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Transfer and toxicity of atmospheric urban particles to edible vegetables: Evidence of the role of epicuticular waxes

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Vincent Dappe, Fabien Bernard, Sylvain Dumez, Benjamin Hanoune, Damien Cuny, et al.. Transfer and toxicity of atmospheric urban particles to edible vegetables: Evidence of the role of epicuticular waxes. Colloque Agricultures Urbaines Durables : Vecteur pour la Transition Ecologique, Jun 2017, Toulouse, France. hal-04428000

HAL Id: hal-04428000

<https://hal.science/hal-04428000>

Submitted on 31 Jan 2024

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Context and objectives

Metal-rich fine particles

Transportation

Emissions

Deposition on vegetable leaves

Accumulation/foliar Transfert foliaire of metals

Edible vegetables cultivated in urban Area

2 main issues

- Physiological impacts on vegetables and biodiversity changes
- Quality of vegetables for fooding

objectives

Investigating the phytotoxicity induced by foliar transfer of atmospheric particles through the evaluation of:

- the photosynthetic activity
- The genotoxicity
- The gene expression levels

Investigating the influence of time exposure and particle composition



Monteiro et al., 2012



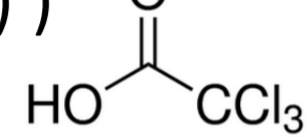
Methodology

Sample preparation



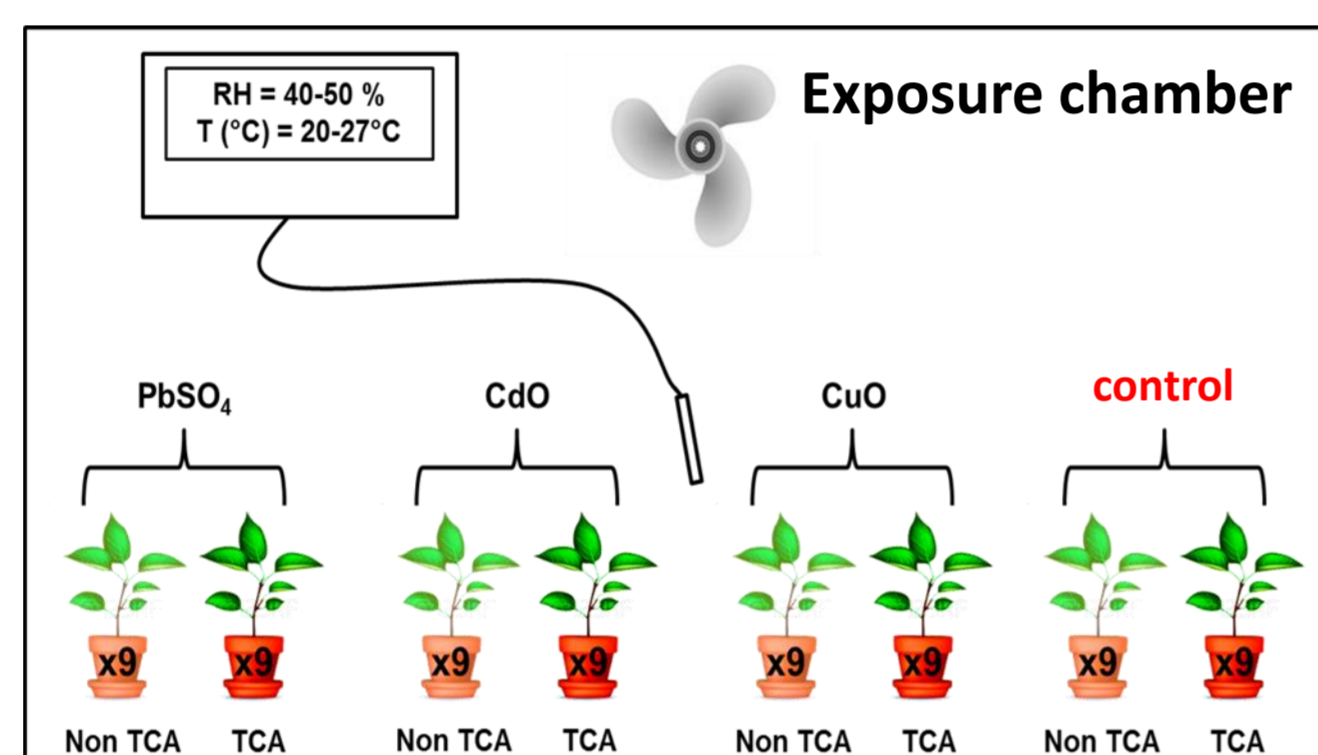
(*Brassica oleracea var. Prover*)

Chemical treatment using trichloroacetic acid (TCA: 10⁻⁴ M (g/g))



Epicuticular wax reduction of 60%

Sample exposure



- Dry deposit of CdO, CuO and PbSO₄ on adaxial part of the leaf
- Estimated covering rate 1-1,5% of the leaf surface
- 5, 10 and 15 days of exposure

Sample analysis

Leaf surface and cross section analysis

- ☐ SEM-EDX
- ☐ Raman Microspectrometry

PSII Chl fluorescence (Fv/Fm parameters)

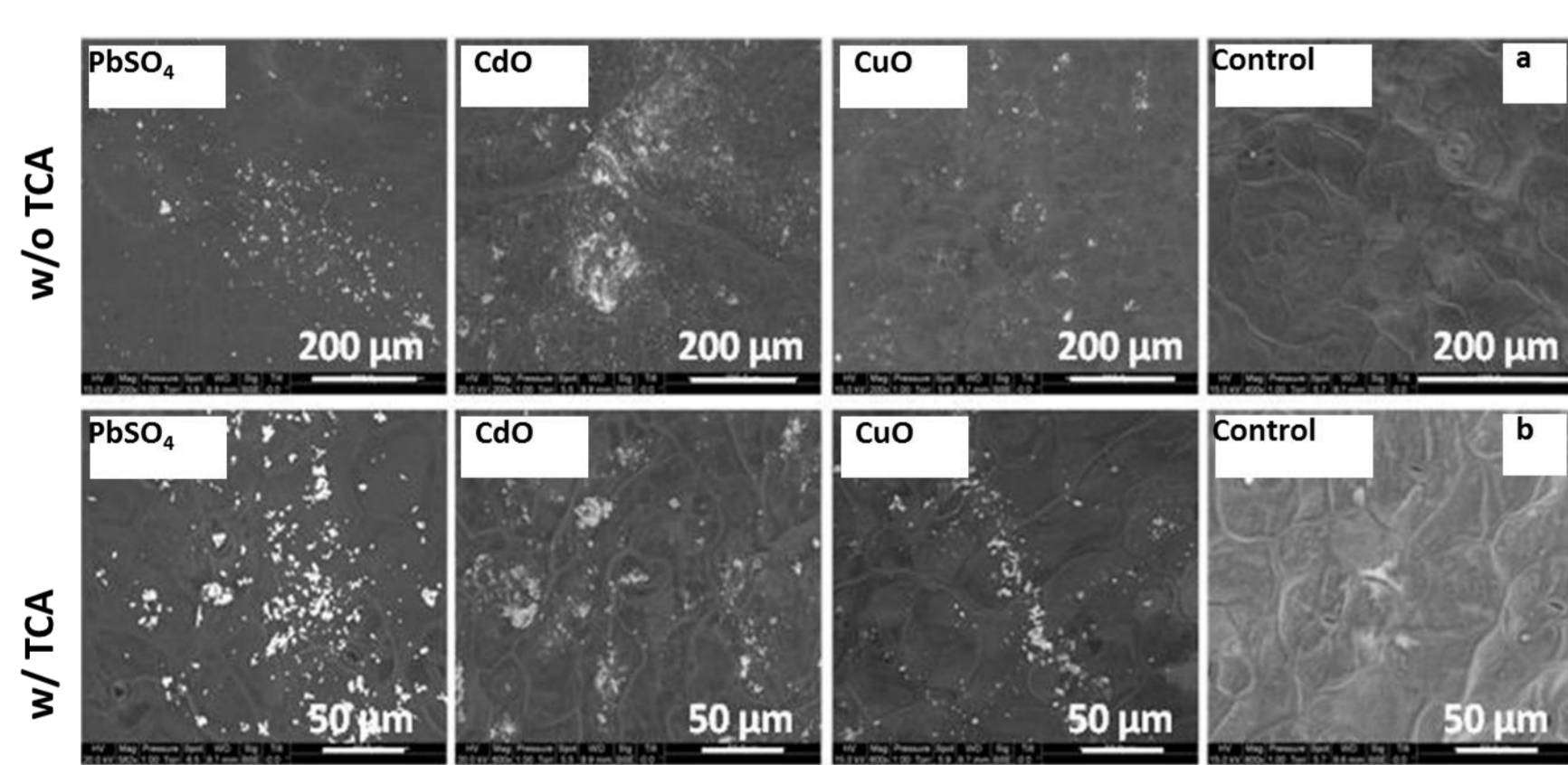
Comet assay

Real-time quantitative PCR (qPCR) procedure

- Particle location and characterization of particle transfer
- Photoactivity and physiological effects
- %DNA damage and genotoxicity
- FSD1, CHL1 and OGG1 genes expression

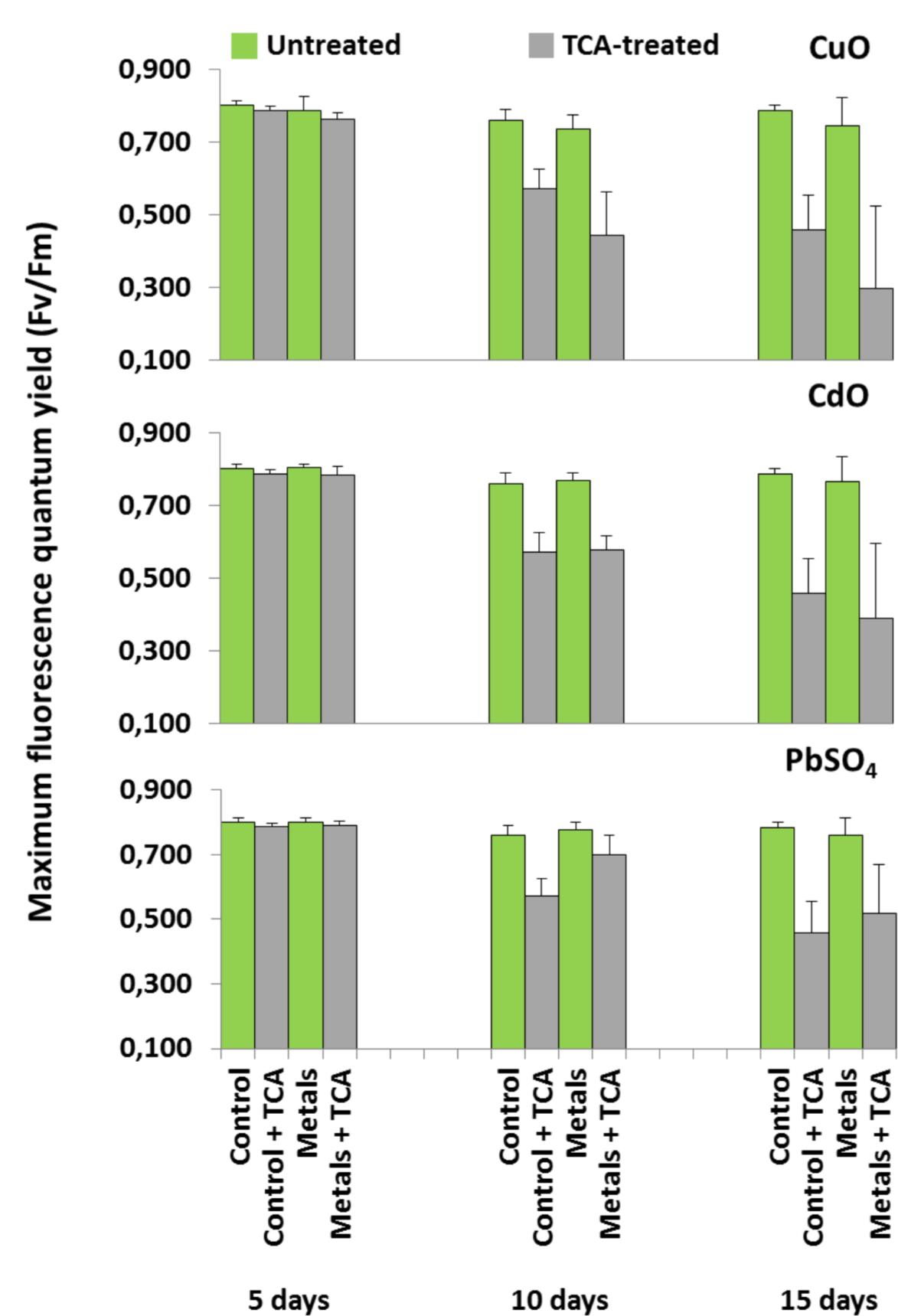
Results

Metal accumulation within the leaves (VALEUR ?) and particle trapping into cuticular wax



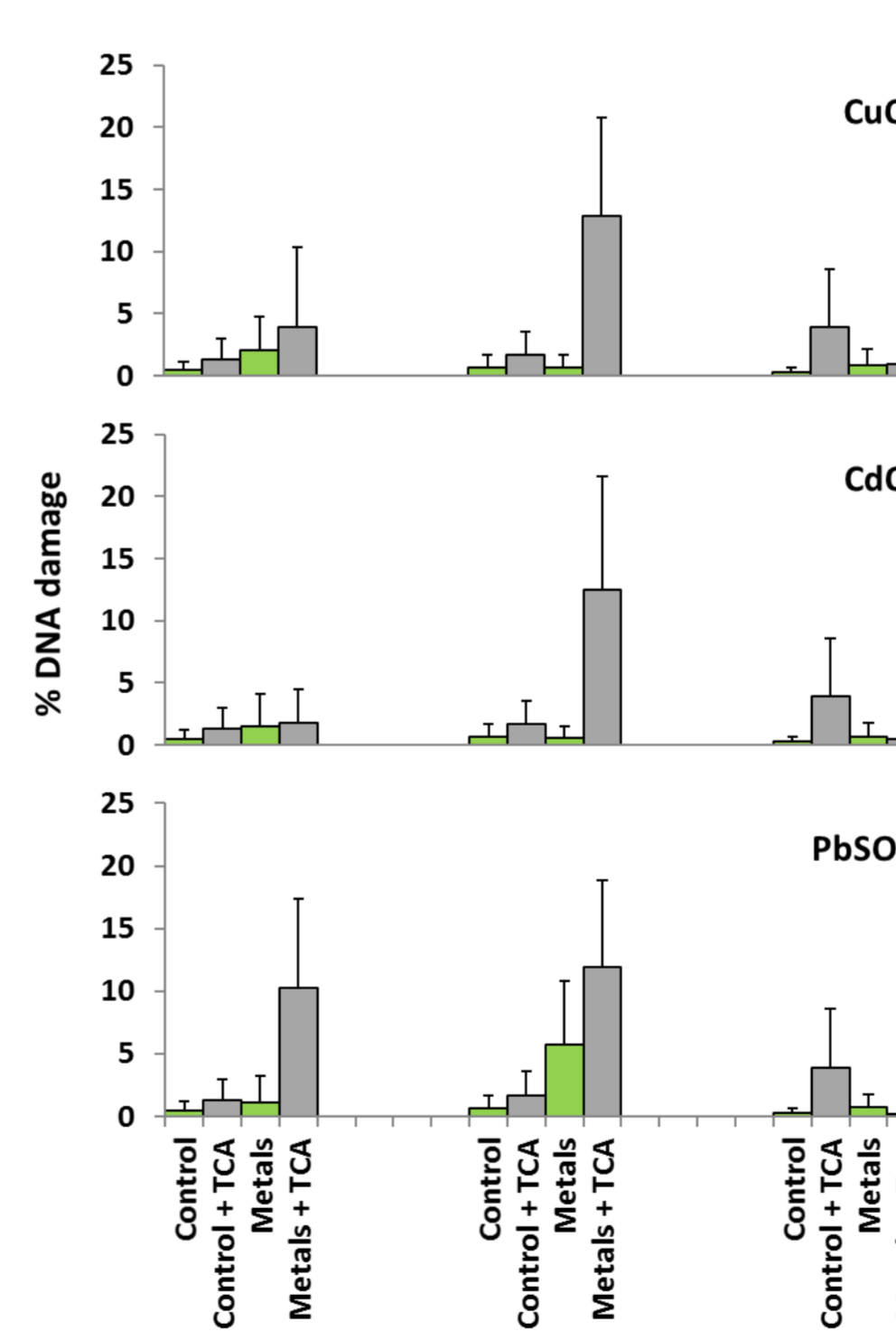
Je ne vois pas sur les images en coupe les particules – le spectre EDX n'est pas parlant Spectre Raman ?

PSII Chl fluorescence



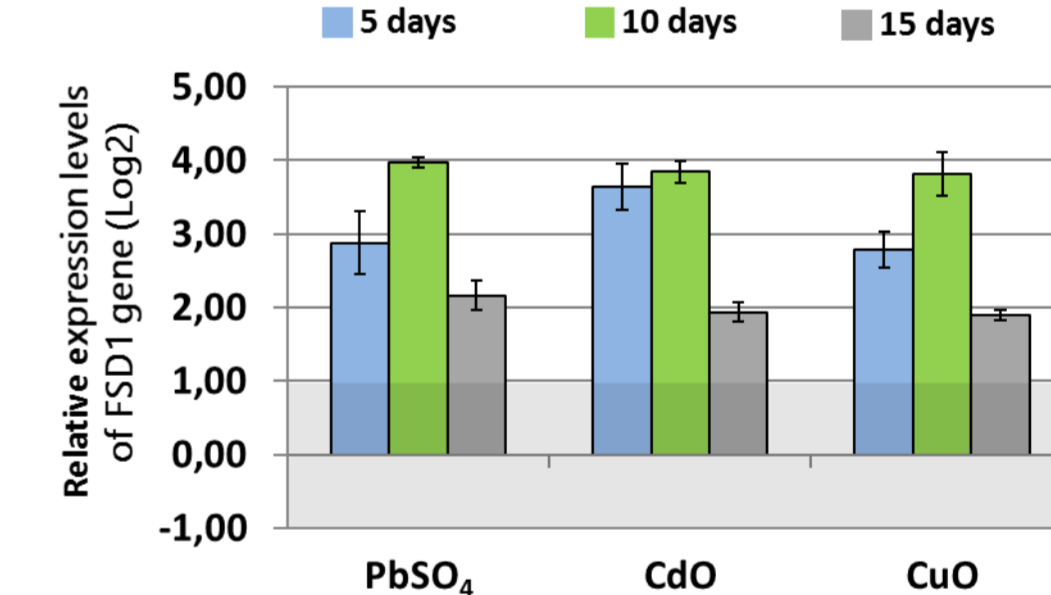
- Impact for CuO > CdO > PbSO₄
- Pronounced for TCA-treated plants
- Influence of the time exposure

Cellular toxicity (Comet assay)

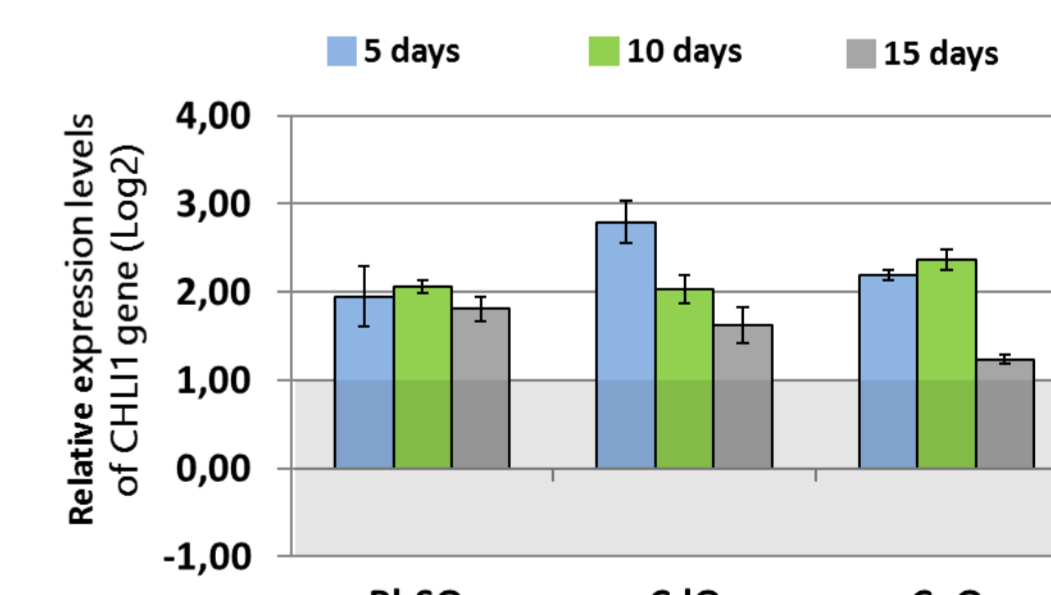


- genotoxic effects are significant for TCA-treated plants
- More pronounced for PbSO₄
- Repair mechanisms

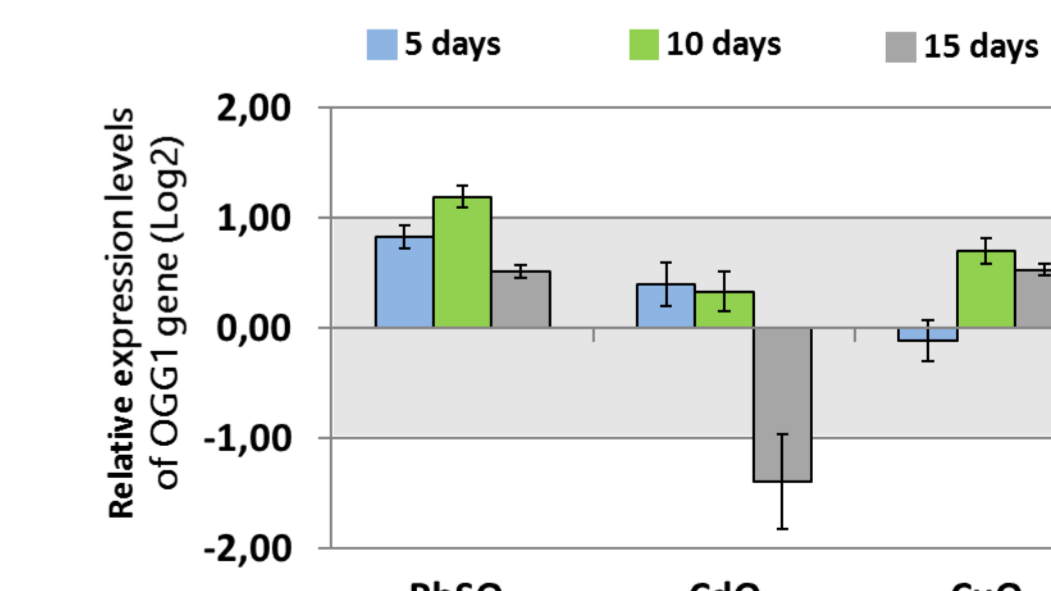
Relative expression levels of genes



CHL1 overexpressed for each condition due to stomatal sealing

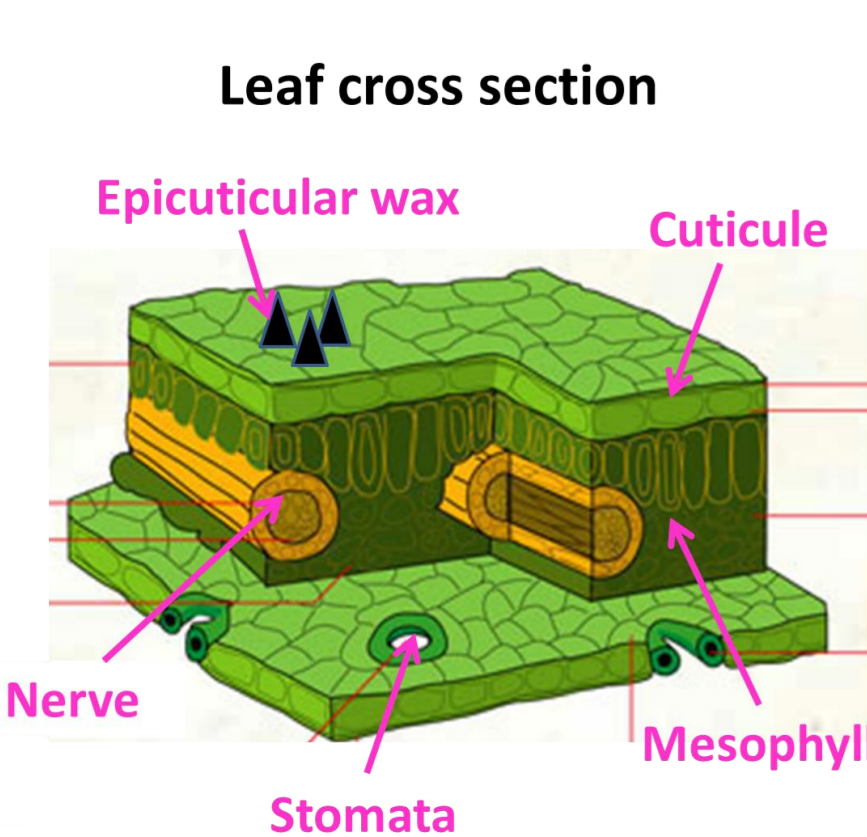


Oxidative stress limitation Repair mechanisms for CdO and CuO ??



No obvious oxidative stress

Conclusion



Metal-rich particles are trapped by adaxial face of leaves in case of atmospheric exposure. It appears that the transfer through the stomatae induces a PSII activity decrease. The DNA damage xxx Oxidative stress ????
The results clearly showed the role of epicuticular wax to limit the metal transfer and the genotoxic effects.

Acknowledgments

The authors acknowledge the Region Hauts de France and IRENI program for financial support. Authors are grateful to collaborators Pr. C. Dumat, Dr A. Austruy and Dr E. Schreck for the fruitful discussions. P. Recourt is thank for the ESEM-EDX measurements.