# POSSIBILITIES FOR UTILIZATION OF HEAVY METAL POLLUTED SOIL

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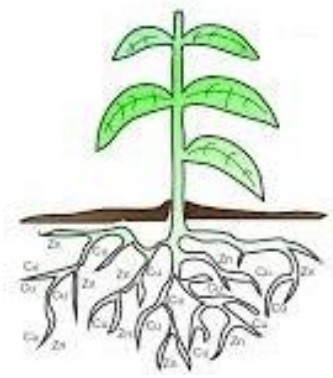
## INTRODUCTION

The reduction of arable land and the increase of contaminated soil due to industrialization and mining occupies the attention of scientists in finding solutions for soil utilization. The use of plants to accumulate heavy metals (HM) from the soil has been recognized as the most economically- and ecologically-friendly alternative. Different plants have different potential to uptake HM. The ability to take up and tolerate metals varies between and within species as well as between metals. Most of the data in the literature focused on hyperaccumulating properties of plant and not paying enough attention to excluders - plants with low accumulating abilities tolerant to high concentrations of HM in soil. Although promising, phytoremediation using natural hyperaccumulators has not achieved its predicted potential as a commercial technology due to the physical limitations of the natural hyperaccumulators like their slow grow, low-biomass production, specific ecology, and climate requirements, specific requirements for soil characteristics, water regime, etc. Another more promising strategies are to plant low accumulated crops on HM polluted soil to produce safe food or to plant fast-growing, high-biomass-producing non-hyperaccumulating plant species like rooting woody species willow (*Salix* spp.) and poplar (*Populus* spp.) which can accumulate HM from the dipper soil layers due to their deep root system. The review focused on positive and negative sites of some strategies for utilization of HM polluted soil that differ in the type of the employed plant.

**Hyperaccumulator**
High accumulation and high translocation ability

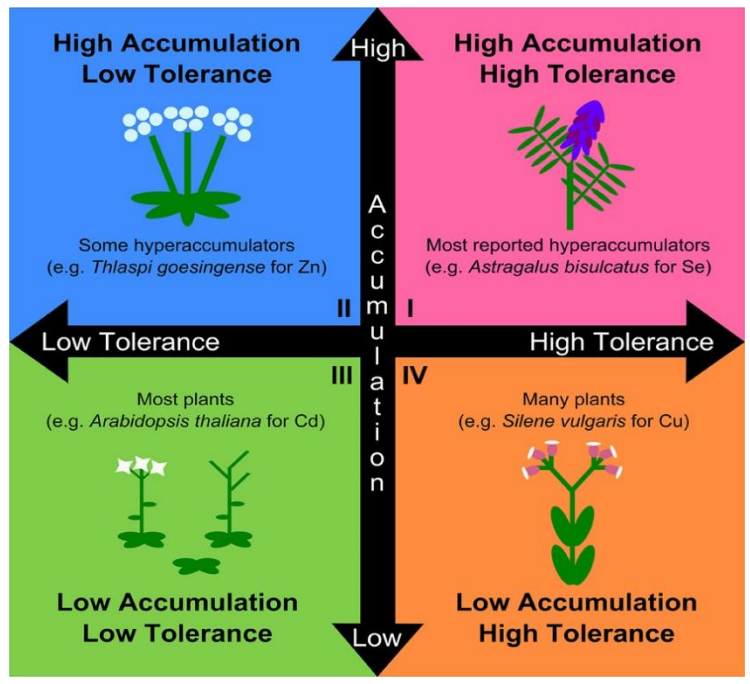
**Excluder**
High accumulation and low translocation ability



The content of HM in dry biomass in hyperaccumulators are 100 mg/kg for Cd and Se, 1000 mg/kg for Co, Cu, Ni and Pb, and 10 000 mg/kg for Zn and Mn (100 –1,000-fold higher than in non-hyperaccumulating species.

## HYPERACCUMULATORS

| Advantages | Disadvantages |
|---|---|
| • Cost effective<br>• High bioaccumulation rate<br>• Prevent introduction of potentially invasive species | • Slow growth<br>• Low biomass production<br>• Specific agro-ecological requirements<br>• HM specificity<br>• Long term process |





Four conceptual groups of plants are recognized according to their ability to accumulate and tolerate highconcentration of certain metal in soil. Evidence stongly indicates that tolerance and accumulation are separate traits mediated by genetically and physiologically distinct mechanisms in plants. Both groups of plant species showing high tolerance toward high metal concentrations in soil no meter if they are high or low accumulators may be considered in phytoremediation technology.

## NON –HYPERACCUMULATOR HM TOLERANT PLANTS

| Advantages | Disadvantages |
|---|---|
| • Cost effective<br>• Low requirements<br>• High biomass production<br>• Low metal specificity and applicability for mixed contamination | • Low bioaccumulation rate<br>Disadvantage or advantage?!! |





| Some hyperaccumulator plant species | | Some non-hyperaccumulator HM tolerant plant species | |
|---|---|---|---|
| *Berkheya coddii* | Ni | *Salix spp.* | Cd, Zn |
| *Helianthus annuus* | Pb, Cd, Zn | *Populus spp.* | Cd, Zn |
| *Alyssum bertolonii* | Ni | *Gossypium sp.* | Cd, Cu, Pb, Zn |
| *Alyssum murale* | Ni | *Mentha piperita* | Cu, Fe, Mn, Pb, Zn |
| *Arabidopsis halleri* | Zn, Cd | *Lavandula angustifolia* | Cu, Fe, Mn, Pb, Zn |
| *Minuartia verna* | Zn, Cd, Pb | *Zea mays* | Cd, Zn |
| *Sedum alfredii* | Pb | *Paulownia tomentosa* | Pb, Cd, Zn |
| *Euphorbia cheiradenia* | Cu, Fe, Pb, Zn | *Cytisus scoparius* | Pb, Cd, Zn |
| *Astragalus racemosus* | Se | *Mimosa caesalpiniaefolia* | Pb |
| *Medicago sativa* | Pb | *Erythrina speciosa* | Pb |
| *Viola boashanensis* | Pb, Zn, Cd | *Schizolobium parahyba* | Pb |

## CONCLUSION

Hyperaccumulators produce little biomass and are slow-growing plants, thus employing hyperaccumulators to decrease the toxic level of HM in the soil is a long process. Another alternative is to use non-hyperaccumulator, HM tolerant plant species particularly crop plant species that have high biomass production or woody plant species. Despite the fact that these species do not accumulate high concentrations of metal, their biomass production overcomes by several orders of magnitude the capability of typical hyperaccumulator plant species. Therefore, the total metal extraction can be higher in non-hyperaccumulator than in hyperaccumulator plant. More advanced approach is to employ hyperaccumulator and non-hyperaccumulator tolerant plant species together and take advantage from their synergic action.