MERCURY UPTAKE INTO POPLAR LEAVES

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Introduction

Tailings dumps require mercury stabilization to prevent air pollution by evaporated mercury, which can be achieved through plant covers. Plants are considered a net sink for atmospheric Hg via incorporation into leaf tissues (Stamenkovic and Gustin 2009). However, most studies related to Hg uptake by plants have considered plants exposed to only atmospheric Hg, whereas in the case of tailings dumps, plants are potentially exposed to both soil and atmospheric Hg. The goal of this work is to evaluate the relative contributions of root and atmospheric pathways by growing poplar (*Populus trichocarpa* X *Populus maximowiczii*) cuttings on either control or polluted substrates and under either natural or controlled exposure conditions.

Methods

Field experiment: Poplar cuttings were grown on 4 L pots for various lengths of time, i.e., 66 days at the atmospheric polluted site and 142 days at the atmospheric control site. Pots were left for a longer period at the control site to reach detectable levels of Hg in the leaves. A leaf age of one day was defined when a leaf has a foliar index equal to three (corresponding to expanded leaf), as defined by Larson and Isebrands (1971).

Growth chamber experiments: Poplar cuttings were grown for 45 days in control substrates, as detailed above except that 9 g of osmocote fertilizer (N/P/K 11/11/18, osmocote exact, Heerlen, Netherlands) was added to each pot at the beginning of the experiment. The second experiment began immediately after, which consisted of growing poplar Skado cuttings for 46 days in either control or polluted substrates, as described above. Polluted and control pots were mixed in the growth chamber.

Hg analysis in biomass : Freeze-dried leaves were analysed after milling using an advanced mercury analyser (AMA 254).

Results

We showed that foliar Hg concentrations significantly increased with age, reaching 120 ng g^{-1} dry mass when poplars were exposed to Hg-contaminated substrate under natural exposure. Remarkably, we did not observe significantly different Hg concentrations in poplar leaves grown on either the control or polluted substrates when cultivated together in growth chambers with a significant accumulation of 2.3 ng g^{-1} dry mass day^{-1} for each substrate type (Fig.1). Our set of data prompted us to conclude that Hg entry into poplar leaves is exclusively through an atmospheric pathway. Our results are discussed in line with existing literature.

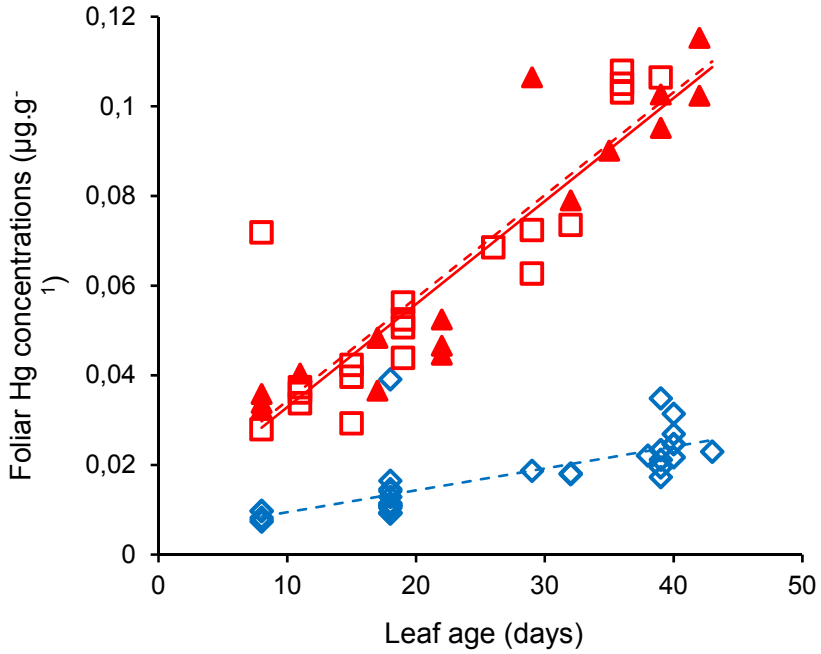

Figure 1: Line regression for foliar Hg accumulation in leaves of poplar exposed to Hg. In the first experiment, Poplar cv Skado cuttings were planted in 3-L pots containing control substrate and grown for 45 days (◇, [Hg] = 0.0005 Leaf age + 0.0046, dotted blue line, total of 35 samples). In the second experiment, poplar cuttings were planted in either the control substrate (□, [Hg] = 0.0023 Leaf age + 0.0114, dotted red line, total of 20 samples) or polluted substrate (▲, [Hg] = 0.0023 Leaf age + 0.0099, full red line, total of 16 samples) and left to grow for 46 days. Polluted and control pots were mixed in the same growth chamber.

Conclusion

Our data suggest that poplar leaves may be a pertinent indicator of Hg contamination in the atmosphere for any Hg content in soil.

References

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