MONTPELLIER PLANT PHENOTYPING PLATFORMS

LABORATOIRE D'ECOPHYSIOLOGIE DES PLANTES SOUS STRESS ENVIRONNEMENTAUX
LEPSE - UMR759

21 nov 2019

@umr_lepse

# Quelle est notre démarche dans l'innovation?

L'idée

Ce n'est pas parce qu'il a des mains que l'homme est le plus intelligent des êtres, mais parce qu'il est le plus intelligent des êtres qu'il a des mains.

Aristote, Les parties des animaux

L'outil

L'idée

L'outil
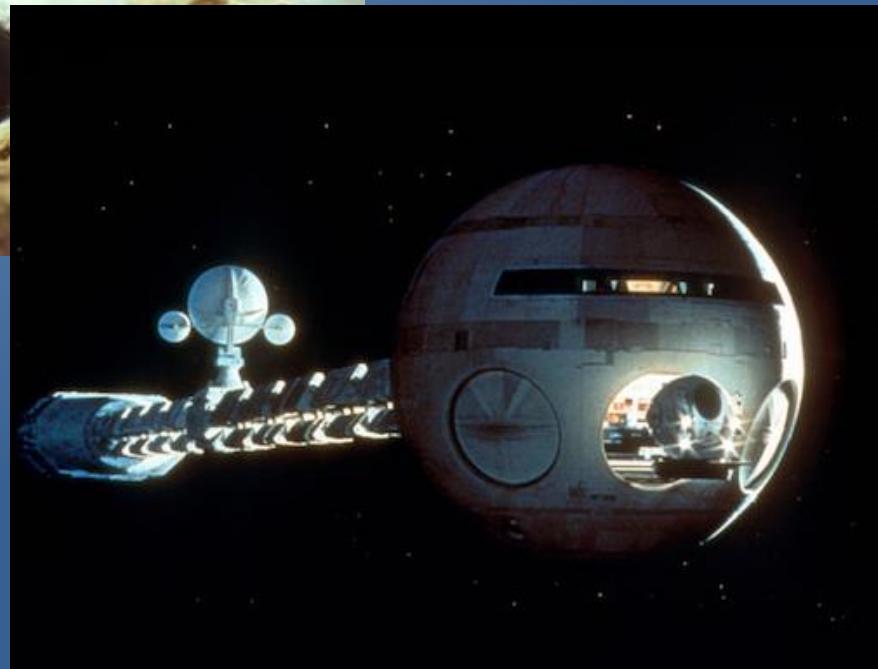
Leaf Enlargement and Metabolic Rates in Corn, Soybean, and Sunflower at Various Leaf Water Potentials[1]

J. S. BOYER
Department of Botany, University of Illinois, Urbana, Illinois 61801
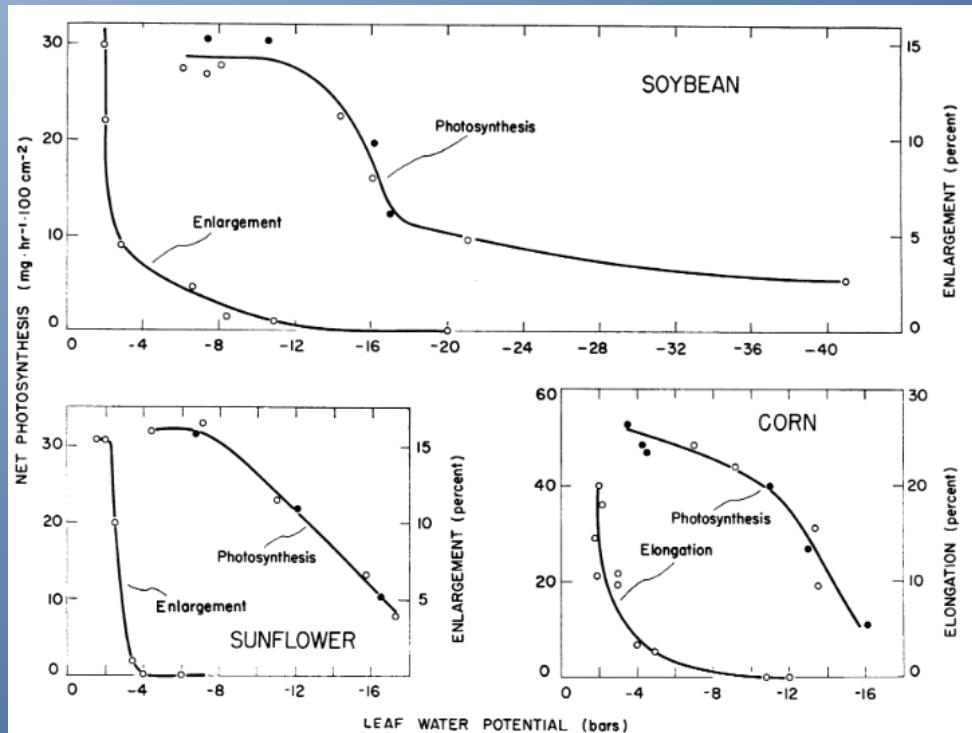
Night growth
No soil water deficit
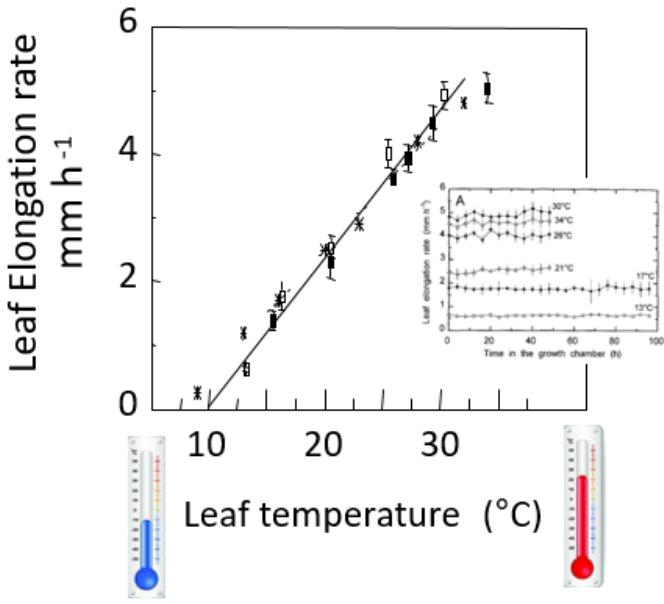
Day growth
No soil water deficit
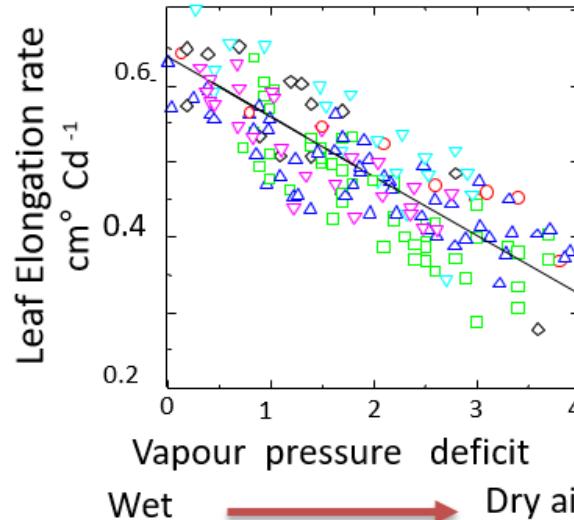
Night growth
Soil water deficit
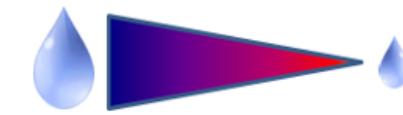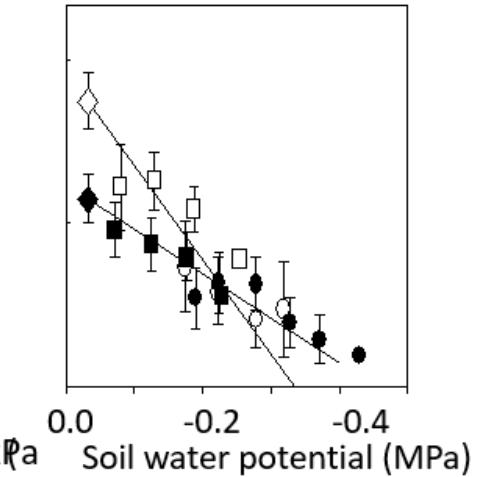
Leaf elongation rate = (T – T$_0$) . a

Leaf elongation rate = (T – T$_0$) . (a - b VPD)

Leaf elongation rate = (T – T$_0$) . (a - b VPD - c . Ψ)

The (very) first steps of a (low tech) phenotyping platform... (1999)
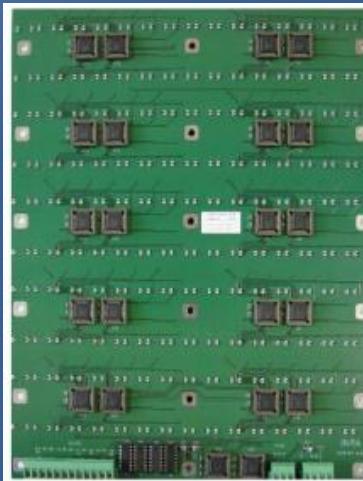
Face composants

Face prises RJ11

PHENODYN

Organ **elongation rate** and plant **transpiration** with high temporal resolution

500 displacement tranducers
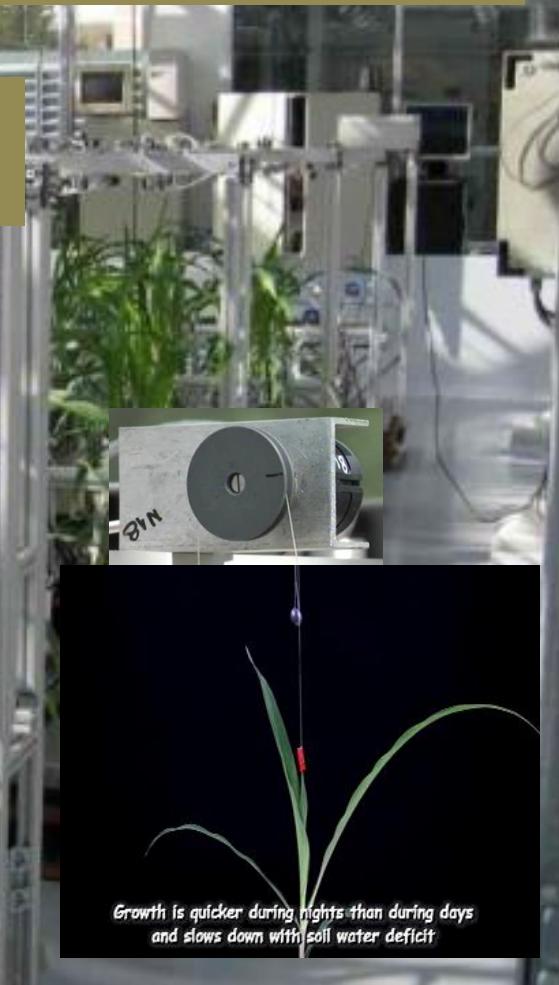
180 balances + individual pumps

Growth is quicker during nights than during days and slows down with soil water deficit

CC BY-NC-ND

PHENODYN

Organ **elongation rate** and plant **transpiration** with high temporal resolution
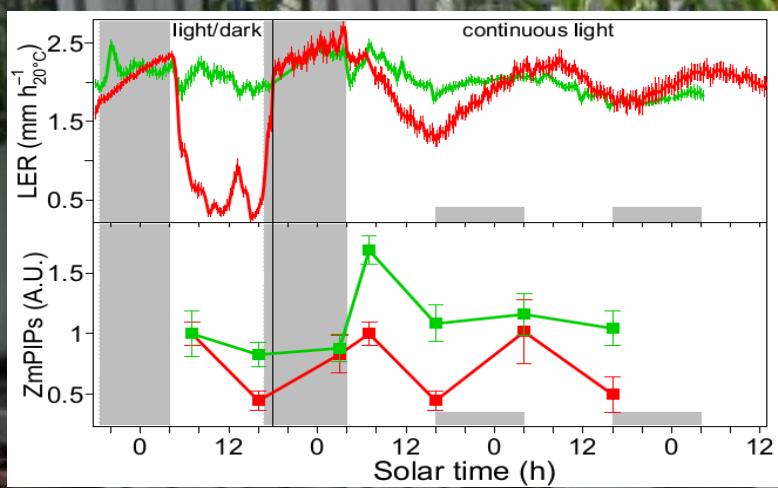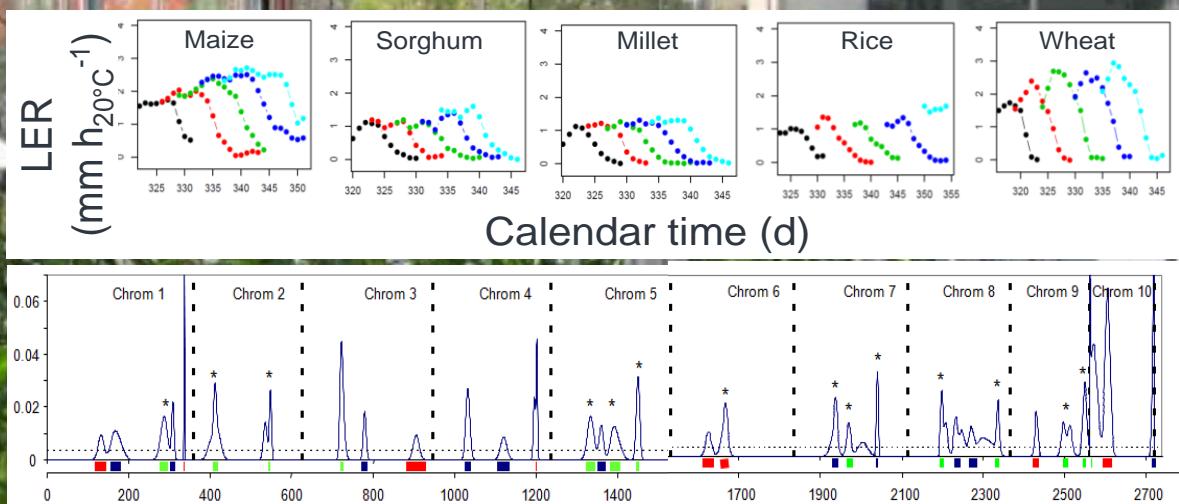
Caldeira et al 2014, Nature Com
Welcker et al 2011, Plant Phys
Sadok et al 2007, PCE

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PHENOPSIS

(originaly) devoted to A thaliana
Growth & functional analyses based on
imaging (vis, RGR, fluo)

PHENOARCH

2400 plants

Daily growth, transpiration & architecture

RUE, WUE

Since 2011. Multi species (maize, grapewine, cotton, sorghum, apple tree)

Technology is not enough. Methodological developments

$$Biomass = \int Incident\ light \times Intercepted\ light \times RUE$$
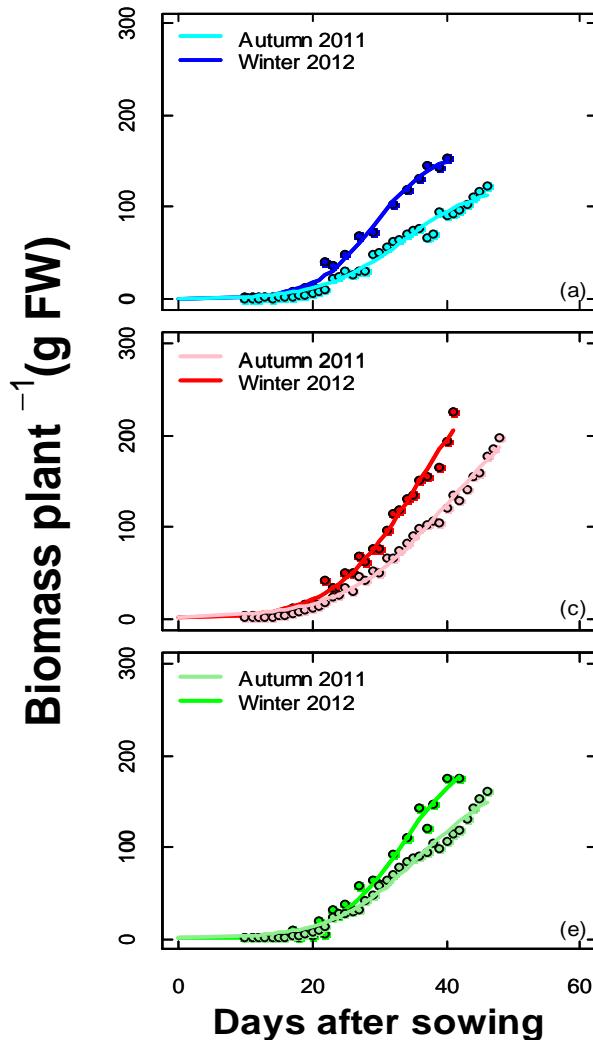
1. Calculation of diffuse light transmission
SOC model (Moon & Spencer, 1942)
(*zenith angle and gap fractions*)

Diffuse transmission light map

Y position
X position
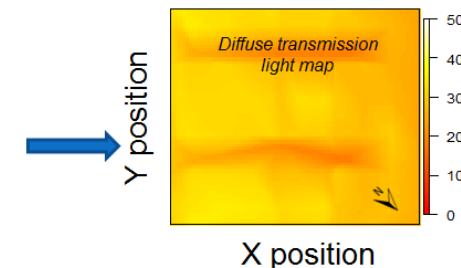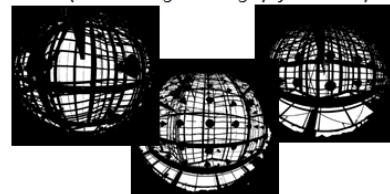
2. Calculation of direct light transmission
(*gap fraction at each position of the sun path*)

21 Dec   22 Sep
21 Jun

Every hour every day

Transmission (%)
Hour

Direct transmission light maps (daily)

i + 3
i + 2
i + 1
i
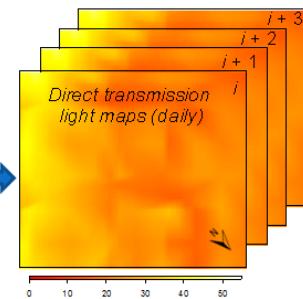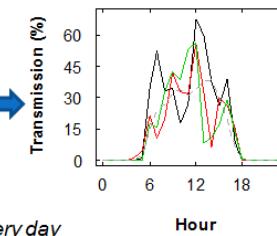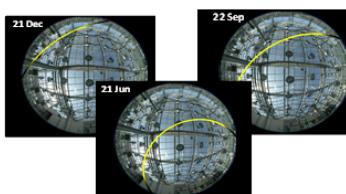
3. Validation with PAR sensors

Measured
Estimated

PPFD (µmol m^{-2}s^{-1})
Hour

Biomass plant^{-1}(g FW)
Days after sowing

(a) Autumn 2011 / Winter 2012
(c) Autumn 2011 / Winter 2012
(e) Autumn 2011 / Winter 2012
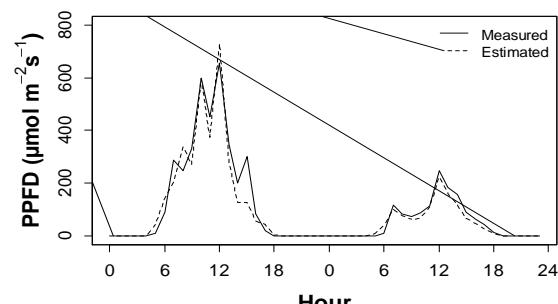
Technology is not enough. Methodological developments

Daily imaging → 3D virtual scene
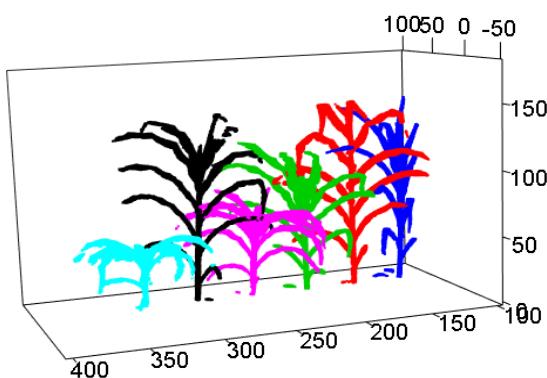
Same *RUE* between experiments
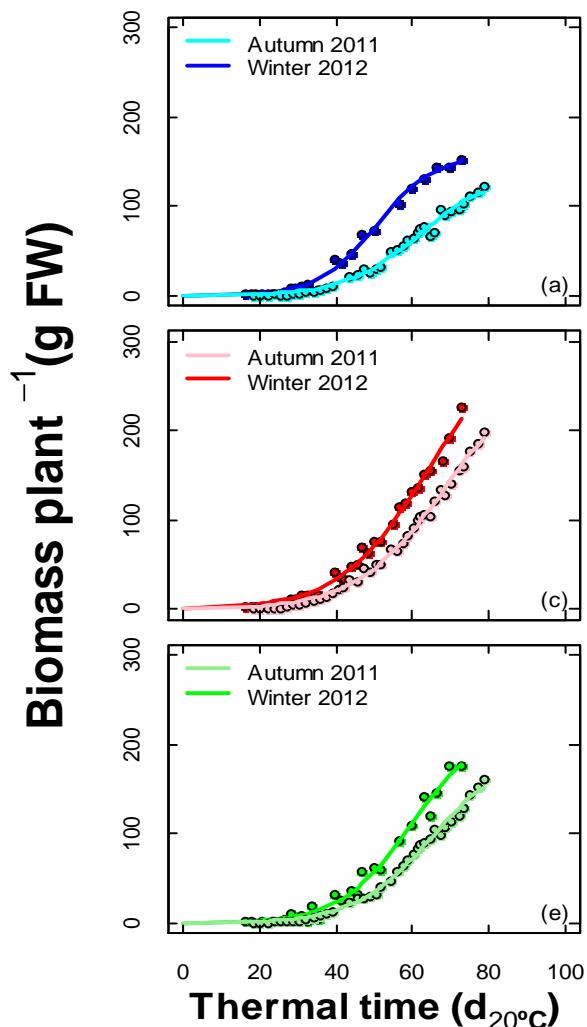
Architecture + light → intercepted light

Cabrera-Bosquet et al 2016 New Phyt

Laboratoire d'Ecophysiologie des Plantes
Sous Stress Environnementaux

lepse
Montpellier

INRA
SCIENCE & IMPACT

M3P
Montpellier **P**lant **P**henotyping **P**latforms

PHENOME FPPN
Réseau Français Phénomique végétale
INVESTISSEMENTS D'AVENIR
IBiSA

ISC INRA

Charte des infrastructures de recherche

IPPN
International Plant Phenotyping Network

Proof concept Mod éco (DIFA, papier IPPN)

74 Projets accueillis sur 6 ans (2012-2017)
12/an,
cadre partenarial académique et Public/Privé

30 ANR, LabexAgro, region, INRA

34 Internat. dont 21 Europ

10 privés
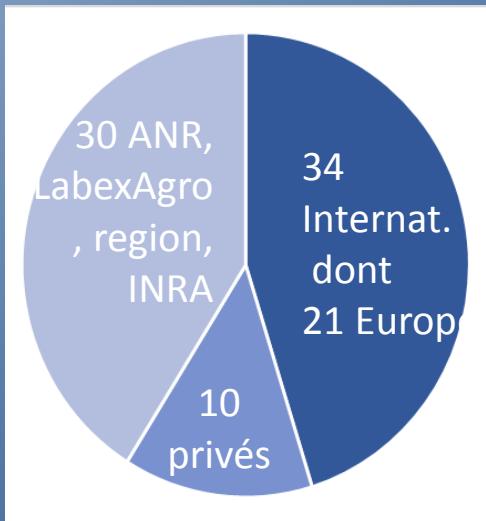
ETP	Production	Evolution
Permanent	4	2.1
CDD	2.64	4.8

Coût moyen /an	1.5 M€
Personnel	475 (perm) + 210 (cdd)
Fonctionnement	200
Equipement	500 (infra) + 150 (équipt)

20 M images,
250 M données phénotypiques,
154 M données environnementales
57000 plantes caractérisées (panel de diversité, collection d'introgression, série historique, population multiparentale, collection de mutants)

45 publi rang A de 2014 à 2018

A Thaliana, maïs, sorgho, blé, mil, vigne, colza, pommier, coton, tomate, Brachypodium, riz, banane

EDA

lepse
Montpellier

SupAgro Montpellier

INRA SCIENCE & IMPACT

Partnership is essential

The ongoing revolution in HT phenotyping

Low cost sensors

L'outil

L'idée

(Predictive) statistical models

Network of data providers

Participatory sciences

What's the future of HT phenotyping in controled conditions ?

HT parametrization of predictive models

Combinations of stresses (biotic + abiotic, CO2, minerals…)

Innovation

Merci !