# NANJING FORESTRY UNIVERSITY

# Cadmium stress in *Pontederia cordata*: uptake, phytotoxicity and detoxification

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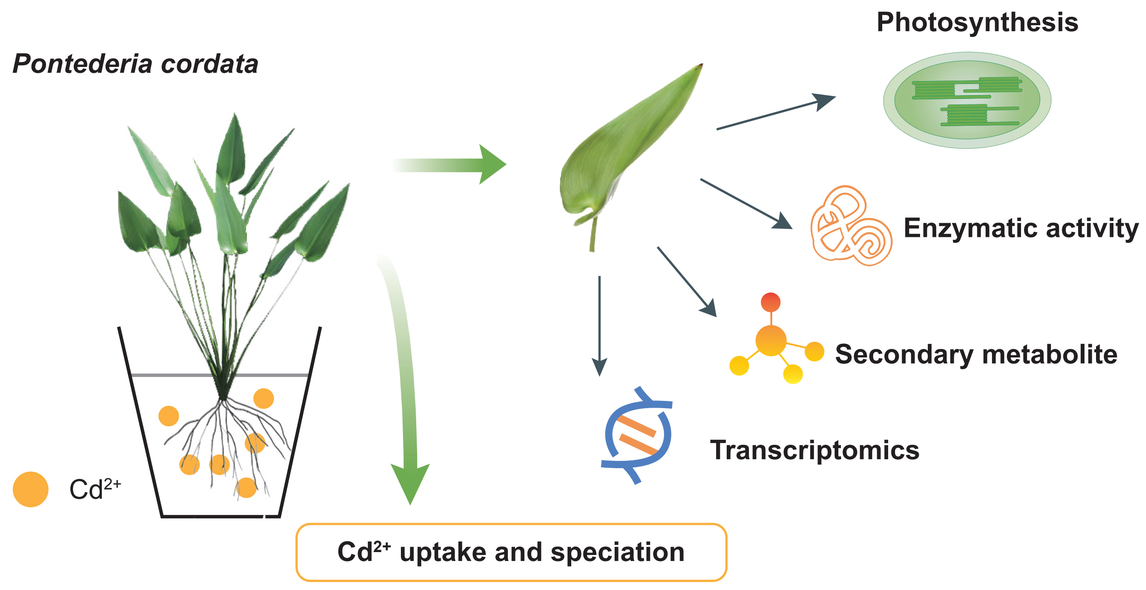
## Introduction

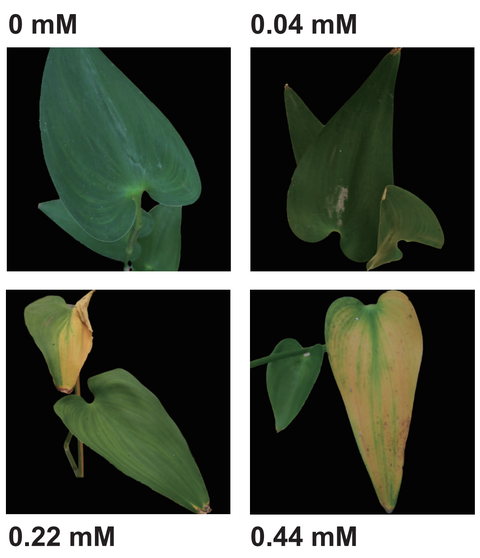
Cadmium (Cd) is widely accepted as one of the most toxic and distributed heavy-metal pollutants with high water-solubility and easy absorption by plant roots, consequently constituting a threat to the health of humans and other organisms through its accumulation in the food chain and biological amplification. Phytoremediation is an ecologically sustainable technology with low costs and low maintenance, which can effectively remove heavy metals from sediments and water in wetlands, and contemporarily delivers oxygen to the rhizosphere of wetland plants through aerenchyma from the shoot to root, thereby improving water quality.

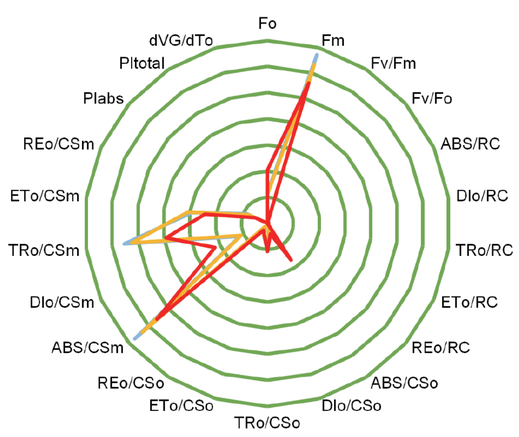
*Pontederia cordata*, an ornamental macrophyte in wetlands, is easily propagated and has the high biomass and stout rhizome. Our previous investigation indicated this species is heavy-metal tolerant, immobilizing most of the heavy metals in its roots, and is therefore an excellent material for wetland restoration and revegetation.

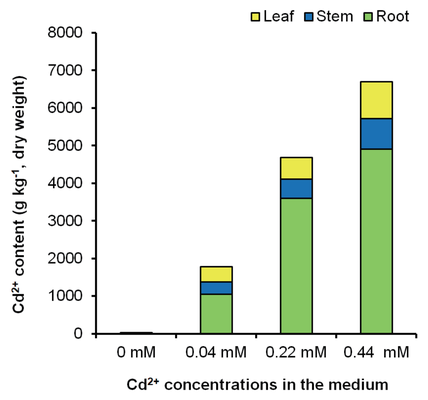
## Materials and methods

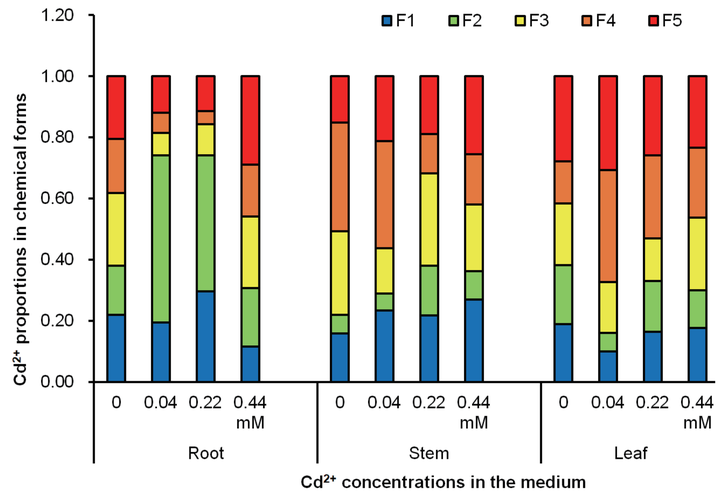


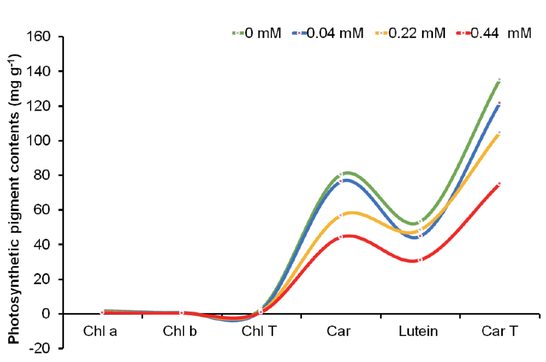

## Results and discussion

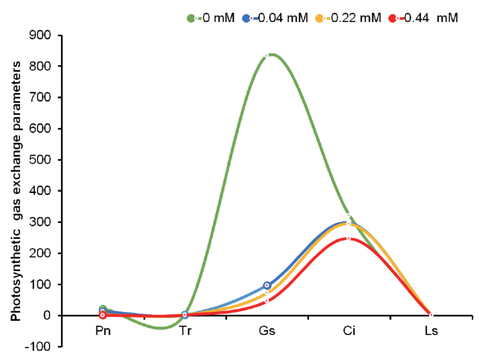


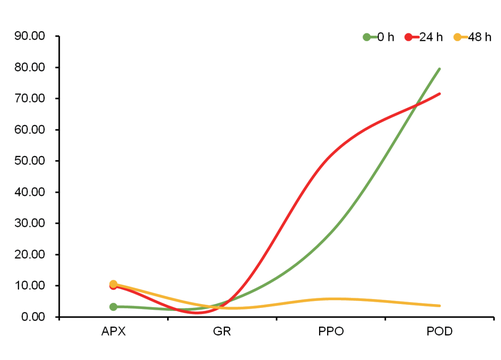



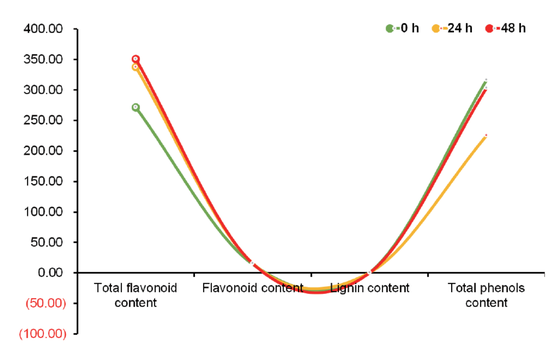



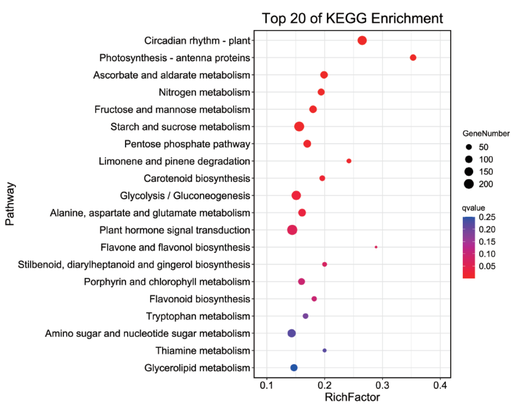



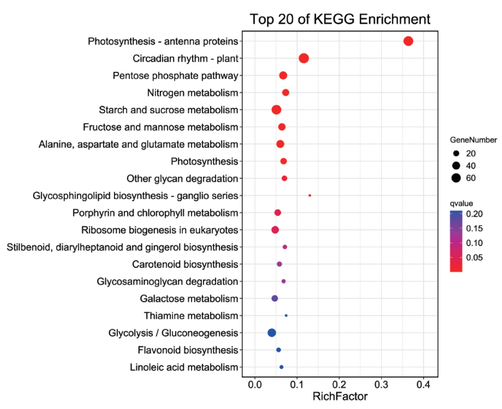



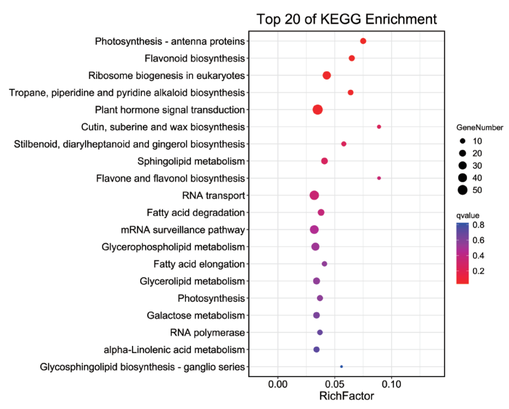



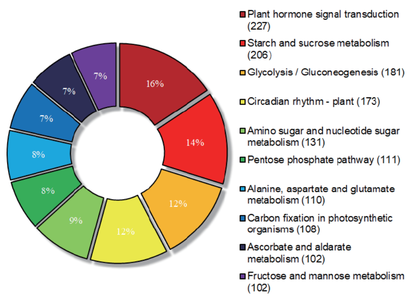



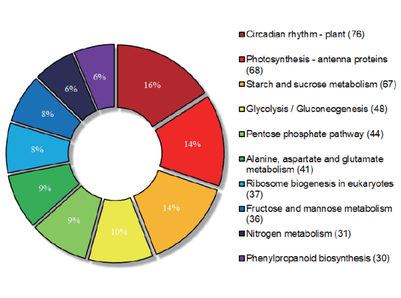



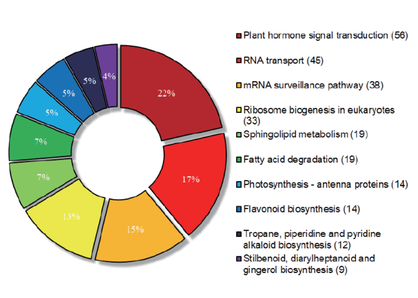



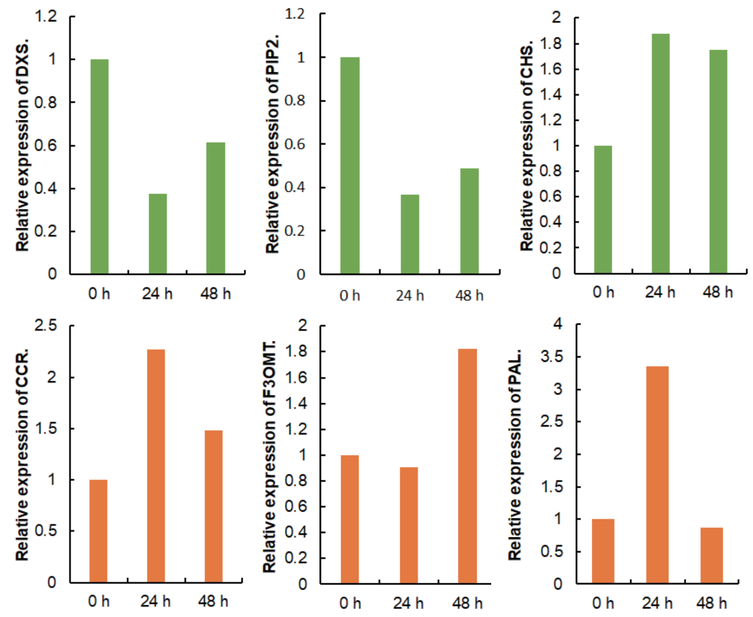




The top 20 of KEGG enrichment analysis of DEGs in sets of CK-0 h vs T-24 h, CK-0 h vs T-48 h, and T-24 h vs T-48 h, respectively. The number of genes in the top 10 pathways with the lowest *q* value in sets of CK-0 h vs T-24 h, CK-0 h vs T-48 h, and T-24 h vs T-48 h, respectively.

Relative expression levels of six selected DEGs of *P. cordata's* leaves:




## Conclusion

*Pontederia cordata* represents a cadmium accumulator with high tolerance potential.

The phenylpropane pathway serves as a crucial chemical defense in *P. cordata* defense against $Cd^{2+}$ phytotoxicity.

The metabolic pathways involved in *P. cordata* against $Cd^{2+}$ mainly included (1) primary metabolic pathways such as nitrogen metabolism, starch and sucrose metabolism, fructose and mannose metabolism, as well as pentose-phosphate pathway to maintain cellular structure and function stability; (2) flavonoid biosynthesis, and stilbenoid, diarylheptanoid, and gingerol biosynthesis to alleviate oxidation damage; and (3) pathways involved in photosynthetic pigments.

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## References

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[2] Xin JP, Ma SS, Li Y, Zhao C, Tian RN* (2020) *Pontederia cordata*, an ornamental aquatic macrophyte with great potential in phytoremediation of heavy-metal-contaminated wetlands. Ecotox Environ Safety 203: 111024.

[3] Xin JP, Ma SS, Zhao C, Li Y, Tian RN* (2020) Cadmium phytotoxicity, related physiological changes in *Pontederia cordata*: antioxidative, osmoregulatory substances, phytochelatins, photosynthesis, and chlorophyll fluorescence. Environ Sci Pollu Res 27: 41596-41608.

[4] Xin JP, Zhao C#, Li Y, Ma SS, Tian RN*. Transcriptional, secondary metabolic, and antioxidative investigations elucidate the potential mechanisms of *Pontederia cordata* against cadmium phytotoxicity (to be published).