Are the aerenchyma ratios in rice roots and leaves correlated?

A Cirad/Agropolis project

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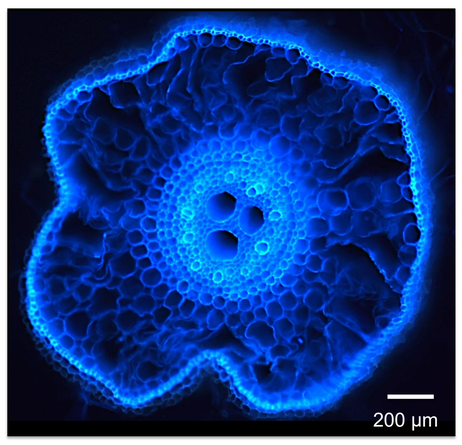
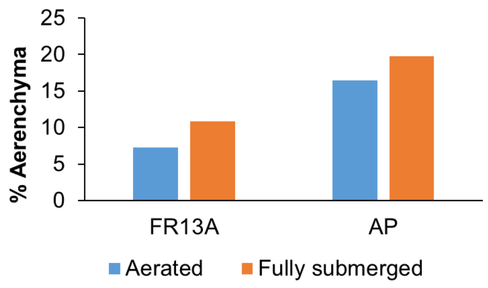
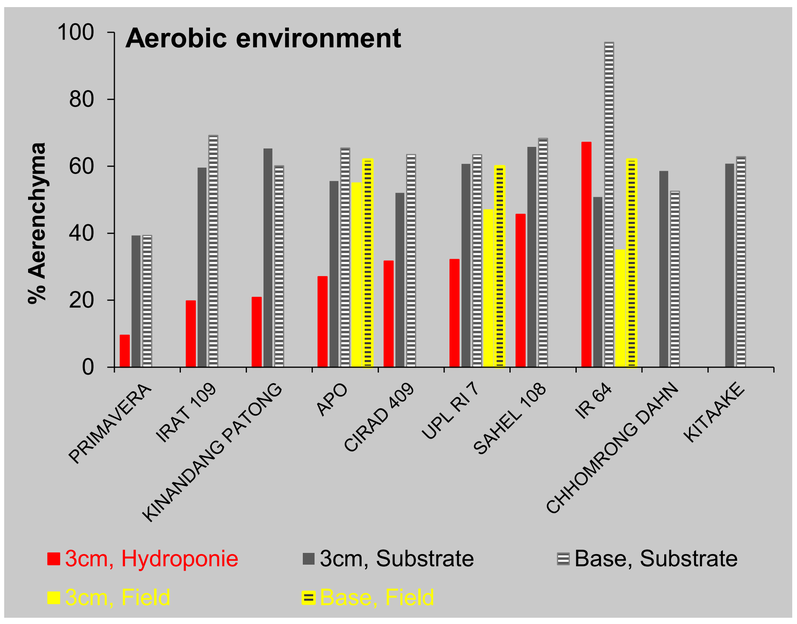
Aerenchyma ratio is lower in the roots of upland rice grown in aerobic environments than in lowland rice



Epifluorescent cross-section of a rice nodal root



Aerenchyma % in leaf sheaths of two rice varieties grown in pots and fully submerged for the three last days in the submerged treatment (From Parlenti, 2011).

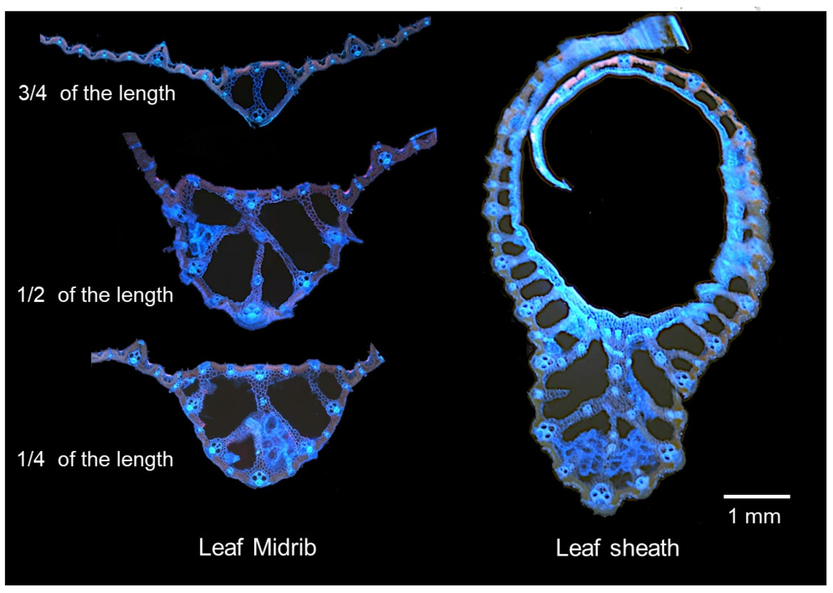


Aerenchyma:cortex ratio at either 3 cm from the root apex or 1 cm from the root base-stem junction in ten rice varieties grown in 1) aerated solution (Rebolledo, 2023), 2) drained substrate, and 3) drained field soil (Ouyang, 2020).

Aerenchyma lacunas in rice leaves and roots permit gas exchanges in the flooded plants but simultaneously reduce radial water transportation in roots. Root aerenchyma ratio was always lower in the elite Brazilian rainfed variety Primavera, and this trait could potentially help further improvement of rainfed varieties. However, routine root phenotyping is not feasible, while inter-variety variability for aerenchyma ratio in roots in aerobic environment and in the sheath has been previously reported. Therefore, we proposed to study the correlation between aerenchyma ratios in roots and leaves to investigate if aerial parts could be used in future research.

Do performing upland rice varieties and CRISPR edited lines with less aerenchyma in roots also show less aerenchyma in the leaves?

A 2023-2024 project.



Epifluorescent cross-sections of the leaf midrib at three distances from the base and of the sheath of a n-2 leaf of IR 64 at harvest time.

General objective

Determine the genotypic variability for the relative volume occupied by the aerenchyma within the matured leaf sheath, leaf midrib and matured roots using ten varieties and eight knockout edited lines.

Specific objectives

- Establish a standard and reliable method for obtaining high-quality images of cross-sections in both the rice leaf sheath and leaf midrib.
- Adapt the existing image analysis pipeline for root cross sections to leaf cross sections to estimate aerenchyma ratio.
- Adapt a mounting protocol for X-ray CT acquisition of the whole rice plant. Design a visualization method for X-ray CT volumes based on existing software. Design a semi-automatic analysis method to estimate morphometric features along the aerenchyma trajectory from the leaf tip to the root insertion point.
- Measure the aerenchyma ratio in leaves and roots in a genetically diverse set of ten genotypes and eight knockout edited lines in aerobic and flooded horticultural substrates.
- Determine the correlation of the aerenchyma ratios in roots and leaves.

Reference Maria Camila Rebolledo, Benoit Clerget, Sylvie Jaffuel, Christophe Périn, Romain Fernandez, Sandrine Roques, Audrey Dardou, Angel Aller Estevez, Justin Savajols, Clara Cavagnoli. *Would rice varieties without root aerenchyma perform better in upland environments?* International Rice Research Conference 2023, Manila, Philippines.

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