

Phenotyping in Genoplante

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INRA LEPSE



Géno plante

- Reinforce French research in plant genomics
- Federate academic and private sectors
- Develop functional genomics on model species (*Arabidopsis* and rice)
- Analyse the genome of the main crop species, and their synteny with model genomes.

INRA

CNRS

CIRAD

IRD

BIOGEMMA

(Limagrain, Pau Euralis,
RAGT

BAYER CropScience

BIOPLANTE

200 millions euros / 5 years - > 400 scientists

2 projects involving water deficit

- Maize

Identify genes and QTL which control the responses of maize plants to moderate water deficit

ESTs, QTLs, transcriptomics, proteomics, functional validation (KO and transgenics + association genetics)

- Arabidopsis (with Germany)

Characterising a core collection of accessions

In the two cases :

- (i) large collection of genotypes
- (ii) precise characterisation of environmental conditions
- (iii) precise measurement of plant responses

Field studies (maize)

- Collection of mutants
- Phenotyping of transgenics (ABA ; ASR etc)
- Characterisation of RILs

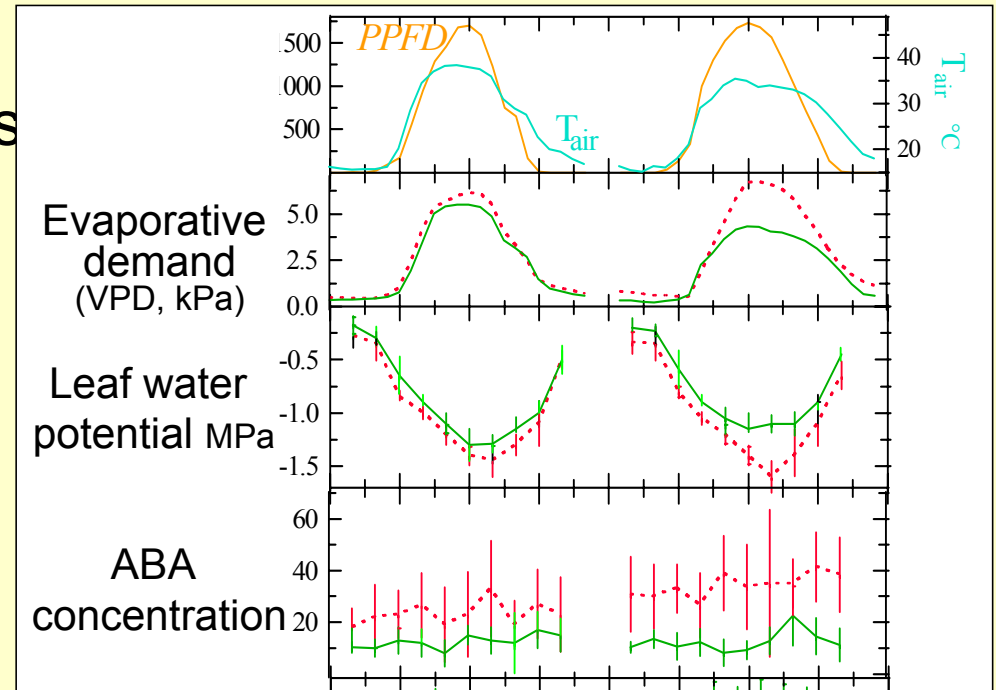
In open field or rainout Shelter



Field studies (maize)

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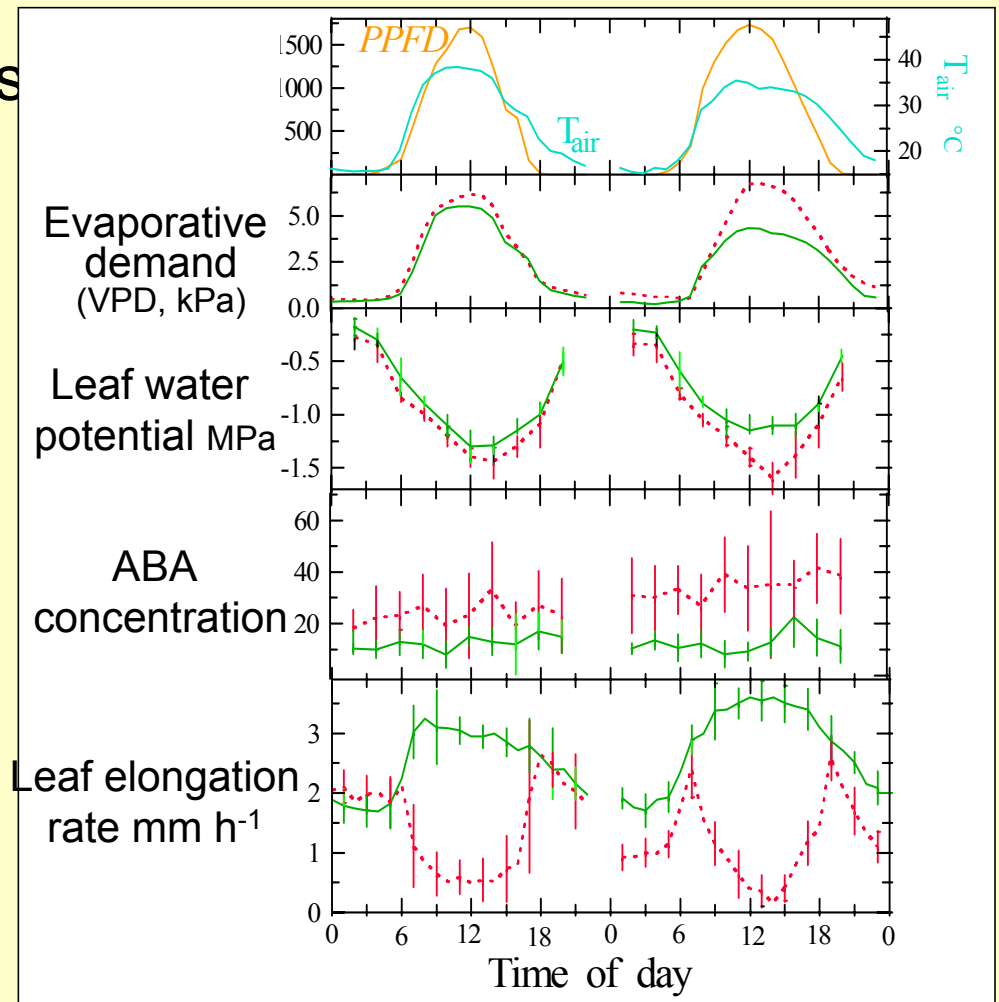
*A detailed micrometeorology
T, PPFD, predawn leaf water
potential*



Field studies (maize)

- Collection of mutants
- Phenotyping of transgenics (ABA ; ASR etc)
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*A detailed micrometeorology
T, PPFD, predawn leaf water potential
and time course of growth*

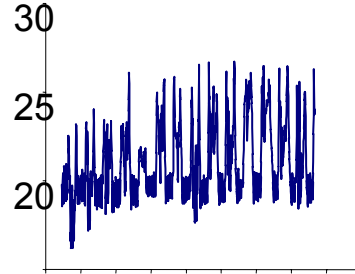


— well-watered - - - - - water deficit

Leaf growth and transpiration, water deficit maize.

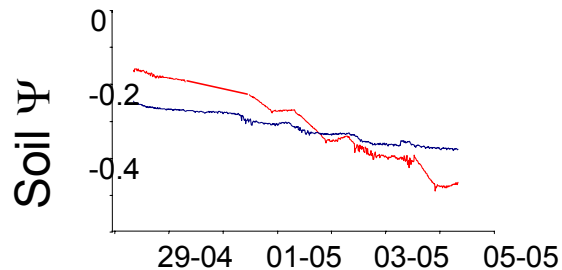
- Micrometeorology

(T_{air} , light, VPD, T_{organs})



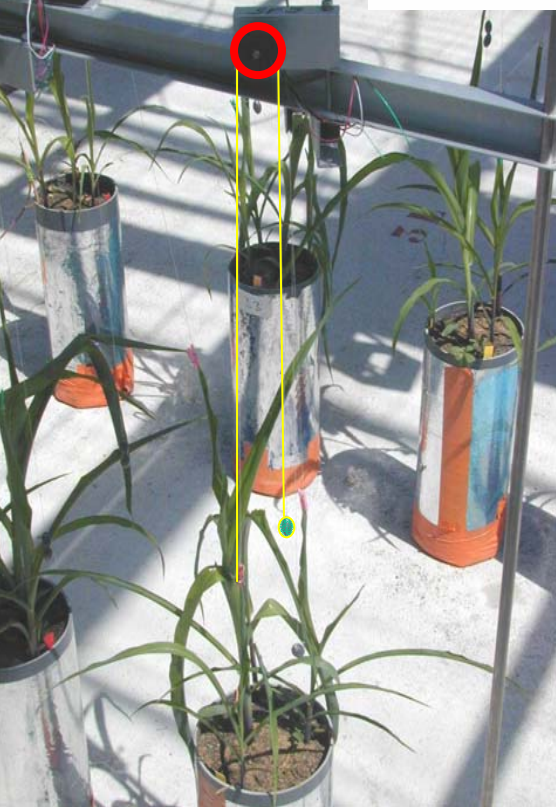
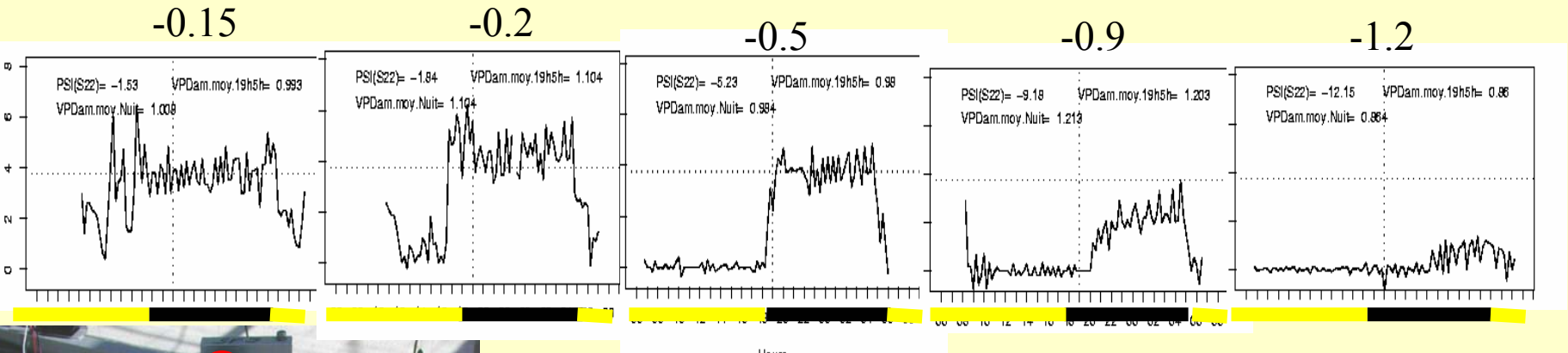
- Soil water status and transpiration of individual accessions

weight - soil water content - predawn leaf water potential of a test genotype

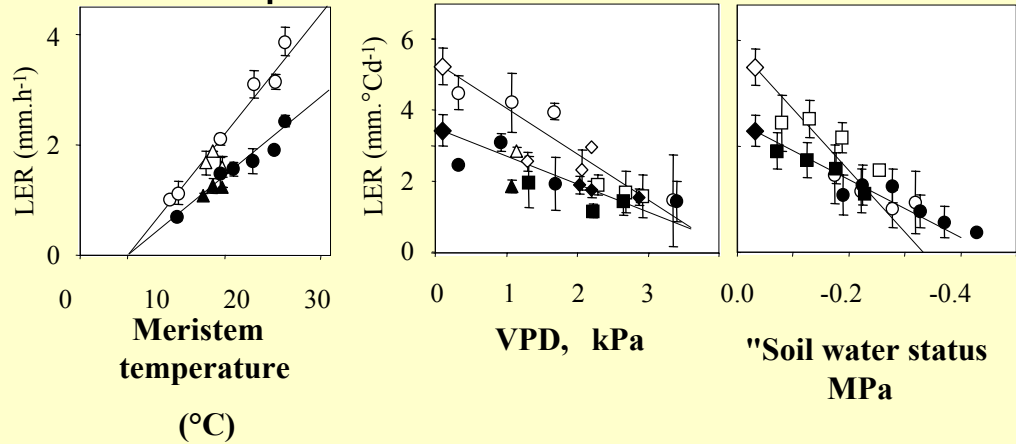


Leaf growth and transpiration, water deficit maize.

Outputs : elongation rate (definition 20')



and response curves



Short timescale
typical experiment : 2 weeks

Leaf growth and transpiration, Arabidopsis.

Monocots : Leaf elongation rate constant with time

Changes in environmental conditions can be interpreted

1 leaf = 10-20 data points

Light relatively unimportant.

Dicots, leaf elongation rate never constant with time

1 leaf = 1 data point

Light affects leaf growth

needs extremely constant environmental conditions

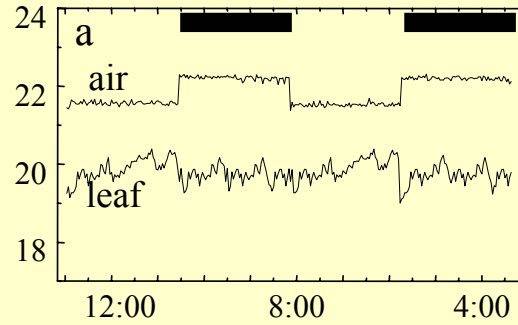


- No change with time in environmental conditions
- Very precise controls of water supply and micrometeorology
- Controls of growth and transpiration

Leaf growth and transpiration, Arabidopsis.

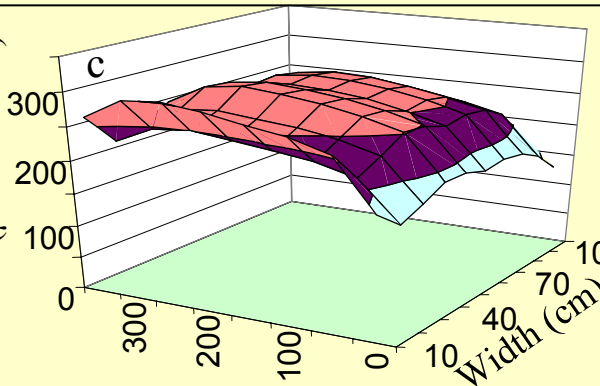


Air and leaf temperature ($^{\circ}\text{C}$)



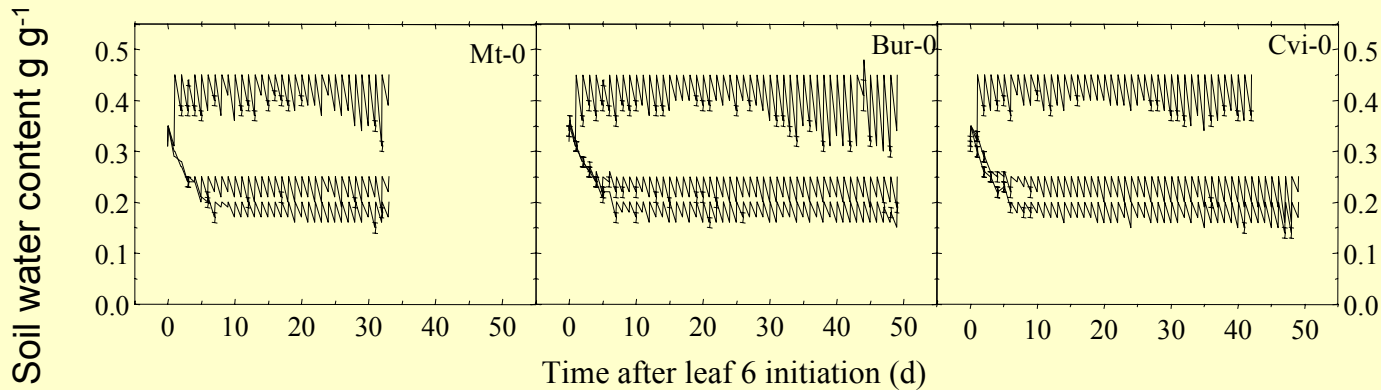
Time of the day (h)

PAR ($\mu\text{mol m}^{-2} \text{s}^{-1}$)

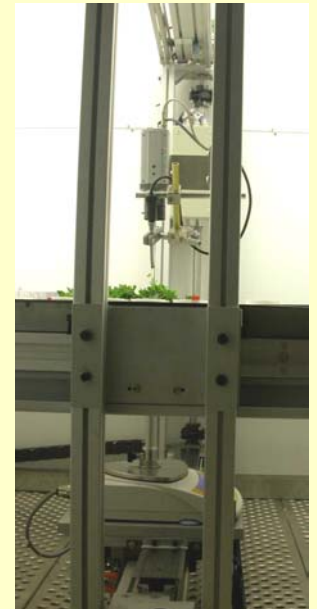


Length of the growth chamber (cm^2)

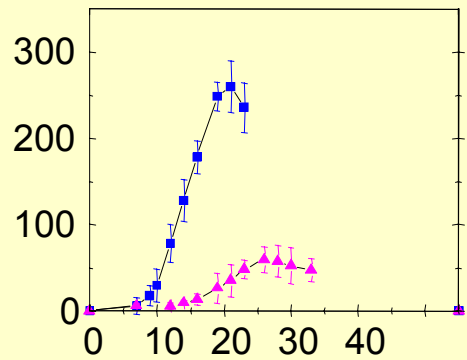
Micrometeorological controls.



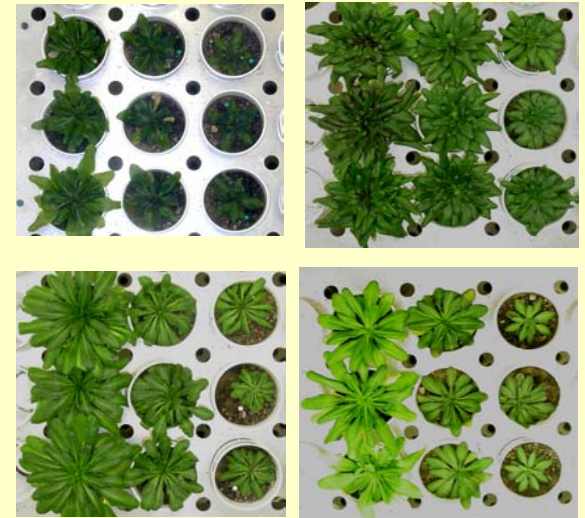
Precise control of water supply : same for all genotypes regardless of leaf area and stomatal conductance



Leaf growth and transpiration, Arabidopsis.



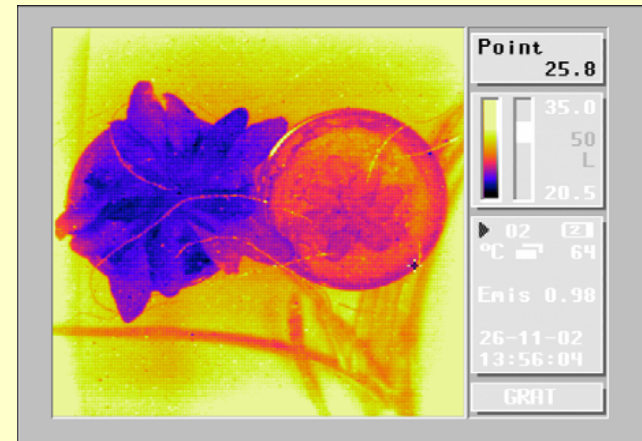
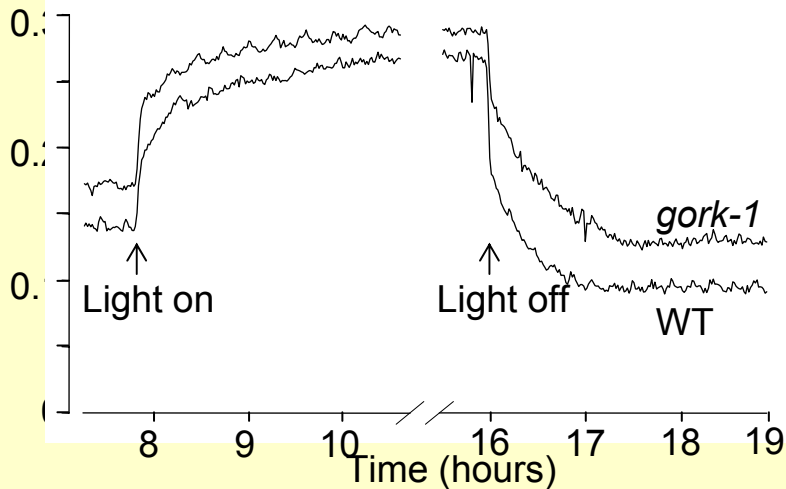
Time after leaf 10 initiation (days)



0.45 0.25 0.20 0.45 0.25 0.20

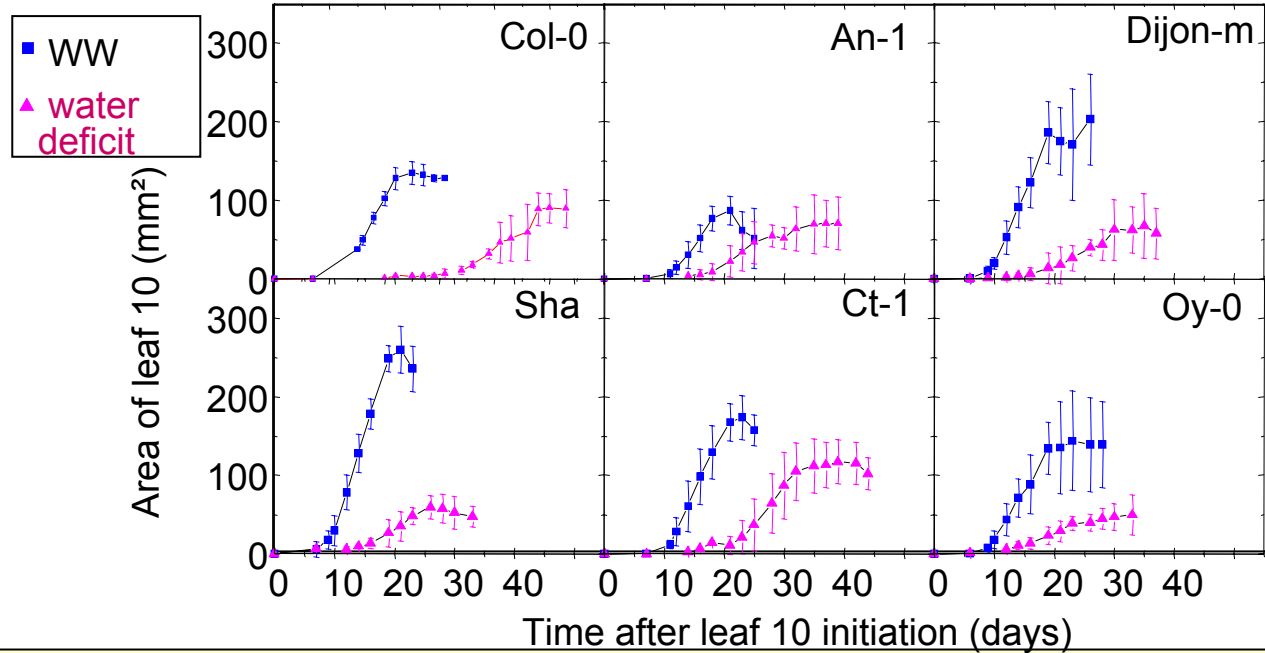
Soil water content (g g^{-1})

Measurement of leaf growth

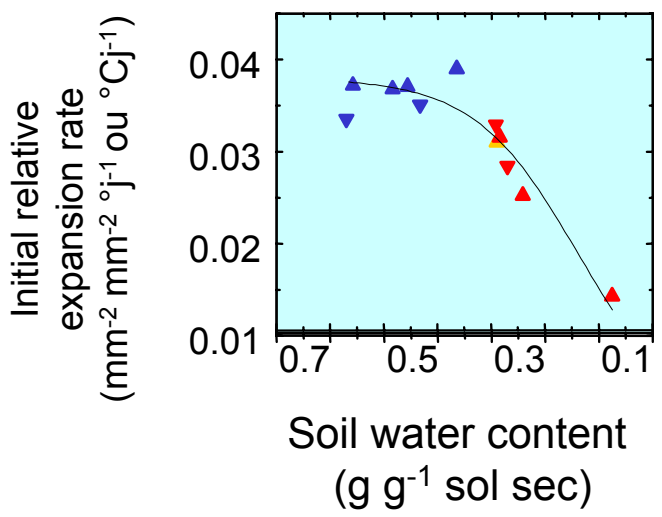


Plant transpiration ; calculation of stomatal conductance

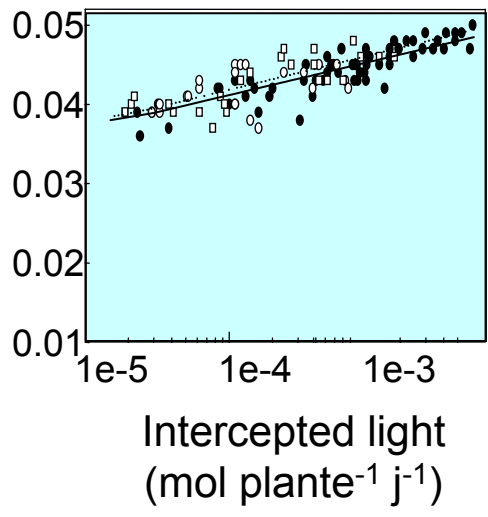
Leaf growth and transpiration, Arabidopsis.



Outputs :
 time courses
 Definition 1day
 as a function of :
 genotypes
 environments



Chenu et Granier 2001, DEA



Frank et Lecoeur, 2001, DEA

Response
 curves

In all cases

- We began by hand...
- A combination of environmental measurements and "plant" data
- For growth : easier in the case of monocots.