

La retraite 2016 côté TSF



Iron deficiency: a major public health issue

WORLD-WIDE IRON-DEFICIENCY ANEMIA



In developing countries:

- Every second pregnant woman
- 40% preschool children

In France

- Fe deficiency: children, teenage girls, women of childbearing age
- Fe anemia: 10-30% pregnant women

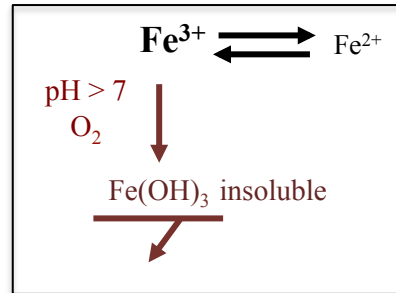
People from developing countries feed on plants,
a poor source of Fe

WHO recommendations:
improve iron content in seeds

Biotechnological challenge!

Iron deficiency: a major public agronomic issue

Précipitation



Fe deficiency chlorosis in soybean



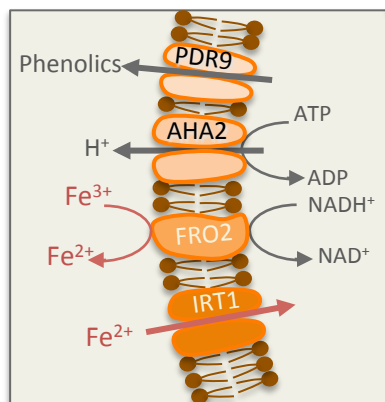
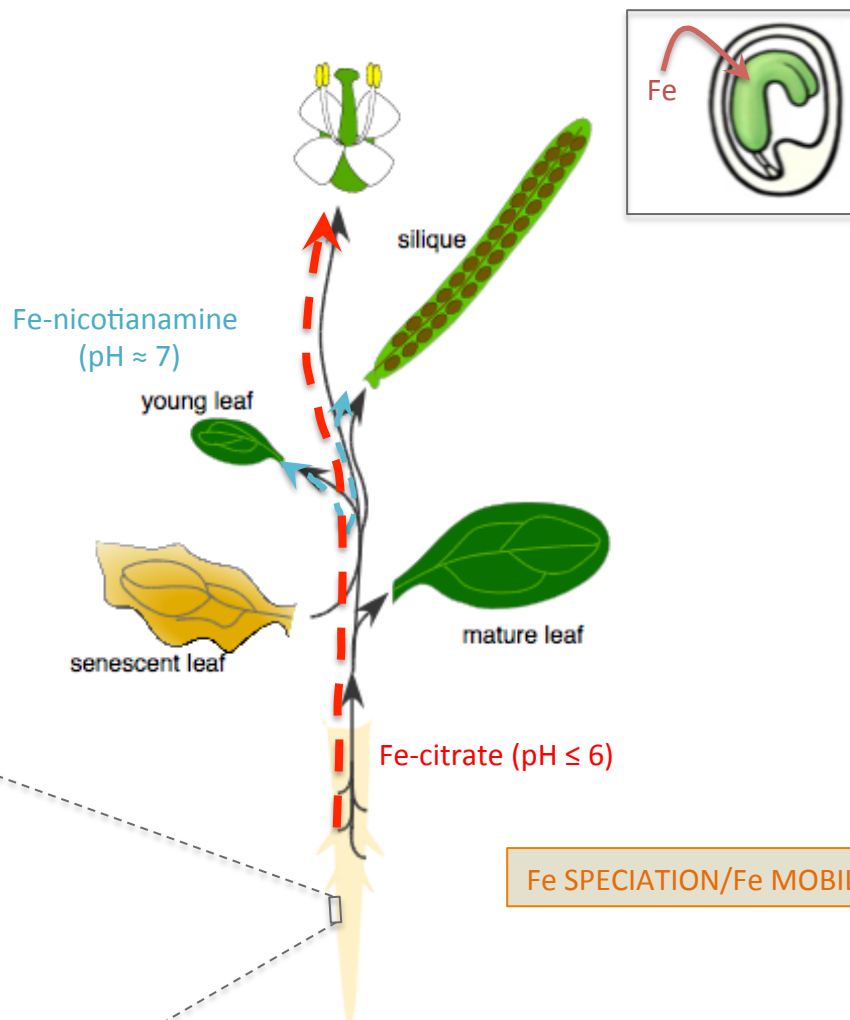
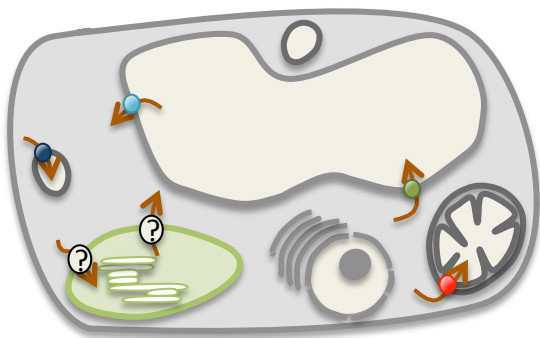
Alcaline/high lime containing-soil

Consequences of Fe deficiency:

- Yield loss
- Low fertility
- Low Fe content in seeds
- Heavy metals accumulation

TSF interests: Iron mobilization from soil to seeds

INTRACELLULAR DISTRIBUTION



COMPLEX REDOX CHEMISTRY

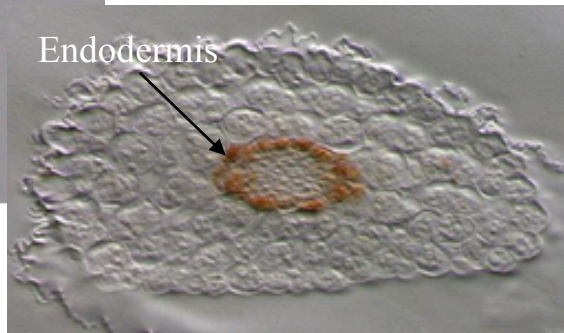
Fe SPECIATION/Fe MOBILITY

Ligands?
Oxido-reductases?
Transporters?

Perls/DAB staining : a powerful method to image iron in tissues and cells



Hannetz
Roschttardt
PUC Chile



Roschttardt et al. Plant Phys. (2009)
Roschttardt et al. Front Plant Sci (2013)

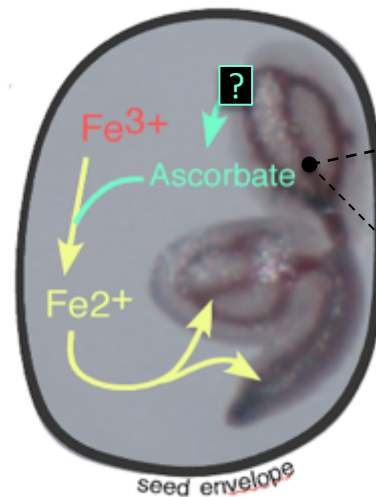
Results: New actors of Fe distribution



Ascorbate: a key actor of Fe assimilation in seeds



Louis Grillet



Fe uptake from the embryo relies on its reduction by ascorbate effluxed by the embryo

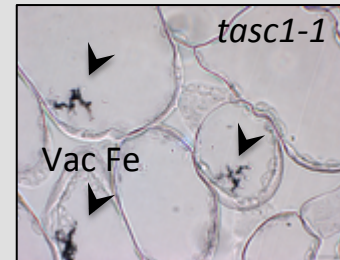
Grillet et al., JBC 2014
Flis et al., New Phytol. 2016

Bourse thèse INRA

Nature and transport of intracellular Fe pools



Minh Hoang

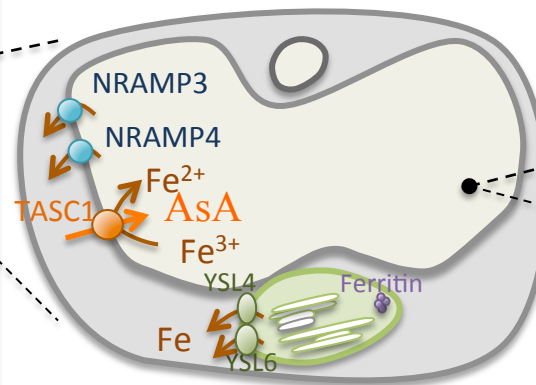


TASC1 transports ascorbate into the vacuole and enables remobilization of Fe during germination

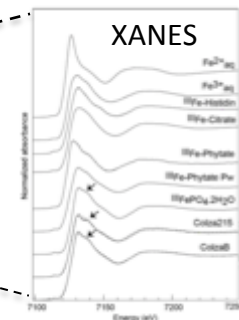
Hoang et al., In prep



Sandrine Chay



In seeds, iron is stored as Fe-phytate



Chay et al., In prep
Belgaroui et al., PCP 2014 (« METAUX »)



Fanchon Divol



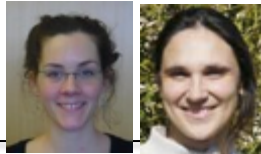
YSL4 and YSL6 transport Fe out of the chloroplasts and protect the plant from Fe excess

Divol et al., Plant Cell 2013



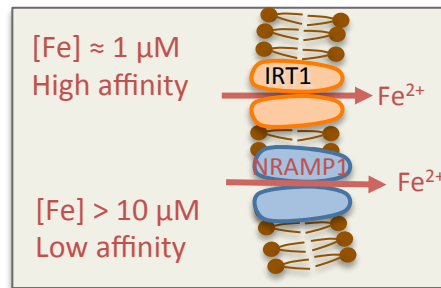
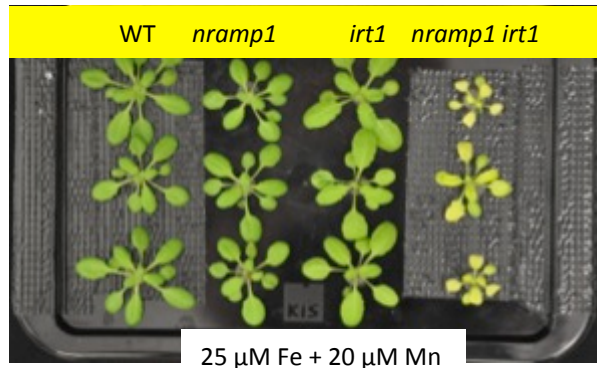
Results: Function of the manganese transporters NRAMP1 and NRAMP2

IRT1 and NRAMP1 cooperate for Fe uptake



ANR France-Taiwan
MANOMICS 2012-2015

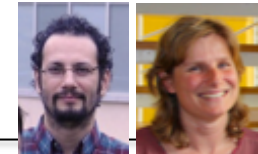
Loren Stéphanie
Castaings Loubet



- Functional redundancy between NRAMP1 and IRT1 for Fe acquisition by the root in the low affinity range
- NRAMP1: high affinity Mn/ low affinity Fe

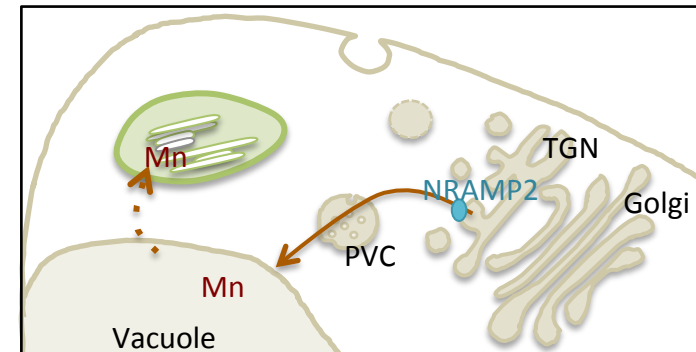
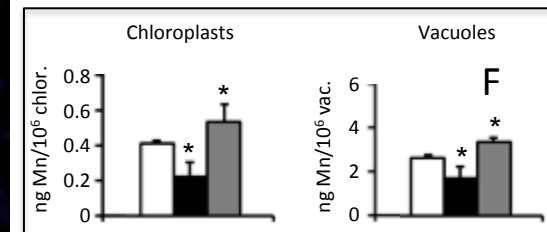
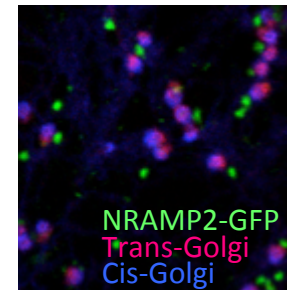
Castaings et al., in preparation

NRAMP2 distributes Mn within the cell



ANR PLANTMAN 2011-2014

Santiago Alejandro
Carine Alcon



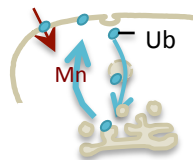
- NRAMP2 is a Mn transporter of the TGN
- NRAMP2 acts upstream to provide Mn to downstream organelles

Alejandro et al., in preparation

Projects



Mn transport, its regulation and ox stress



ANR ECOMAN



GWAS
Gene discovery



Seed iron storage

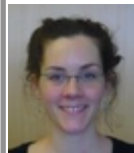


ANR ISISTOR

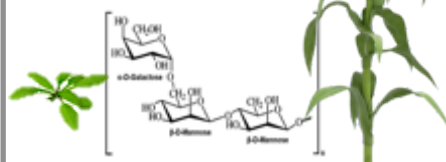
« Transfer biology »



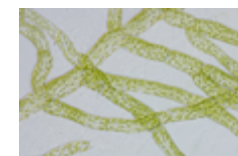
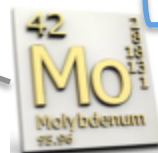
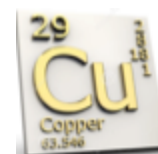
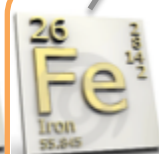
AAP BAP 2016
IRONSEED



Impact of agropolymers
on plant nutrition

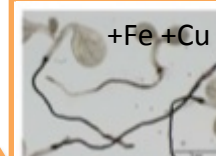


SOLVAY 2015-17



Fe nutrition in the non-vascular plant model
Physcomitrella patens

« Cross-talk »



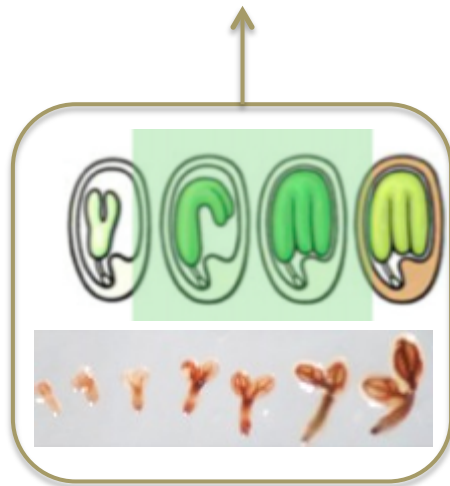
Angela Carrio
Valencia University

Iron speciation and mobility



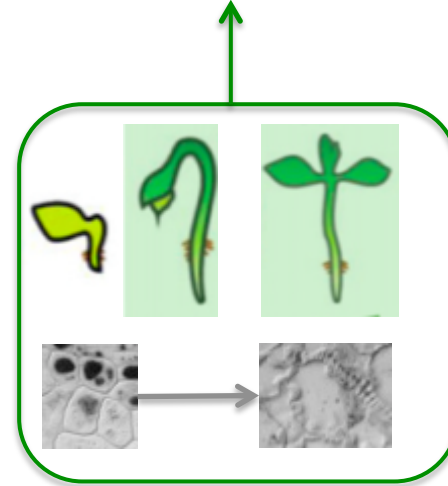
New genes controlling Fe transport

- ascorbate transporters
- GWAS



Machinery of Fe remobilization

- Ascorbate transporters
- Phytases
- GWAS, suppressor screen



ANR ISISTOR 2016?



S. Thomine
I2BC

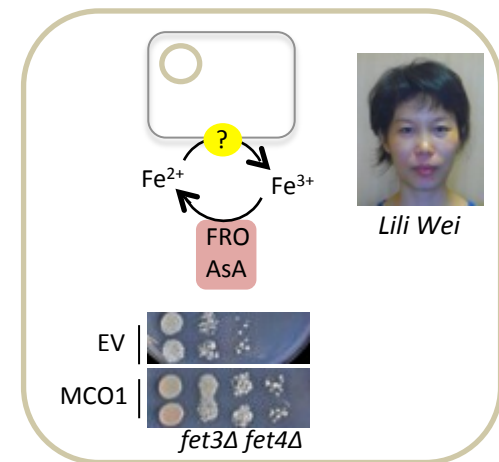


C. Bailly
UPMC

Impact of Fe on seed biology

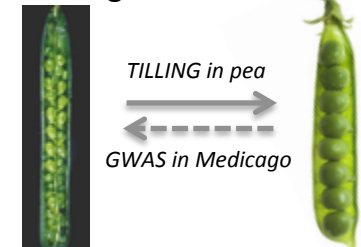
- dormancy
- germination
- ROS, hormones

Identification of ferroxidases



Karine Gallardo, Dijon

Knowledge transfer



AAP BAP 2016
IRONSEED

Fe nutrition in the non-vascular plant model *Physcomitrella patens*



Léon
Dirick

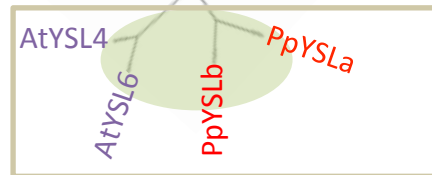
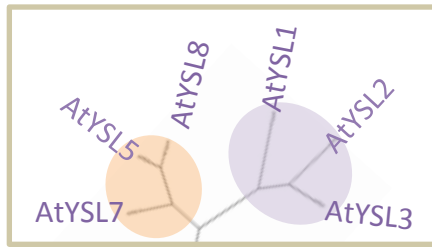


Alessandro
Alboresi
Padova

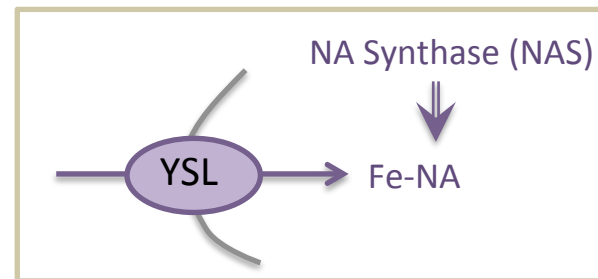


Célia
Ahier
M1

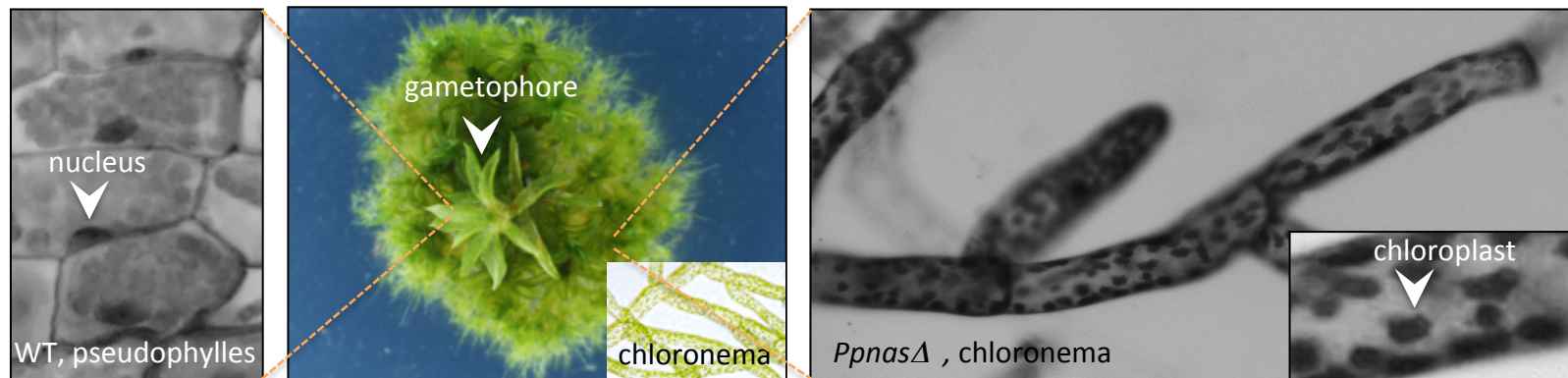
Long-distance transport



Cellular distribution



➤ Can we uncouple long-distance and cellular Fe transport functions of NA/YSL?



Physcomitrella, an attractive non-vascular plant model

- Predominant haploid phase (genetics)
- Homologous recombination (KO, KI)
- A few cell types/ simple development
- Monolayers tissues (histology)
- Easy culturing (agar plates, “Arabidopsis conditions”)
- Long term storage in water at +4°

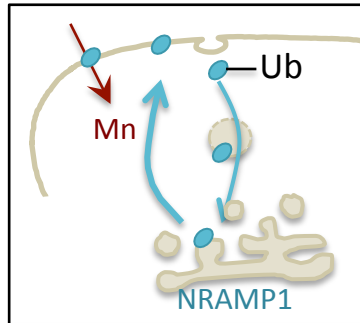
Role of NA in Mn nutrition: cellular or long-distance?

- *PpnasΔ* and *PpyslaΔ*, *PpyslbaΔ* mutants:
 - Fe distribution
 - Fe content/tolerance
- Complementation Arabidopsis mutants with PpYSLa/PpYSLb

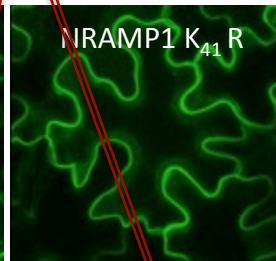
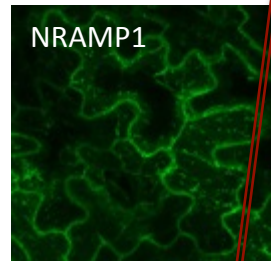


Control of Mn uptake and distribution

Membrane traffic of NRAMP1



S. Leveau
M1

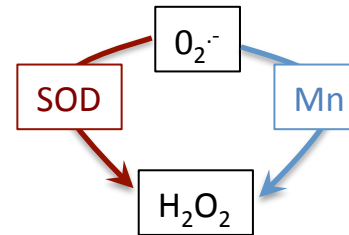


- Identification Ub-peptides
Phospho-peptides
- Identification NRAMP1
Partners MS/MS

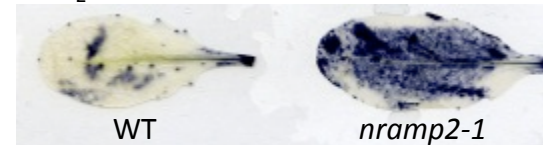


- NRAMP1
Partners
Associomics
candidates

Mn antioxidant



$O_2^{\cdot -}$ production in *nramp2* mutant



sod1Δ complementation



- Identification of Mn antioxidant species
 - In yeast
 - In plant extracts
- by ENDOR/RPE techniques (CEA Saclay)

ANR ECOMAN 2016?



S. Thomine
I2BC



Claude
Grison
CEFE



Sun Un
CEA Saclay

MANY THANKS!!!

TSF group members

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Karine Gallardo (Dijon)
Alessandro Alboresi (Padova University)

Funding



➤ **Poster Talita:** « Iron hyperaccumulators »



➤ **JOB OFFER:** CDD Assistant Ingenieur 12 months

Study the impact of agropolymers on growth and mineral nutrition of Arabidopsis and maize

