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STUDY PHOSPHATE UPTAKE IN PLANTS

EBMP team



P is crucial for plant development



GPRI & Institute for Sustainable Futures (ISF), Sydney; Cordell et al. 2009

-50% of soils used for agriculture have not sufficient bio-available P content -Bio-available Pi ressources are limited (recovered from mineral P rocks of mostly from sedimentary and a fraction from volcanic origin)

Pi (phosphate) is crucial for metabolism



 Pi (phosphate) is the main source of P that can be taken up by plants **IMAGING Pi BY STAINING TISSUES**





Visualize mineral Pi distribution

Natural conditions (0-5/10µM) not very discriminant

Semi quantitative

Guo et al., 2024. Nature Plants

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Weak mobility of phosphate in soils



single lens reflex	
taper FOP with CsI scintillator (50μm)	Ų
protection film	&~~ <mark>*</mark>





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COMPLEXITY OF TRANSPORTERS MANIPULATION



Misson et al., 2004 PMB; Misson et al., 2005 PNAS; Bayle et al., 2011 Plant Cell; Chen et al., 2015 Plant Cell; Ayadi et al., 2015 Plant Physiol; Kanno et al., 2016 elife; Dindas et al., 2022 Current Biology



PHT1.1-GFP



PHF1: ER localized PHF1: a protein facilitating ER crossing

Bayle et al., 2011 Plant Cell

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Pi at root tip





Uptake or translocation?



³³Pi labelling experiment

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Pi uptake at the root tip level



From Lee et al., 2013, J.Exp.Bot.

- Pi absorption is rapid: measurable within 1min
- Root tip contributes to 1/3 of Pi influx

Kanno et al., 2016 elife

Thanks to Pr Nakanishi and Dr Kanno

Fast adaptive responses to Pi deficiency



Introduction

Identification of fast responsive genes to Pi

Refeeding Pi starved plants -> RNAseq 22 fast responsive markers (within 20 min) identified



Roots respond faster than in shoots Regulation highly conserved (crops...)->PCR markers DE LA RECHERCHE À L'INDUSTR



DETECTION OF PI DEFICIENCY IN PLANTS

μM Pi (KH₂PO₄)







- RNA degradation varies (¹/₂ life of mRNA ~ 107 mins on average but up to 1 day)
- Decay of fluorescent proteins ~ hrs
- Transcriptional control can occur within seconds (light stress)



SOLUTION: MS2-MCP SYSTEM FOR LIVE TRANSCRIPTION IMAGING



REAL-TIME VISUALIZATION OF PI-MEDIATED TRANSCRIPTIONAL REPRESSION



Spinning disk Microscope

Hani et al., 2021 Nature Plants

Pi modified transcription within 3/5 min in whole root (PCR detect only after 20/30 min)

Cez

Thanks to...











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PHT1:

