FACULTY OF
BIOSCIENCE ENGINEERING

DEPARTMENT OF GREEN CHEMISTRY AND TECHNOLOGY
RESEARCH GROUP LIWET

A CONSTRUCTED WETLAND POPULATED WITH TYPHA AND VETIVER FOR GOLD MINE TAILING STORAGE FACILITIES SEEPAGE TREATMENT

Wendkuuni Florentin COMPAORE, Ann DUMOULIN, Diederik ROUSSEAU

GHENT UNIVERSITY

IsDB البنك الإسلامي للتنمية Islamic Development Bank

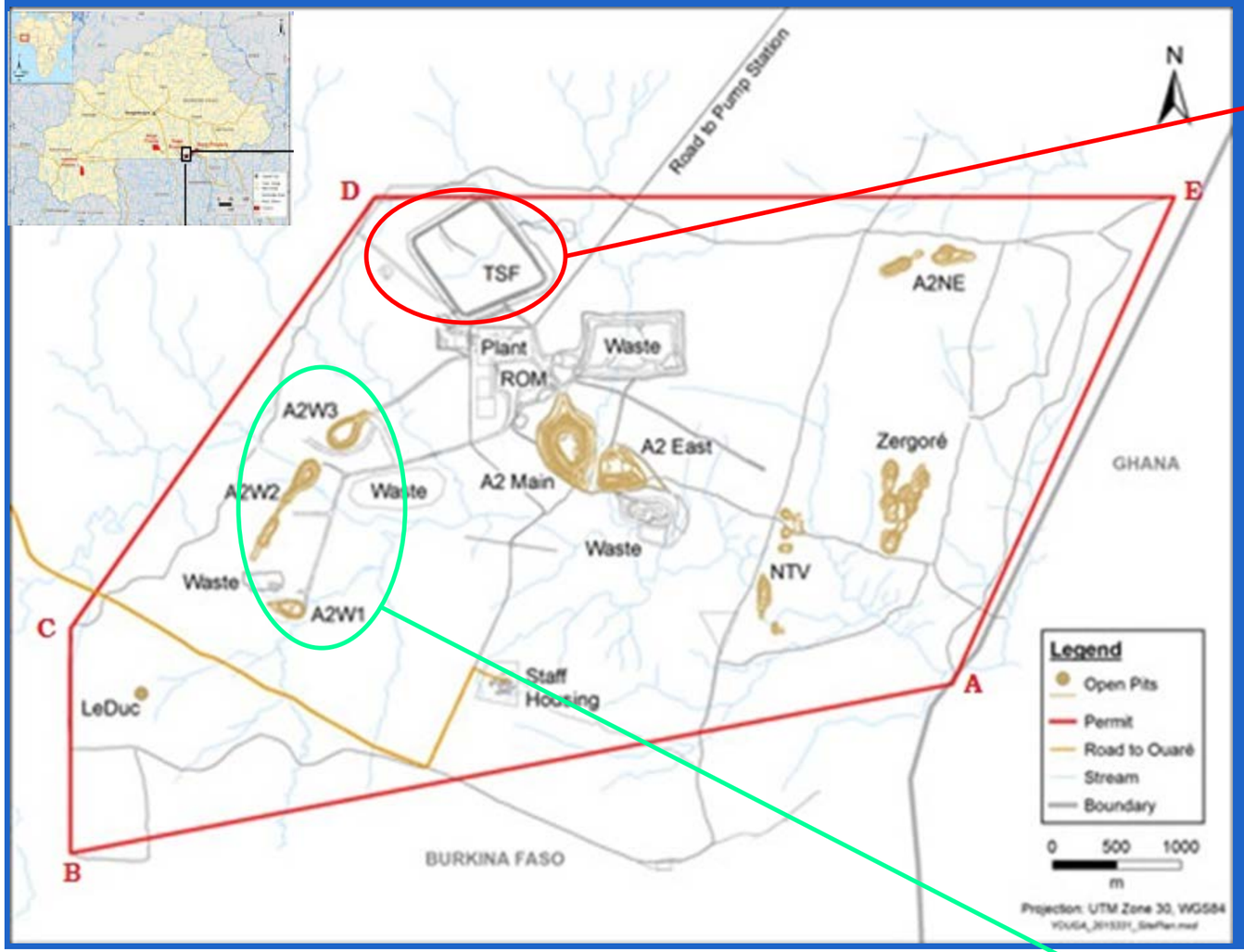
WETPOL 2019
AARHUS UNIVERSITY - DENMARK

8th International Symposium
On Wetland Pollutant Dynamics Control
17-21 June, 2019

SOLIDUM PETIT IN PROFUNDIS · UNIVERSITAS ARHUSIENSIS

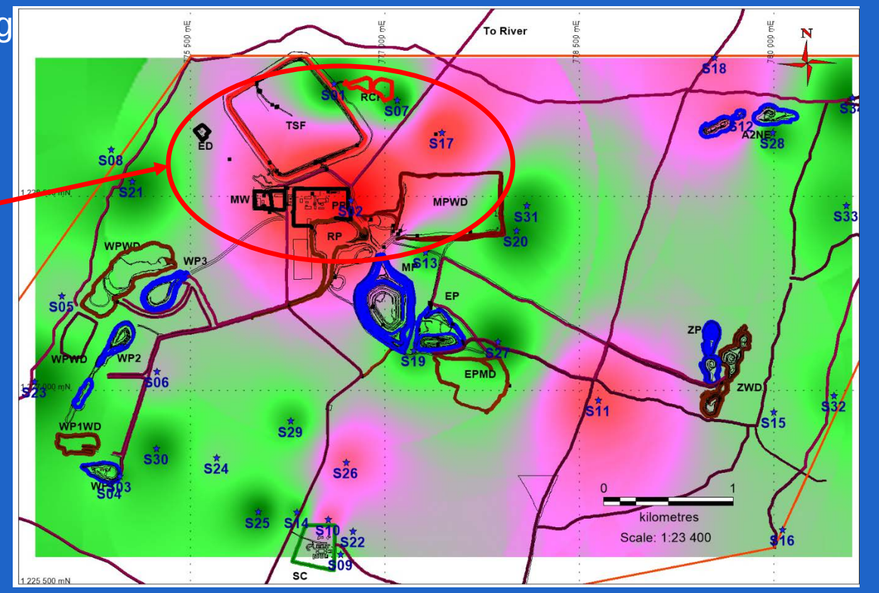
AARHUS UNIVERSITY

INTRODUCTION

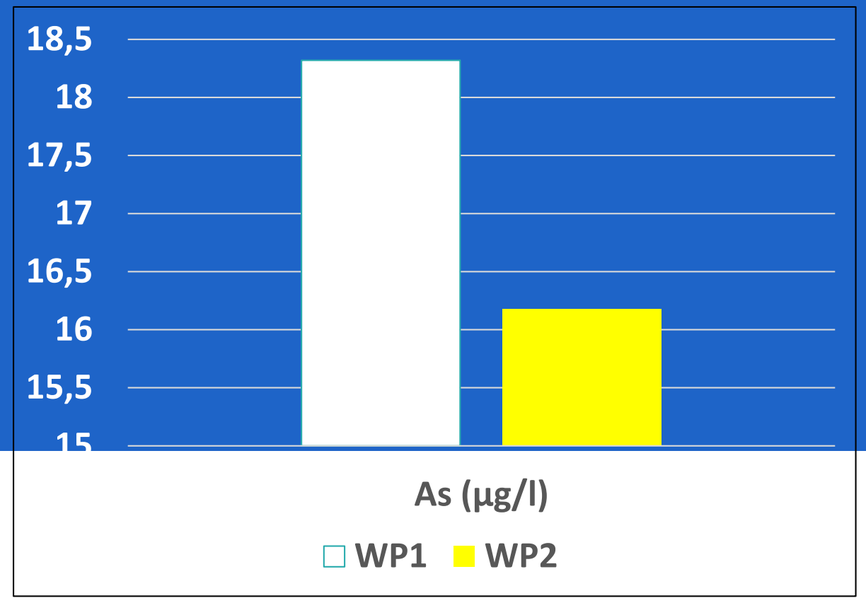


285 mg/kg

3 mg/kg



Soil trace elements (As) contamination map

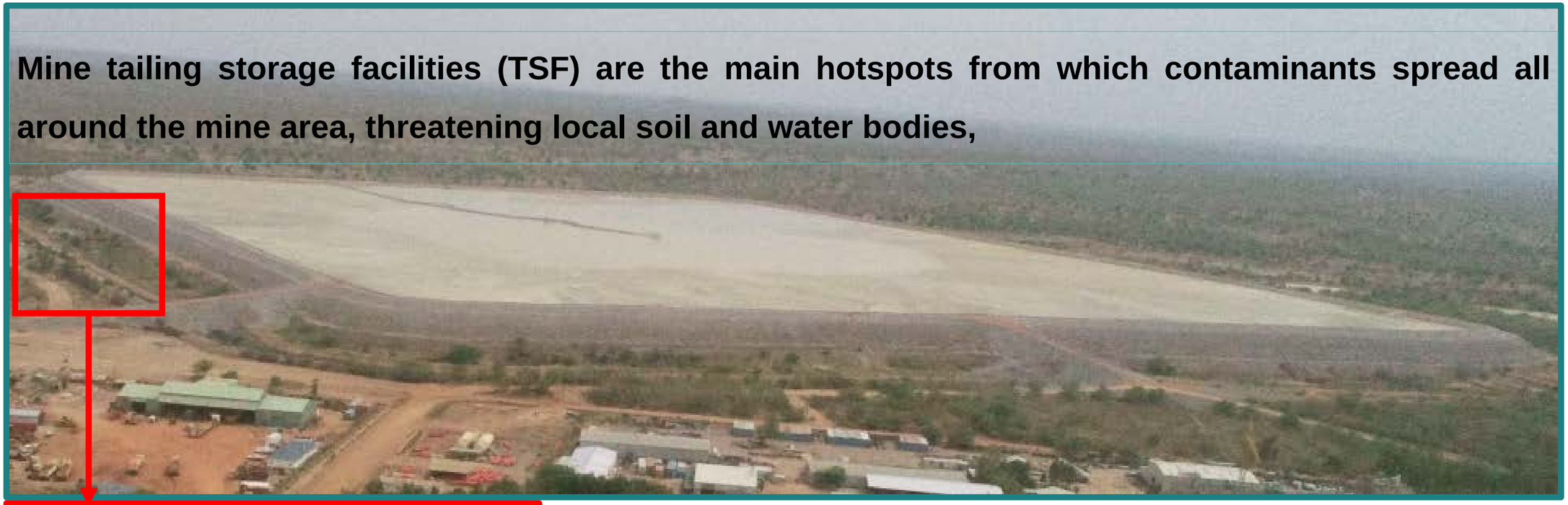


Water quality of pit lakes

GHENT UNIVERSITY

INTRODUCTION

Mine tailing storage facilities (TSF) are the main hotspots from which contaminants spread all around the mine area, threatening local soil and water bodies,



GHENT UNIVERSITY

INTRODUCTION

Objectives

Assess the ability of *Typha domingensis* and *Chrisopogon zizanioides* to mitigate trace elements before seepage reaches the environment (after the mining closure stage in which the TSF should be rehabilitated and erosion controlled).

Firstly, assess the ability of Typha and Vetiver to grow in this specific condition, based on their growth rate

Secondly, measure the trace elements uptake capability, using bioaccumulation factor, translocation factor and standing stock

Finally, compare the two species, and estimate a sustainable harvesting period for appropriate removal of trace elements

GHENT UNIVERSITY

METHODS

Experimental set up

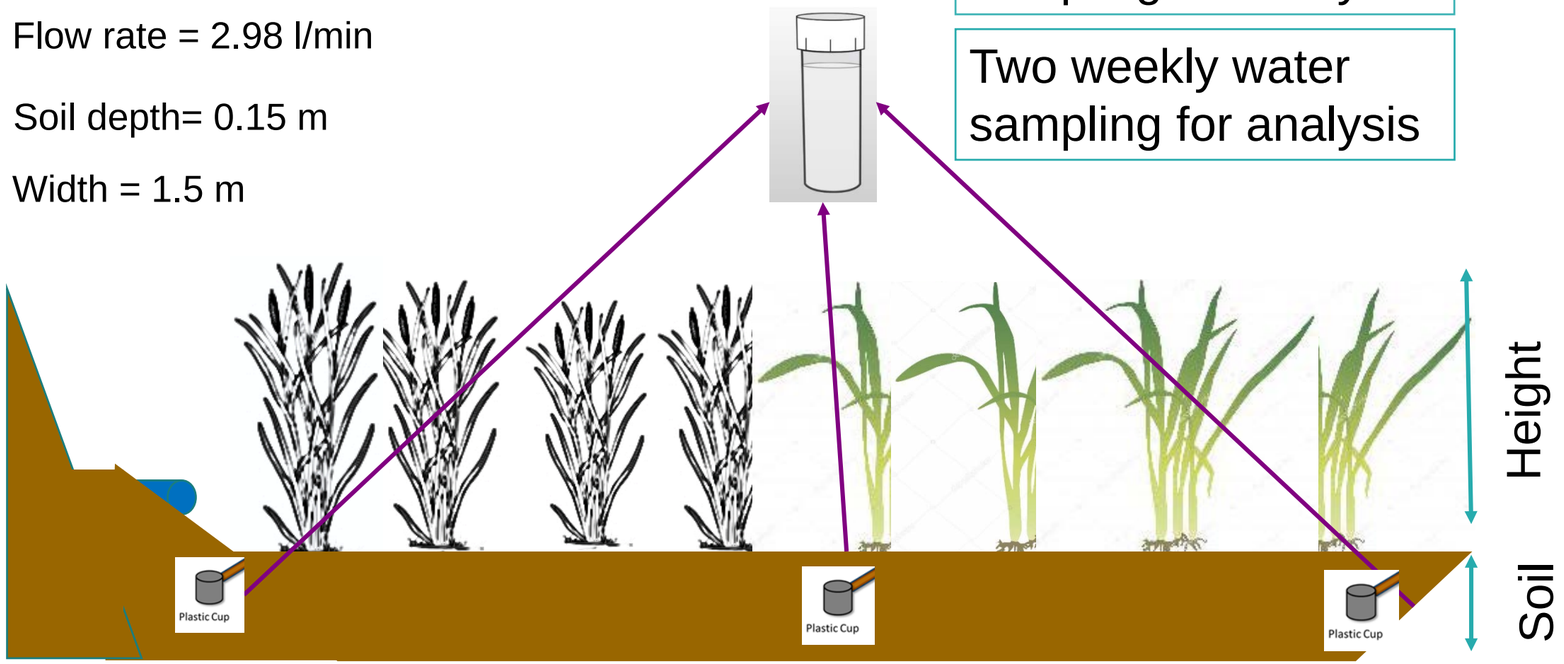
Flow rate = 2.98 l/min

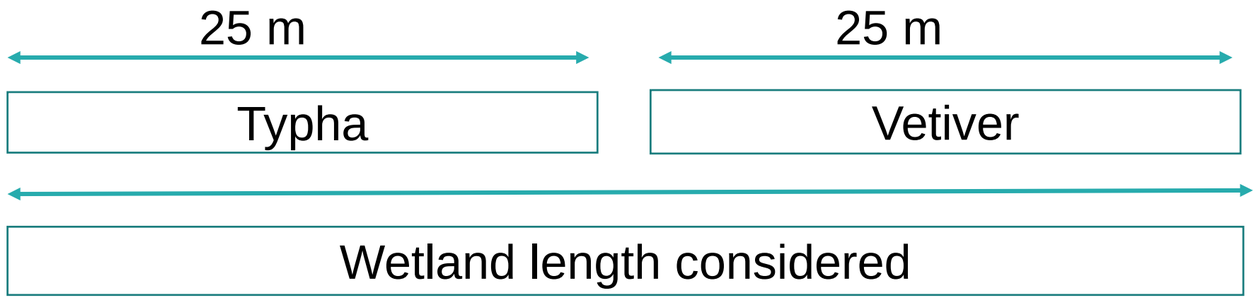
Soil depth= 0.15 m

Width = 1.5 m

Two weekly weed sampling for analysis

Two weekly water sampling for analysis





Humidity : 52%

Temperature : 32 °C

Evapotranspiration : 2827 mm

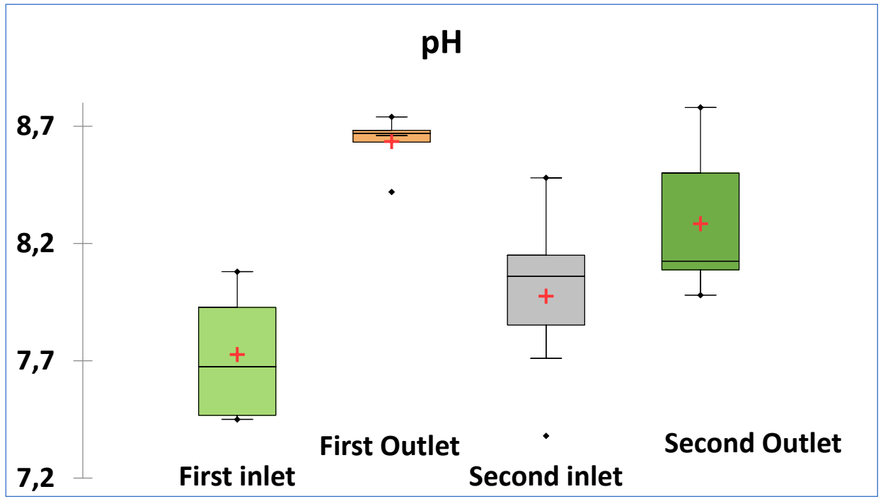
Rainfall : 1100 mm

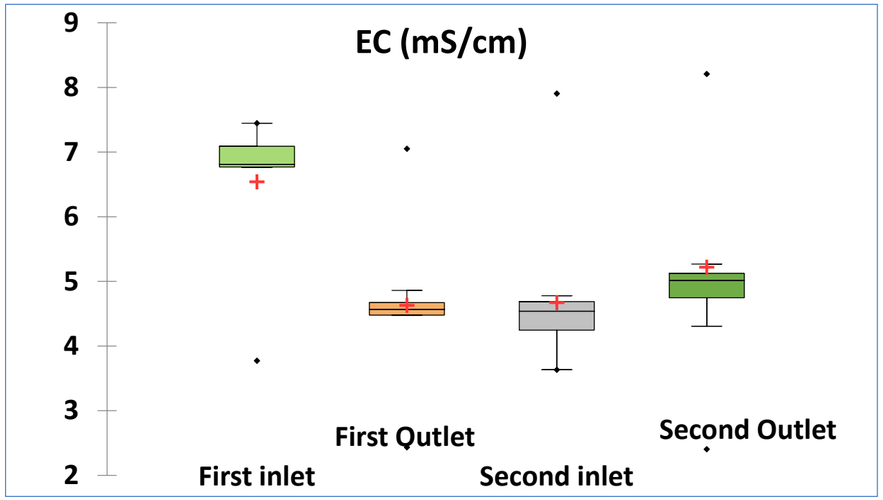
GHENT UNIVERSITY

Wetland populated with Typha (first cycle) and Typha and Vetiver (Second cycle).

RESULTS

Seepage quality





High EC, pH and TDS

Decrease in ORP, EC and TDS in first cycle (Typha),

No decrease in second cycle (Typha + Vetiver),

Designation		pH	ORP (mV)	DO (%)	EC (mS/cm)	TDS (g/l)	T°C (°C)
First Cycle	Inlet	7.73±0.26	147.87±70.47	69.36±11.44	6,54±1,12	3,28±0,56	27.92±1.56
	Outlet	8.64±0.10	7.46 ±55.37	146.49±46.7	4,63±1,24	2,07±0,67	32.64±1.45
Second Cycle	Inlet	7.98±0.34	-61.46±74.59	35.94±5.07	4,73±1,08	2,22±0,55	30.09±1.09
	Outlet	8.28±0.29	23.64±27.05	90.24±13.37	5,22±1,57	2,40±0,85	32.48±1.94

Mann-Whitney test p-values. Bold values mean significant difference. Bracket values mean increase %.

First inlet - outlet	**0.000**$^{(12\%)}$	**0.000**$^{(-95\%)}$	**0.000**$^{(111\%)}$	**0.012**$^{(-29\%)}$	**0.009**$^{(-37\%)}$	**0.000**$^{(17\%)}$
Second inlet - outlet	0.054$^{(4\%)}$	**0.000**$^{(138\%)}$	**0.000**$^{(151\%)}$	**0.024**$^{(10\%)}$	**0.005**$^{(8\%)}$	**0.005**$^{(8\%)}$

GHENT UNIVERSITY

RESULTS

Seepage quality (mg/l)

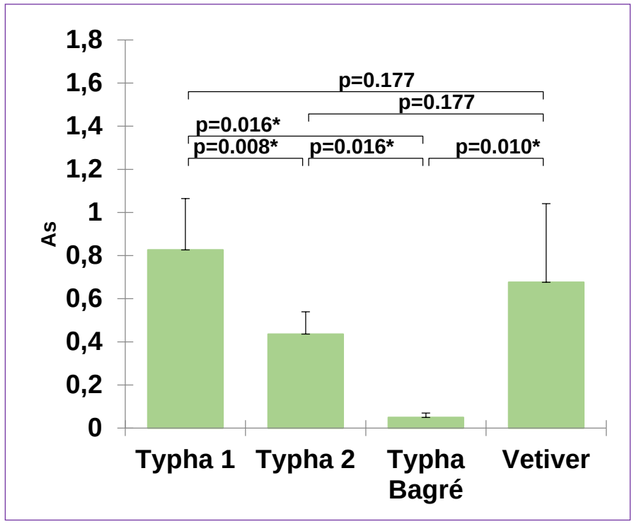
Statistic			As	Co	Cu	Mn	Ni	Pb	Zn
First cycle (n = 6)	Inlet	Mean	80.34	605.73	40.45	433.31	2.18	51.16	30.44
		Std	41.47	136.93	29.52	294.69	0.25	36.72	20.16
	Outlet	Mean	85.28	957.20	5.69	431.75	2.88	63.41	5.22
		Std	59.43	124.34	4.60	390.29	0.60	30.58	2.66
Second cycle (n = 9)	Inlet	Mean	111.44	363.89	9.44	408.89	<MDL	1.14	8.11
		Std	32.95	270.33	3.40	189.15		0.38	2.42
	Outlet	Mean	81.56	330.00	10.33	396.00	<MDL	1.13	10.50
		Std	44.02	229.67	3.57	179.79		0.35	3.63

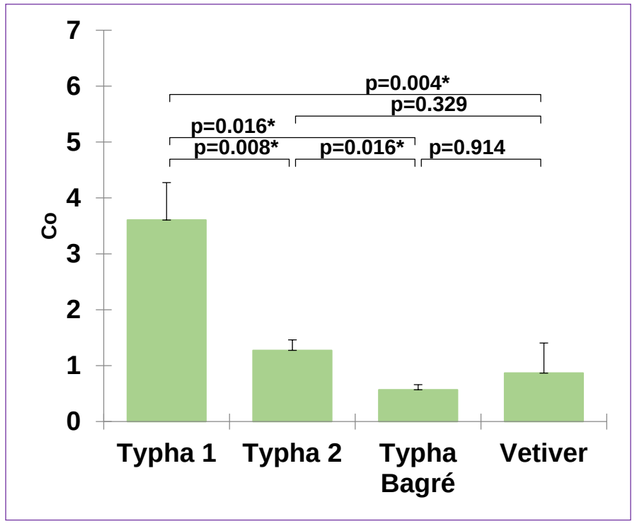
Variable\Test	As	Co	Cu	Mn	Ni	Pb	Zn
First inlet-first outlet	0.937	**0.004**	0.095	0.699	0.063	0.589	**0.016**
First inlet-second inlet	0.170	0.088	0.134	0.955	< **0.000**	**0.002**	**0.006**
First outlet-second outlet	0.840	**0.000**	0.091	0.689	< **0.000**	**0.001**	**0.019**
Second inlet-second outlet	0.142	0.796	0.496	0.931		< **0.000**	0.131

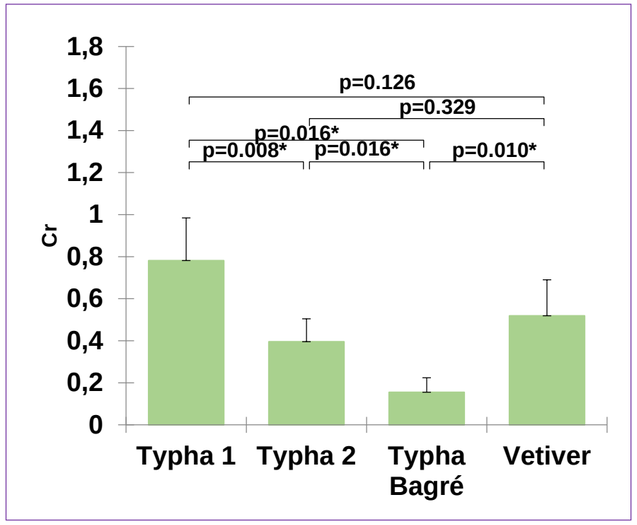
Mann-Whitney test p-values of water MTE levels in inlet and outlet seepage during the two cycles of experimentation. Bold values mean significant difference

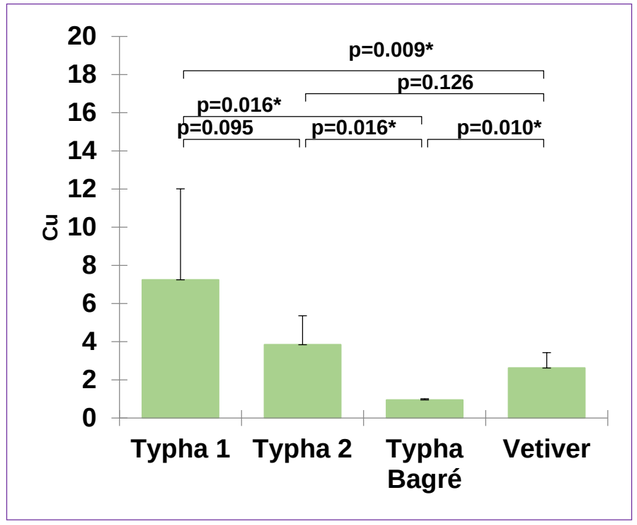
GHENT UNIVERSITY

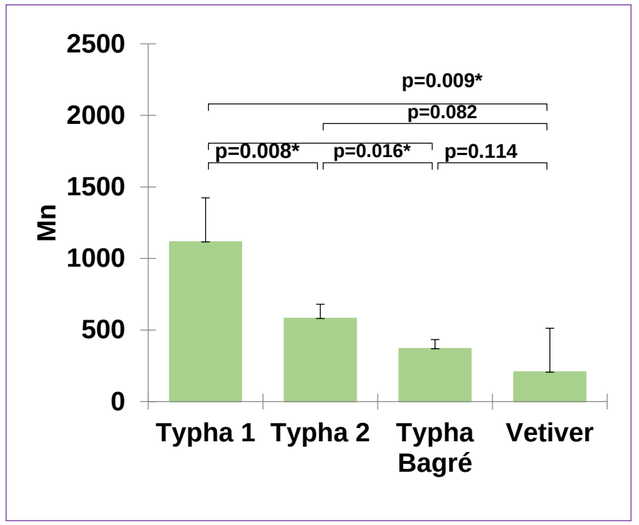
RESULTS

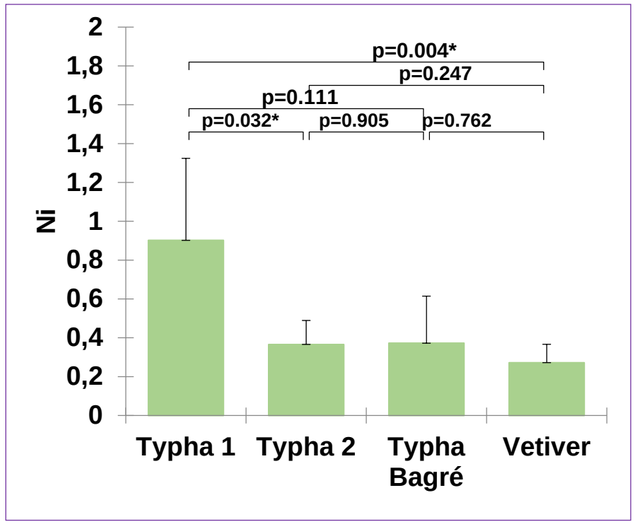


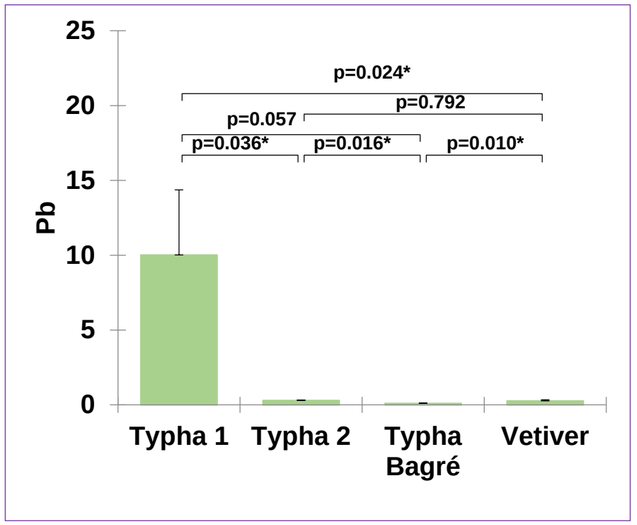


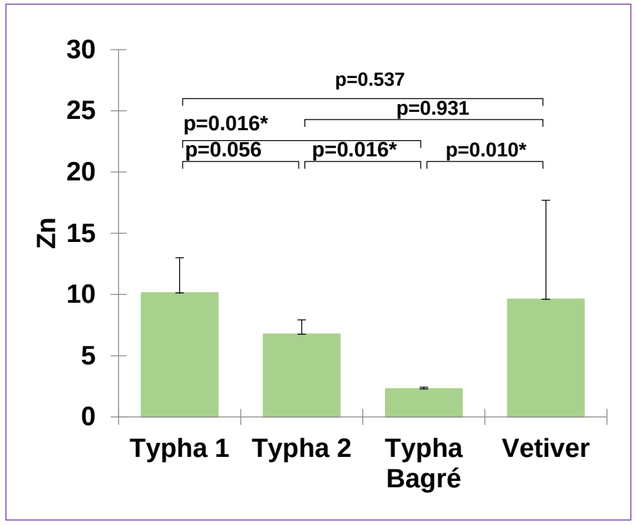












GHENT UNIVERSITY

AVERAGE TRACE ELEMENTS IN TYPHA AND VETIVER (MG/KG)

RESULTS

Differences in trace element uptake

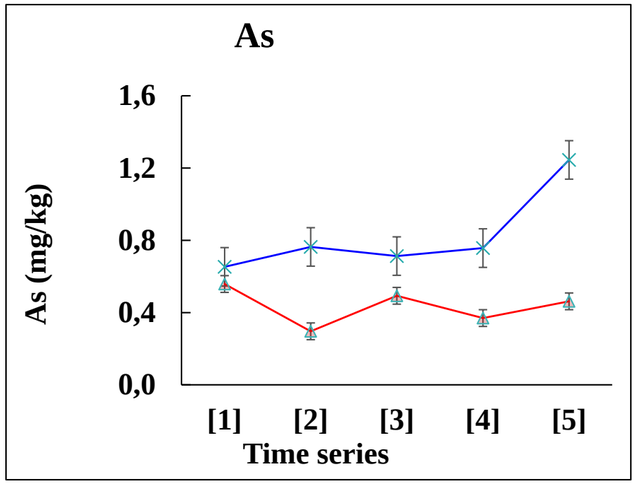
Variable\Test	As	Co	Cr	Cu	Mn	Ni	Pb	Zn
Typha 1-Typha 2	**0.008**	**0.008**	**0.008**	0.095	**0.008**	**0.032**	**0.036**	0.056
Typha 1-Typha Bagré	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	0.111	0.057	**0.016**
Typha 2-Typha Bagré	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	0.905	**0.016**	**0.016**
Typha 2-Vetiver	0.177	0.329	0.329	0.126	0.082	0.247	0.792	0.931

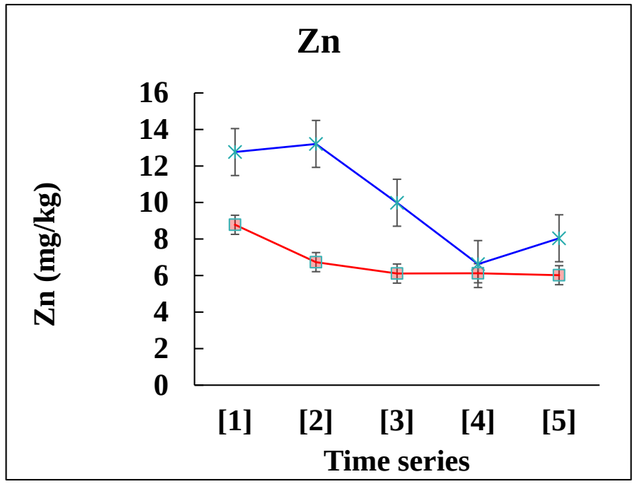
Mann-Whitney test p values; bold values stand for significant differences

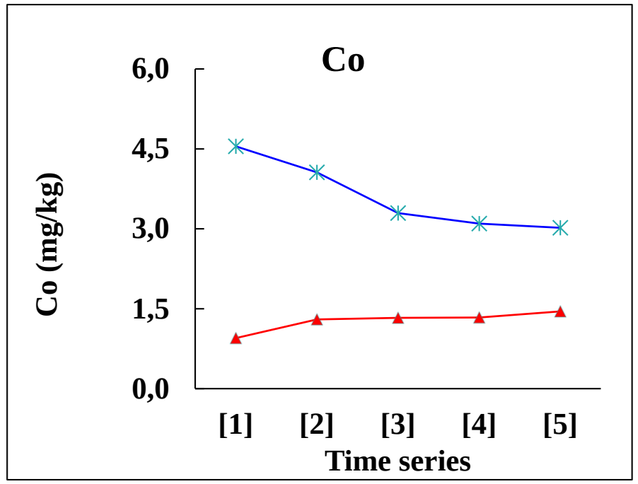
GHENT UNIVERSITY

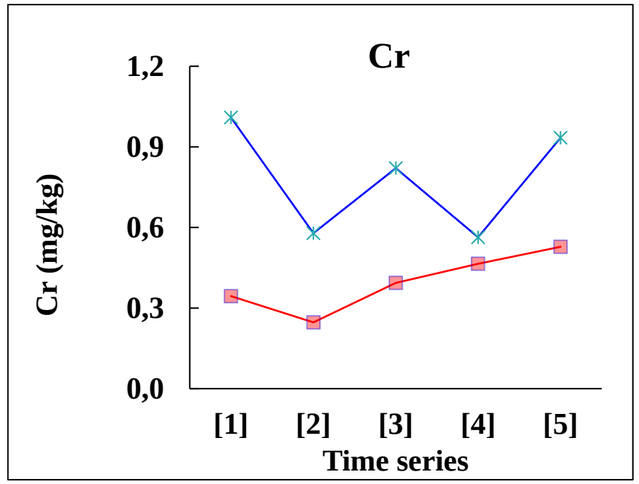
RESULTS

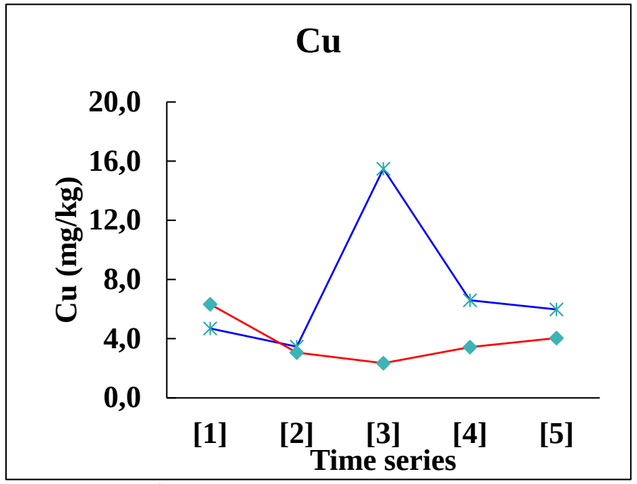
Trace element content evolutions in Typha (mg/kg)

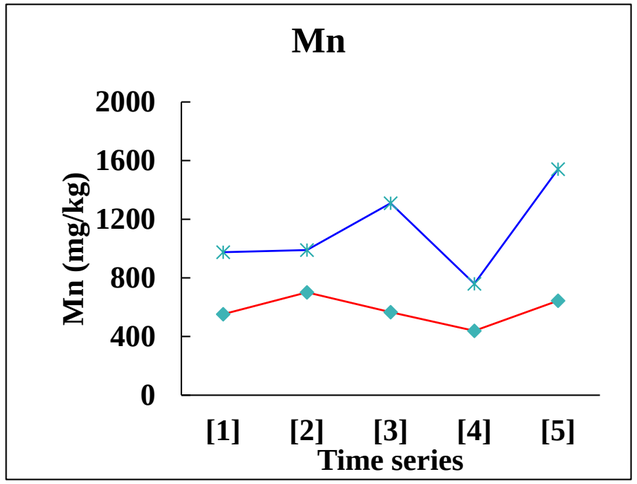


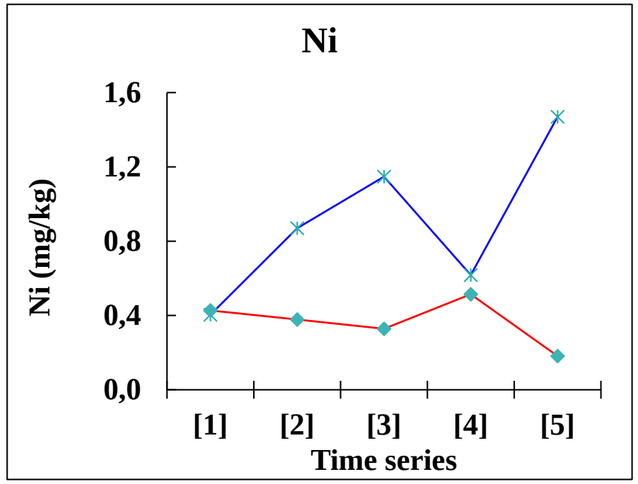


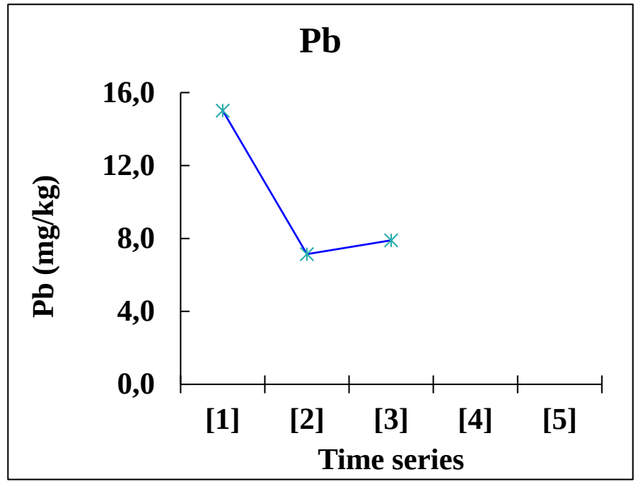










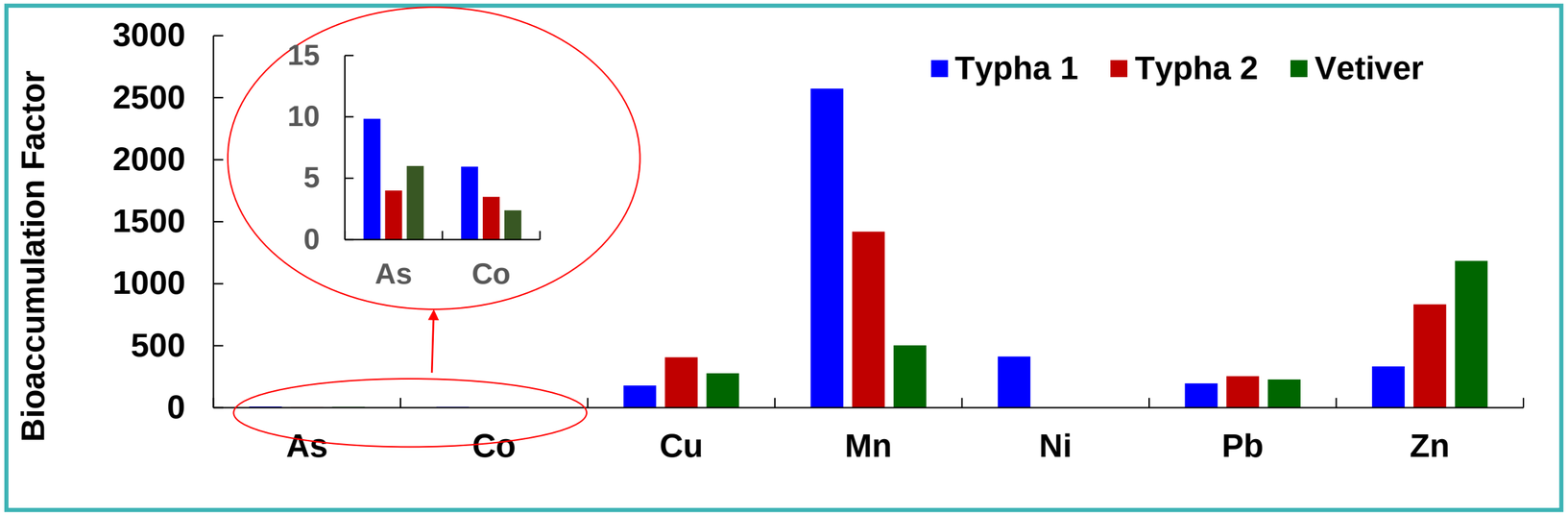


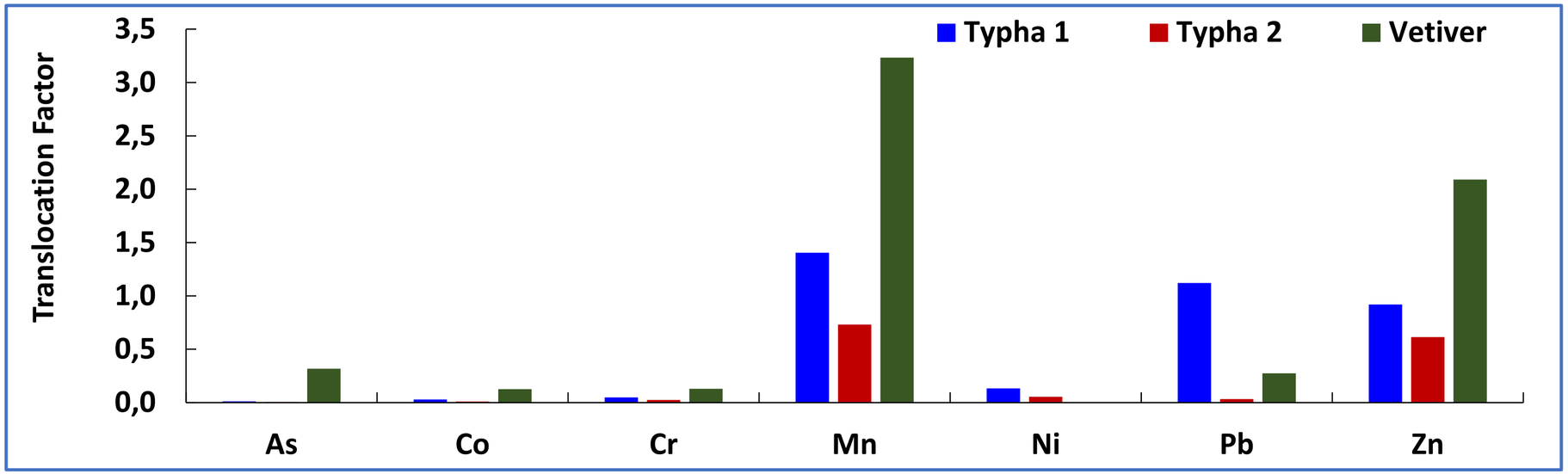
GHENT UNIVERSITY

First cycle Second cycle

RESULTS

Bioaccumulation/Translocation factor

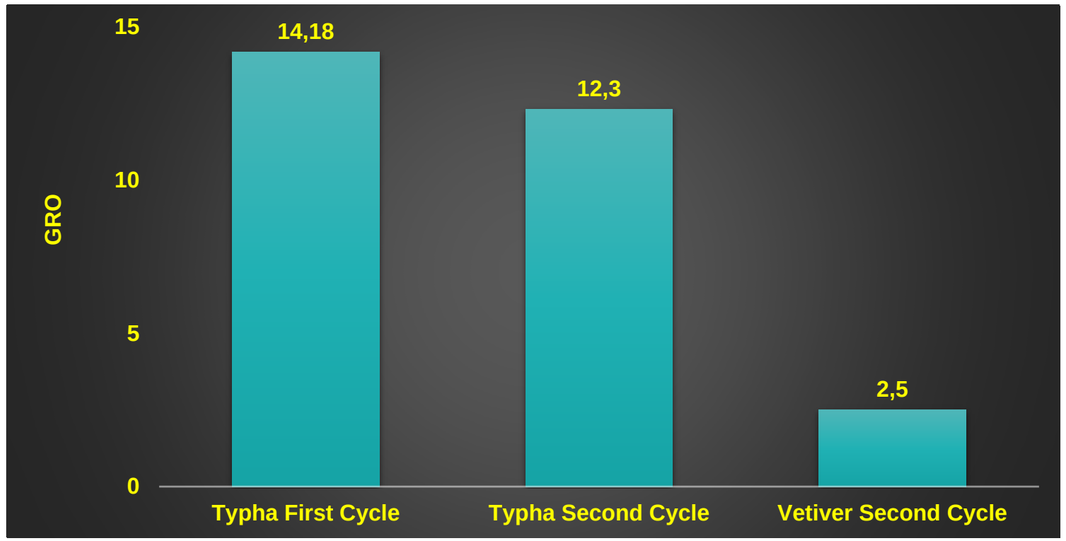




GHENT UNIVERSITY

RESULTS

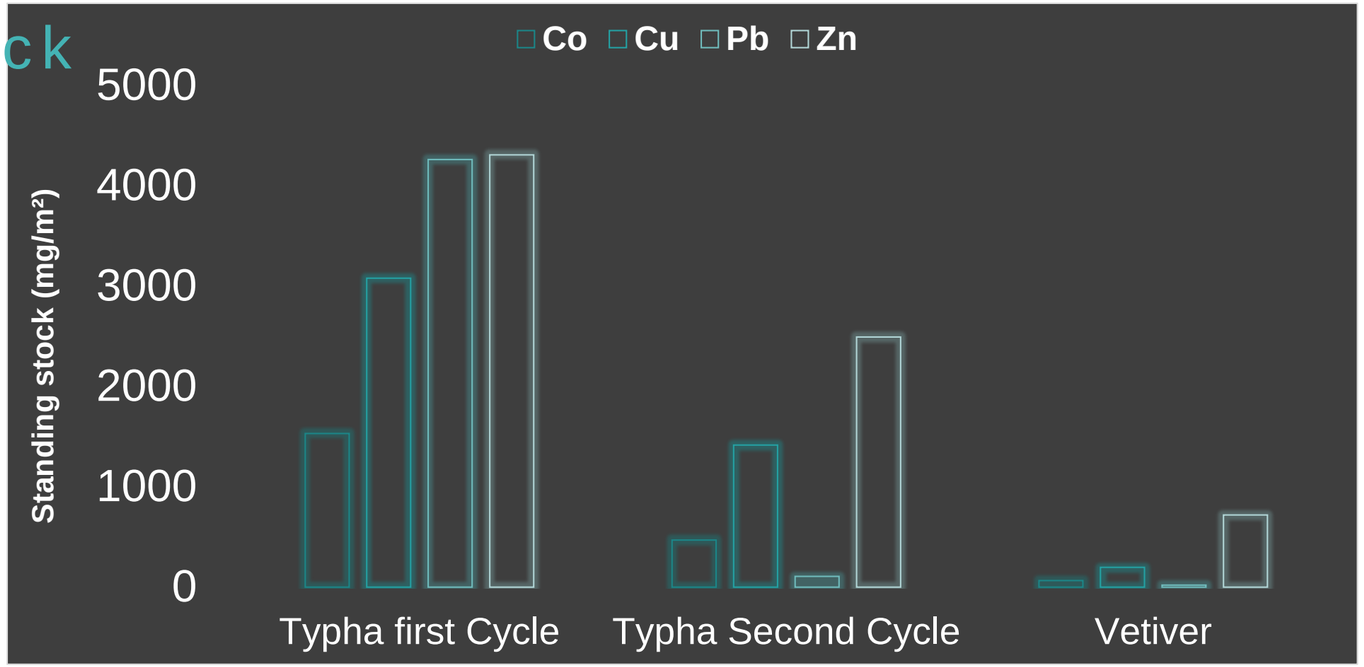
RGR (75 days growth) /Standing Stock

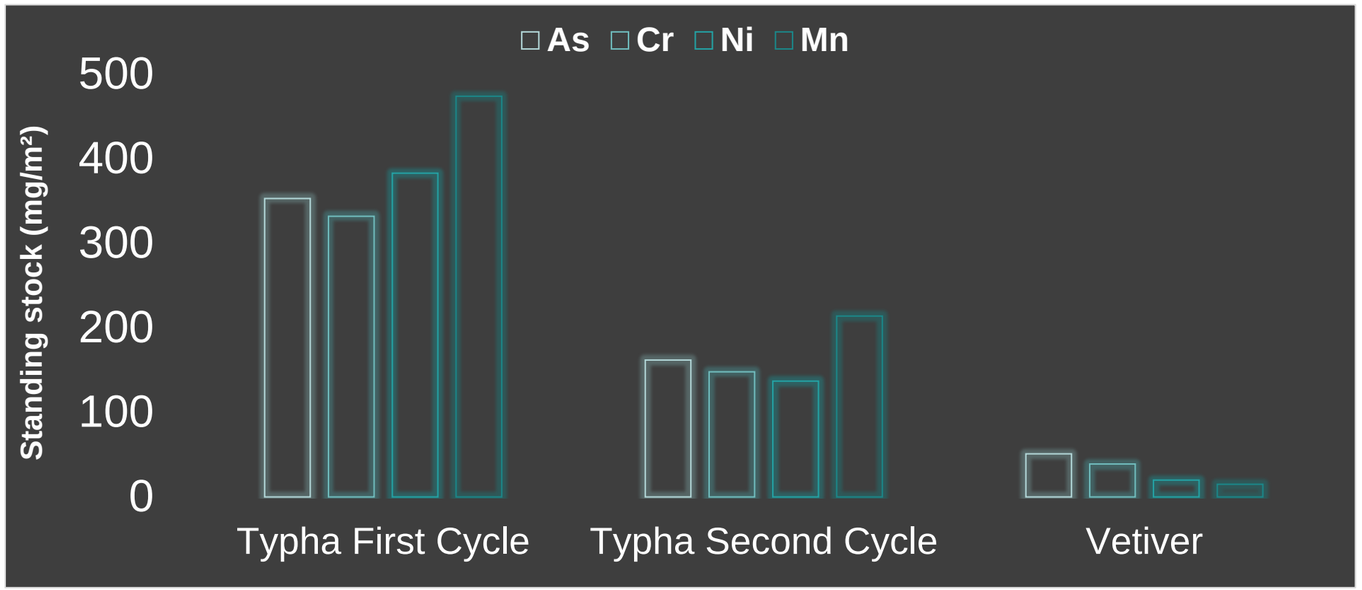


Biomass production in 75 days' growth of *Typha domingensis (shoot)*
-first cycle: 14.18 mg DW/shoot
-second cycle: 12.30 mg DW/shoot.
C. zizanioides was 2.50 ± 1.39 g DW/shoot

GHENT UNIVERSITY

Above ground part of Typha and Vetiver (mg/m²)





CONCLUSIONS

Key points

Seepage water from the TSF contained a high content of trace elements, which was influenced by the processing residue which, in turn, depends on the ore type being processed.

Spontaneously grown *T. domingensis* demonstrates a fast growth rate of 0.44 g per day on average reaching, 1.61 meters high after 75 days' growth and presenting better adaptability than *C. zizaniodes*.

Uptake of trace element by spontaneously grown *T. domingensis* and introduced *C. zizanioides are similar,*

***T. domingensis* is more indicated than *C. zizanioides* for gold mine seepage trace element phytoremediation,**

***End of the 75 days harvesting shows optimal removal of Trace elements by Typha, Vetiver is not growing in this specific condition of horizontal surface flow wetland*.**

GHENT UNIVERSITY

FACULTY OF
BIOSCIENCE ENGINEERING

Wendkuuni Florentin COMPAORE

PhD Student

DEPARTMENT OF GREEN CHEMISTRY AND TECHNOLOGY
(BW24)

E WendkuuniFlorentin.Compaore@ugent.be
T +32 56 24 12 17
M +32 76 07 61 22

http://www.ugent.be/campus-kortrijk
http://www.liwet.ugent.be/

Universiteit Gent
@ugent
Ghent University

GHENT
UNIVERSITY