: 3.54 dS.m^{-1}

T2: 6.76 dS.m^{-1}



Conclusions

EP is an irrigation technique with acceptable uniformity (85%) for a line without emitters but is exposed to root intrusion causing clogging of pipelines.

Studied parameters confirmed a superiority of SDI over DI until 60 days after transplanting previous to the clogging of pipelines. But the subsequent clogging by roots makes impossible to support EP for SDI unless further experiments can contribute with different evidence.

Thank you