Risultati del Progetto STOPP

Un approccio multidisciplinare al monitoraggio ambientale multi-scala attraverso bioindicatori vegetali

Plant Phenotyping in Europa ed Italia: stato dell'arte e prospettive

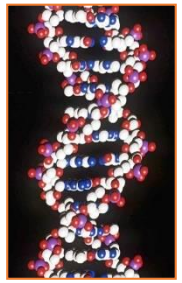
Francesco Cellini, Angelo Petrozza, ALSIA

ASI, Roma, 22 maggio 2025

Phenotype = G x E x M

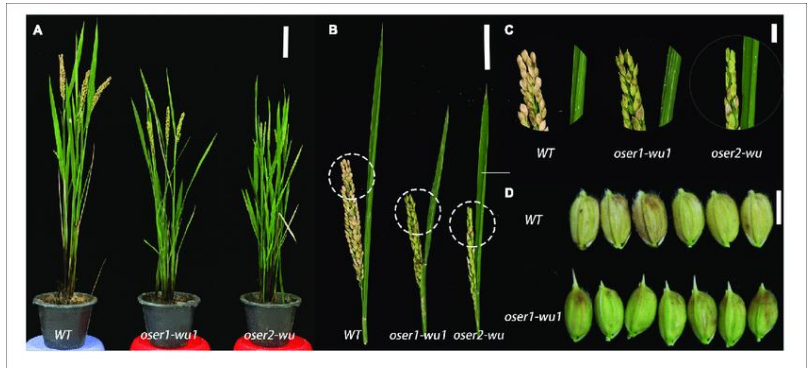
farming

environment



genetics

Plant performance and plant production

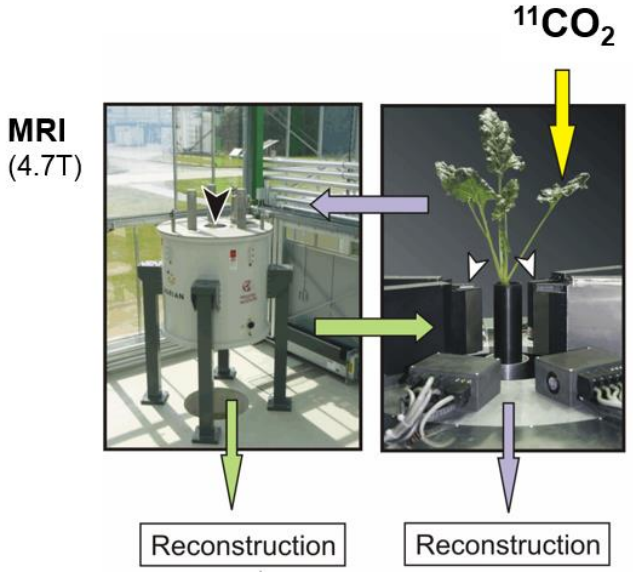


Phenotyping: limits and challenges

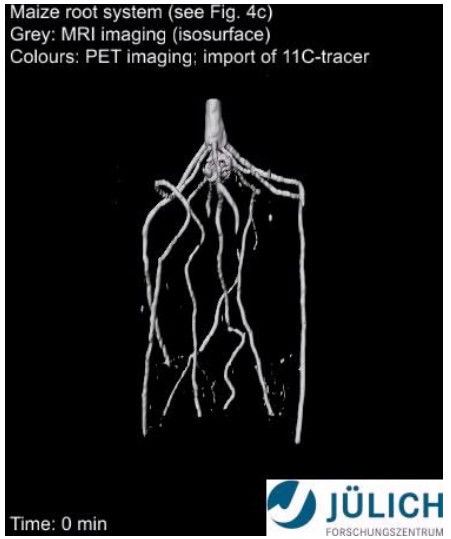
- High-throughput measurements
- Non invasive measurements

State-of-the-Art Phenotyping 1

Deep phenotyping - tomographic

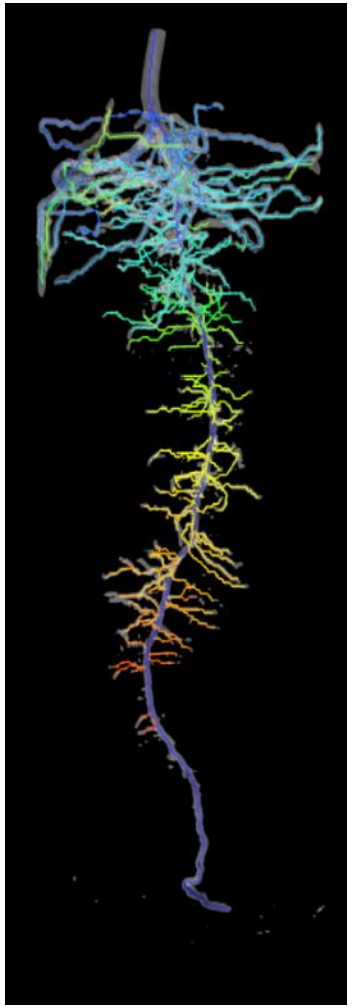


Live imaging of carbon flow



3D-structures

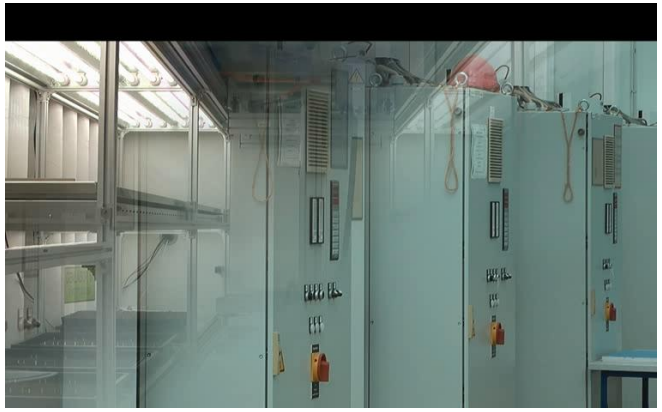
Root parameters



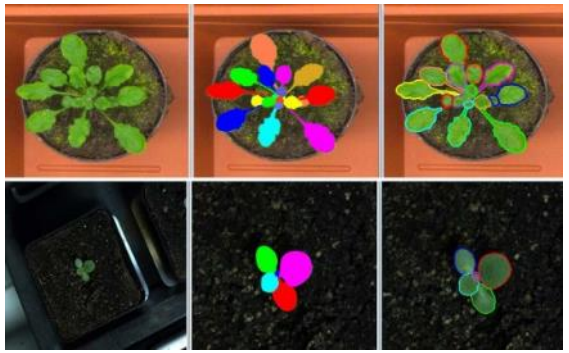
State-of-the-Art Phenotyping 2

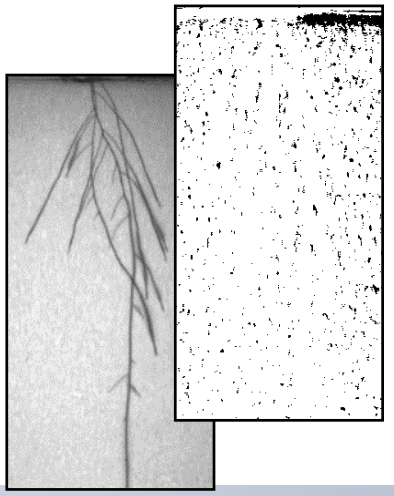
High-throughput in controlled environment

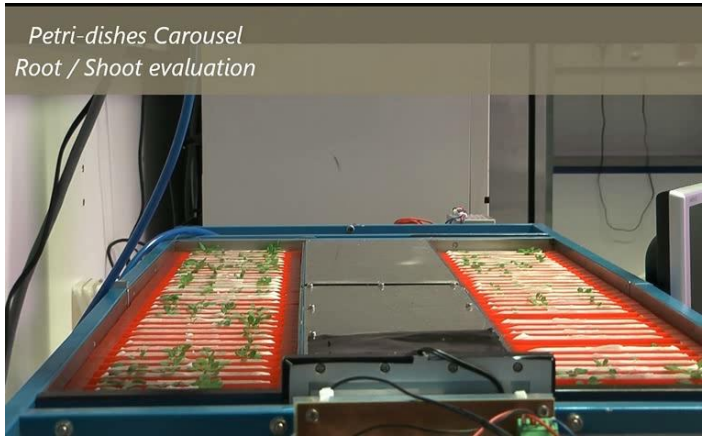
WHIWAM Gent



Fluogrowscreen Jülich



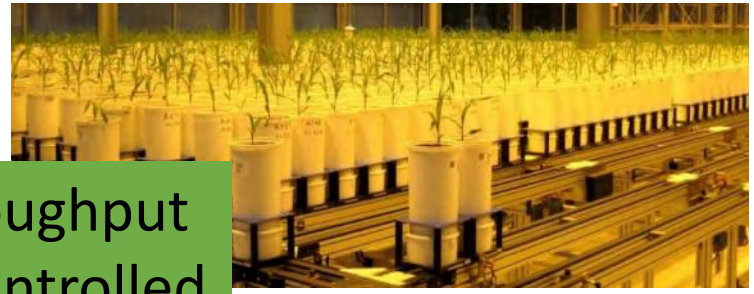




Root Carousel Jülich

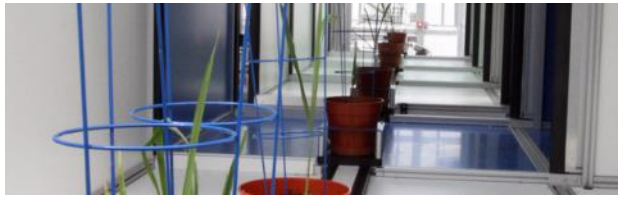
State-of-the-Art Phenotyping 3

High-throughput in semi-controlled environment



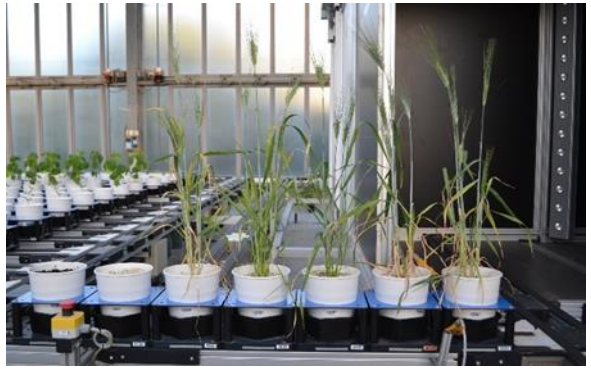
PhenoArch, Montpellier

Lemnatec, Aberysthwyth



Extended Lemnatec, Gatersleben

GrowScreenRhizo, Jülich

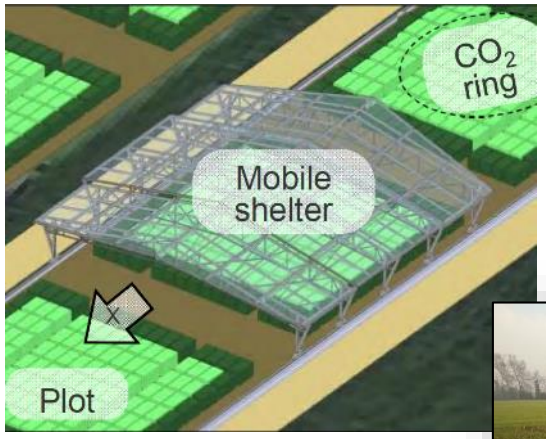


Scanalyzer 3D, ALSIA Metaponto

PPHD, Dijon

Intensive field sites highly equipped

State-of-the-Art Phenotyping 4

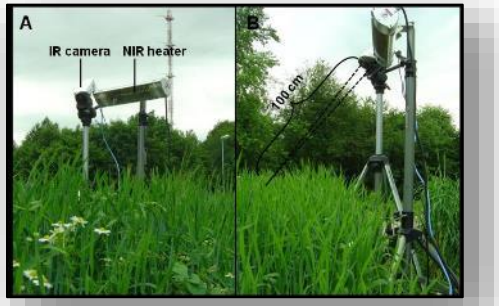


BreedFace
Jülich/ Bonn

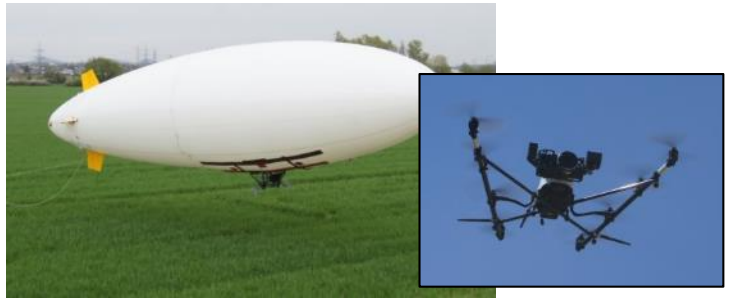
Phenomobiles

Avignon
Jülich
Metaponto

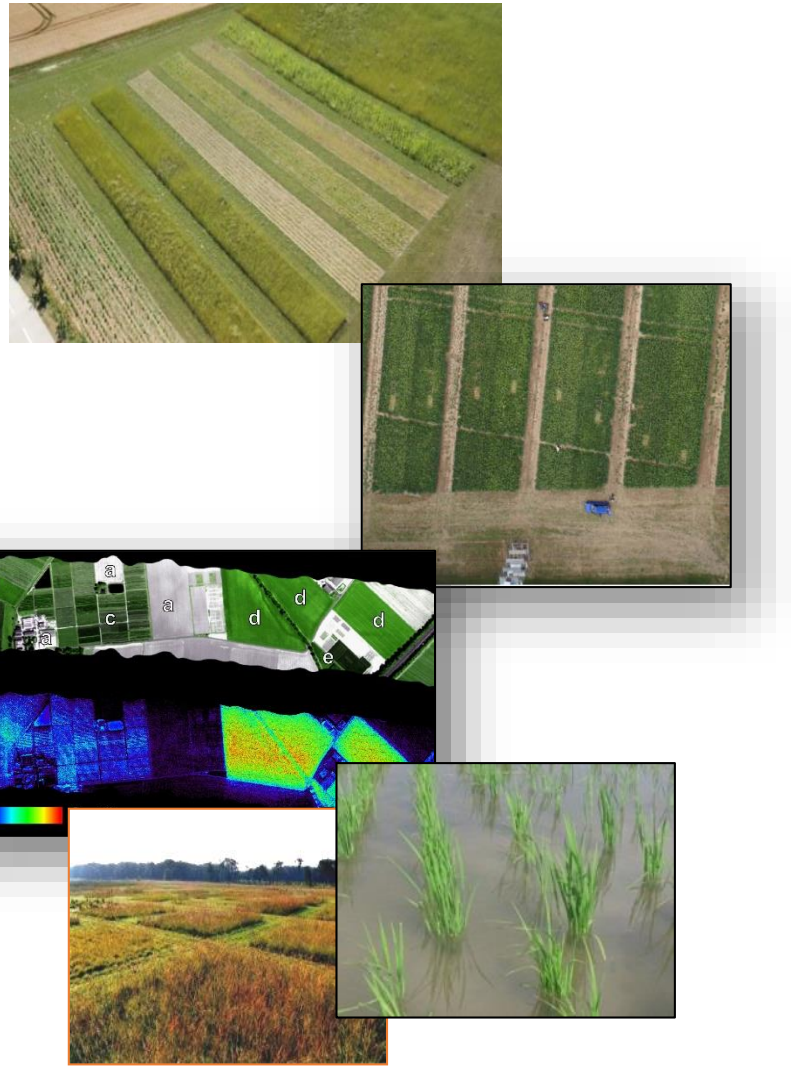
Stationary field sensor networks

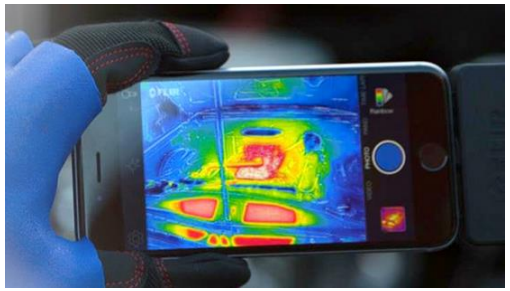


Flying platforms



State-of-the-Art Phenotyping 5





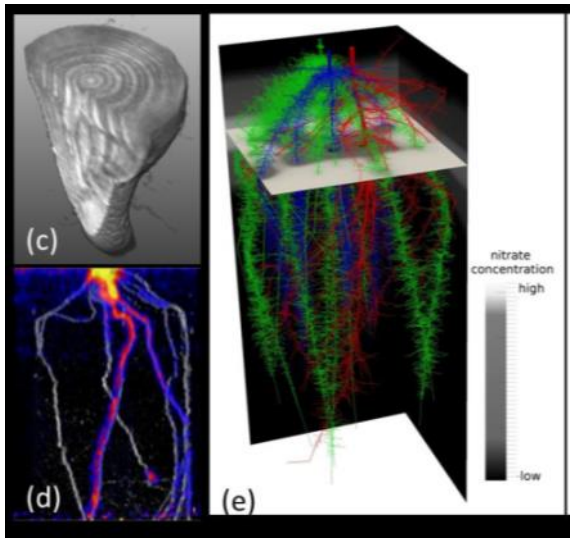
Portable sensors („cheap“)

Easy carriers

Lean fields

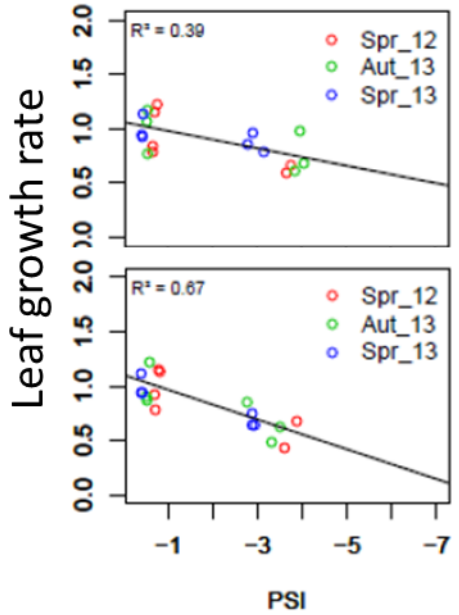
Modelling

Disentangling complex traits



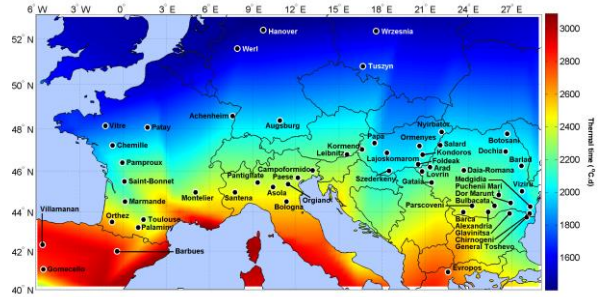
What is the relationship between root structure and nutrient use efficiency?

Genetic analysis of complex traits



What is the sensitivity of leaf growth to drought?

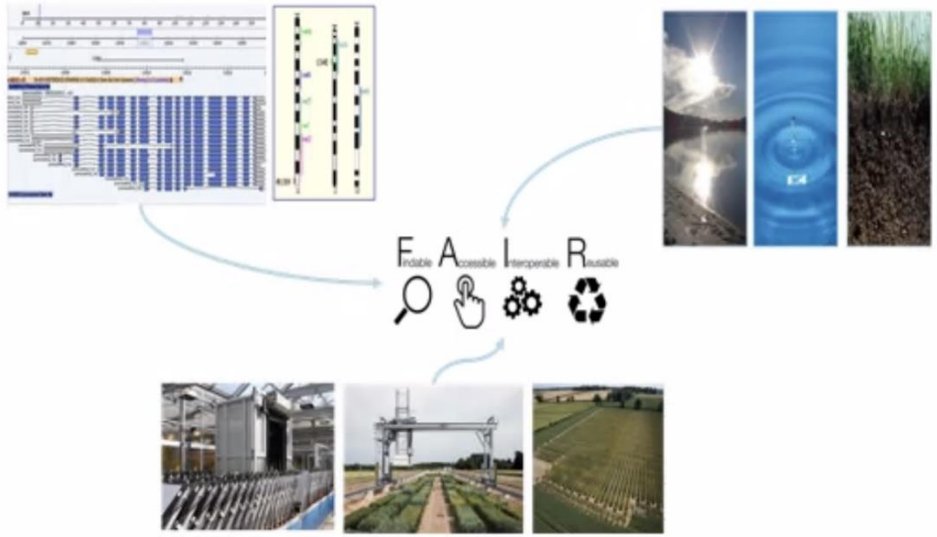
Crop – climate optimisation



Which genotype would work best in which environment scenario?

Infrastructure: information system

- ✓ FAIR Information systems plant phenotyping data
- ✓ Access to data
- ✓ Local installation data-management
- ✓ EMPHASIS installations should have integrated information systems



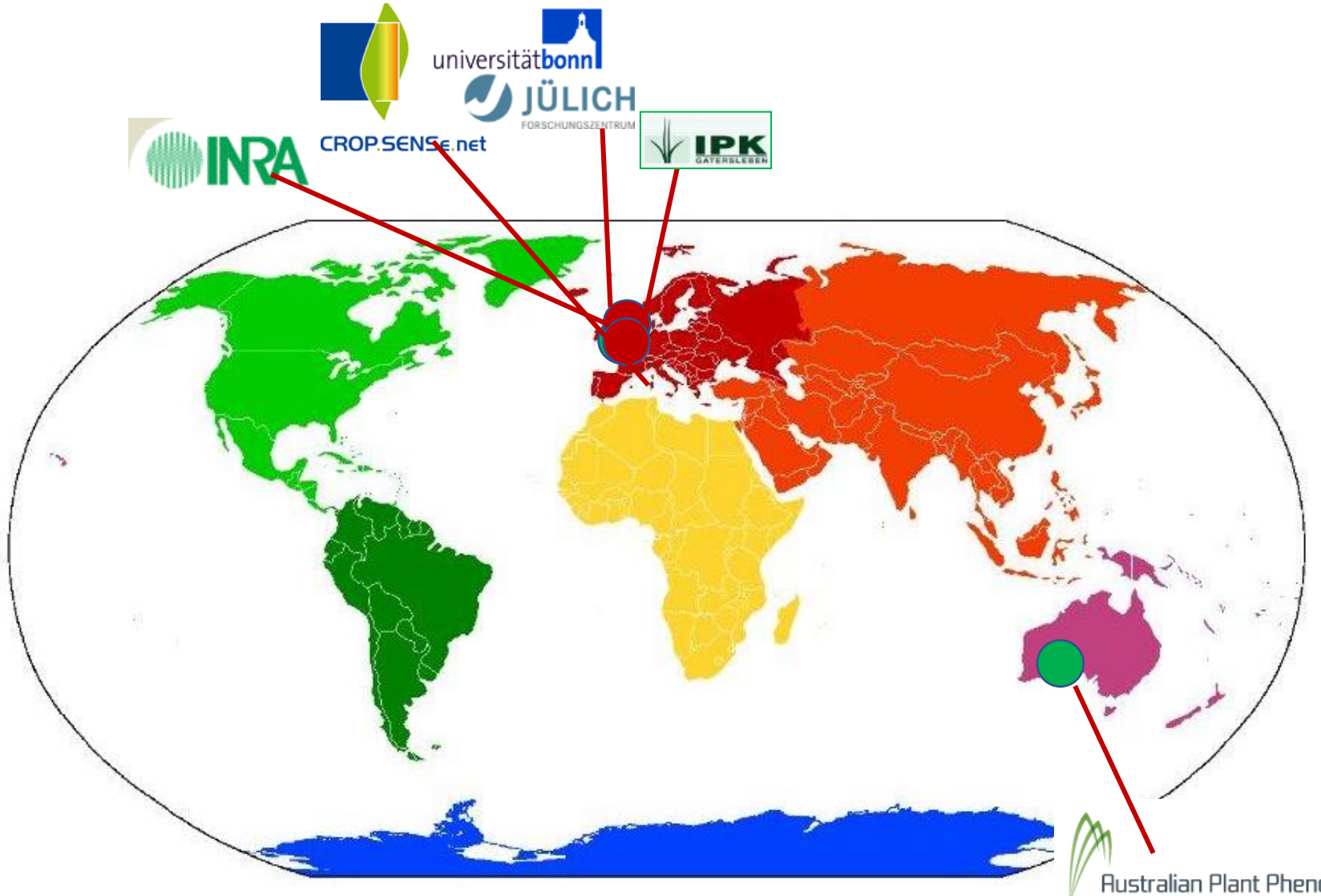
More details: Thematic session 4 (Wednsday, 9:30 -10:30)

C Pommier, R. Pieruschka: *Plant phenotyping data management from phenomics to integration for analysis and PGR characterizations: challenges and solutions from ELIXIR and EMPHASIS*

EMPHASIS

14

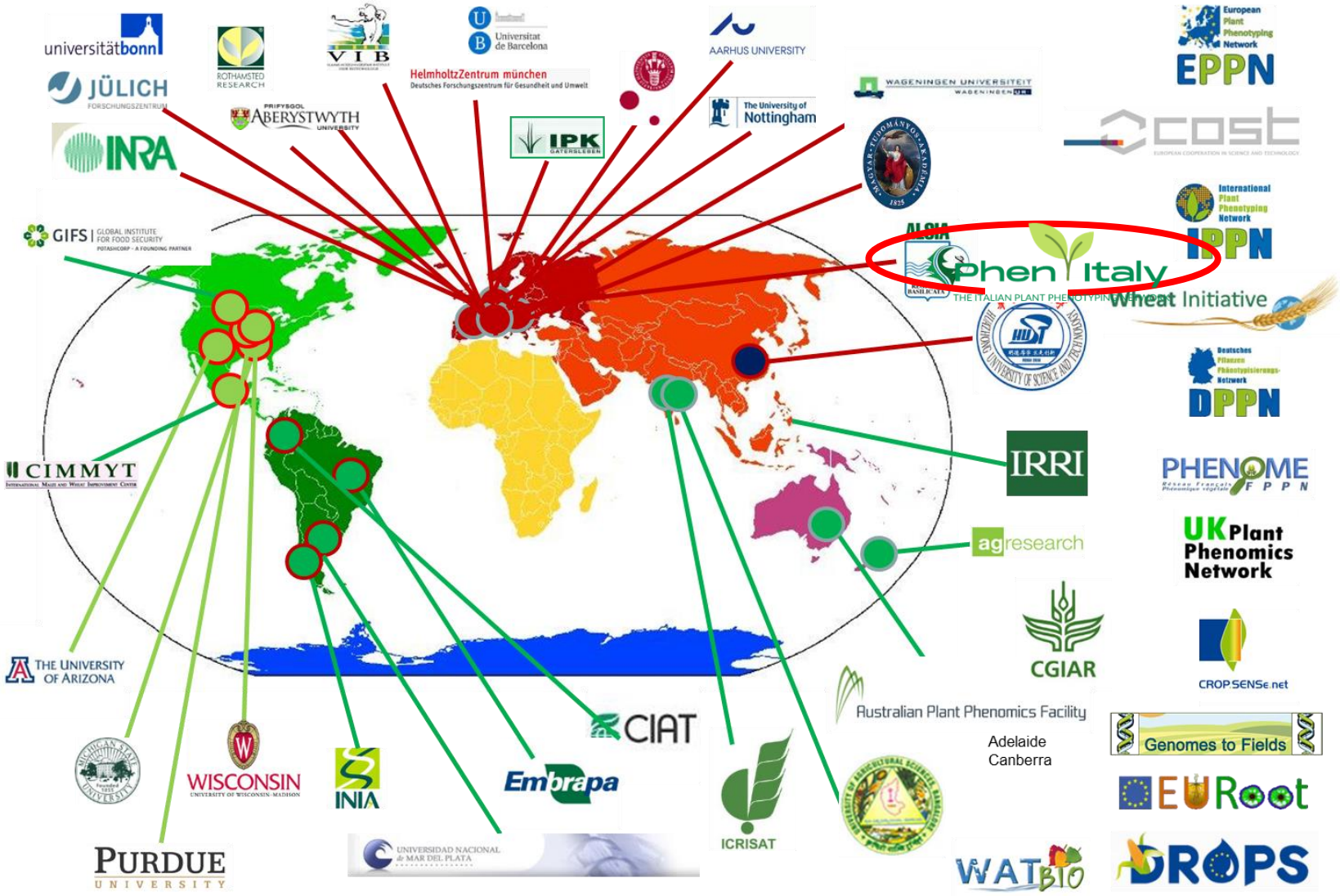
Plant phenotyping is developing rapidly



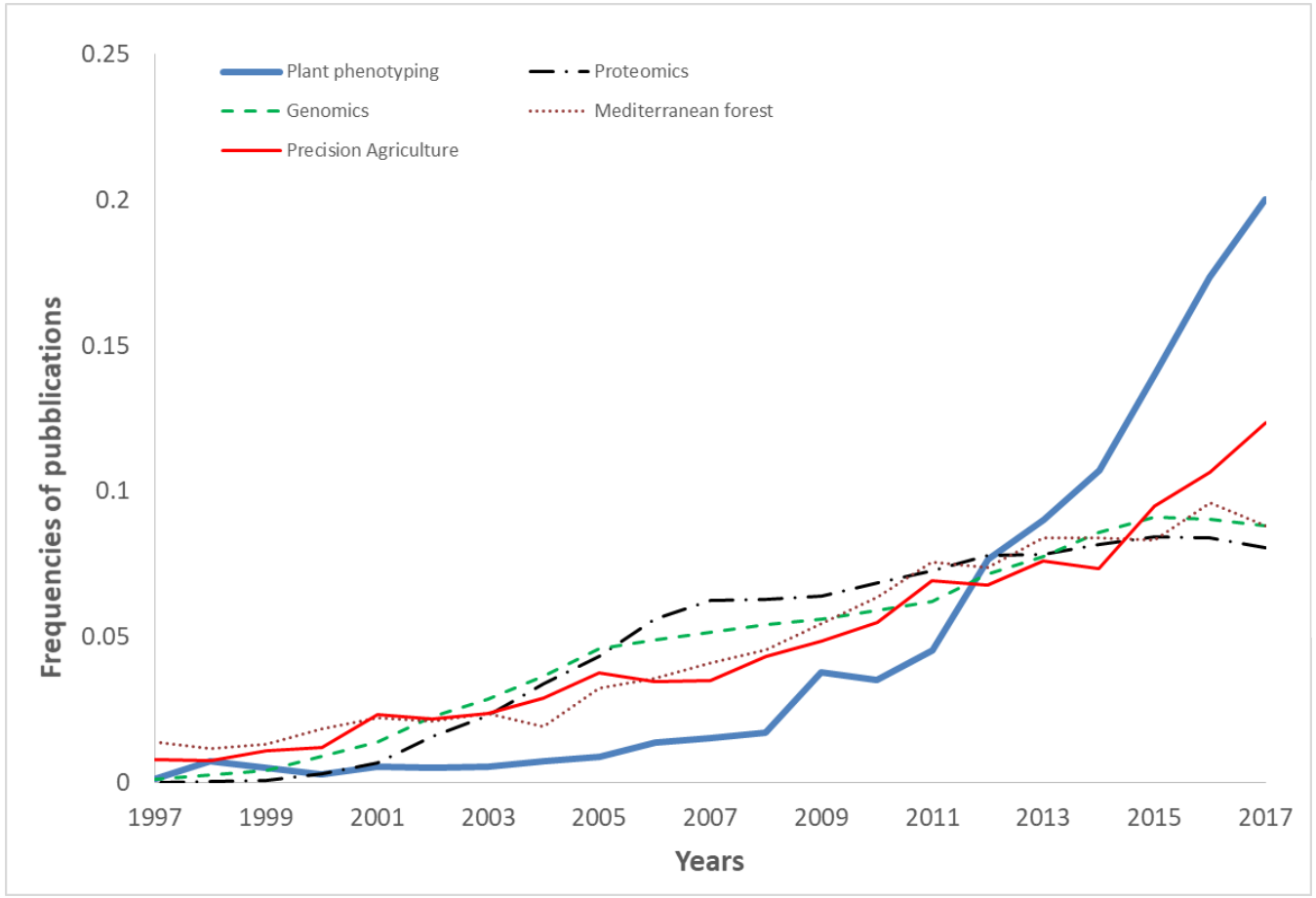
2008

Plant phenotyping is developing rapidly

2025



Plant phenotyping super-rapid development



frontiers in Plant Science

SYSTEMATIC REVIEW
published: 07 January 2019
doi: 10.3389/fpls.2018.01933

Plant Phenotyping Research Trends, a Science Mapping Approach

Corrado Costa[1], Ulrich Schurr[2], Francesco Loreto[3], Paolo Menesatti[1] and Sebastien Carpentier[4,5]**

Plant Phenotyping Networking

National platforms

European projects/ networks

EMPHASIS

European Infrastructure for Multi-Site Plant Phenotyping And Simulation for Food Security in a Changing Climate

EMPHASIS Partner Countries

EMPHASIS-PREP Policy Manifesto

The EMPHASIS infrastructure is based on previously established national infrastructures in Germany, France, the United Kingdom and Belgium.

Since its inclusion in the ESFRI Roadmap 2016, EMPHASIS has supported

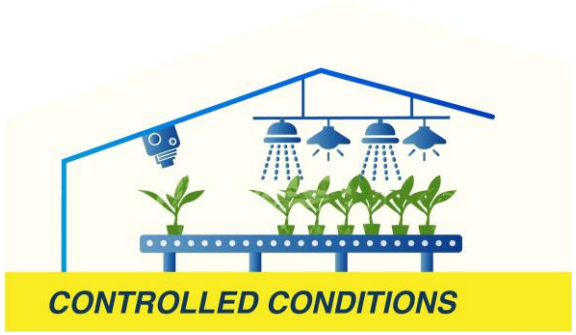
- the financing of plant phenotyping infrastructures through national/regional funding mechanisms,
- applications for inclusion in the national infrastructure roadmap,
- several initiatives that have been formed to establish plant phenotyping at national level.

In addition, several countries are in the process of initiating their national activities and are integrated into the EMPHASIS Council.

Pan European approach: 12 countries support the development of EMPHASIS within an Interim General Assembly with ministry representatives. Additional 14 countries are interested in plant phenotyping EMPHASIS Support Group

EMPHASIS

Main plant phenotyping infrastructures

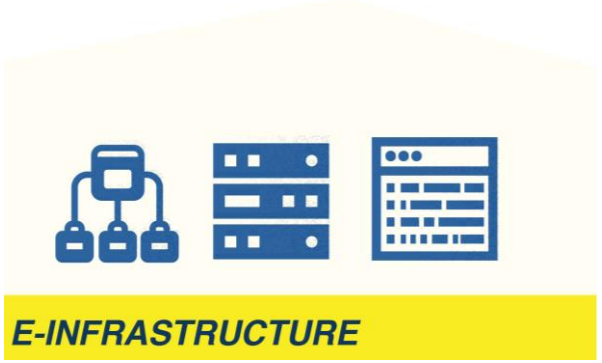


Plant phenotyping in (semi-)controlled conditions.

Intensive field experiments in highly equipped field sites or semi-controlled field sites

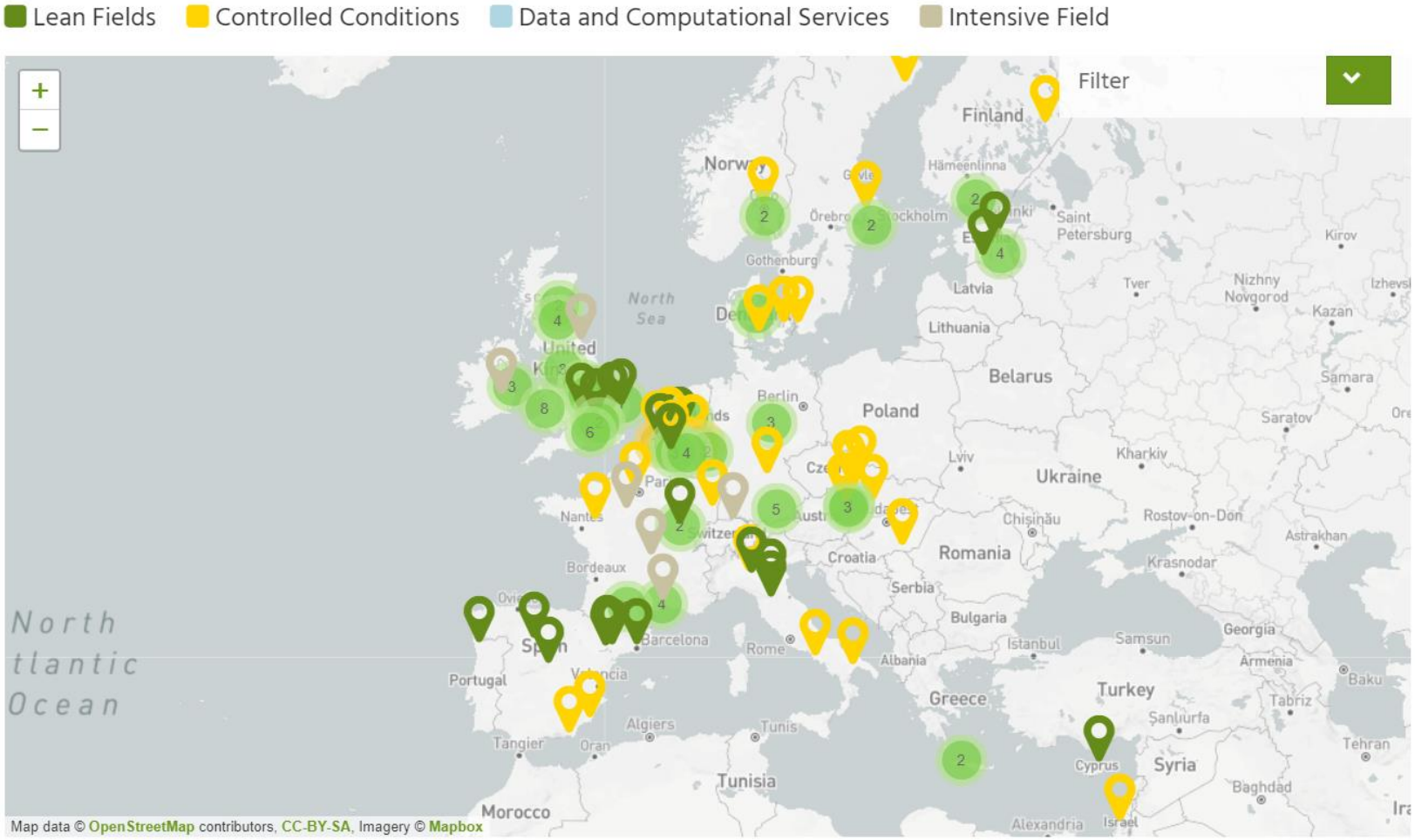
Field sites with minimal equipment, which could be combined in a network of fields with different environmental conditions

Modelling platforms to support plant phenotyping data analysis



Information systems for plant phenotyping data management supporting open science

Map infrastructures



Source: EMPHASIS homepage (https://emphasis.plant-phenotyping.eu/emphasis_infrastructure_map)

Timeline

2015 - 2016 — **EMPHASIS proposal**

2017 - 2020 — **Preparatory (PREP)**

2021-2023 — **Implementation (IGA)**

2024-2036 — **Operational (ERIC)**

ESFRI ROADMAP

- EMPHASIS on ESFRI Roadmap

EMPHASIS-PREP

- legal framework
- business plan
- community building

EMPHASIS – GO legal entity

-sustainable operation
-RI life cycle: new infrastructure

2026 EMPHASIS LANDMARK

EMPHASIS community

2021-2023

- EMPHASIS **pilot services** will be provided.

→ Field **Training*** Data
→ Harmonization Modelling Innovation

- EMPHASIS participation in **HE infrastructural projects/programmes**.

→ **INFRADEV**: EMPHASIS-GO

→ **INFRASERV**: AGROSERV (coord. ANAEE)
MICROBES4CLIMATE (coord. MIRRI)

INFRATECH: PHENET

EMPHASIS

Training programme on

Affordable Phenotyping
Matera-Metaponto, Italy
18-21 April 2023

EMPHASIS-GO is supported by the European Union (Grant Agreement: 101079772).

The Italian Plant Phenotyping Landscape

ACCORDO PER COSTITUZIONE E FUNZIONAMENTO DI UNA RETE NAZIONALE DI PLANT PHENOTYPING TRAMITE UNA JOINT RESEARCH UNIT (JRU) DENOMINATA ITALIAN PLANT PHENOTYPING NETWORK – PHEN- ITALY

Phen Italy
THE ITALIAN PLANT PHENOTYPING NETWORK

Universities

International Organizations

CIHEAM
IAM BARI

Nutrients and Biostimulants Efficiency

(biomass, colours, photosyntetic activity, kinetics of plant de

Control

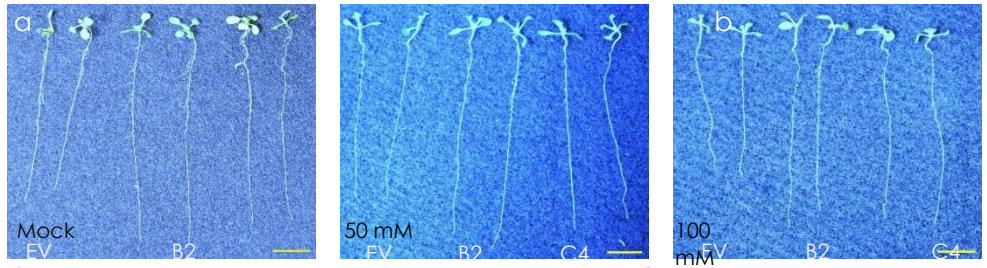
Biostimulant

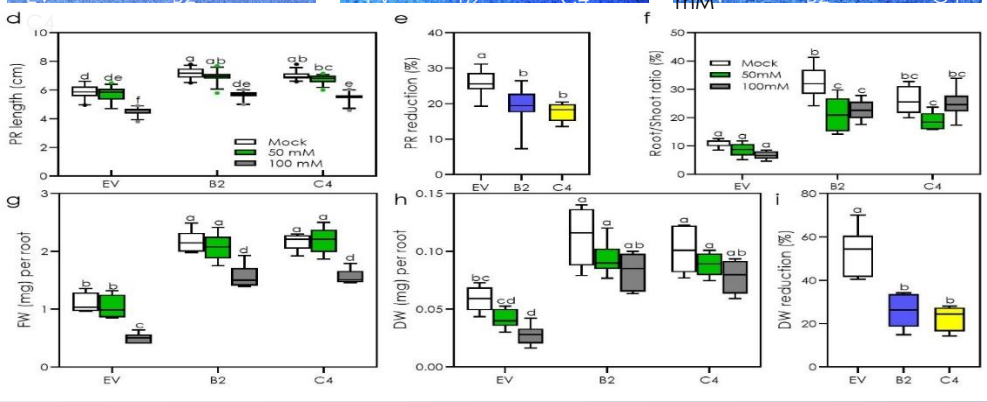
Plant Breeding: Screening of mutants lines and crosses for new phenotypes

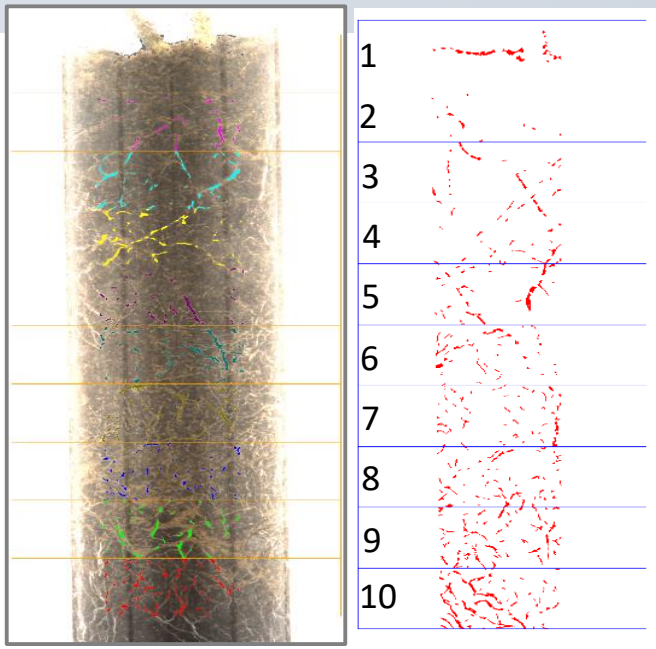
(heritability of the trait, association mapping, eg.)

High-throughput *analysis* to study plant *stress* responses

Root biomass and root distribution

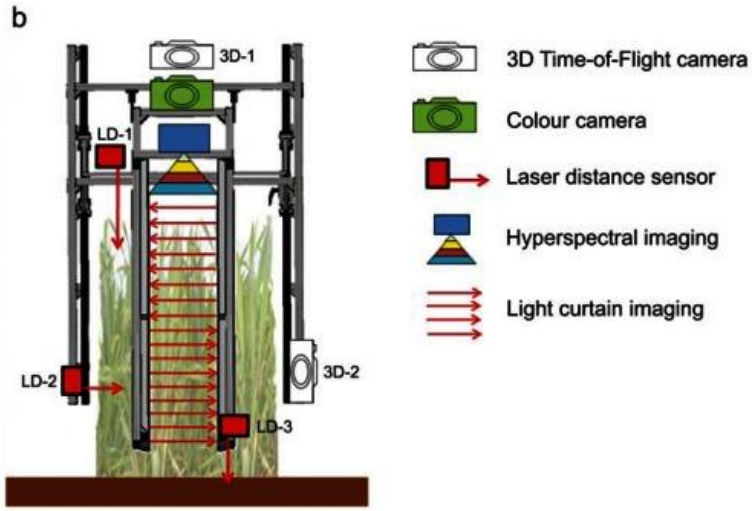


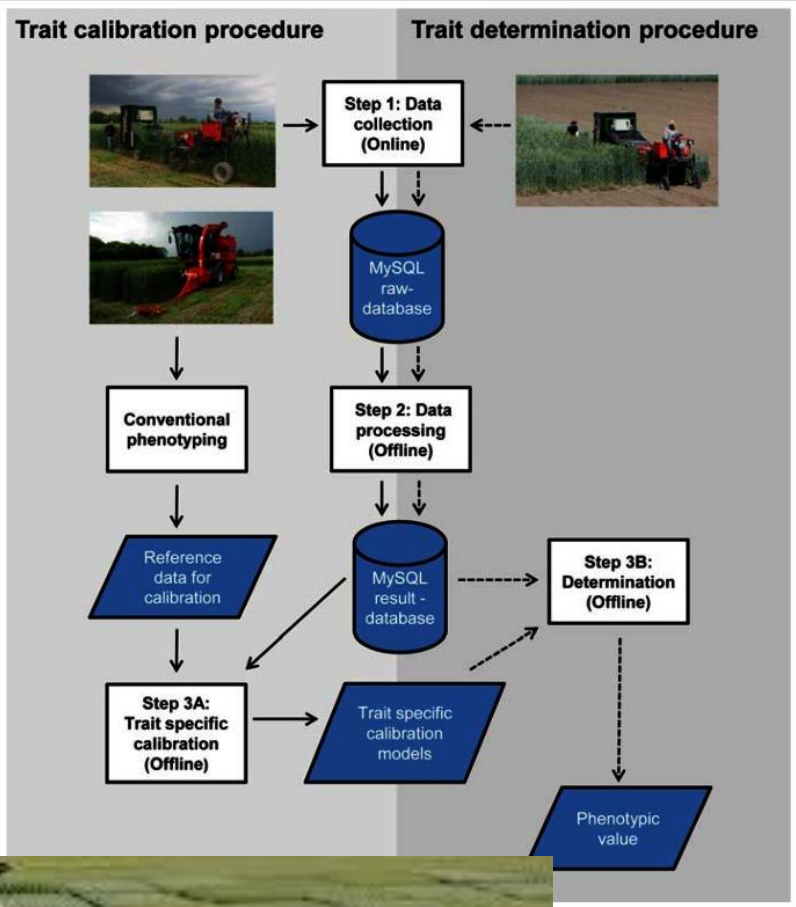




Manuel Bellucci ,
Campus Bio-Medico University of Rome
Novel functions of isoprene in root physiology and salt stress tolerance

HT field phenotyping for scaling up the throughput in plant breeding





FONDAZIONE EDMUND MACH

Direct high-throughput high-sensitive analysis of volatilomes

PTR-MS based high throughput phenotyping platform for plant and fruit **volatile compounds**:

- Direct injection
- Rapid analysis (1-3 minute/samples)
- Automatic sampling/data handling
- High sensitivity

Applications:

- Plant/fruit phenotyping
- Fast screening of genotypes

Example of large genotype screening:
single leaf emission of isoprene by modified arabidopsis (2000 samples/week)

PHENOPLANT: AN INNOVATIVE PLANT PHENOTYPING PLATFORM FOR DROUGHT STRESS ANALYSIS IN ROOTSTOCK/SCION GRAPEVINE COMBINATIONS

Paladini F, De Palo F, Patono DL, Ferrandino A, Milani AM, Comino C, Lanteri S, Lovisolo C, Acquadro A

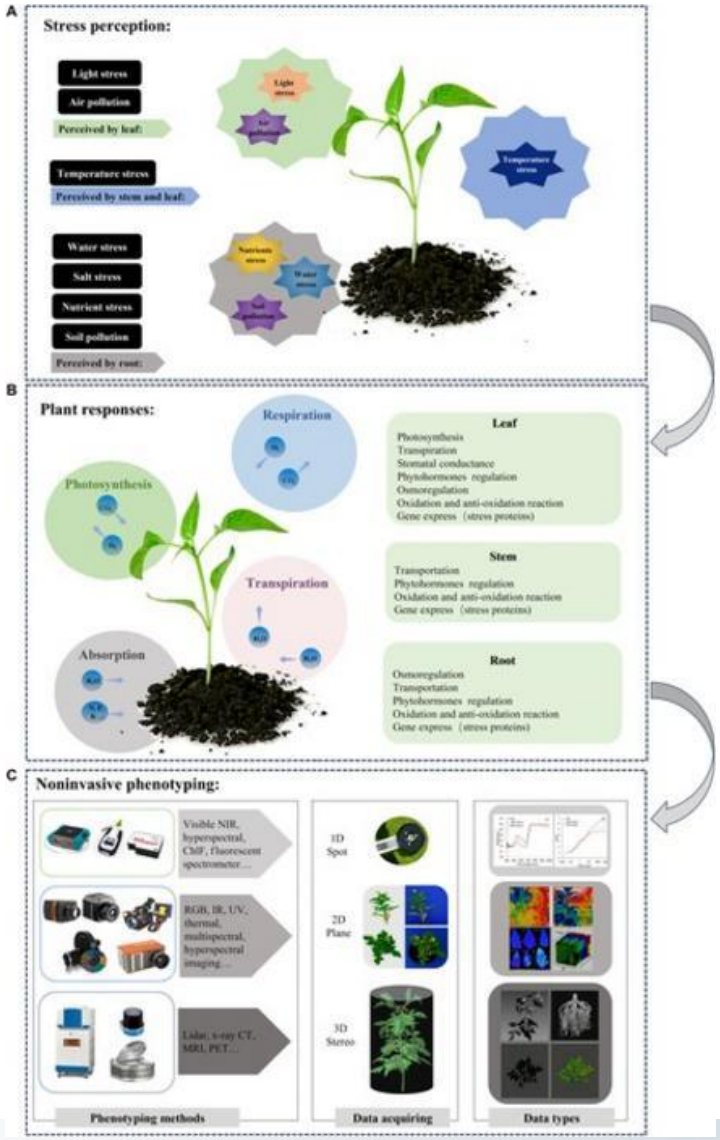
Department of Agricultural, Forest and Food Science (DISAFA), University of Torino, 10095 Grugliasco

Background

- **PhenoPlant** is the new high-throughput **plant phenotyping platform** of the University of Torino (http://tiny.cc/DISAFA-infrastructures), a **non-invasive tool** that combines **3D vision** and **multispectral imaging** to capture precise and objective plant **morphological** and **spectral indexes.**
- Within the **VINO project (NODES)**, **PhenoPlant** made it possible to collect **morphological/spectral data**, as well as **physiological** data using proximal sensing tools such as **IRGA** (infraRed Gas Analyzer).

PHENITALY PLATFORMS

CONCLUSIONS & PERSPECTIVES



- Imaging is central for HTPP
- Technology development is very fast
- Large facilities for intensive measurements needed
- Digitalization, IoT and AI applications needed
- Demand is
  - increasing and diverse
  - often linked to special expertise for development
  - often requires specialised infrastructures
- Networking at national end international level is essential

Breakthrough in noninvasive plant stress phenotyping: a multi-organ approach to combat abiotic stressors

NANJING AGRICULTURAL UNIVERSITY THE ACADEMY OF SCIENCE

JOURNAL *Plant Phenomics*DOI*10.34133/plantphenomics.0180*

GRAZIE PER L'ATTENZIONE

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