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ABSTRACTS

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Evolution and functional differentiation of recently diverged phytochelatin synthase genes from *Arundo donax* L.

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Phytochelatin synthases (PCS) play pivotal roles in the detoxification of heavy metals and metalloids in plants (1). Despite such relevance, little information on the evolution of recently duplicated *PCS* genes in plant species is available.
Here we characterize the evolution and functional differentiation of three *PCS* genes from the giant reed (*Arundo donax* L.), a biomass/bioenergy crop with remarkable resistance to cadmium (Cd) and other heavy metals (2). Phylogenetic reconstruction with *PCS* genes from fully sequenced monocotyledonous genomes indicates (3) that the three *A. donax* PCS, namely *AdPCS1-3*, form a monophyletic clade (Fig. 1). *AdPCS1-3* genes are expressed at low levels in many *A. donax* organs and, in particular, display different levels of Cd-responsive expression in roots (Fig. 2). Overexpression of *AdPCS1-3* in *Arabidopsis thaliana* and yeast reproduces the phenotype of functional *PCS* genes (4). Mass-spectrometry analyses confirm that AdPCS1-3 are all functional enzymes, but also evidence significant differences in the amount of the phytochelatins synthesized (Fig. 3). Moreover, heterogeneous evolutionary rates characterize the *AdPCS1-3* genes, indicative of relaxed natural selection (5).
These results highlight the elevated functional differentiation of *A. donax PCS* genes from both a transcriptional and an enzymatic point of view, providing evidence of the high evolvability of *PCS* genes and of plant responsiveness to heavy metal stress.

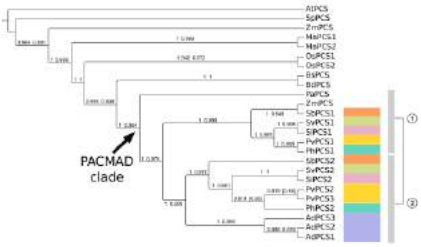

Fig. 1. *AdPCS1-3* phylogeny

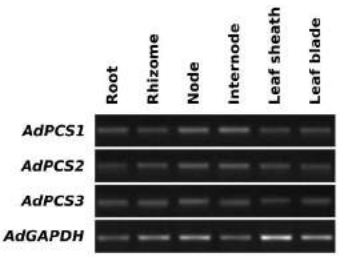

Fig. 2. *AdPCS1-3* expression

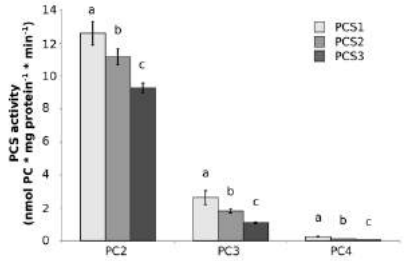

Fig. 3. *AdPCS1-3* specific activity

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