The over expression of the strigolactone transporter PDR1 as a tool to improve plant growth on phosphate poor soils

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The phytohormone strigolactone (SL) was discovered 50 years ago as germination stimulant for parasitic weeds. In the last years we learned that SLs are carotenoid derivatives playing several additional roles. In the interaction between plants and environment, SLs induce hyphal branching of mycorrhizal fungi, thus promoting the first steps of root mycorrhization. In plants, SLs regulate shoot and root architecture, such as the development of lateral organs (1).
As for animal hormones, plant hormones are often transported from their site of synthesis to their site of action, even over long distances (2). We investigate how SLs are transported from the root to the soil as well as to the shoot, as suggested by previous experiments (3). The only up-to-date characterized SL transporter, the ABC protein PDR1, is required for SL exudation to the soil and deliver to the aboveground part of the plant (4). PDR1 is asymmetrically localized in root cortex cells, thus suggesting that polar SL transport is necessary for SL function (5). *pdr1* mutants are less efficient than wildtype in establishing mycorrhization and have increased shoot lateral branching. On the contrary, plants over- expressing PDR1 (PDR1 OE) have a pronounced apical dominance and their root exudates strongly promote the germination of parasitic weeds. Both these phenotypes are related to de-regulated SL transport/exudation.
We report here the effects of PDR1 OE on plant biomass production, root development and mycorrhization in two Solanaceae, *Petunia hybrida* and *Nicotiana benthamiana*. PDR1 OE plants produce more biomass on nutrient deprived soils, compared to wildtype, due to higher/faster mycorrhization levels and to dramatic changes in root cell identity and root architecture. As resulted from x-ray tomography analyses on petunia roots, PDR1 OE promotes lateral root development, root hair elongation and the amount of specialized cortex cells called hypodermal passage cells (HPCs). HPCs are exodermal, non-suberized cells and are the exclusive entry points for mycorrhizal fungi. Additionally, HPCs likely regulate the uptake of several ions from the soil to the root, as they lack the hydrophobic suberin layer present in neighboring hypodermal cells. Our first results indicate that SL, in crosstalk with other phytohormones, regulates the identity and/or maintenance of HPCs, thus integrating soil nutrient uptake with root/shoot architecture and plant biomass production.

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