PHARM - SWAP MED
removal of PHARMaceuticals from treated wastewaters in the Soil - Water - Plant continuum in the MEDiterranean basin

EIP Water Online Market Place
Matchmaking for water Innovation

MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)

MAR SOL MANAGED AQUIFER RECHARGE SOLUTIONS

Evolution of the soil buffer capacity during the provision of two water related ecosystem services

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N°abstract *2582*

Early Career Hydrogeologists' Network

iah • aih 60 years
25-29th September 2016
Montpellier, France
CORUM CONFERENCE CENTER
43rd IAH congress

Framework

Reuse of treated wastewater (TWW) is nowadays a relevant issue in EU in water management in the framework of the circular economy concept

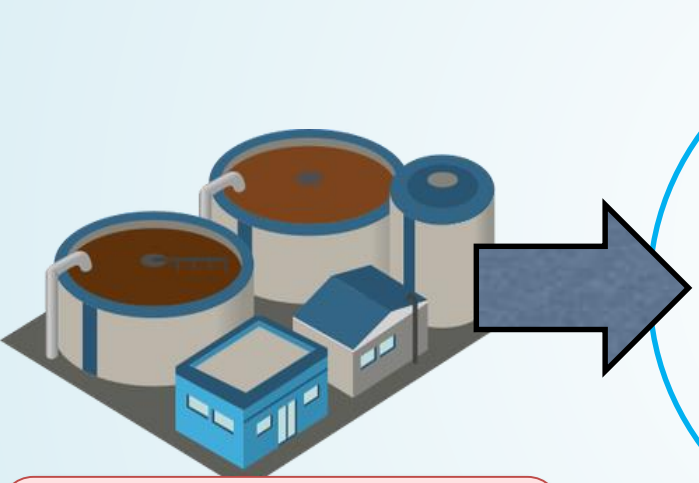
In this context **are now under discussion**
a new version of the draft Common Implementation Stragey (CIS) guidance document of the WFD on water reuse, and a possible legislation setting minimum requirements for:

- water reuse in irrigation
- groundwater recharge

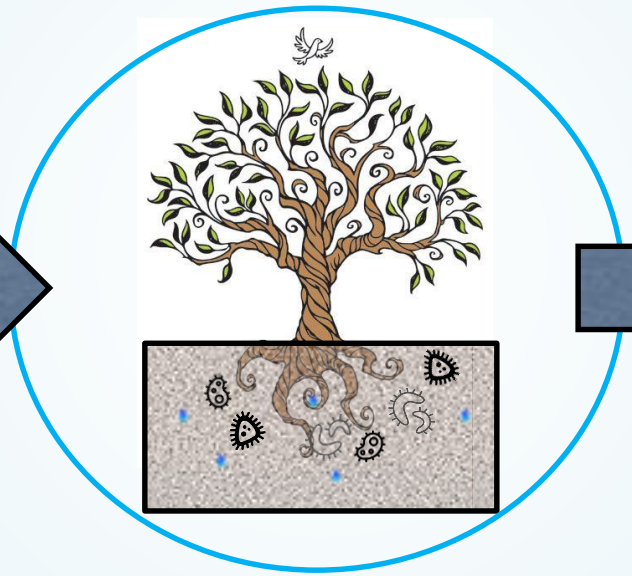
These solutions are now known as water-related ecosystem services such as **phyto-treatment plants** and **SAT-MAR schemes**

Introduction

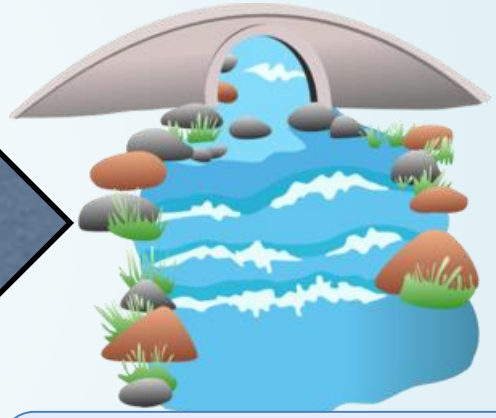
In phyto-treatment and SAT-MAR, several factors influence the quality of the “outcome”



Treated Wastewater



Soil-Water-Plant Continuum



Outflow – water for reuse/receptor

Objective

Evaluating by means of

Column Test

the buffer capacity of bare soils against potential pollutants in secondary TWW in the provision of Water Related Ecosystem Services

Sandy-Silty Soil

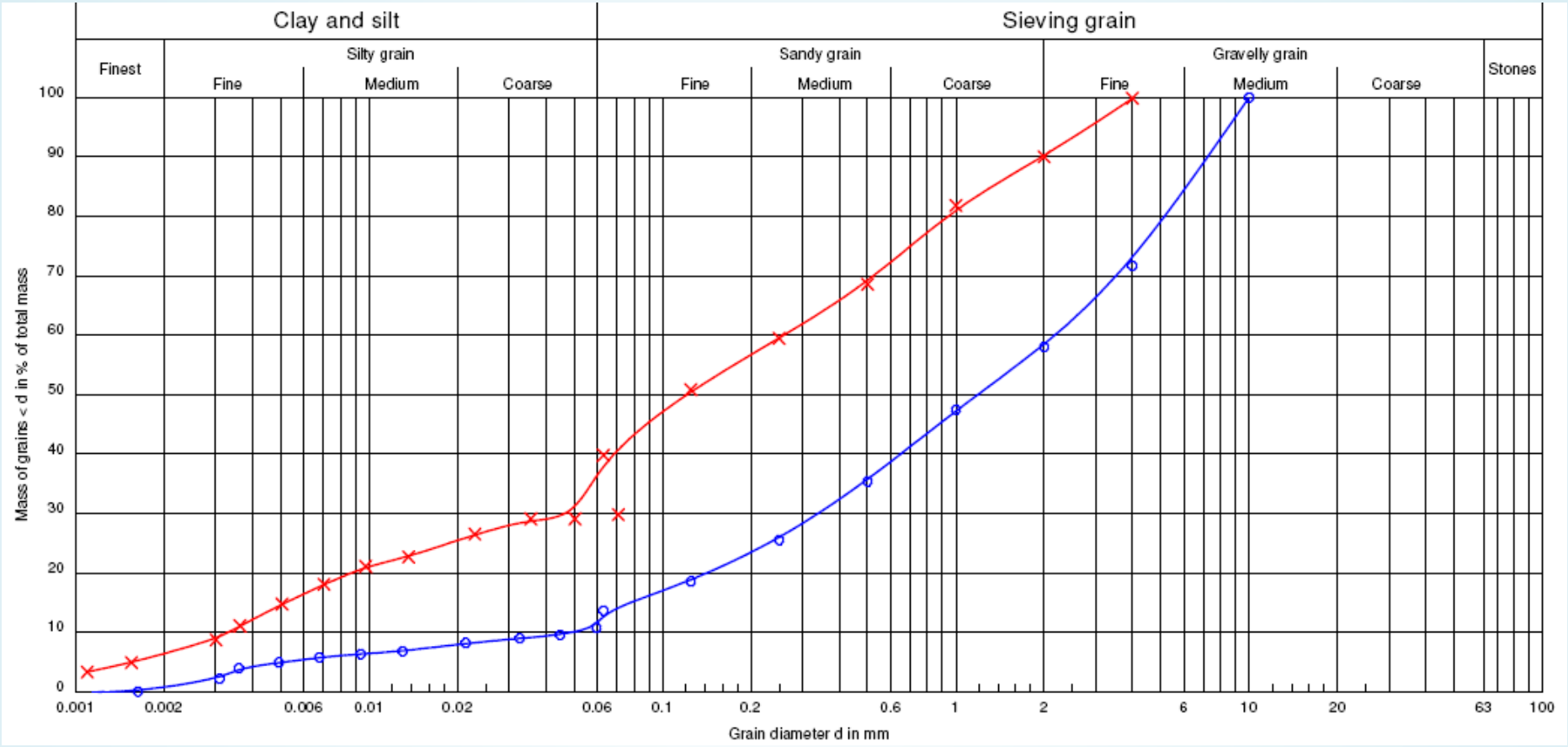
Two different soils

Peaty Soil

Sant'Alessio - IRBF

S. Niccolò – Phyto.

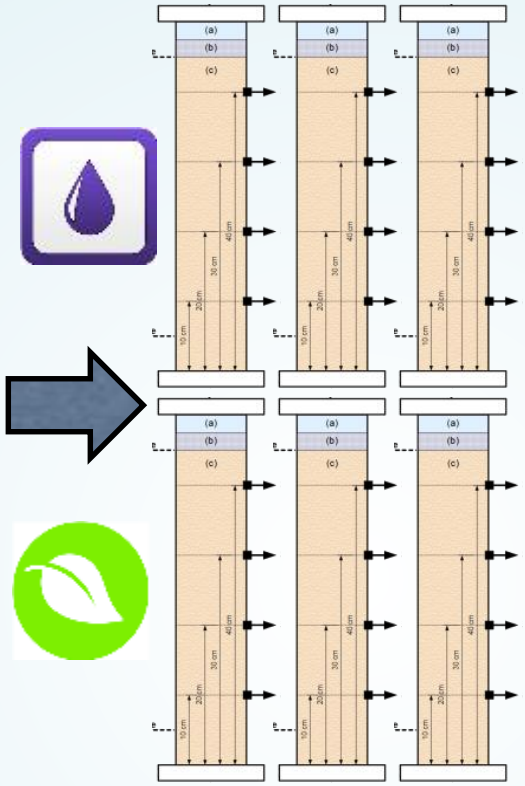
Materials and Methods – *Soil Characterization*



	Water Content [%]	C Org. [%]	C Ino. [%]	pH -H2O	EC [mS/cm]	Carbonates [%]	Olsen-P [mg/L]	CEC_{dry} [$cmol_c/kg$]
M	48.6	47.9	15.9	4.31	1.21	n.d.	2.15	12.5
S	8.6	0.9	13.0	8.75	0.18	3.4	0.04	4.9

Materials and Methods – *Test Design*

Secondary TWW used as infiltration source



Continuos upward flow for 7 months

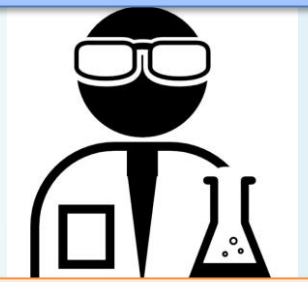
3 replicas per each soil

4 sampling points per column

2 Head Osbs. Tube

26 samples per week:

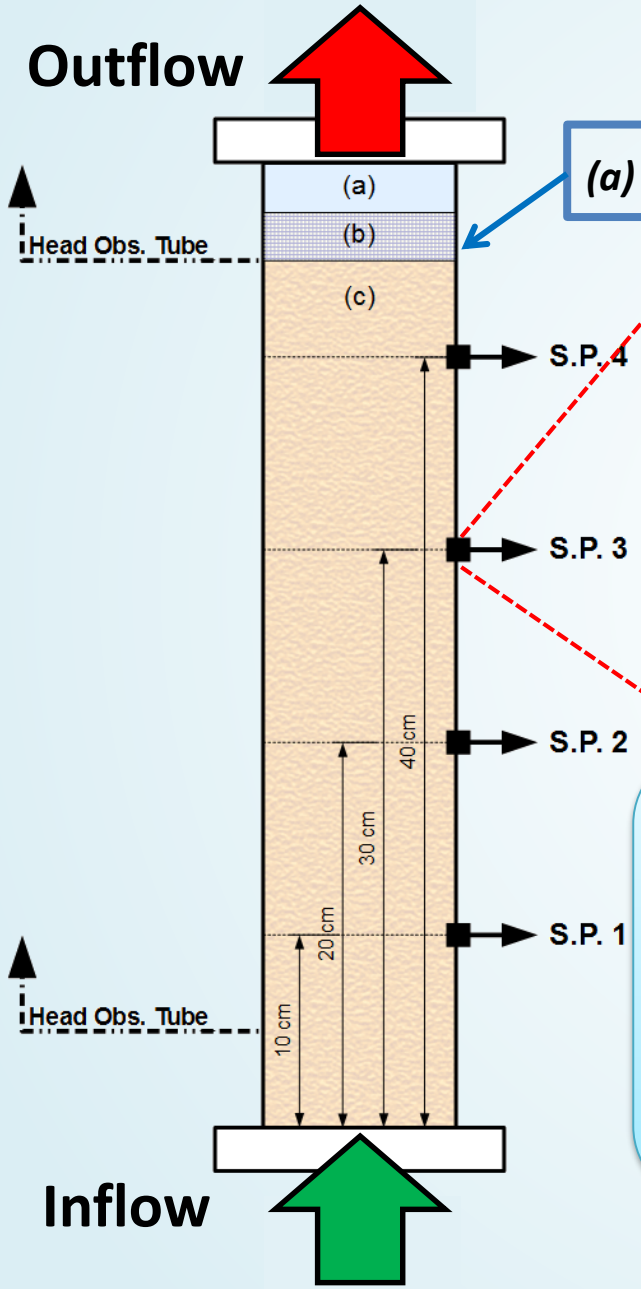
- pH and EC
- Major ions
- Nitrate, Nitrite, Ammonium
- Phosphate
- Iron and Manganese
- Inorganic and NPO Carbon



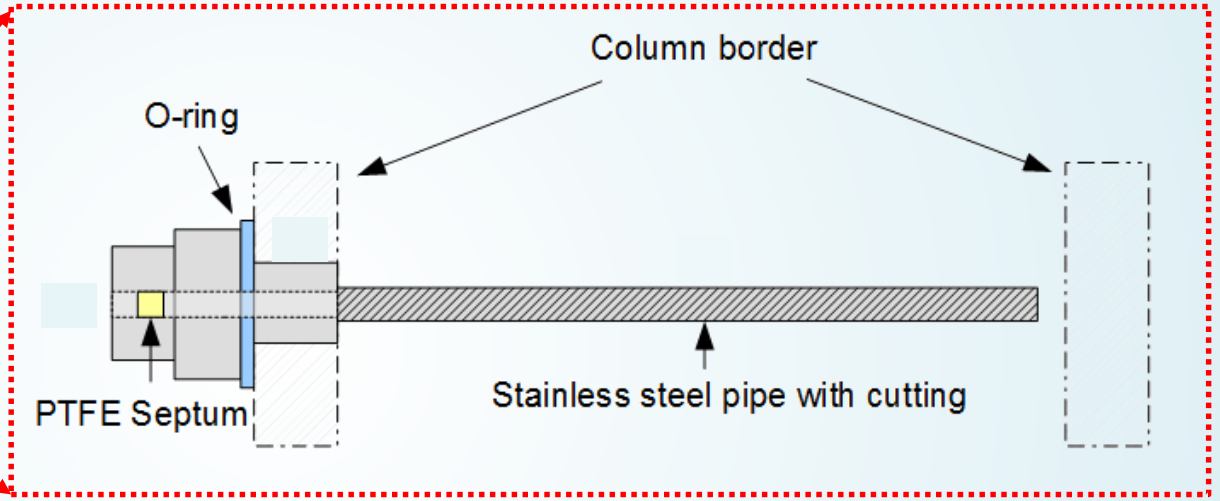
13 samples per week: *(starting from the 5th month)*

- Carbamazepine
- Diclofenac
- Terbuthylazine

Materials and Methods – *Column Design*



***(a)** Water Observation Screen; **(b)** Quartz Fine Sand Filter; **(c)** Soil*



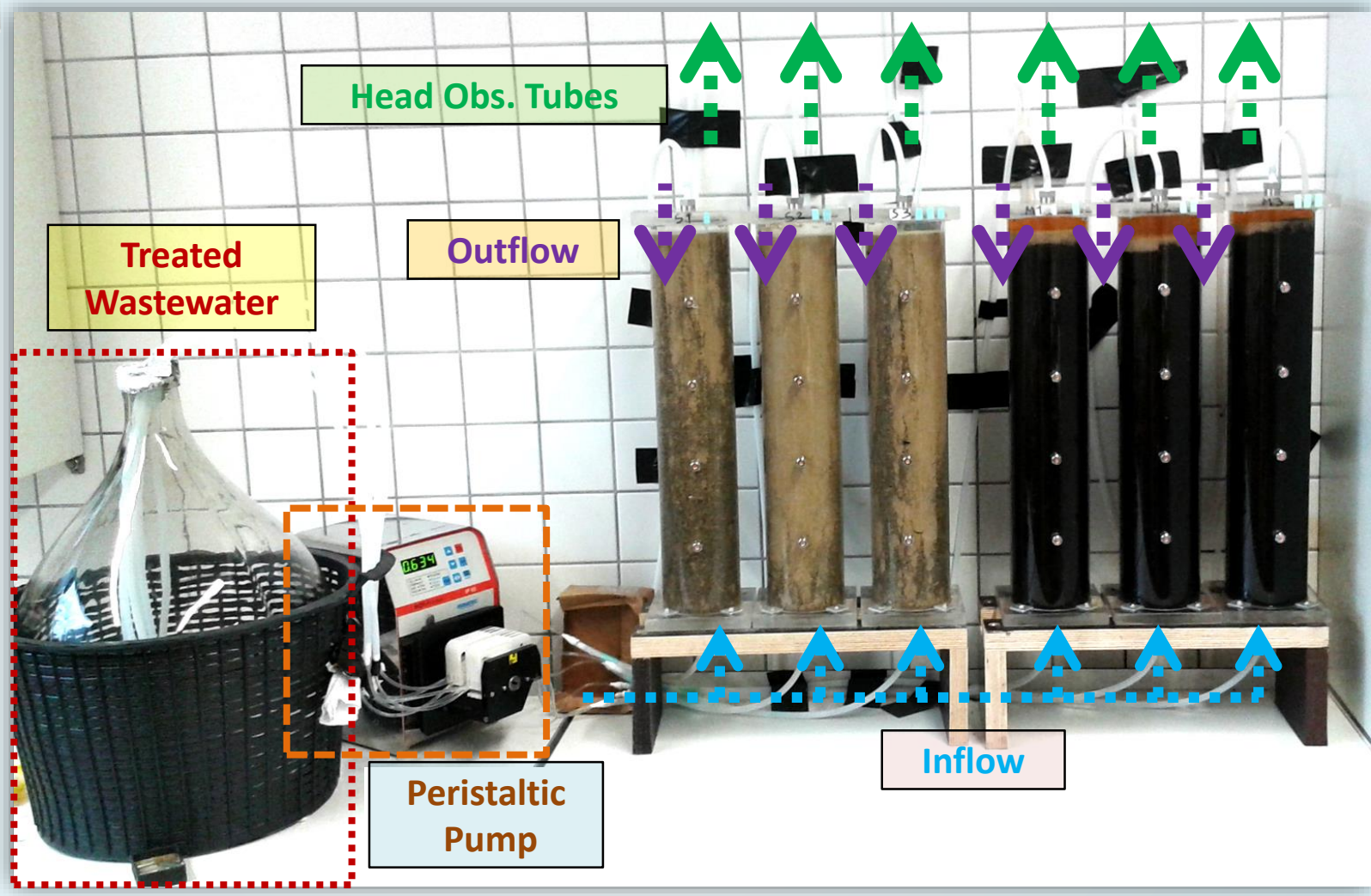
- Main Str. Material **PPMA**
- Total Column Length **50 cm**
- Internal Diameter **9 cm**
- Soil Total Thickness **45 cm**

Others:
PTFE
Stainless Steel

Bertelkamp et alii 2016; Burke et alii 2013; Hebig et alii 2014; Patterson et alii 2011; Rauch-Williams et alii 2010; Schaffer et alii 2012; Scheytt et alii 2006).

Materials and Methods – *Column Final Setup*

Column



Sampling Port

Materials and Methods – *Analytical Methods*

- Major ions
- Nitrate, Nitrite, Ammonium
- Phosphate

→ Ion Chromatography

- Iron and Manganese

→ Atomic Absorbance

- Inorganic and NPO Carbon

→ LiquiTOC ISO 8245

- Carbamazepine
- Diclofenac

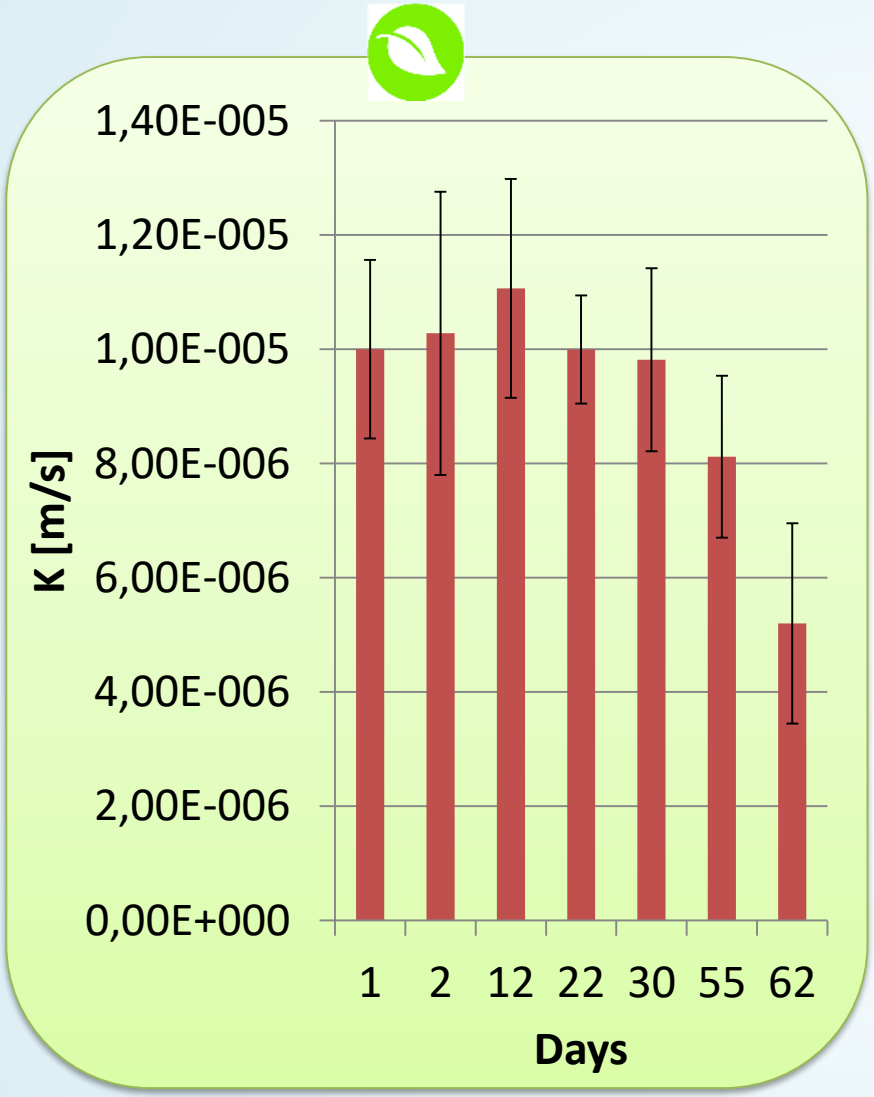
→ **Sample preparation** *(Xu et al., 2009)*
- Extraction with HyperSept C18
- Nitrogen blow-down
- Derivatization with MTBSTFA

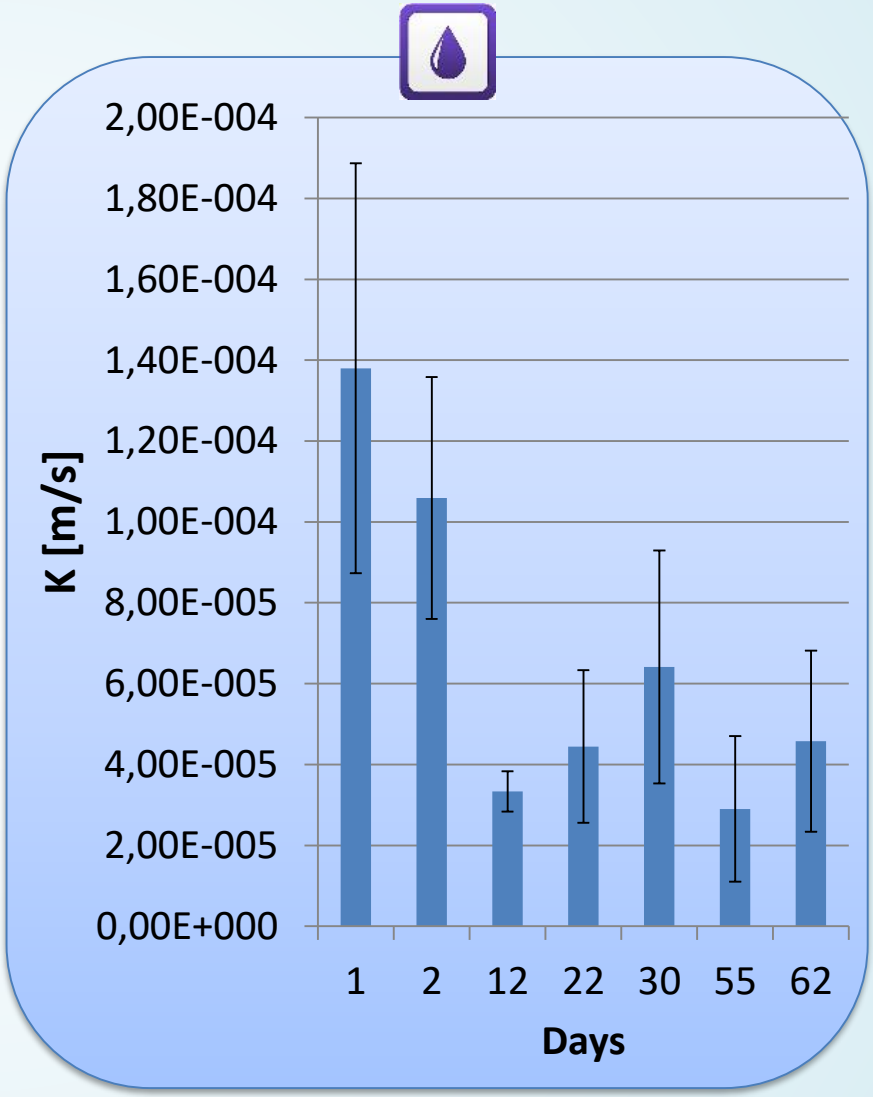
GS-MS analysis *(Durán-Alvarez et al. 2009)*
- He carrier
- scan range from m/z 50 to 500

Running the Test – *Inflow Quality*

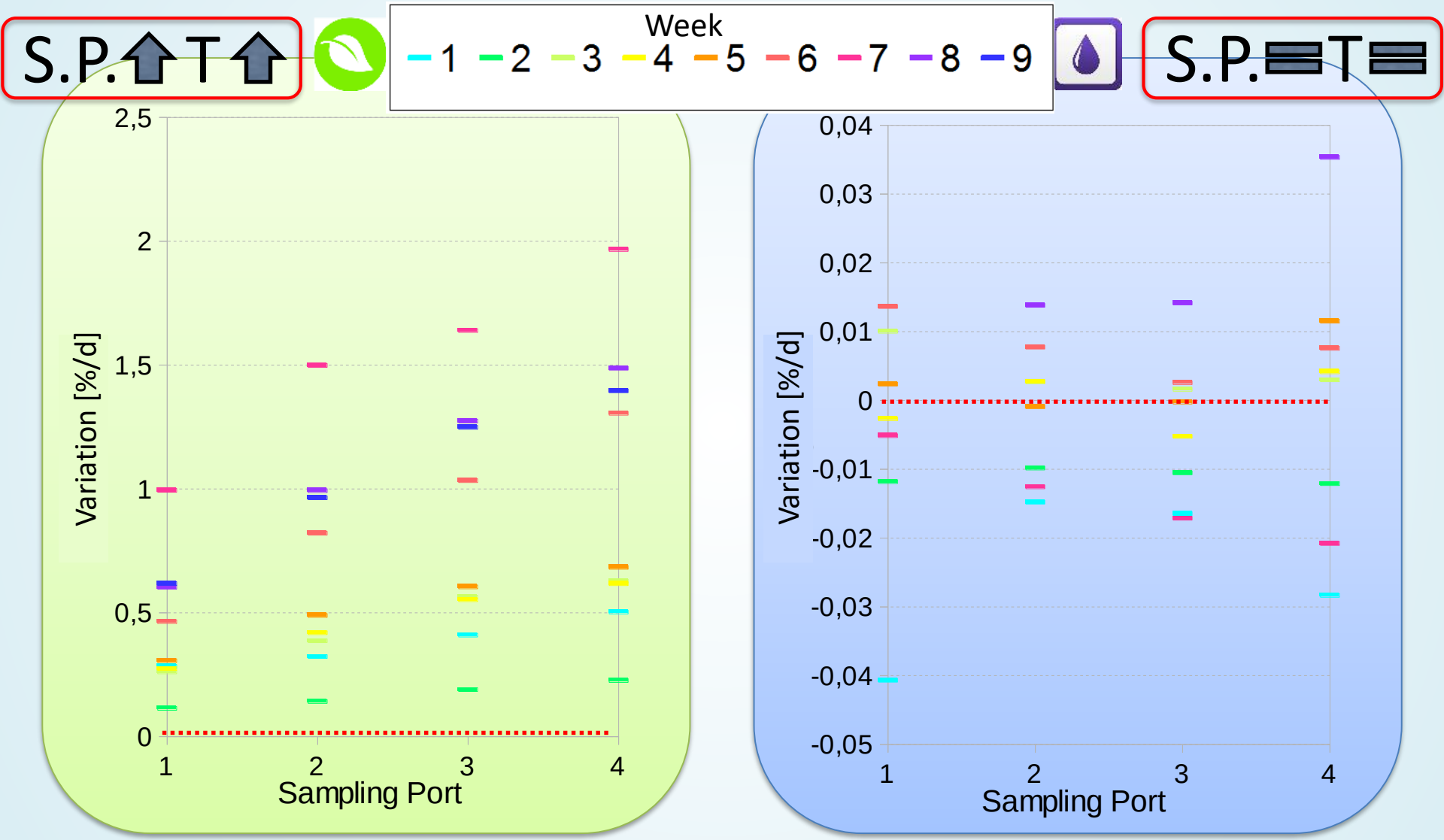
Water source quality, NOT constant during the test

Results – *Hydraulic Conductivity*





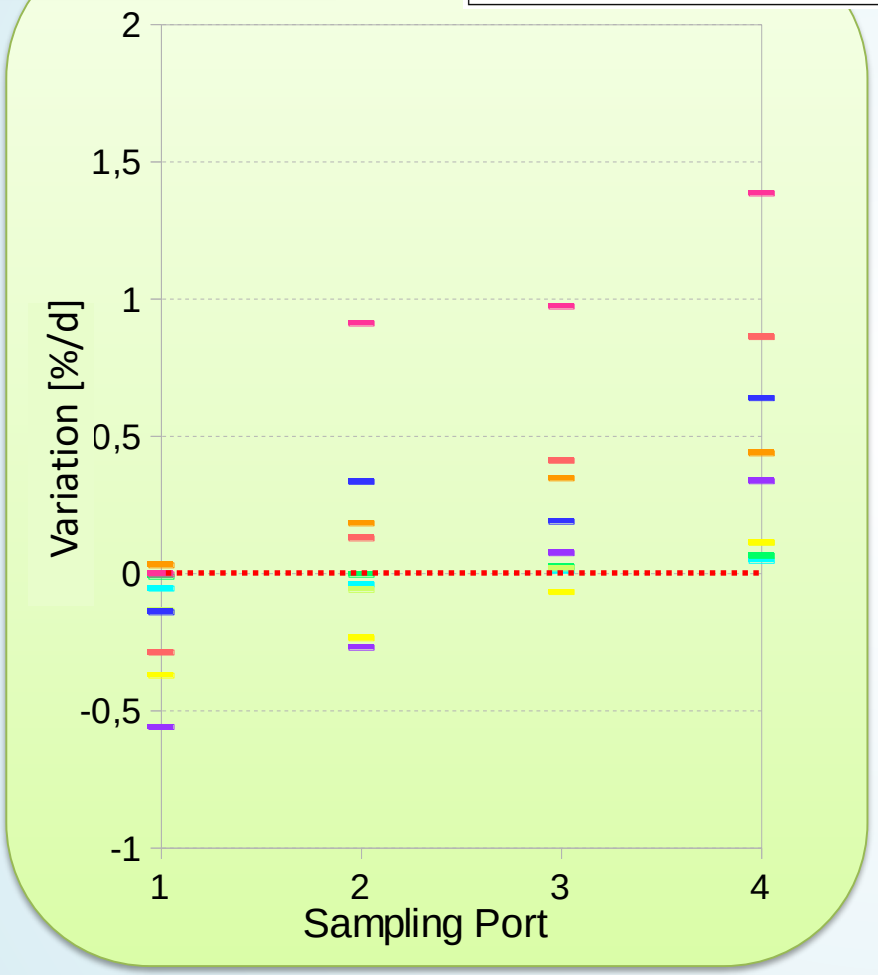
Results – *Ammonium*



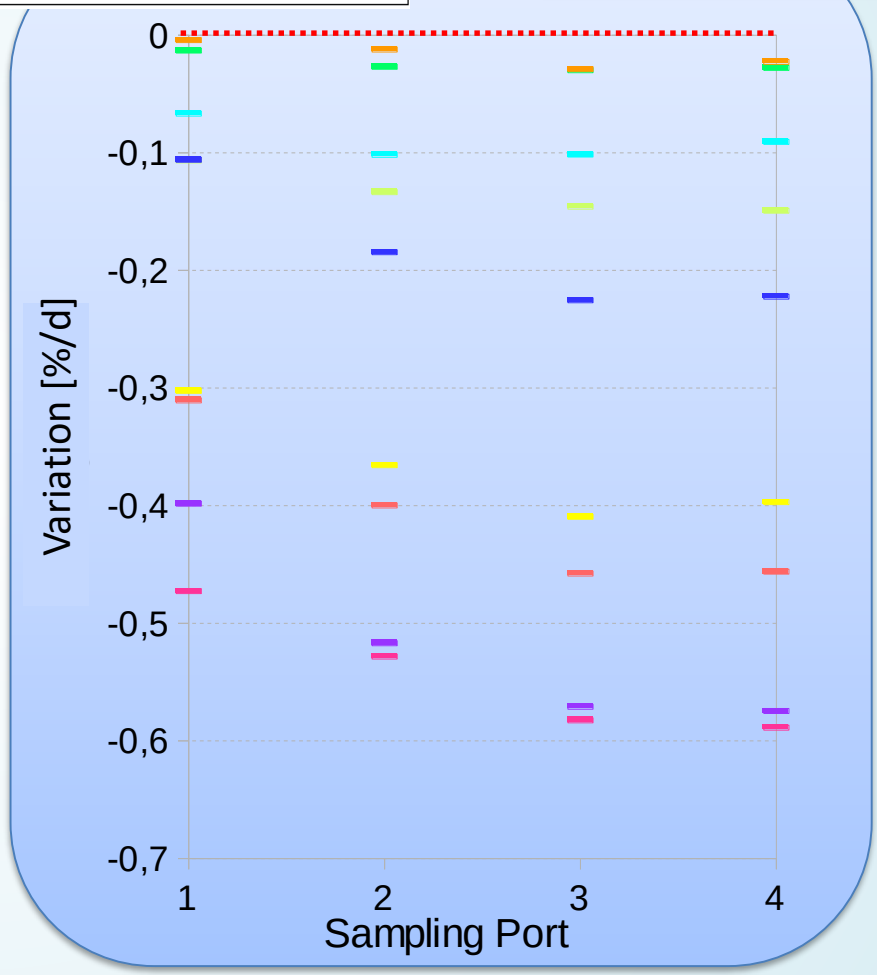
Results – *Phosphate*

S.P.↑T=

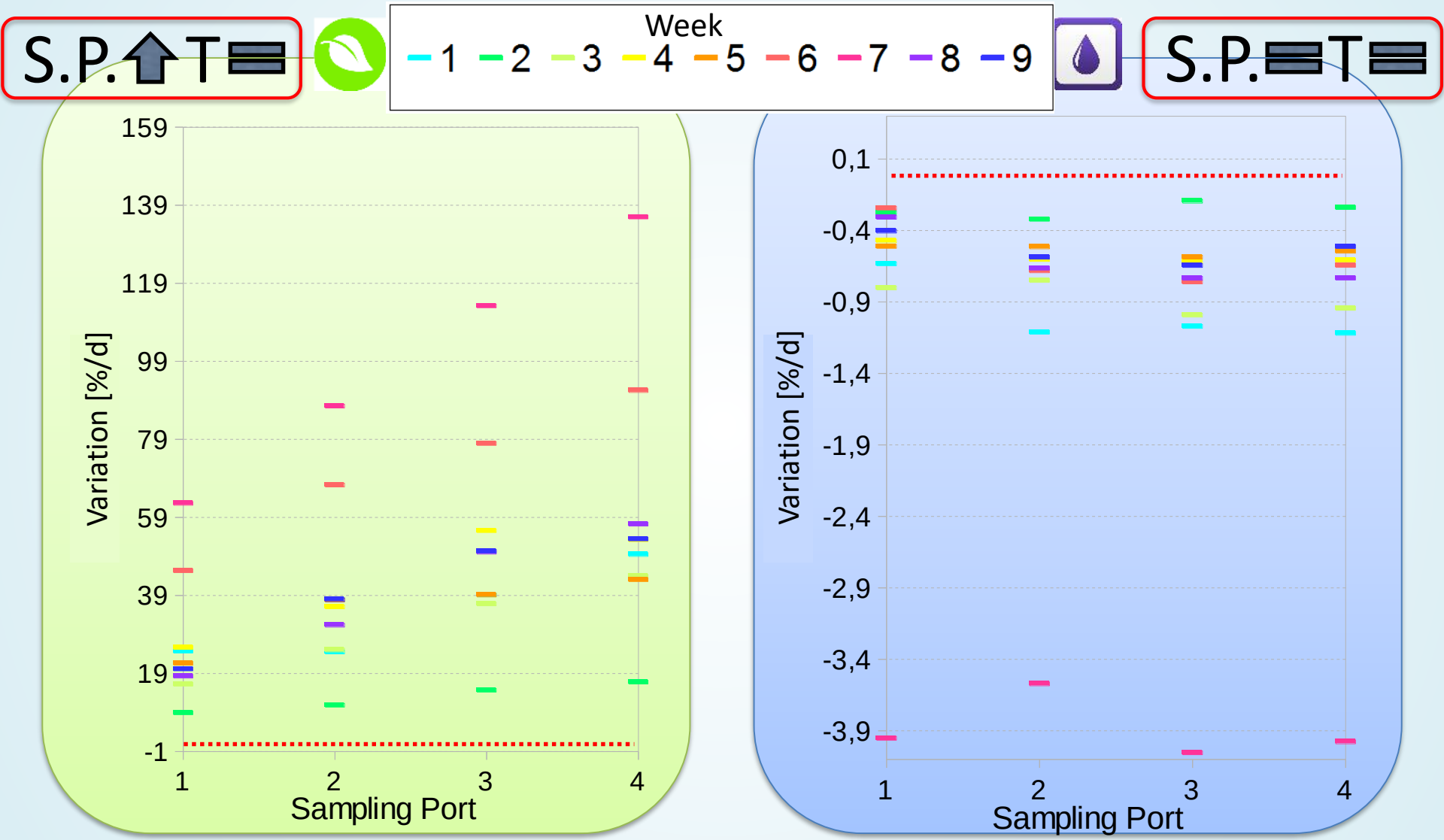
Week 1 2 3 4 5 6 7 8 9



S.P.↓T=

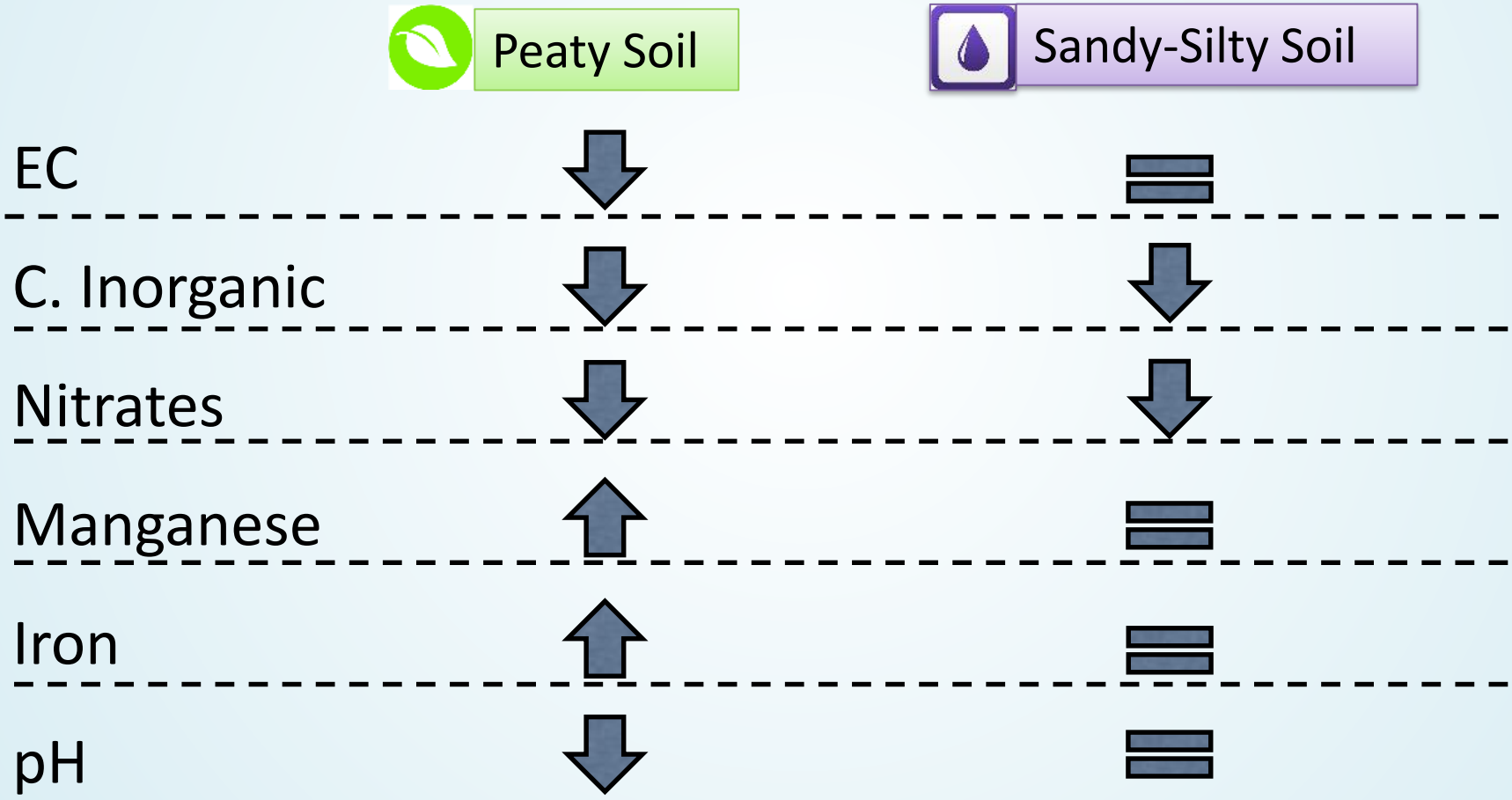


Results – *Non Purgeable Organic Carbon*

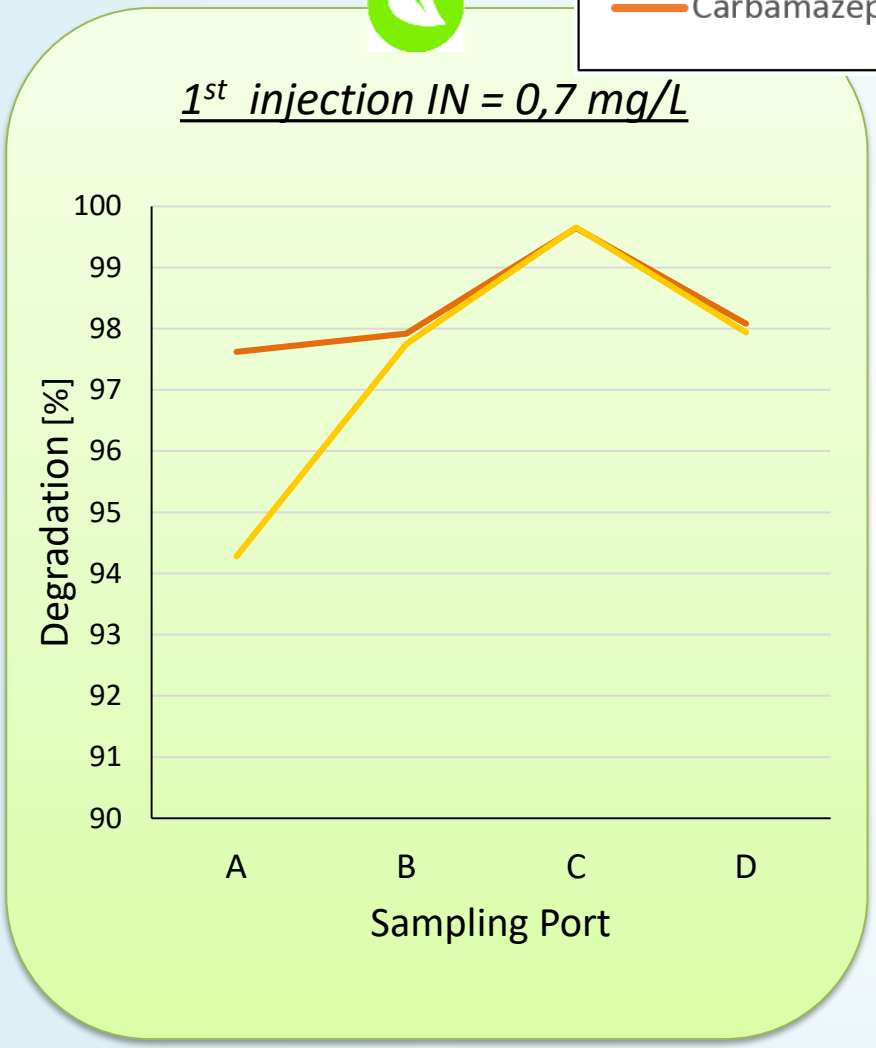


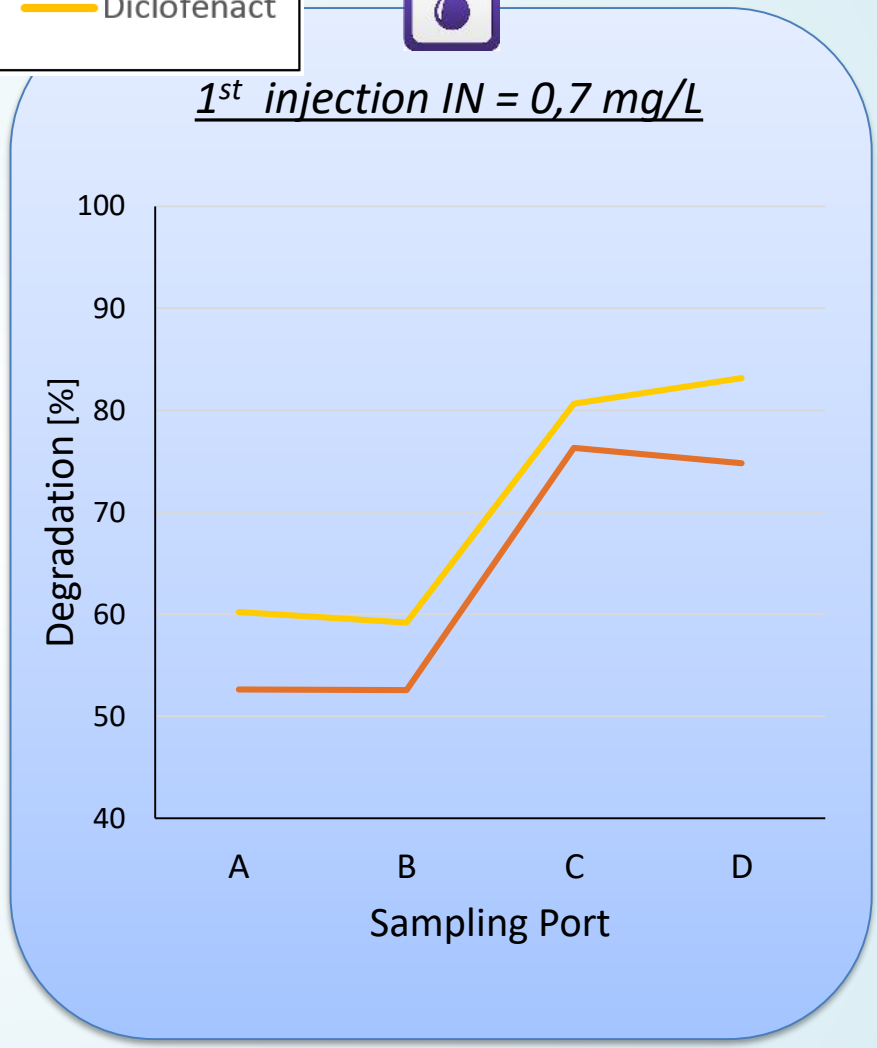
Results – *Others*

Changes along the column:



Results – *Pharmaceutical*





Conclusion

Although the chemical characteristics of soil represent only one over the many factors that play a role in the soil-water-plant continuum, they can strongly influence the water quality

- pH
- Organic Matter degradation
- Particle filter effect
- Cation Exchange Capacity

Soil characterization is important to achieve the expected performance of the MAR-SAT system

The test run so far demonstrate an high capability of the soil medium to remove CLA. e DIC. from the TWW. These promising outcomes allow to start controlled experimental field studies on removal of Pharms in the soil water plant continuum using not enriched TWW. This experiment is run within the Pharm-Swap Med project

Thanks for Your Attention!

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