Plant architecture, auxin homeostasis and phenol content in seedlings of *Arabidopsis thaliana* grown in a Zn/Cd-enriched medium

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AIM

To investigate the hierarchic relationship between zinc accumulation, auxin transport, phenol synthesis and shoot/root morphology in roots and shoots of the model plant *Arabidopsis thaliana* (L.) Heynh.

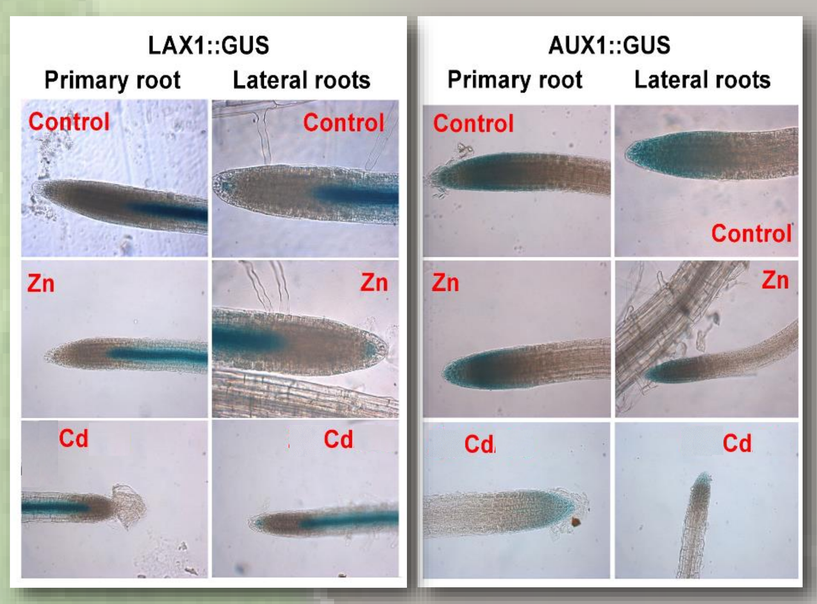
MATERIALS AND METHODS → FIGURES AND TABLES → RESULTS

EXPERIMENTAL DESIGN

Zinc and cadmium **(100 to 200 µM $ZnSO_4$, and 10 to 20 µM $CdSO_4$, respectively)** were supplied for three weeks to *Arabidopsis* seedlings growing in micropropagation transparent glass tubes with **a gradient of distances between germinating seeds (to = low concentrations) and metal-contaminated agarized medium (bottom = high concentrations).**

AUXIN ROOT TRANSPORT

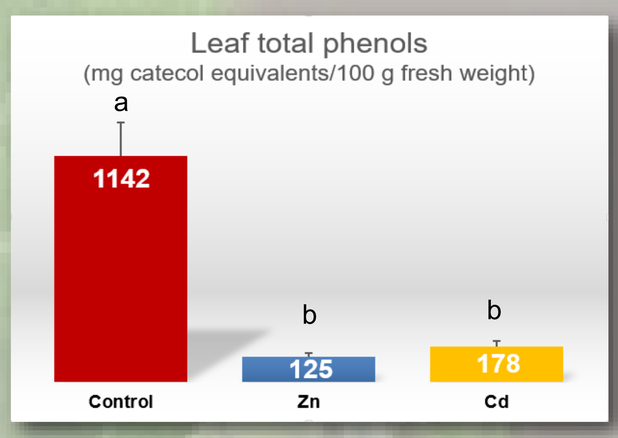
The **analysis** of the genes encoding for auxin influx carriers in the root cells by the use of transgenic *Arabidopsis* lines (**LAX3::GUS** and **AUX1::GUS**) was carried out by confocal microscopy. A more intense blue color indicates a higher genic expression level.



In comparison with the apical localization of the IAA signal in the control seedlings, **Zn seemed to reinforce the intensity of the signal**, without affecting its localization. In Cd-treated plants, the IAA localization remained apical but weaker compared to control plants.

TOTAL PHENOLS SYNTHESIS

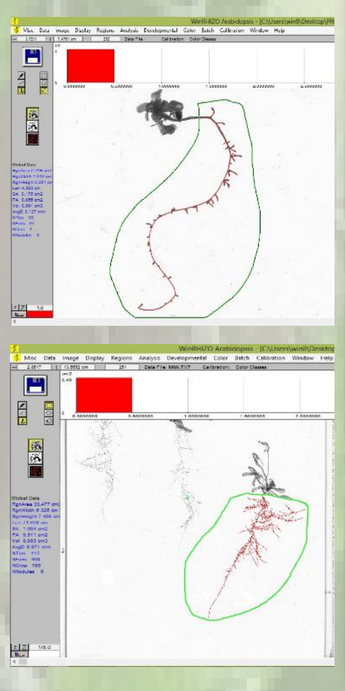
Total phenolic content was determined spectrophotometrically by the **Folin-Ciocalteu colorimetric method,** using catecol as a standard. Significant differences at $P < 0.05$ with different letters.

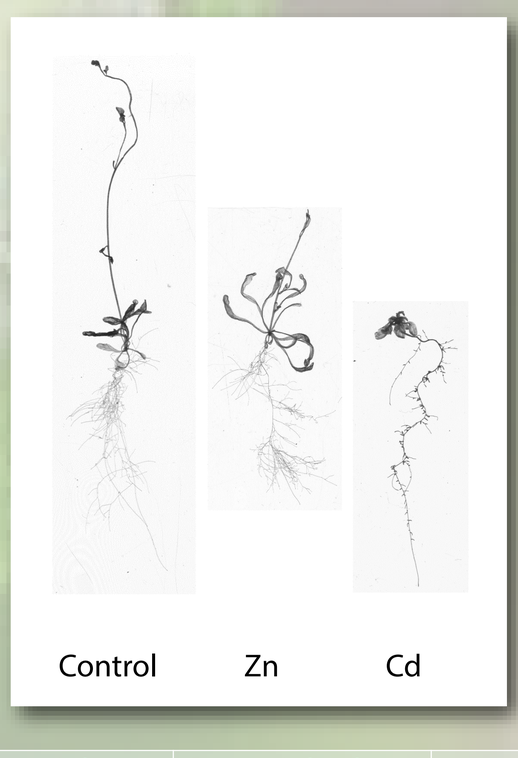


Phenols are secondary metabolites with an antioxidant, protective action, whose synthesis and accumulation **decreased when plant were exposed to Zn and Cd.**

SHOOT AND ROOT MORPHOLOGY

All plants were removed from the tubes and **scanned at high resolution** (600 DPI) by STD4800 Image Acquisition System and the whole root systems analyzed by WinRhizo Arabidopsis V2009c (Regent Instruments Inc., Chemin Sainte-Foy, Canada). Significant differences at $P < 0.05$ with different letters.





Significant changes of shoot and root morphology and architecture reflected the two levels of toxicity of Zn (low) and Cd (high). Cd caused **decreased in shoot and root development**, and an increase in root diameter and root/shoot ratio.

	Dry weight root (g)	Dry weight shoot (g)	Root/shoot	Specific leaf area (cm^2/g)
Control	0.00033 a	0.00159 b	0.201 b	987.42 a
Zn	0.00038 a	0.00182 a	0.225 b	904.77 a
Cd	0.00010 b	0.00027 c	0.320 a	427.04 b

	Average root diameter (mm)	Root tips (number)	Total root surface (cm^2)	Specific root lenght (cm/g)
Control	0.079 c	228.71 a	1.674 a	219667.22 a
Zn	0.090 b	223.43 a	1.583 a	146605.12 b
Cd	0.105 a	30.14 b	0.185 b	62330.48 c

CONCLUSIONS

Results show that the Zn- and Cd-induced changes in shoot and root morphology are caused by a hormonal unbalance, mainly governed by auxin transport and accumulation. The remodelling of the root architecture in response to Zn/Cd could be a pollution 'escaping strategy' aimed at seeking metal-free areas and protecting the root system from the toxicity of the metals. The methods used and the results obtained by this model plant could be transferred to species with bioremediation or agronomic importance.

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