METAL DISTRIBUTION IN POPLAR (*POPULUS TREMULOIDES*) AND RED MAPLE (*ACER RUBRUM*) POPULATIONS FROM RECLAIMED MINING SITES: ISSR ANALYSIS

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Abstract

Understanding the dynamic of metals in soil and plants is essential for ecosystem management and risks assessment of environmental pollution and sustainability. The aim of the present study is to determine how poplar and maple cope with metal soil metal accumulation.The translocation of metals from roots to leaves varied with the type of metals. The results showed that only a small portion of total metals was bioavailable to plants. The enrichment factor values for the targeted elements were far above the value of contamination resulting in high availability and distribution of metals in soil. With the exception of Cu, the translocation factor values were high for poplar and very low for maple. Poplar accumulate metals in leaves while maple doesn't. A specific marker differentiating contaminated and uncontaminated populations was identified.

Objectives

1. To determine the level of phytoavailable metals in soil and their accumulation in poplar and red maple tissues (roots, branches and leaves).
2. To identify population diagnostic markers related to metal contamination.

Materials and Methods

Metal Analysis

- Leaves were collected from 14 poplar and red maple trees along with 14 soil samples . Total and phytoavailable metals were determined as described by Abedin *et al*. (2012) and Nkongolo et al. (2013) for five metals of interest; Cu, Fe, Mg, Ni and Zn.
- The translocation factors (TF) were determined according to the equations described by Mehes-Smith *et al*. (2013).
- ISSR analysis was performed according to established protocols.

Results

- Concentrations of metals in soil and maple and poplar trees are presented in figures 1 - 5
- Metal translocation in maple and poplar are described in table 1.
- Figure 6 shows the consensus sequence of a specific marker that is present in red maple DNA samples from reference sites and absent in contaminated sites.
- ISSR amplification of red maple samples using the primer 17898B are shown in figure 7.

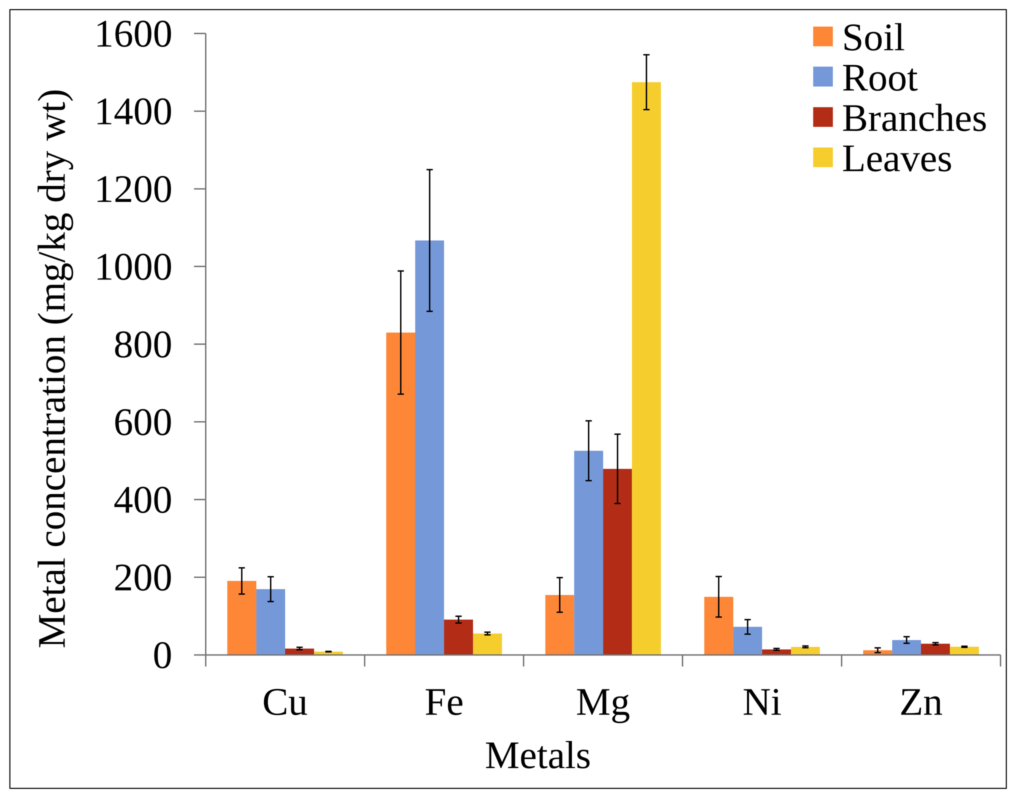

Figure 1. Concentration of metals in soil and red maple tissues rom contaminated sites .

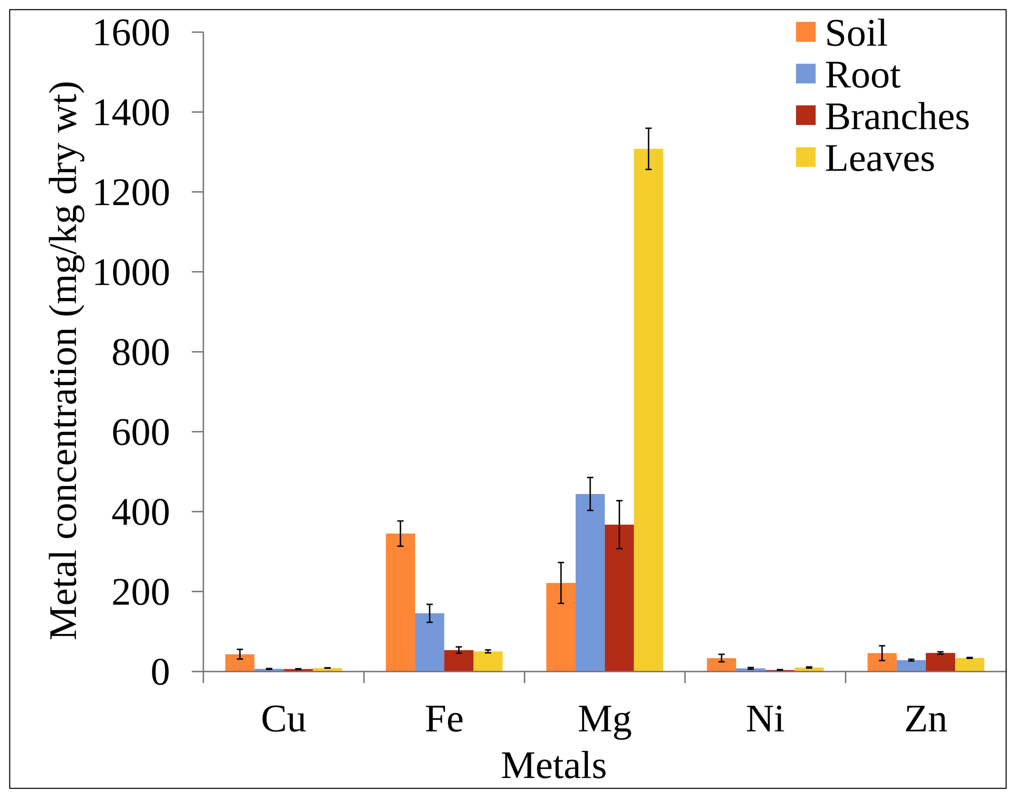

Figure 2. Concentration s of metals in soil and red maple tissues from reference site .

Results

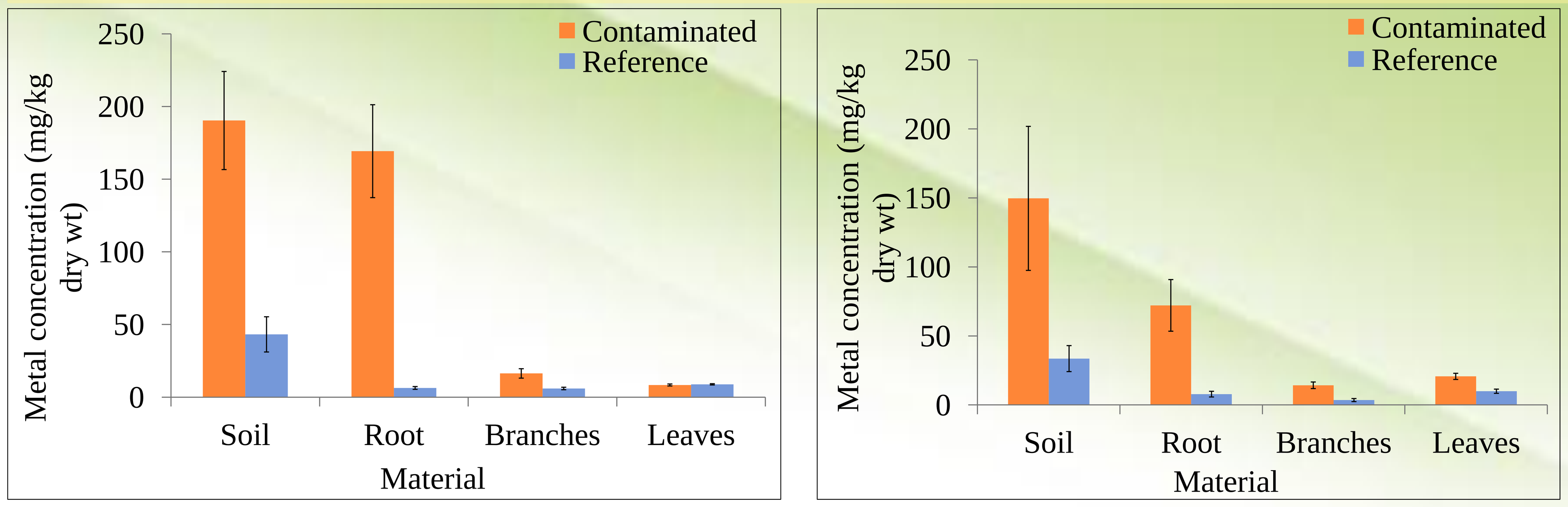

Figure 3: Metal concentrations in soil and maple tissue from reference and contaminated sites A): Cu, and B): Ni.

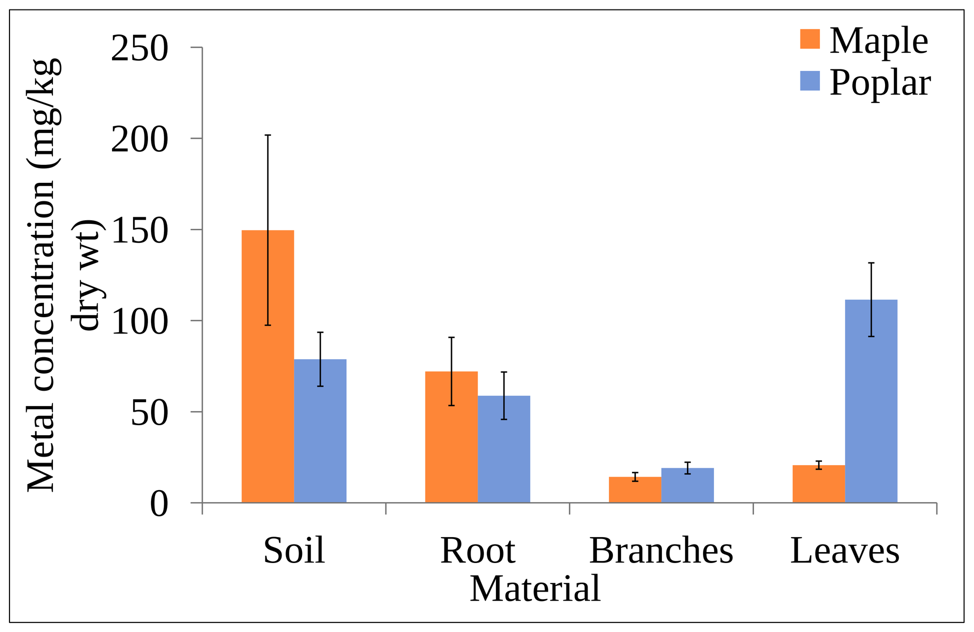

Figure 4: Nickel concentration in soil and various maple tissue from contaminated sites.

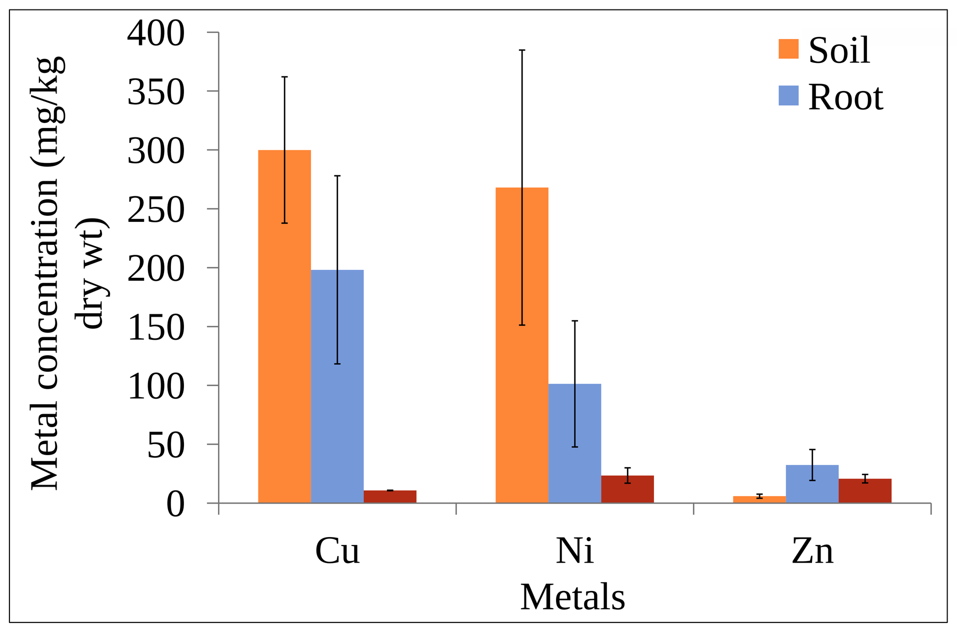

Figure 5: Metal concentration in soil and red maple roots and leaves.

1 <u>CACACACACA CAG</u>TCCTCAA ATCCACTACT TGAATGAAAG TTTACAACTT AGTTTGACCT
61 CAACCATTCT TGGTCACTAA CCCTTCCACT CTACCCAACG GGCCTTTAGT AGTAATTCTA
121 GACCTACTTG ATTGTGCACT AAACAACTTA CTCACAAGGC TTTAATCACA ATGAAGAGAA
181 CACAACCTAT GTGAATATCA AGTGCGTAAT TGCTAGGTTA GCACATTTAA TGCTTGTCAA
241 ACCATGCATG AGCATGTCAA TCAATCCTAA ACATCATGTG GCTACATGTC ATATAAAACT
301 TAGTTATATA AGATTAAAAA CAATCTTAGA TGCAATAGCA ATCACAATAC AACAGCCCAA
361 TCAATCAACA AAAAAATCTC AATATTGTAT ATAAAATCTA ATCTAGATGC ATACAAATAA
421 TAAATGAGAT TTCTTGCTAA GTAAGAACAC TAAAATGGAT TAAGAAGGTG TTCAACTTAC
481 ATGTTTGATG TACATGAAAA TGAGTTTGGA GAATTAAAGA AGCAATCTTG ATGCTTTTTC
541 TCTCAAGTAA <u>CTGTGTGTGT GTG</u>

Figure 6: Consensus sequence of a specific marker (563 bp) present in red maple samples from references sites and absent in samples from metal contaminated sites. ISSR primers are underlined.

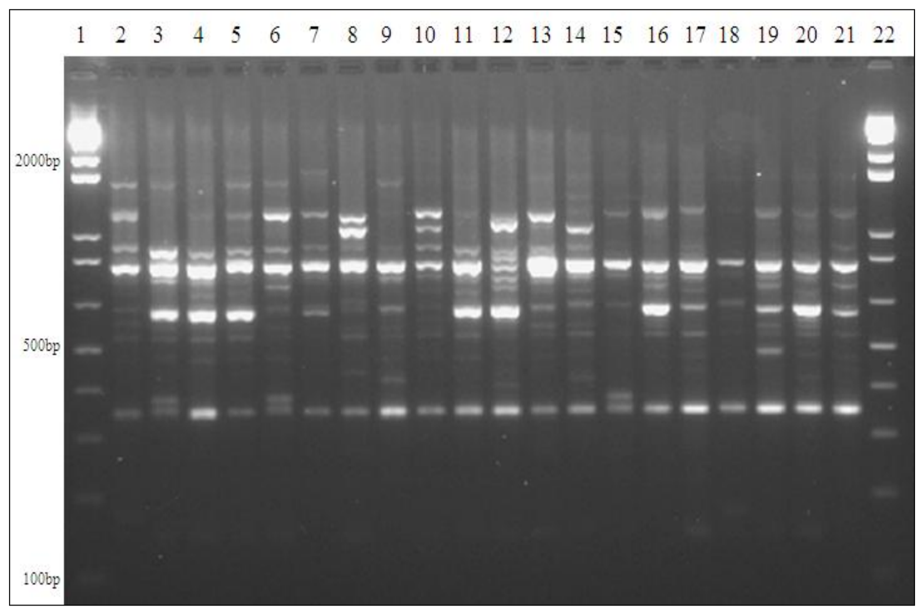

Figure 7: ISSR amplification of red maple samples with primer 17898B. Lanes 1 and 22 contain DNA ladders.

Table 1. Maple translocation factor for red maple and poplar.

	Cu	Fe	Mg	Ni	Zn
Maple	0.160	0.120	7.900	0.235	1.985
Poplar	0.710	1.670	4.770	8.380	2.470

Translocation factor: metal concentration ratio of plant leaves to soil.

Conclusions

- Overall, poplar accumulates metals in the aerial parts while red maple doesn't.
- A population diagnostic marker differentiating metal contaminated populations from references sites was identified and characterized.

References

1. Abedin, J., Beckett, P., & Spiers, G. (2012).. *Can. J. Soil Sc., 92*(1, Sp. Iss. 1), 253-268.
2. Nkongolo, K. K., Spiers, G., Beckett, P., Narendrula, R., Theriault, G., Tran, A., & Kalubi, K. N. (2013).. *Water, Air, & Soil Pollut. 224*(7), 1-14.
3. Mehes-Smith, M., K.K. Nkongolo, and E. Cholewa. (2013). Amer. J. Envir. Sci. 9 (16): 483-493.

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