



Quality characteristics of treated wastewater irrigated tomatoes

Anja Vehar, Doris Potočnik, Lidija
Strojnik, Ana Kovačič, Marina
Pintar, Nina Kacjan Maršič, David
Heath, Ester Heath, Nives Ogrinc

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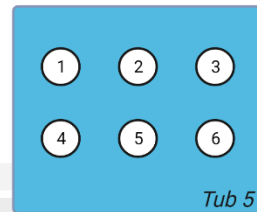
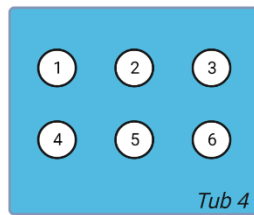
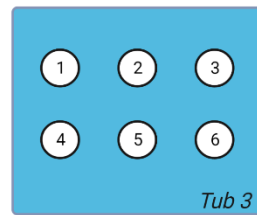
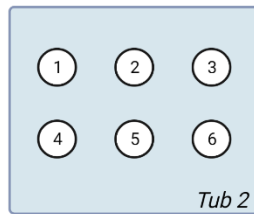
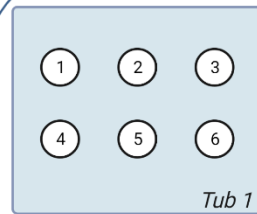
Experimental design

Hydroponics (soil-less)



Potable Water
+
Fertilizer
HPW

Potable Water
+
Fertilizer
+
CEC 0.1 mg/L
HSPW

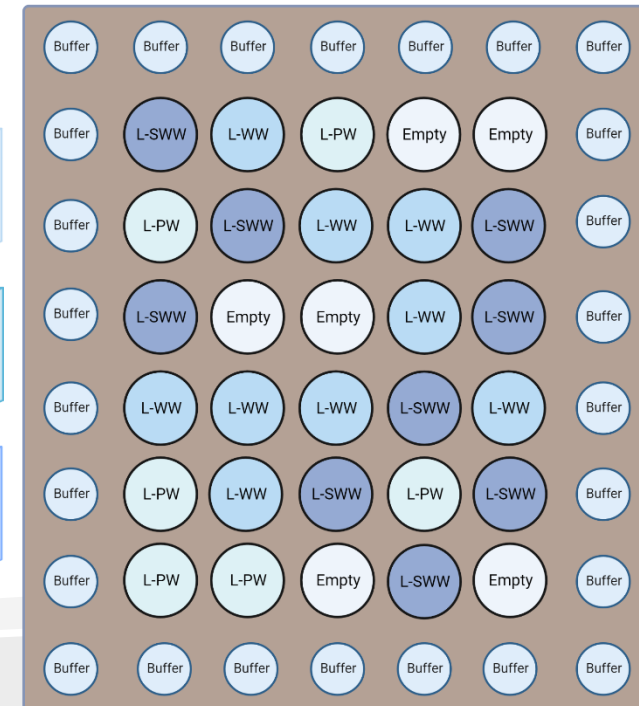


Lysimeters (soil)

Potable Water
LPW

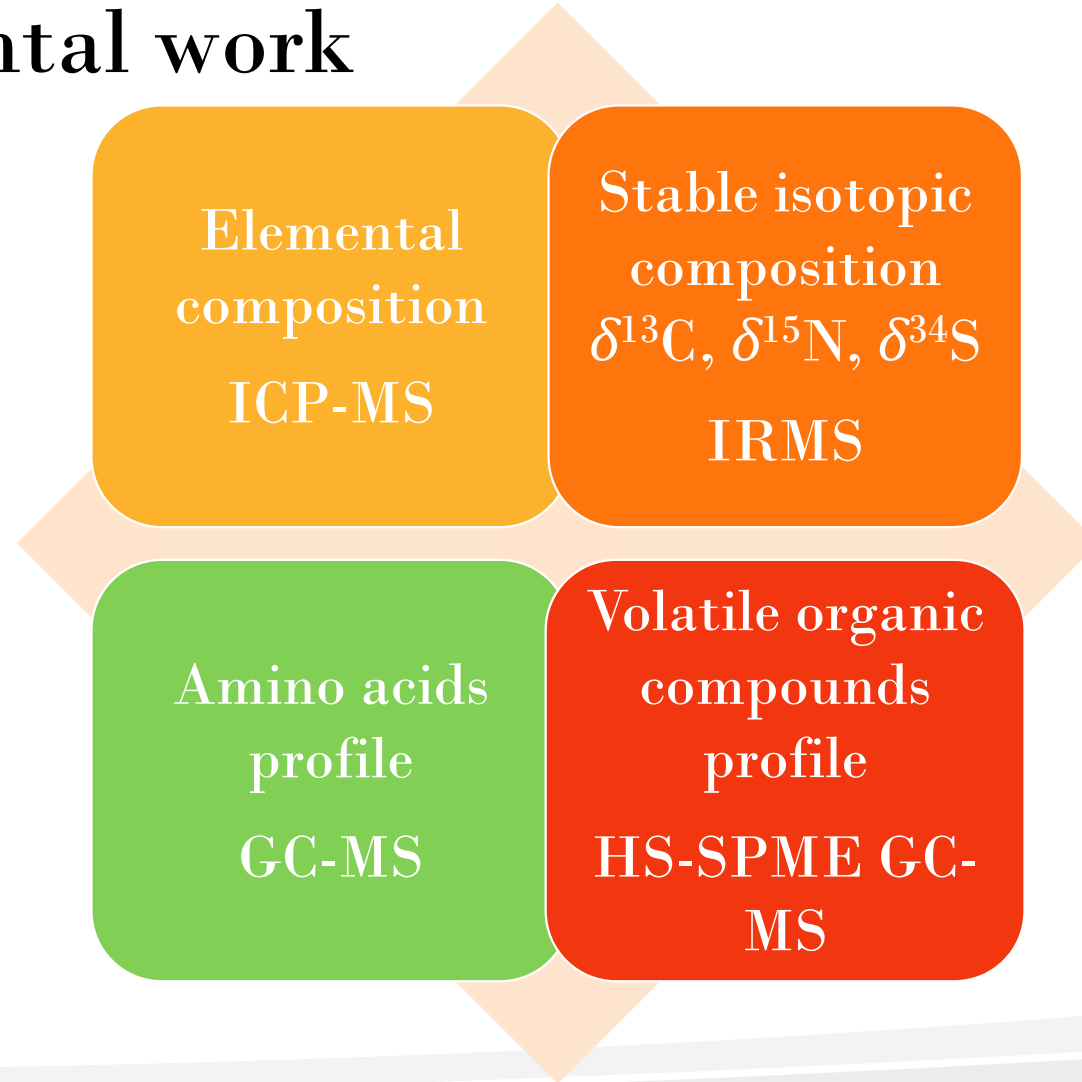
Wastewater
LWW

Wastewater
+
CEC 0.1 mg/L
LWW





Experimental work





Experimental work

- Different uptake according to different treatments
- Risk assessment

Elemental
composition
ICP-MS

Stable isotopic
composition
 $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$
IRMS

Amino acids
profile
GC-MS

Volatile organic
compounds
profile
HS-SPME GC-
MS



Experimental work

- Different uptake according to different treatments
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Elemental composition
ICP-MS

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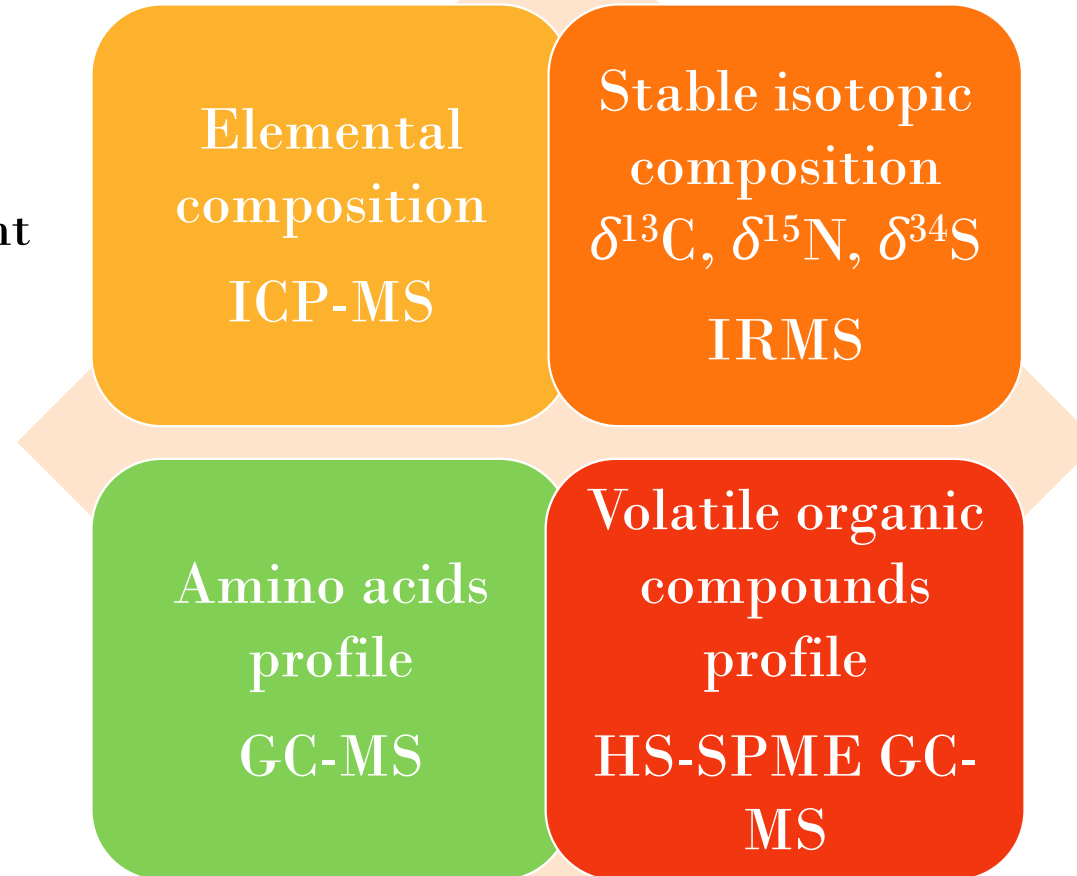
Amino acids profile
GC-MS

Volatile organic compounds profile
HS-SPME GC-MS

- Differentiation according to growing media and treatment

Experimental work

- Different uptake according to different treatments
- Risk assessment



- Differentiation according to growing media and treatment

QUALITY

- Do AA and VOCs profiles depend on the treatment?



Experimental work

Elemental
composition
ICP-MS

Stable isotopic
composition
 $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$
IRMS

Amino acids
profile
GC-MS

Volatile organic
compounds
profile
HS-SPME GC-
MS

Statistical analysis

- Hypothesis testing
- PCA, OPLS-DA



Elemental composition

* stands for $p < 0.05$

** for $p < 0.01$

*** for $p < 0.001$

	Element	Hydroponics	Lysimeters		Controls
		HPW vs. HSPW	LPW vs. LWW	LWW vs. LSWW	HPW vs. LPW
Macro elements	Mg	*			***
	P	***			***
	S	*			***
	Ca				**
	K				***
Micro elements	Al				**
	B		*		
	Ba				**
	Cu	***			***
	Fe				***
	Mn	***			***
	Mo				***
	Na		*		***
	Ni				***
	Rb				
	Sr				**
	Zn	***			***
Trace elements	Ag				**
	As				***
	Cd	***			**
	Co				***
	Cr				***
	Cs				**
	Hg				
	Pb				**
	Se				
	V				**

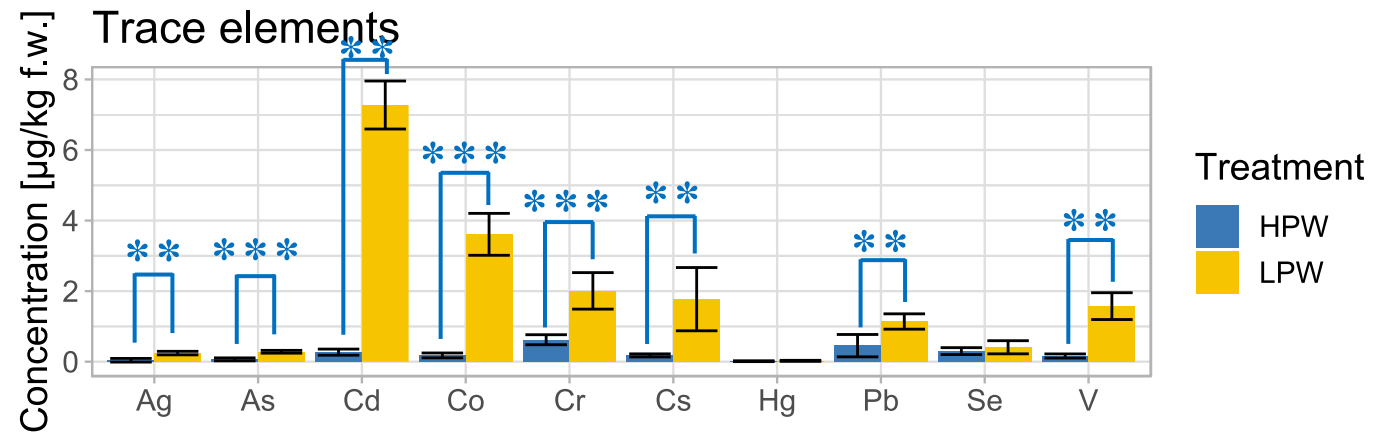
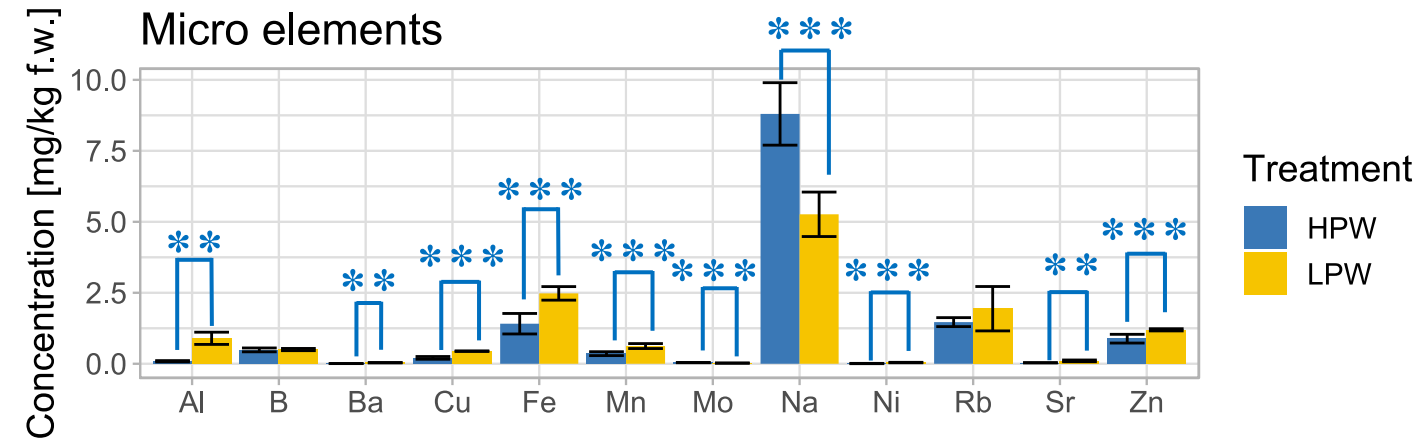
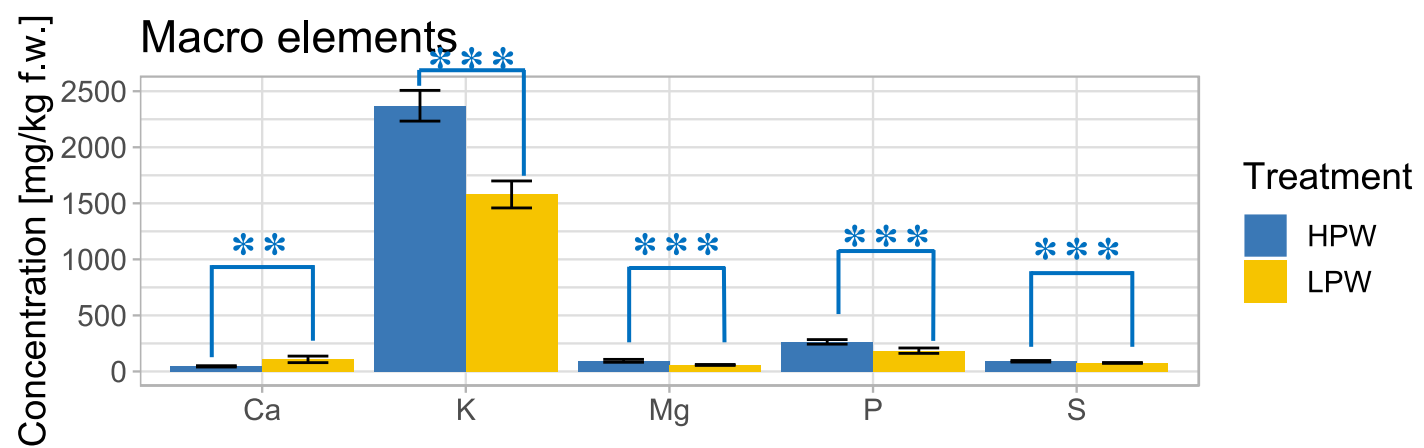


Elemental composition

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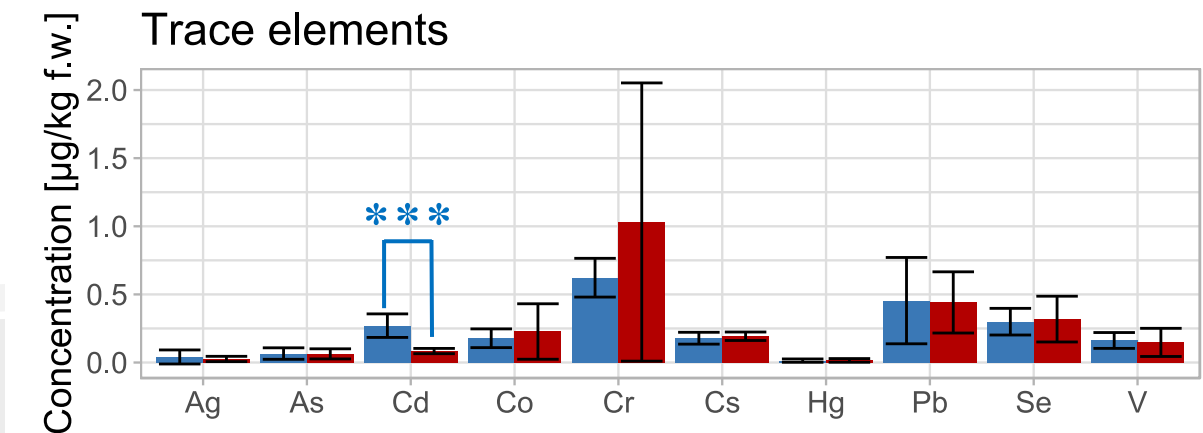
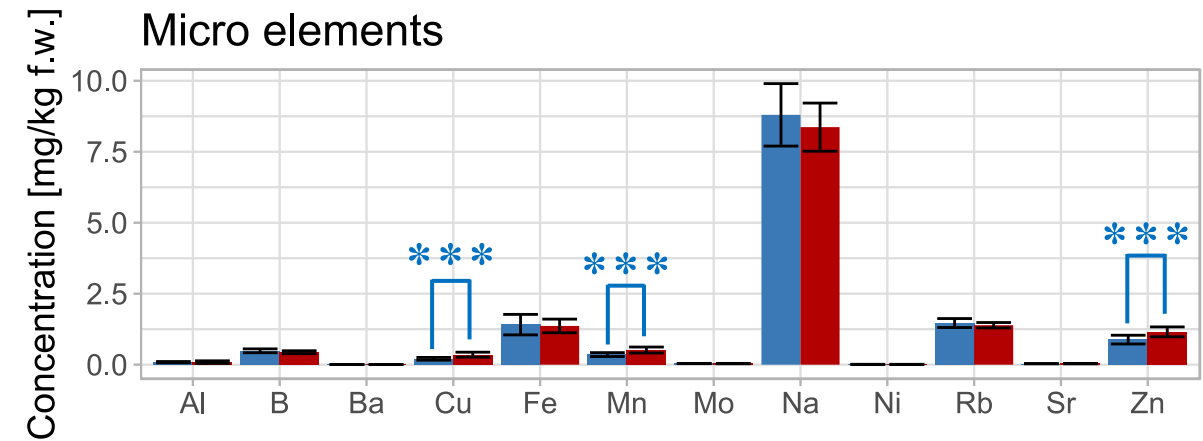
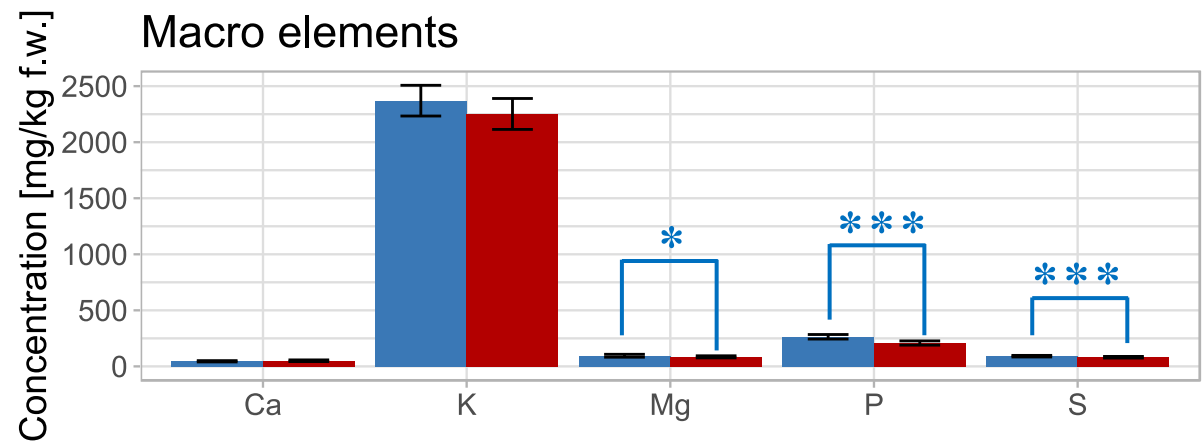


Elemental composition

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*** for $p < 0.001$



Stable isotopic composition of light elements

$\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$

	Hydroponics		Lysimeters		Controls	
	HPW vs. HSPW	LPW vs. LWW	LWW vs. LSWW	HPW vs. LPW		
$\delta^{15}\text{N}$	↓ ***	/	/	↓ ***		
$\delta^{13}\text{C}$	↑ ***	/	/	↑ ***		
$\delta^{34}\text{S}$	/	/	/	/		



Amino acids profile

	Hydroponics	Lysimeters		Controls
	HPW vs. HSPW	LPW vs. LWW	LWW vs. LSWW	HPW vs. LPW
alanine				***
glycine				
valine	*			
leucine	*			
isoleucine	*			
threonine				
4-aminobutanoic acid				
serine				*
proline				
aspartic acid	**			***
methionine	*			
hydroxyproline				
glutamic acid				**
phenylalanine				
lysine				
histidine				**
hydroxylysine				
tyrosine				

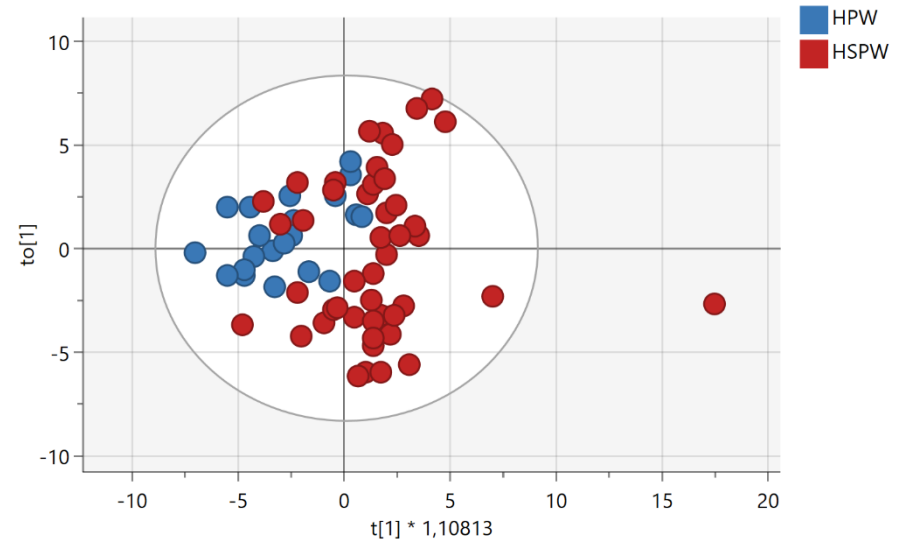
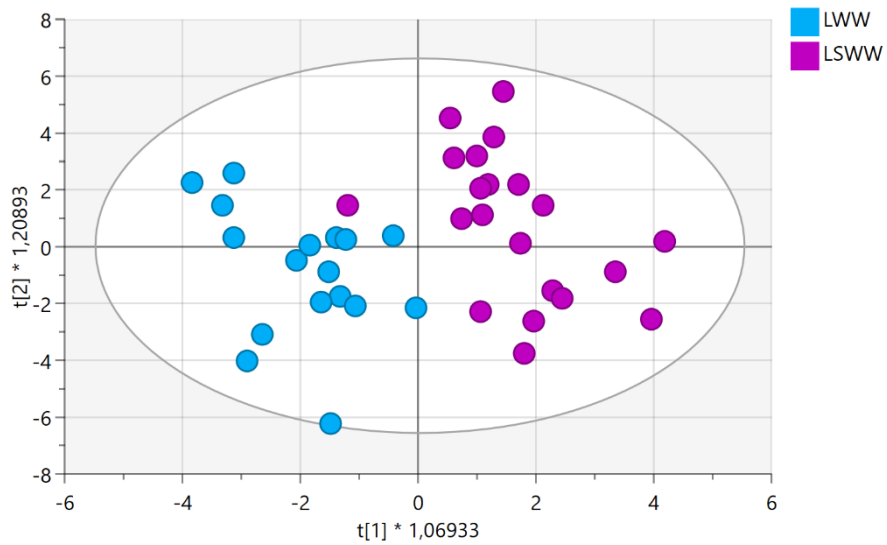
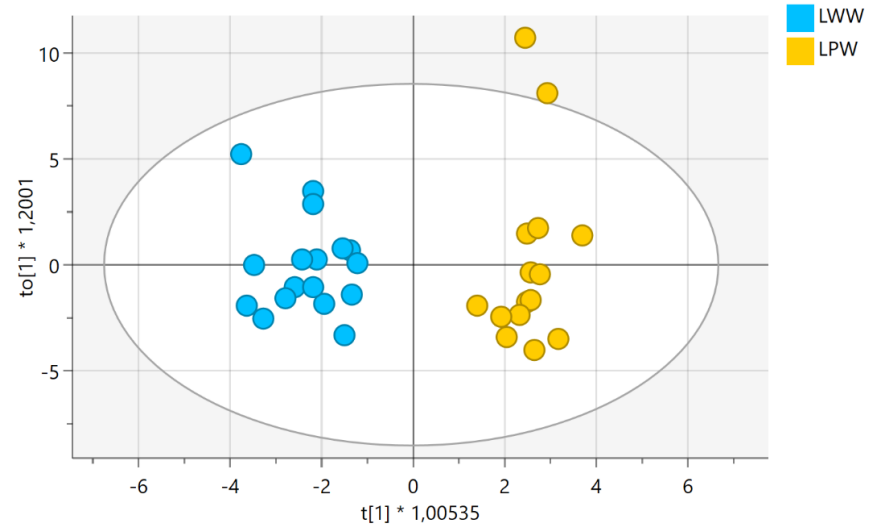
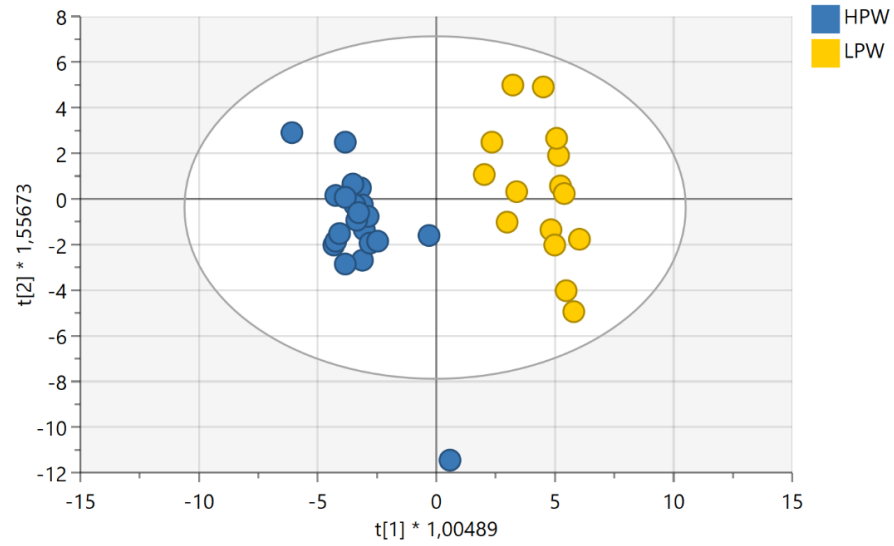


Volatile organic compounds profile

- 120 samples
- 140 identified VOCs
- Max proportion of total area: 22%
- 15 different VOCs above 5%

1	Methyl salicylate
2	Eugenol
3	5-Hepten-2-one, 6-methyl-
4	Phenol, 2-methoxy-
5	5,9-Undecadien-2-one, 6,10-dimethyl-, (E)-
6	Benzaldehyde
7	Citral
8	Terpinen-4-ol
9	2-Isobutylthiazole
10	2-Butenal, 3-methyl-
11	Acetoin
12	Benzene, (2-nitroethyl)-
13	Phenylethyl Alcohol
14	Hexanoic acid
15	6-Methyl-3,5-heptadiene-2-one

Volatile organic compounds profile



Conclusions

- Significant differences:
HPW vs. LPW,
HPW vs. HSPW,
LPW vs. LWW
- No health risk

Elemental
composition

Stable
isotopic
composition
 $\delta^{13}\text{C}$, $\delta^{15}\text{N}$,
 $\delta^{34}\text{S}$

- Fertilizer and its application has an impact on stable isotopic composition of $\delta^{15}\text{N}$
- CECs do change isotopic composition of tomatoes

- Tomato plants in lysimeters experienced more stress than in hydroponics
- CECs in hydroponics might have a negative influence on the quality of tomatoes

Amino acids
profile

Volatile
organic
compounds
profile

- Growing media and irrigation with treated wastewater have an impact on VOCs profile of tomatoes



Acknowledgments



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faculty

