Role of cell wall in plant metal nutrition

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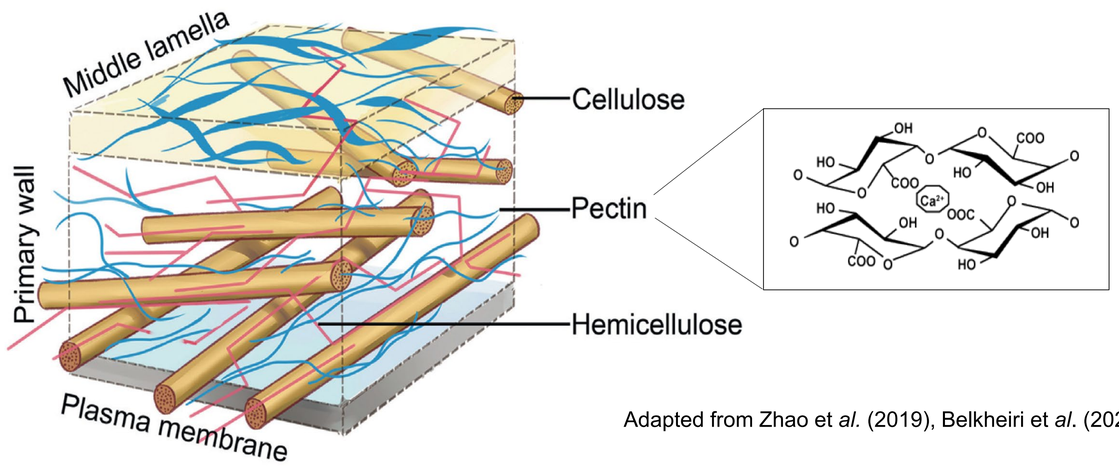
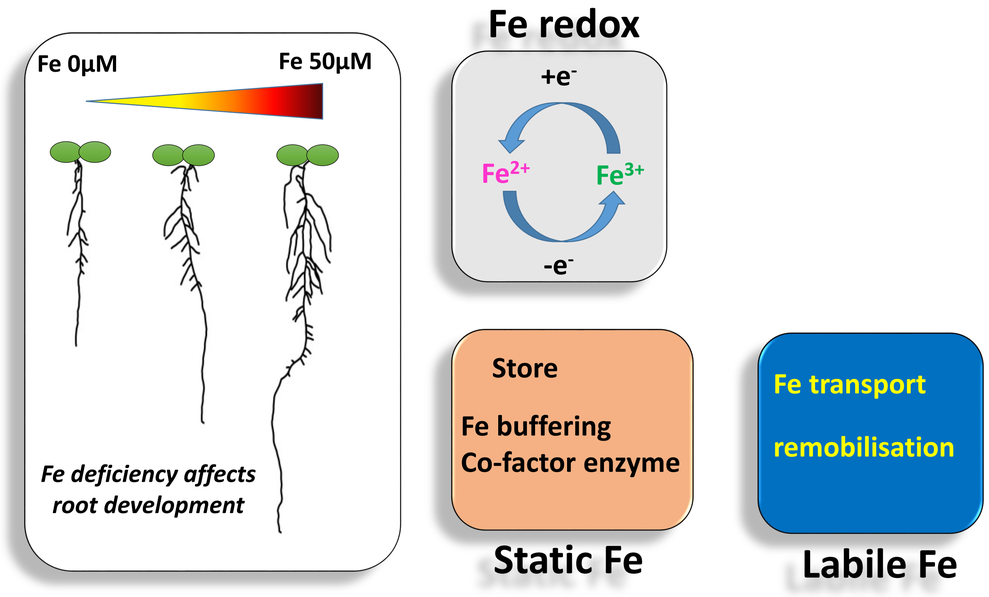
Plant cell wall structure is able to bind cations



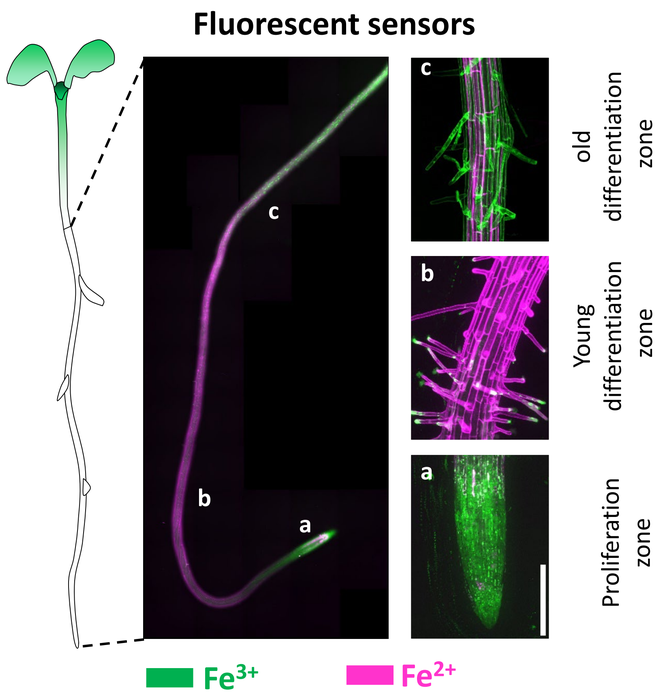
Adapted from Zhao et *al.* (2019), Belkheiri et *al*. (2021)

Schematic illustration of the primary cell wall structure. Pectin is a polymer whose backbone is mainly composed an α-1,4-D-galacturonic acid residue. The pectin carboxyl groups can be methyl esterified and play a role in cell wall rigidity. Demethylated pectins can bind cations to form gels.

Fe is an essential nutrient for plant

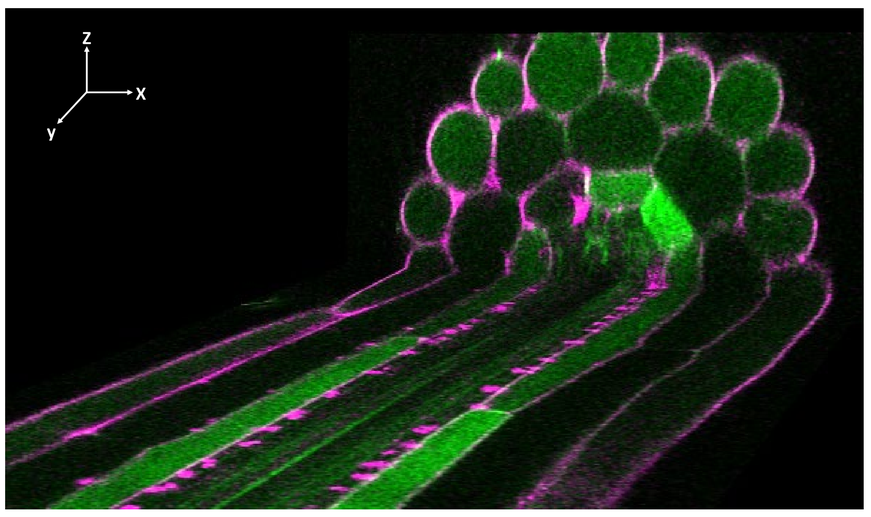


Fluorescent probes for labile Fe^{3+} and Fe^{2+} detection in plant root



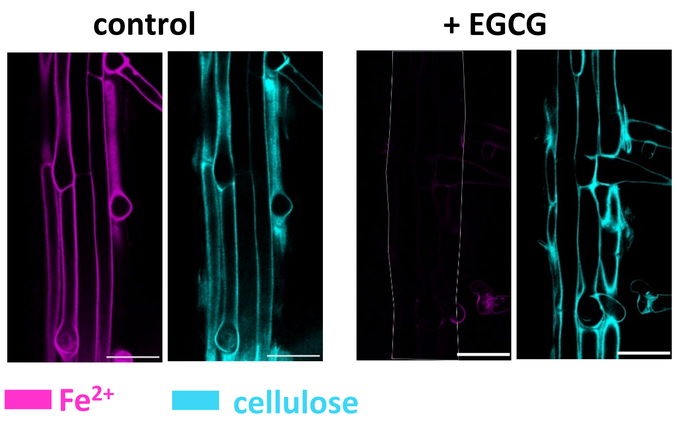
Fe distribution along the root of 7 days old plant of *Arabidopsis thaliana*. Fe^{2+}/Fe^{3+} are visualized with fluorescent probes along the root in three different zones (a,b,c).
Scale bar = 200 µm

Labile Fe^{2+} is localized at the cell wall



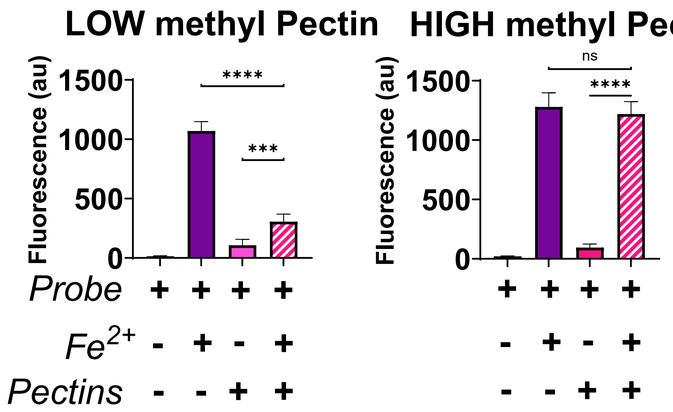
3D view of a onfocal microscopy acquisition to visualize Fe cellular localization in the root of 7 days old plant of *Arabidopsis thaliana*. Labile Fe^{2+} and to a lesser extent Fe^{3+} are localized at the cell wall. Fe^{3+} is mainly detected in the vacuole

Inhibition of pectin methyl esterase leads to loss of the Fe^{2+} fluorescent signal



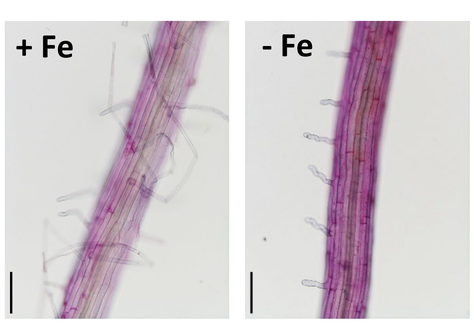
The degree of methylation of the pectin has an impact on the Fe^{2+} labelling. Application of the inhibitor of pectine methyl esterase (EGCG) which favors the high methylated (HM) pectin forms decrease the Fe^{2+} fluorescent signal at the cell wall compared to the control condition. EGCG has no effect on the cellulose staining by the probe DirectRed. Scale bar = 50 µm

Low methylated pectins are able to bind Fe^{2+} *in vitro*



Low methylated pectins decrease the fluorescent level of the probes in presence of Fe^{2+} *in vitro*, suggesting that demethylated of pectins are able to bind Fe^{2+}.

Fe deficiency causes pectin demethylation



Concentration of Fe in the culture medium affects the cell wall structure in the plant root. Absence of Fe increases the ruthenium red staining (magenta) showing an increase in pectin low methylated.
Scale bar = 100 µm

Objectives

- **Characterize Fe binding to cell wall components**
- **Determine the role of cell wall Fe in plant development**
- **Function of Fe in cell wall structure during environmental stresses**

Technical approches

- **Plant culture, cell wall mutant lines**
- **Molecular biology**
- **Spectrofluorimetry**
- **Live fluorescent microscopy, image analysis**