Uptake and localization of copper in three different moss species

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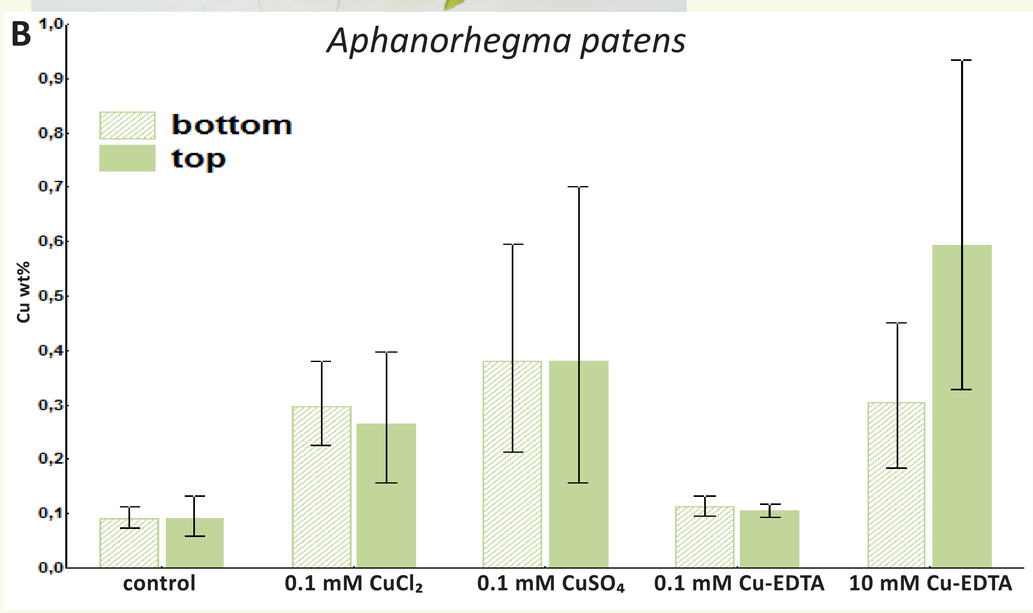
Introduction

Flowering plants of metal contaminated habitats can be classified into excluders or accumulators, depending on whether the root serves as a barrier against heavy metal uptake or not. For mosses, this classification is not applicable due to the absence of a proper root system; nutrients and water are taken up *via* the whole moss surface. Specialised mosses are able to grow on heavy metal sites. In this experiment, the allocation of different copper compounds in the moss *Aphanorhegma patens* (syn. *Physcomitrella patens*), a model for many physiologic and genetic questions, was compared with two metal adapted species *Mielichhoferia elongata* and *Pohlia drummondii*.

(**A**) habitus of the moss *A. patens* (scale bar: 1 mm)

(**B**) EDX results of each treatment in weight percent (wt%) copper, comparing the bottom with the top parts of the moss (error bars: 95% confidence intervall)

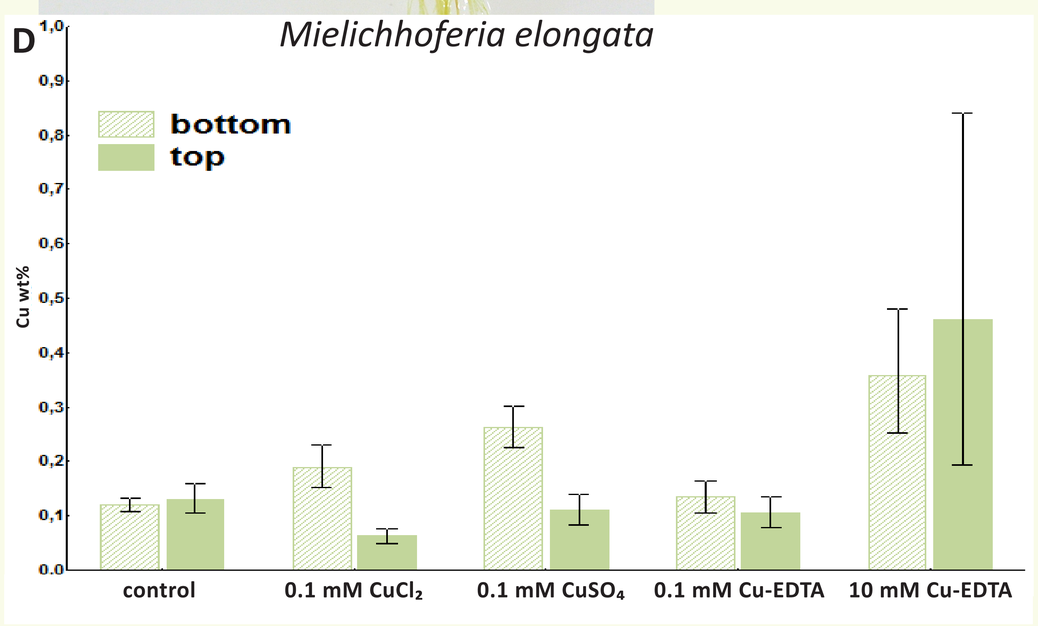


Method

The three moss species were grown on agar supplemented with 0.1 mM $CuCl_2$, 0.1 mM $CuSO_4$, 0.1 mM or 10 mM Cu-ethylenediaminetetraacetate (Cu-EDTA). After six weeks the mosses were harvested, dried and the top and bottom parts of the stem were analyzed by means of energy dispersive X-ray microanalysis (EDX), n = 8-14. Differences were statistically analysed with Student t-test for significance.

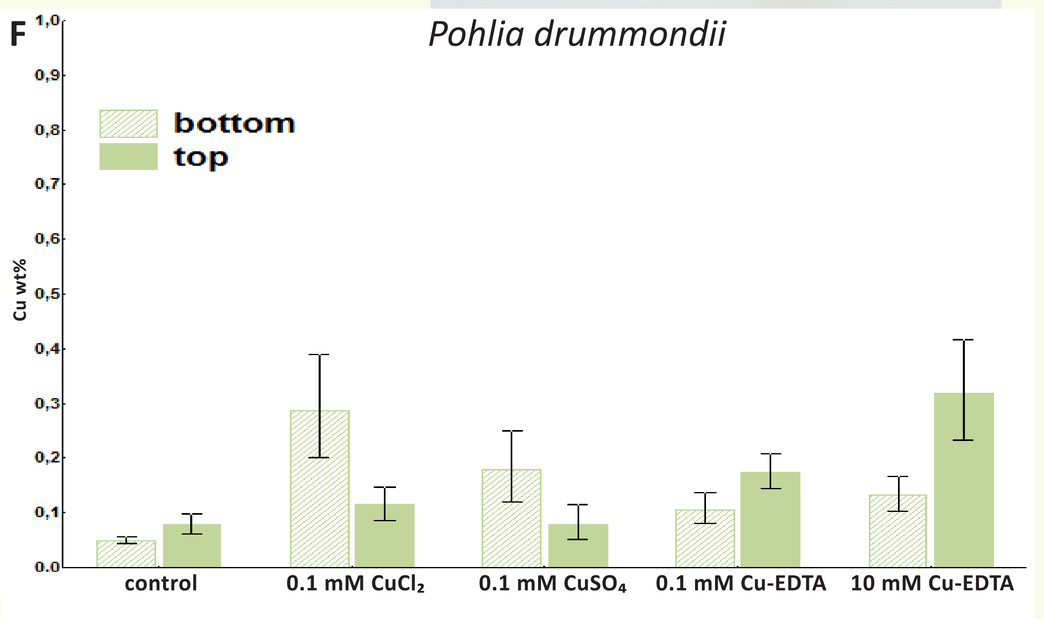
Conclusion

In contrast to the non-adapted control moss *A. patens* the heavy metal adapted mosses *P. drummondii* and *M. elongata* were able to exclude copper from the sensitive growing bud.



(**C**) habitus of the moss *M. elongata* and (**E**) *P. drummondii* (scale bar: 1 mm)

(**D**) & (**F**) EDX results of each treatment in weight percent (wt%) copper, comparing the bottom with the top parts of the moss (error bars: 95% confidence intervall)



Discussion

The copper adapted species *P. drummondii* and *M. elongata* strongly excluded the copper from the top parts in the $CuCl_2$ and $CuSO_4$ treatments. This indicates a strong absorbance capacity of the outer cell walls which has been already observed for zinc [1]. In contrast, *A. patens* was lacking such effective exclusion ability and showed also high amounts of copper in the top parts. The same concentration of EDTA-complexed copper had no strong effect on the uptake of the metal. The accumulation of copper in the top parts in the 10 mM Cu-EDTA treatments possibly resulted from the chelation of copper by the EDTA-complex causing easier translocation into the moss. This effect was already shown for flowering plants, where lead chelated with EDTA increased the translocation into the shoot [2]. As the EDTA-complex lowered the binding to cell walls, it was transferred into the top parts of the stem together with the water flow.

Acknowledgement

Many thanks are due to W. Adlassnig. This study was funded by the ÖAD project APPEAR 43/BIOREM.

References

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[2] Jarvis MD & Leung DWM (2002), Chelated lead transport in *Pinus radiata*: an ultrastructural study. Environmental and Experimental Botany, 48, 21–32