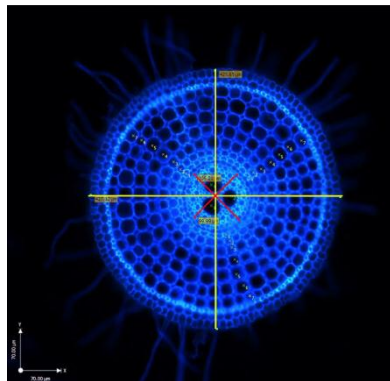
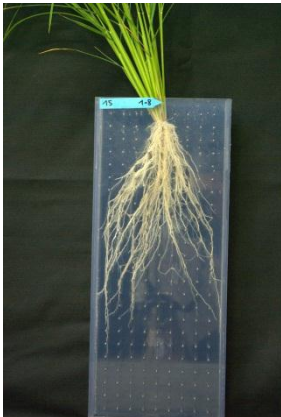


Rhizoscope :

A phenotyping system for root dynamics

A. Audebert, A. Dardou

Journées Groupe Céréales
Montpellier 3 - 4 Avril 2013



Objectives

Main Objective : Root phenotyping

Availability

Good correlation with natural conditions

Diverse constraints possibilities

Specifics Objectives

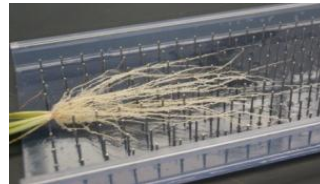
Adult plants (> 30 days for Rice)

Generic ability (other crop)

Flexible (phenotyping and mechanism understanding)



The Rhizoscope platform:



Principe : Mixed hydroponic system with glass beads as inert substrate

- Transparent Plexiglas boxes (50 cm x 20 cm x 2 cm) with a grid of nails
 - * Filled with glass beads = inert substrate providing mechanical resistance.
 - * Easy to empty
 - * 1.5 or 5 mm diameter
- Recycling nutrient solution
 - * Automatic control of pH and temperature
- Medium throughput system: 4 tanks holding each 48 plants (192 plants)
- Plants up to 30-40 days old

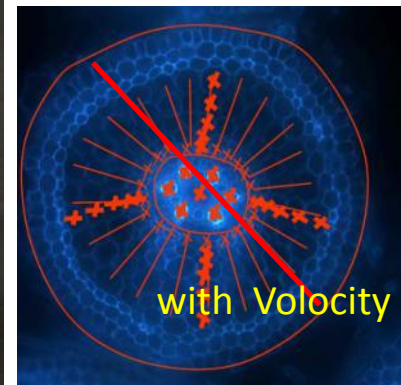
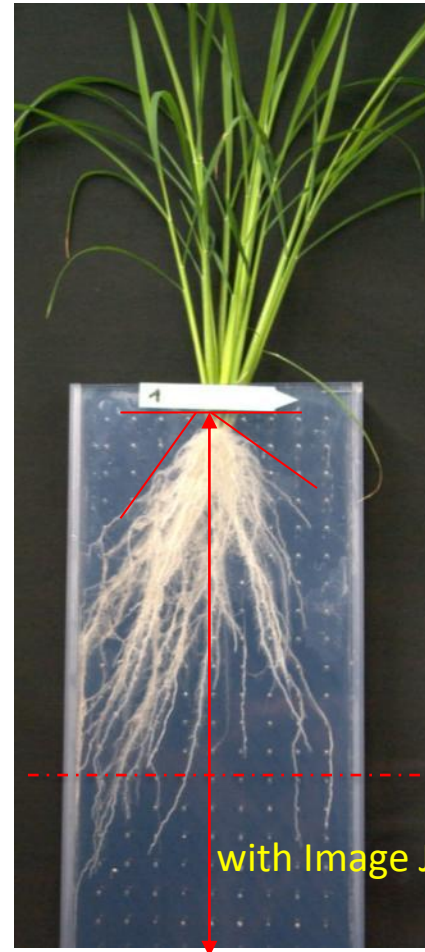
The Rhizoscope platform (2):



- Each tank could be managed individually
- Flexibility
 - *4 traits
 - *2 traits
 - *1 traits
- Imaging system
 - High quality (15 M pixel)
- Possible constraint
 - Beads (Size, Density)
 - Nutrition (deficiency and toxicity)
 - Solution (pH, Temperature, redox)
- Tested with
 - Rice, Wheat, Barley
 - Cotton
 - Wild species

What traits can be monitored?

- Manually or through image analysis:
 - Shoot traits
 - Leaf length; number of tillers per plant; leaf number; shoot biomass;
 - Root traits:
 - Maximum crown root depth; root mass at different depths; crown root number at depth; root cone angle; root diameter
 - Root /shoot ratio; root mass per tiller
- Fluorescence microscope on crown root tips
 - Root diameter; stele area; nb of xylem vessels; diameter of xylem vessels; nb of mesodermis layers



Somes species tested



Rice



Wheat



Sanguisorba minor



Cotton



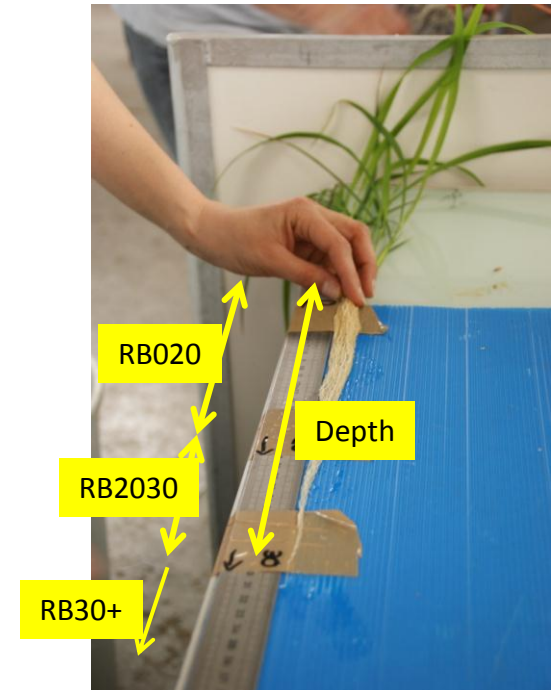
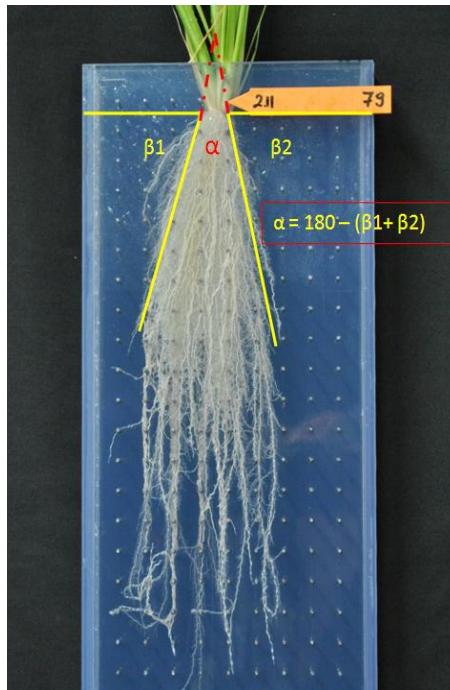
Wheat



Potentilla neumanniana

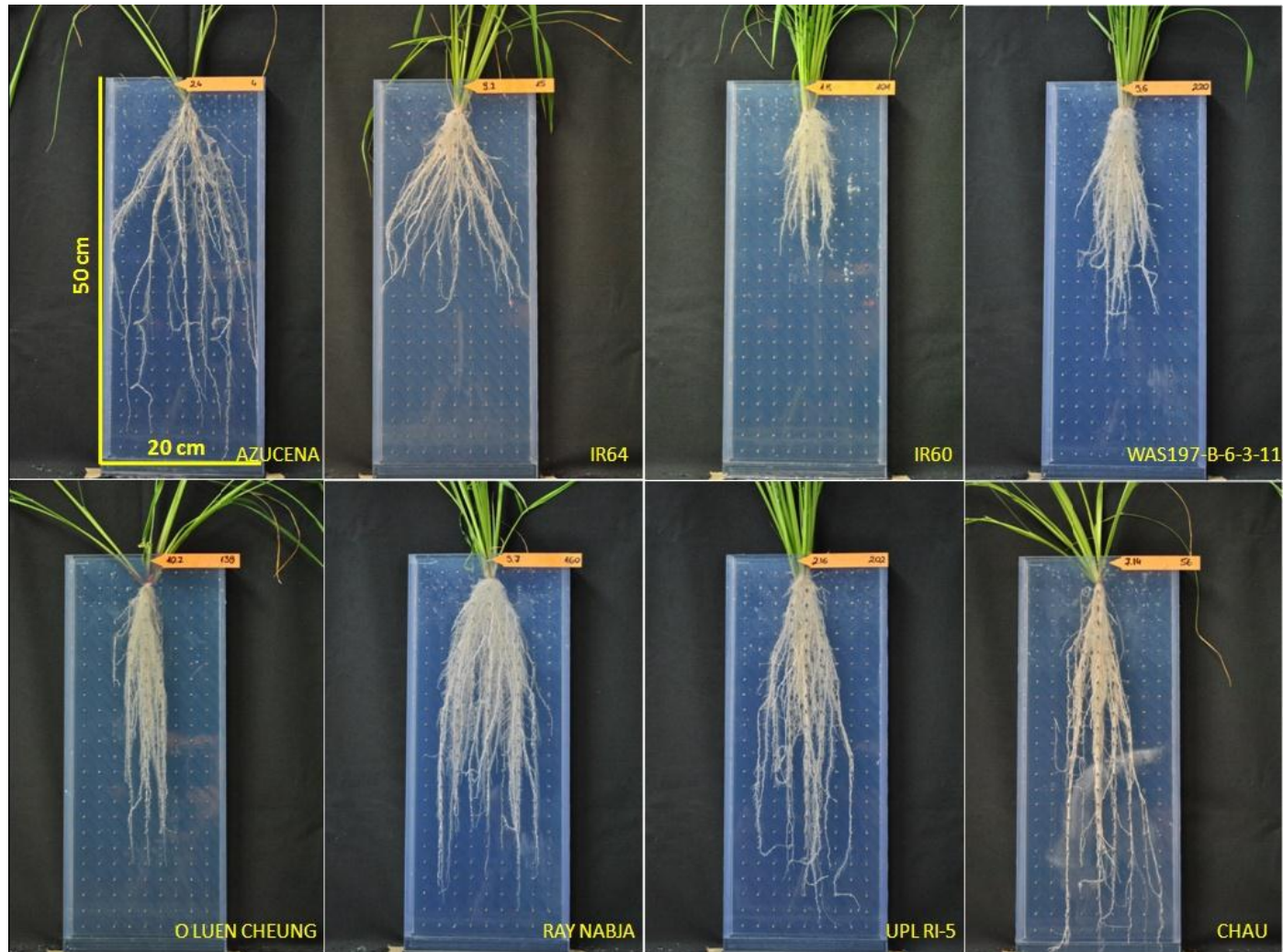
Phenotyping experiments

- 2011 and 2012
- Orytage and Grips funds
- Japonica and Indica panels (172 varieties phenotyped)
- 2 checks varieties (IR64 and Azucena) replicated in each tank
- 2 replications in time
- 30 days growth
- Traits
 - Shoot biomass
 - Root cone angle
 - $\alpha = 180 - (\beta_1 + \beta_2)$
 - Maximum root depth
 - Root nb at 30 cm depth
 - Root biomass
 - 0-20
 - 20-30
 - 30-50
 - Anatomy
 - Root tip



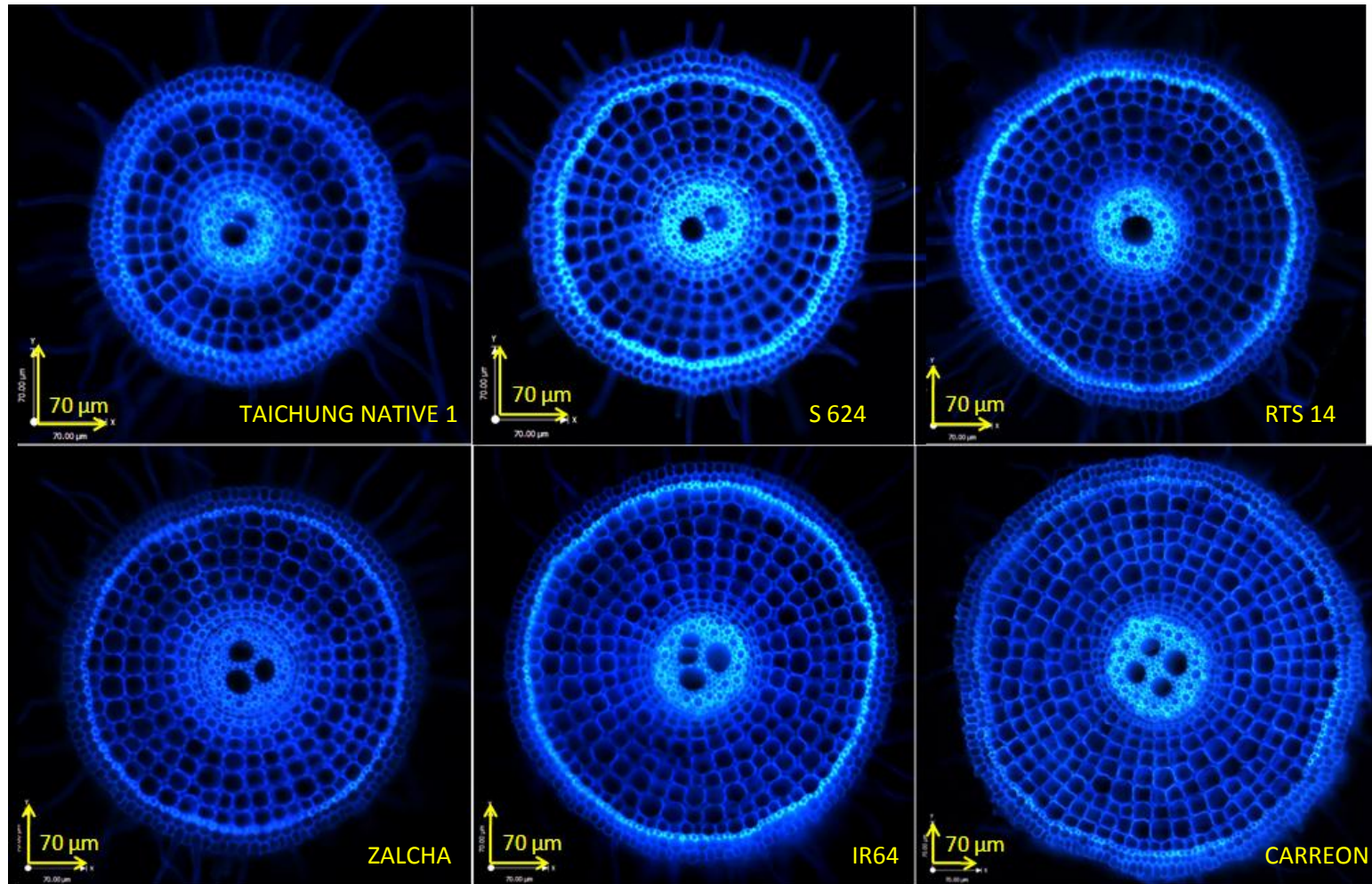
Rhizoscope platform : Some results

(indica panel, 200 acc.)



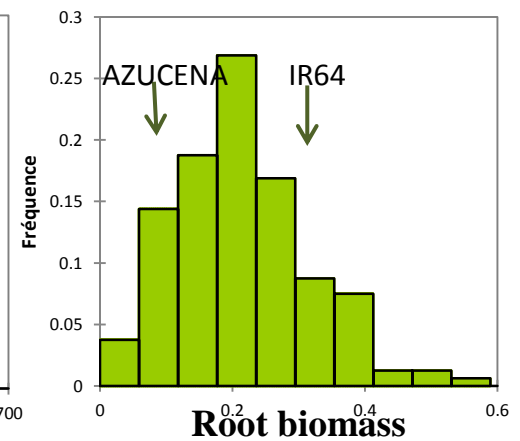
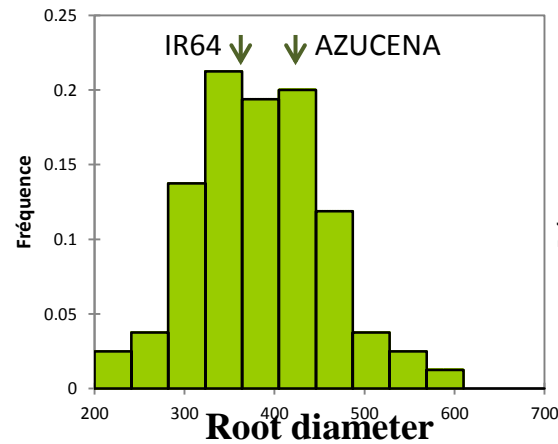
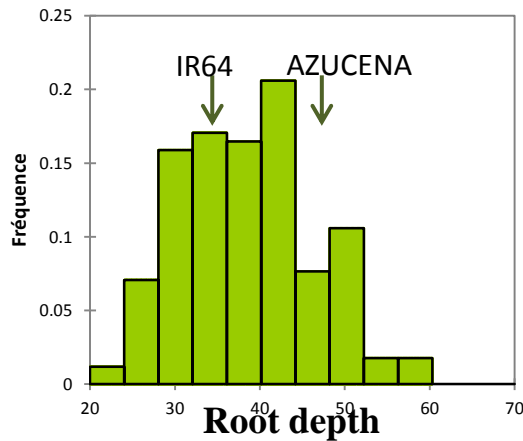
Rhizoscope platform : Some results

(indica panel, 200 acc.)

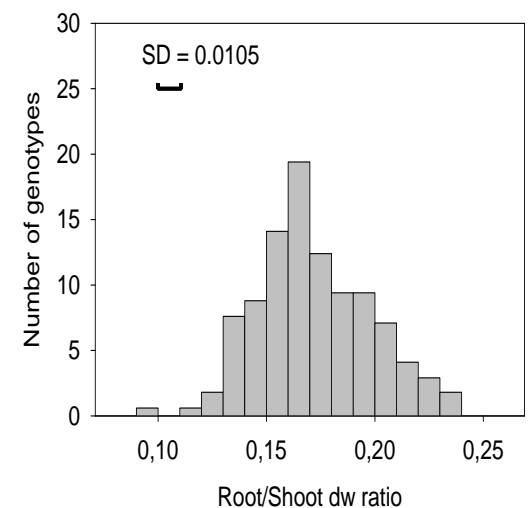
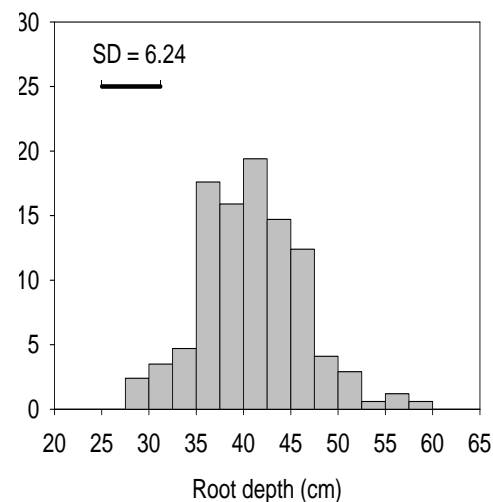
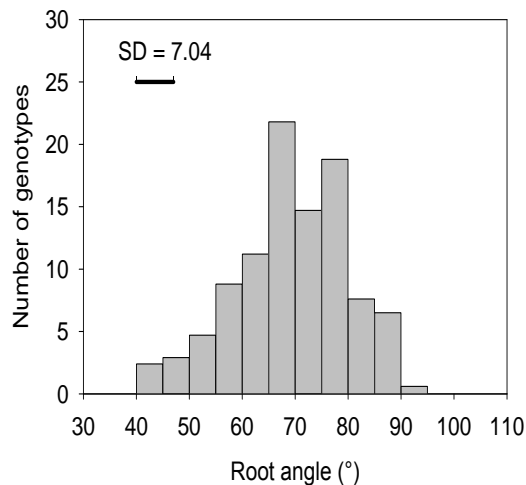


Rhizoscope platform : Some results

Indica panel



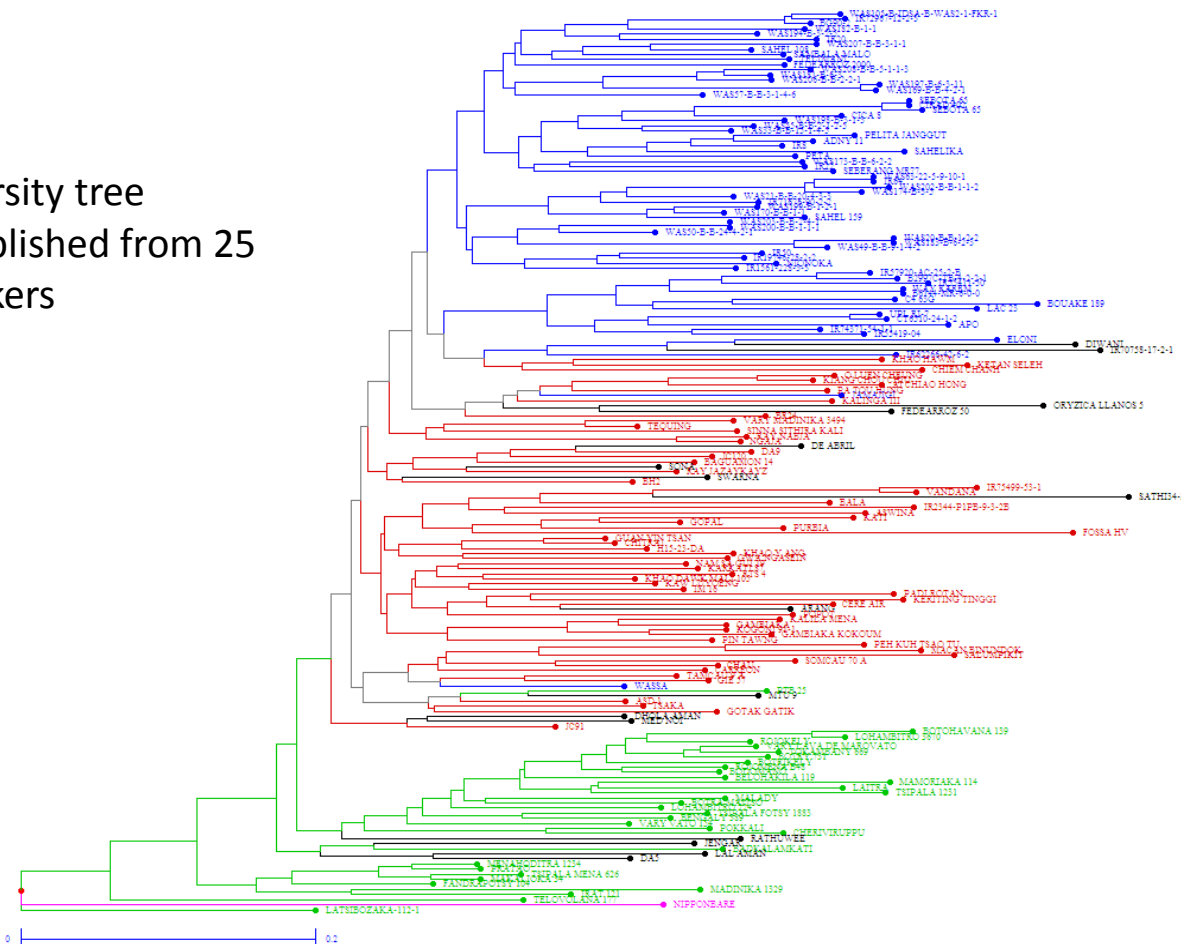
Japonica panel



How explain the indicas diversity ?

Available information for theses varieties: Type (traditional or improved);
Geographical origin (large region); Genetic group

Diversity tree
established from 25
Markers

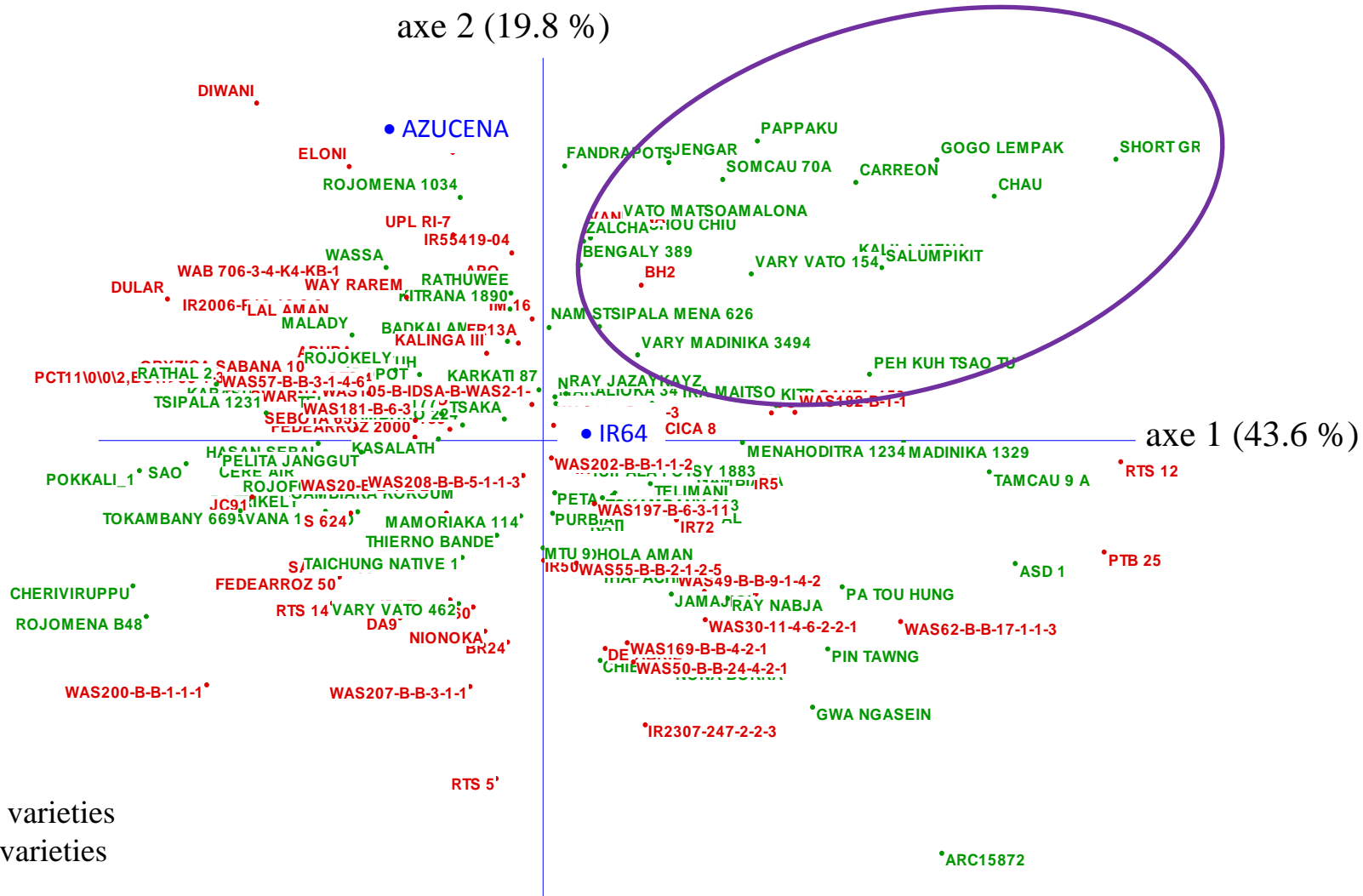


Sub-population 2 :
Improved indicas
from Africa and
Asia

Sub-population 3 :
Traditional Indicas
from Asia

Sub-population 1 :
Indicas from
Madagascar

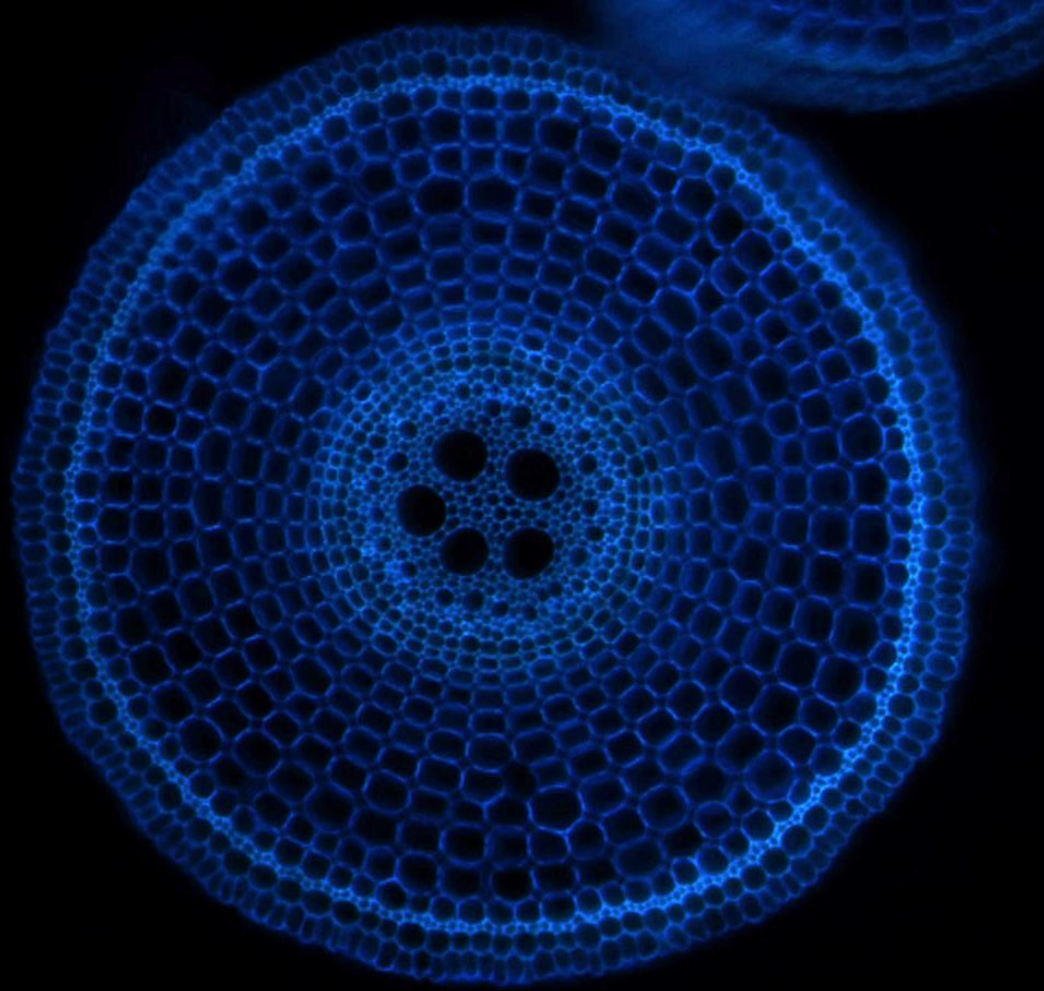
PCA analysis



Next step

- Association study
 - With the SNPs genotyping data
- Improved the picture system
 - For dynamic measurements
 - Image analysis software (Image J, and other)
- Root model
 - Rootyp
 - Root growth
- Improved beads substrate
 - Capillarity
 - Density





Thank you !