

## MASTER'S THESIS

### Using organic amendments and chelates for remediation of metal-contaminated soils by vetiveria zizanioides

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**Using Organic Amendments and Chelates for Remediation  
of Metal-Contaminated Soils by *Vetiveria zizanioides***

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**A thesis submitted in partial fulfillment of the requirements for  
the degree of  
Master of Philosophy**

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## Abstract

*Vetiveria zizanioides* (vetiver) has a massive finely structured and deep root system. Due to its unique morphological and physiological characteristics such as high tolerance to drought, extreme pH (3-10.5), and wide range of metals (vetiver) (As, Cd, Cu, Pb, and Zn ions), the utilization of vetiver in metal-contaminated soils can fulfill the dual purpose of site stabilization and soil properties for succession of other plant species. This study investigated the potential uses of vetiver in removing heavy metal pollution by stabilizing heavy metals and decontaminating mine tailings. The potential uses of vetiver in induced-phytoextraction by chelating agents to decontaminate low to moderate polluted soil were also studied.

Applications of manure compost or sewage sludge increased the water-soluble N and P of Pb/Zn mine tailings. They also decreased DTPA-extractable Pb and Zn concentrations. Sewage sludge improved both root and shoot biomass in vetiver and *Phragmites australis* (common reed), with the most significant improvement observed under the application of 10% sewage sludge (44.05 t/ha). However, manure compost did not improve the biomass of both species. Plant tissue analysis showed that applications of these organic amendments did not reduce Zn uptake and accumulation in the shoots of vetiver and common reed, but significantly decreased the uptake of Cu and Pb in the roots and shoots of both plant species.

Applications of manure compost and sewage sludge to Cu mine tailings amended with manure compost and sewage sludge could also improve nutrient levels (N and P), but resulted in a significant decrease of DTPA-extractable Cu and Pb content. However, both manure compost and sewage sludge could increase the root and shoot biomass of both plant species. Plant tissue analysis showed that the use of these organic amendments could significantly reduce Pb and As uptake and accumulation in shoots of vetiver and common reed.

The effects of chelating agents on the desorption of As-, Cu- and Zn-amended soil were investigated. It was revealed that nitrilotriacetic acid (NTA) could desorb higher concentrations of As and Zn, while N-(2-hydroxyethyl) iminodiacetic acid (HEIDA) could desorb higher concentrations of Cu, at the application rate of 20 mmol/kg. In addition, the surge time on metal accumulation was 20 days when chelates were applied before harvest. Although the chelates enhanced desorption from metal-amended soils, they did not enhance metal ion accumulation in the shoots of vetiver and maize. Therefore, the time that is required by both vetiver and

maize to remove heavy metals (As, Cu, and Zn ions) from soil by phytoextraction and achieve an acceptable level will require a long time (several hundred years).

# Tables of Contents

	Page
<b>Declaration</b>	i
<b>Abstract</b>	ii
<b>Acknowledgement</b>	iv
<b>Table of Contents</b>	v
<b>List of Tables</b>	ix
<b>List of Figures</b>	xi
<b>List of Plates</b>	xiii
<b>List of Abbreviations</b>	xiv
<b>Chapter I. Introduction</b>	
1.1 Heavy metal toxicity in higher plants	1
1.1.1 Sources of heavy metal contamination in the environment	1
1.1.2 The ecological effect on heavy metal pollution	2
1.1.3 The responses of plants to heavy metals	2
1.1.4 Toxic metal pollution from mining activities	3
1.2 Phytoremediation of metal-mined soils	5
1.2.1 Definition of phytoremediation	5
1.2.2 Phytoextraction	6
1.2.3 Phytostabilization	7
1.2.4 Strategies for decontamination	8
1.3 Common characteristics of <i>Vetiveria zizanioides</i>	9
1.3.1 Morphological characteristics	9
1.3.2 Physiological characteristics	10
1.3.3 Ecological characteristics	11
1.3.4 Is vetiver a hyperaccumulator	11
1.4 Aims and objectives of present study	12
<b>Chapter II. Preliminary test on copper, zinc and arsenic tolerance test in <i>Vetiveria zizanioides</i></b>	
2.1 Introduction	15
2.2 Materials and methods	17
2.2.1 Plant collection	17
2.2.2 Plant culture	18

2.2.3 Root elongation test	18
2.2.4 Plant tissue analysis	20
2.2.5 Statistical analysis	20
2.3. Results	21
2.3.1 Root elongation test	21
2.3.2 Index of tolerance	21
2.3.3 Concentration and accumulation of Cu, Zn and As	25
2.3.4 The 14-Day EC <sub>50</sub> values	25
2.4 Discussion	28
2.5 Conclusion	31

**Chapter III. Growth of *Vetiveria zizanioides* and *Phragmites australis* on Pb/Zn and Cu mine tailings amended with manure compost and sewage sludge: a greenhouse study**

3.1 Introduction	32
3.2 Materials and Methods	37
3.2.1 Sample collection	37
3.2.2 Plant growth experiment	38
3.2.3 Tailings substrata analysis	44
3.2.4 Plant tissue analysis	45
3.2.5 Statistical analysis	45
3.3 Results	46
3.3.1 General properties of tailings, manure compost and sewage sludge	46
3.3.2 Effects of manure compost and sewage sludge on the chemical properties of Pb/Zn and Cu tailings	48
3.3.3 Effects of manure compost and sewage sludge on the biomass of vetiver and common reed	55
3.3.4 Metal concentrations in plants	65
3.4 Discussion	72
3.4.1 General properties of tailings, manure compost and sewage sludge	72
3.4.2 Effects of manure compost and sewage sludge on the chemical properties of tailings	74
3.4.3 Effects of manure compost and sewage sludge on the biomass of vetiver and common reed	76
3.4.4 Metal concentrations in plants	80
3.5 Conclusion	83

**Chapter IV: Enhanced uptake of As(V), Zn(II) and Cu(II) by *Vetiveria zizanioides* and *Zea mays* using chelating agents**

4.1 Introduction	84
4.2 Materials and Methods	89
4.2.1 Soil sources and characterization	89
4.2.2 Soil preparation	90
4.2.3 Chelate effects on desorption of amended soils	90
4.2.4 Time course of As(V), Zn(II) and Cu(II) accumulation in shoots	92
4.2.5 Plant source and seedling preparation	92
4.2.6 Chelate treatments in As(V)-, Zn(II)- and Cu(II)-amended soil	93
4.2.7 Plant analysis	95
4.2.8 Statistical analysis	95
4.3 Results	96
4.3.1 Physiochemical properties of soil	96
4.3.2 Effects of chelate treatment on the solubility of metals in soil	96
4.3.3 Biomass of vetiver and maize	102
4.3.4 Surge time metal accumulation of As(V)-, Zn(II)- and Cu(II)-amended soil	105
4.3.5 Effects of chelates on As(V), Zn(II) and Cu(II) desorption in soil and As(V), Zn(II) and Cu(II) accumulation in plants	107
4.4 Discussion	113
4.4.1 Chelate effects on soil As(V), Zn(II) and Cu(II) desorption	113
4.4.2 Biomass of plant in phytoextraction	114
4.4.3 Surge time of heavy metals in plants	115
4.4.4 Heavy metal uptake in two different plant species after desorption treatments	116
4.4.5 Time requirements	118
4.5 Conclusion	120

<b>Chapter V. General discussion and conclusion</b>	
5.1 Problems of toxicities of Pb/Zn and Cu mine tailings	121
5.2 The role of organic amendments (manure compost and sewage sludge) on the growth and metal uptake of vetiver and common reed in Pb/Zn and Cu tailings	125
5.3 The potential use of vetiver in phytoextraction by synthetic chelates	127
5.4 General conclusion	128
5.5 Directions for future studies	129
<b>Appendix</b>	130
<b>References</b>	131
<b>List of paper published, accepted, submitted to journal or presented in meetings</b>	145
<b>Curriculum Vitae</b>	146