TOLERANCE AND BIOACCUMULATION OF LEAD BY THE INDUCED ASSOCIATION BETWEEN *Dodonaea viscosa* AND A FUNGAL ENDOPHYTE

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Introduction. Lead (Pb) is one of the most abundant toxic elements found in soils (1). Phytoremediation is an option to recover these soils through the transformation, extraction and/or stabilization of metals. The role of microorganisms in that process is not entirely clear. However, its efficiency can be modified by manipulating plant-microorganism associations. There are free-living fungi that can form stable and positive associations with plants, acting as endophytes (2). These fungi play a key role in the plants adaptation to polluted soils and can improve the metal phytoremediation, since they have a great ability to tolerate, detoxify and immobilize metals (3). Although studies focused on the endophyte-assisted phytoremediation are scarce, it is important to assess new strategies to establish specific associations between tolerant plants and fungal strains that have some effect on the contaminant to be treated (3).

The aim of this study was to characterize the tolerance and bioaccumulation of Pb by *Dodonaea viscosa* alone and in association with a fungal endophyte.

Methods. 15-days old seedlings of *D. viscosa* were obtained from heat-scarified and surface-sterilized seeds. They were sown in tubes containing perlite moistened (73%) with Murashige & Skoog (MS) medium added with sucrose (10 g/L) and Pb (2000 mg/kg dry weight, DW). The N content in the medium was adjusted to obtain a C/N = 15. To induce the association with the fungus, a part of seedlings was inoculated with ~0.025 mg of *Cladosporium* sp. mycelium, which was isolated from seeds of *D. viscosa*. Four treatments (x7) were done: (**1**) plant (P); (**2**) plant + fungus (PF); (**3**) P+Pb; (**4**) PF+Pb. Plants were maintained under a 16 h photoperiod at 25°C for 50-60 days. Thereafter, the biomass (DW) of roots and shoots was quantified and the Pb bioaccumulated was measured by atomic-absorption spectrometry. The Pb content in tissues was used to estimate the translocation (TF) and the phytostabilization (PSF) factors (4). One-way ANOVA and a Duncan test ($P<0.05$) was used to compare differences among treatments.

Results. The biomass production by *D. viscosa* was significantly enhanced by *Cladosporium* sp. In presence of Pb, the plant biomass increased ~39% regarding the uninoculated controls (Fig. 1), indicating a positive effect of the fungus on the plant tolerance to Pb. Similarly, the growth of *Salix fragilis* in a metal-polluted soil was stimulated by effect of *T. harzianum* (5).

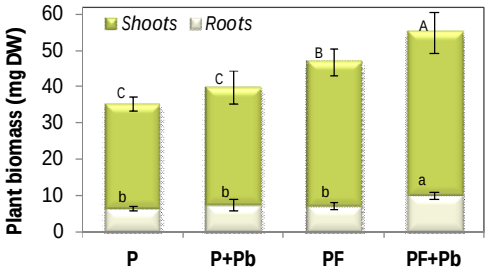

Fig.1. Plant biomass of *D. viscosa* (P) or *D. viscosa* - *Cladosporium* sp. (PF) grown with (+Pb) or without Pb. Different letters indicate significant differences (n = 7).

D. viscosa accumulated up to 24-fold more Pb in roots than in shoots (Table 1), which indicates a restricted transport to the shoots (4) and conduced to low TFs (< 0.08). *Cladosporium* sp. decreased (~45%) the Pb accumulation by *D. viscosa*, obtaining a PSF 47% below than that obtained for the plant alone. This result suggests that the hyphae play a role in the Pb retention, thereby reducing the metal accumulation in plant biomass and improving its tolerance (5).

Table 1. Effect of the presence of *Cladosporium* sp. in the Pb accumulation by *D. viscosa*. Translocation (TF) and phytostabilization (PSF) factors are also shown*

Treatment	Pb (mg/g DW)		TF	PSF
	Shoots	Roots		
P + Pb	0.59±0.06	14.1±1.0	0.05±0.01	6.9±0.5
PF + Pb	0.59±0.12	7.4±1.6	0.08±0.01	3.6±0.8

* Average of 3 determinations ± standard deviation.

Conclusions. *D. viscosa* showed a high tolerance and accumulation of Pb. *Cladosporium* sp. stimulated the plant growth in presence of Pb and restricted the metal accumulation in the roots. This particular plant-fungus association could be proposed to improve the plant growth and the phytostabilization of Pb-polluted sites.

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References

1. Yadav S.K. 2010. *S. Afr. J. Bot.* 76: 167-179.
2. Lynch J., Moffat A. 2005. *Ann Appl Biol*, 146: 217-221.
3. Li H., Wei D., Shen M., Zhou Z. 2012. *Fungal Divers*, 54: 11-18.
4. Audet P., Charest C. 2007. *Environ. Pollut.* 147: 231-237.
5. Adams P., De-Leij F., Lynch J.M. 2007. *Microb Ecol*, 54: 306-313.