NordPlant

EMPHASIS - the European Research Infrastructure for Plant Phenotyping: developments and options

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European Plant Phenotyping Network EPPN 2020

EMPHASIS

International Plant Phenotyping Network IPPN

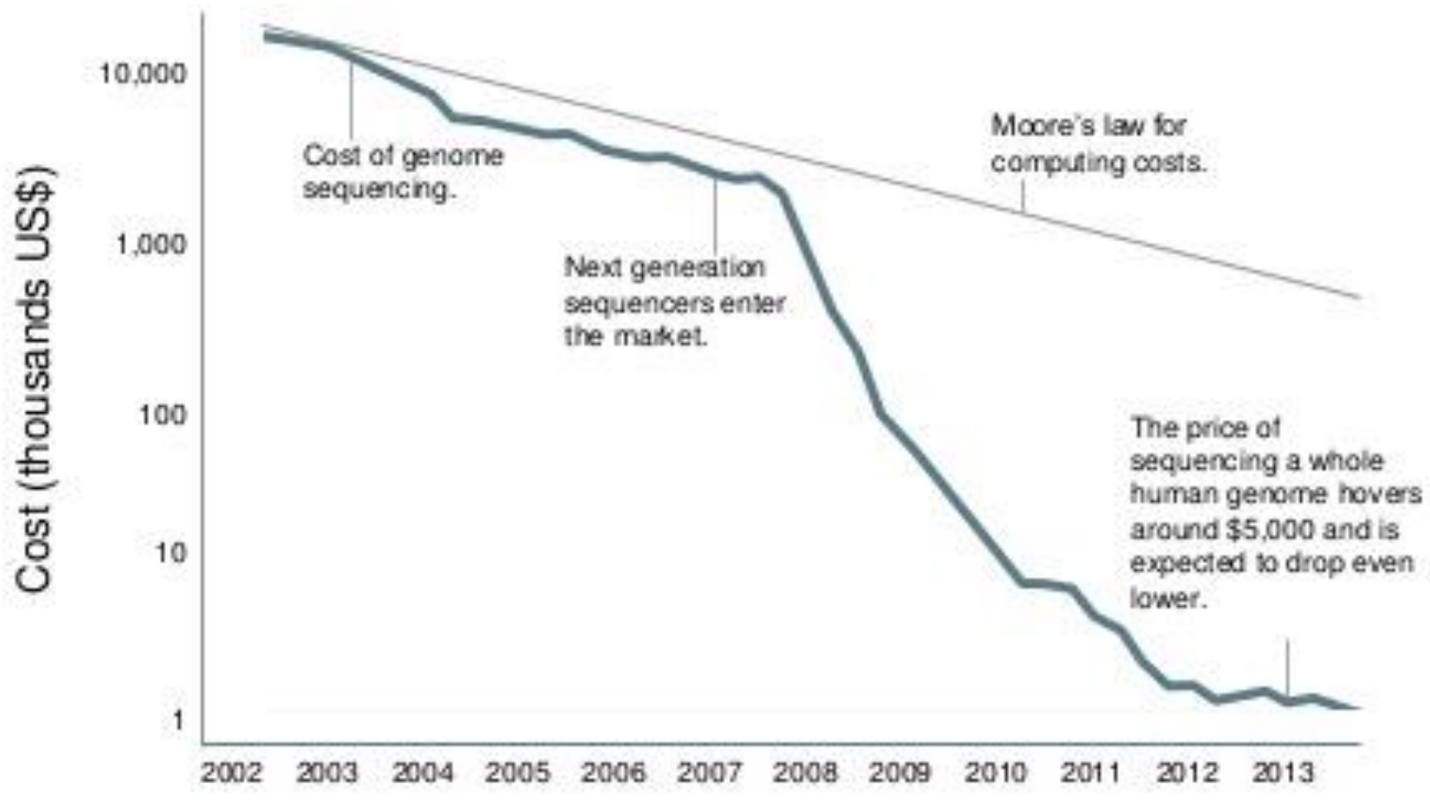
Mitglied der Helmholtz-Gemeinschaft

JÜLICH Forschungszentrum

Developments effecting life sciences

Sequencing

Beyond Moore's law: cost of sequencing ⇒ zero



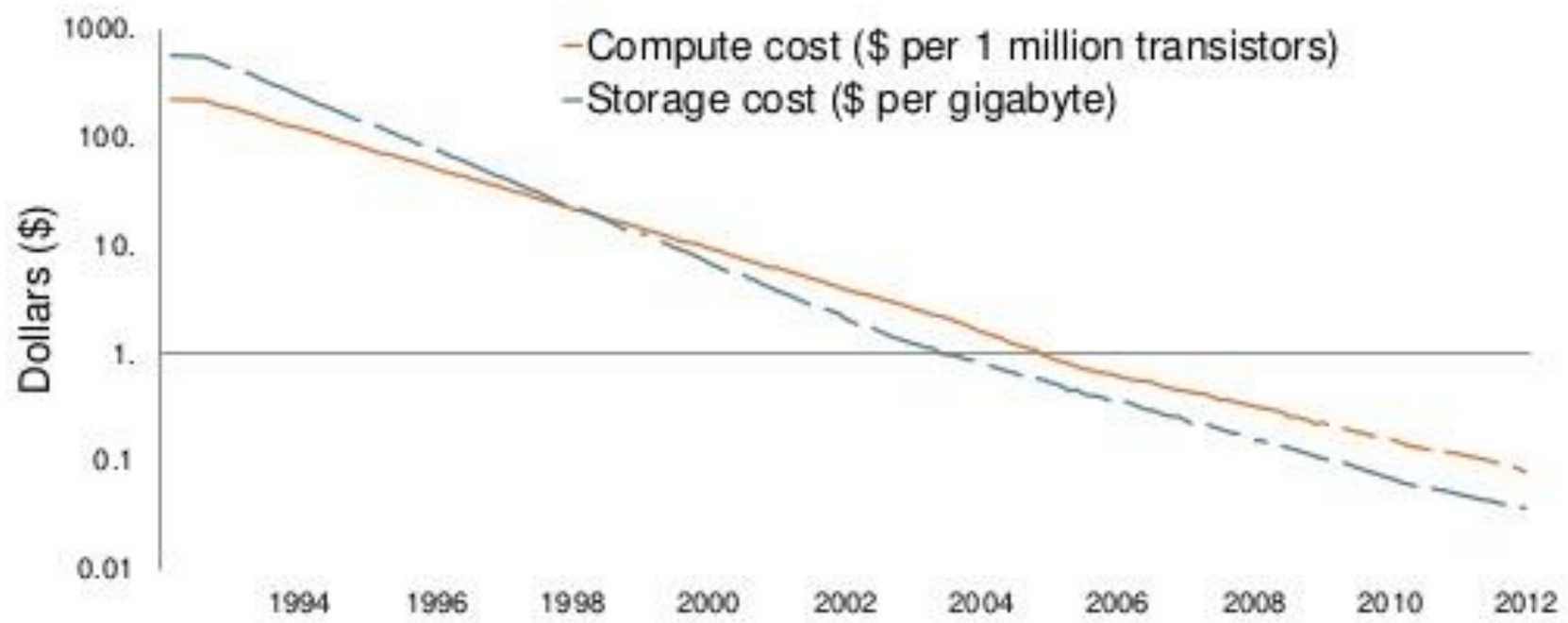
Source: Nature, 2014

Developments effecting life sciences

Computing

Moore's law: cost of storage, compute ⇒ zero

Storage cost-performance and computing cost-performance



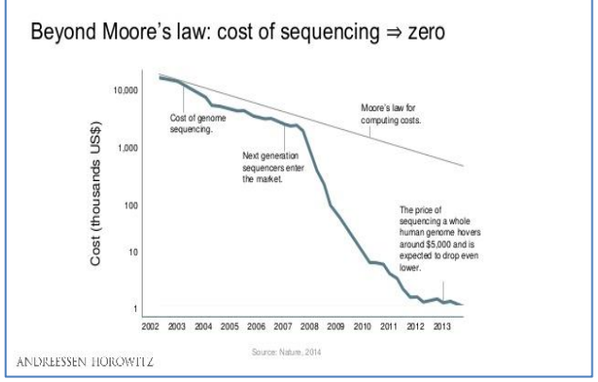
ANDREESSEN HOROWITZ

Developments effecting life sciences

Sensor

Developments effecting life sciences

Sequencing

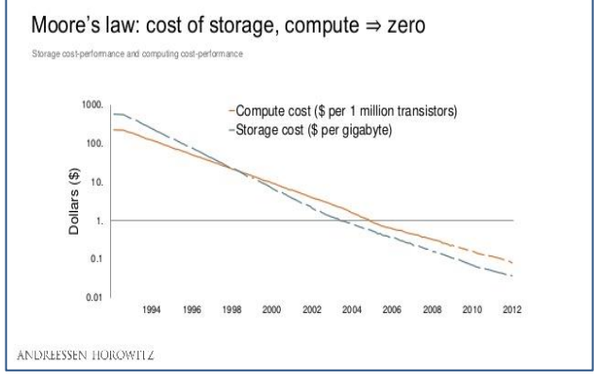


+

Sensor

+

Computing



Enormous opportunities in life sciences:

- Revolutionize our understanding of life
- Address grand challenges (health, food security, climate change…)
- New companies, business models (e.g. big data, personalized medicine...)

What happens in plant sciences / plant phenotyping?

Phenotyping demand

Climate change

Environmental health and risk

Molecular biology

Gene function

Plant-Environment-Interaction

quantitative · deep · high-throughput · field · models

Genetics Breeding

Predictive breeding

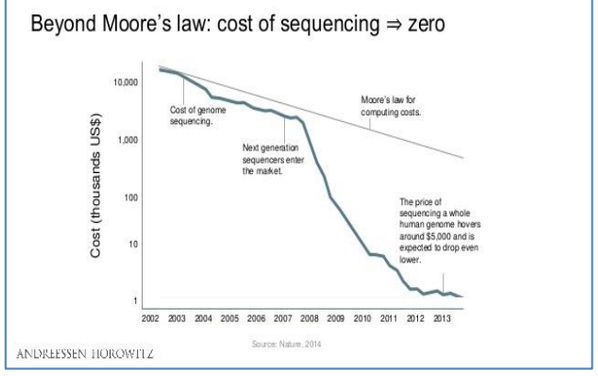
Complex traits

Mechanisms of resource use efficiency

Sustainability

Addressing the phenotyping demand

Sequencing



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Sensor

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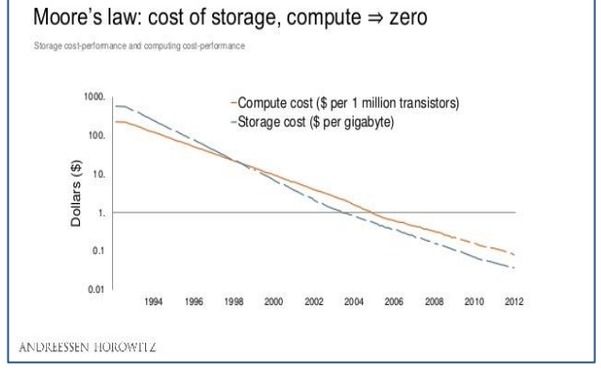
Computing



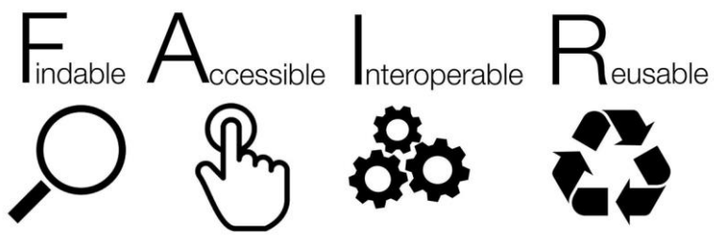
Sequencing ✓

Sensors

- Demand for specialized technology and expertize to address diverse crops and conditions treatments
- Multidisciplinary approach

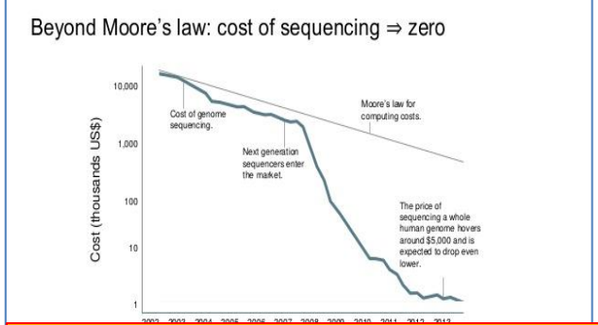
Computing

- Demand for standardisation and FAIR data



Further advancement in plant phenotyping?

Sequencing

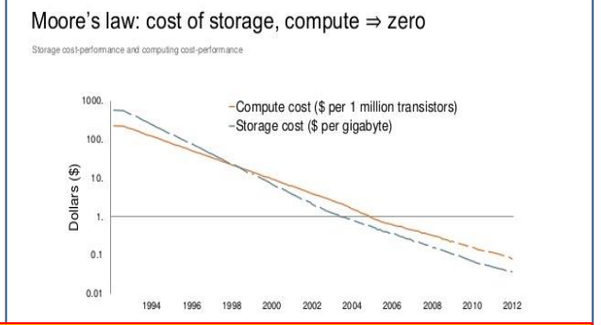


+

Sensor

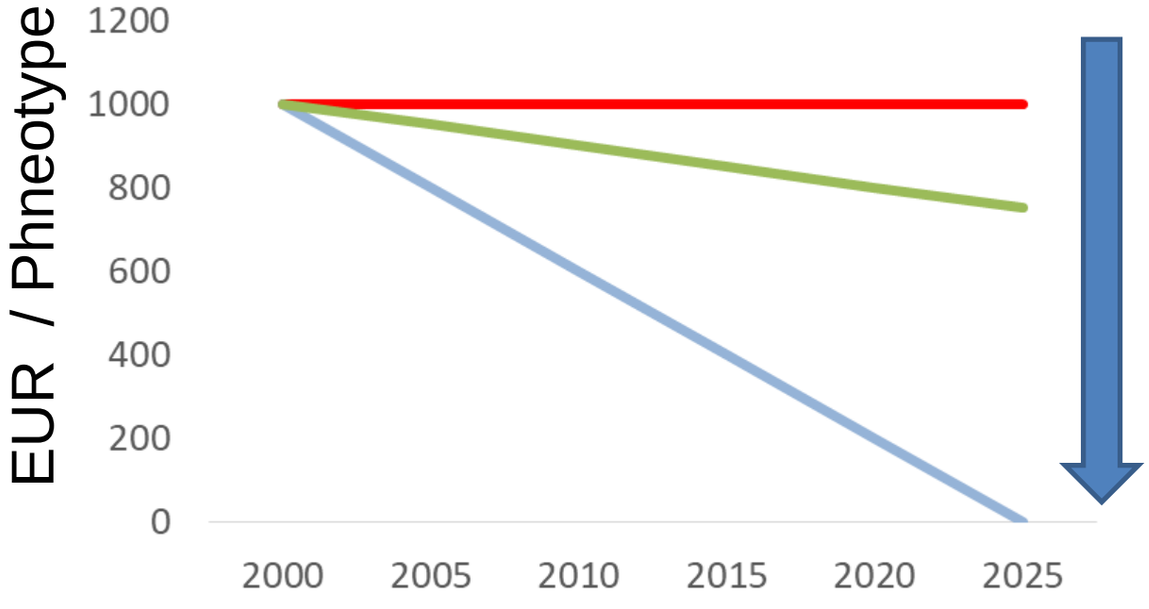
+

Computing



→ Need to Network

Phenotyping

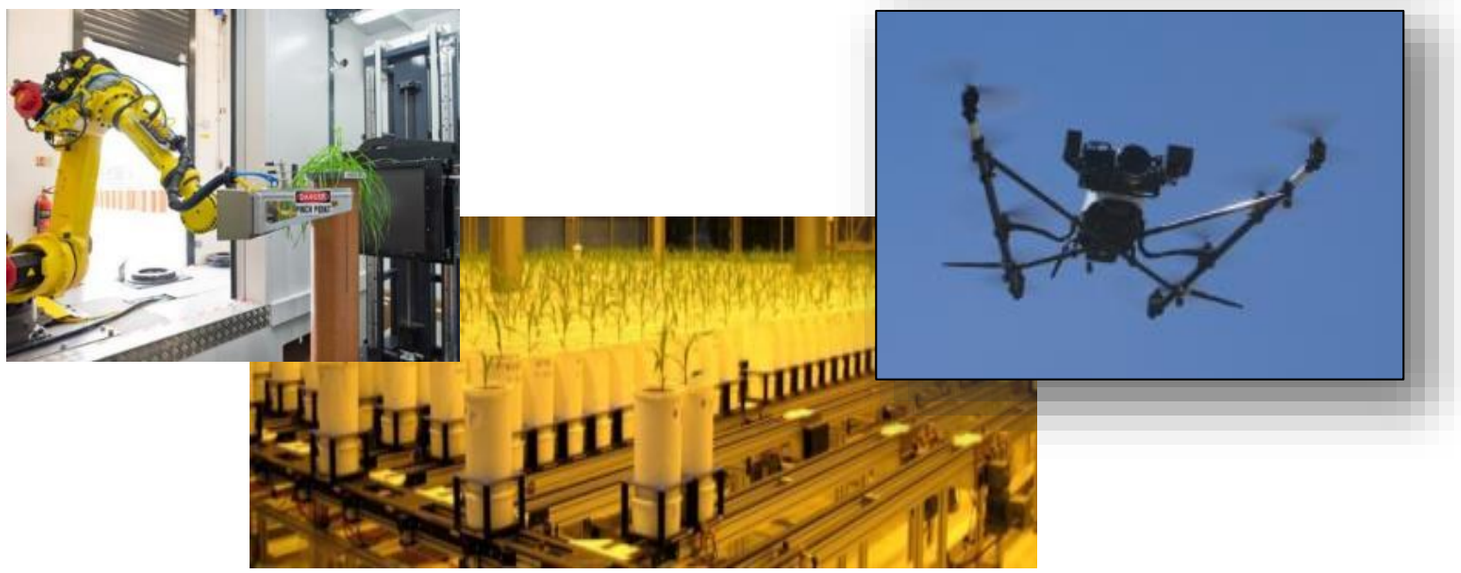


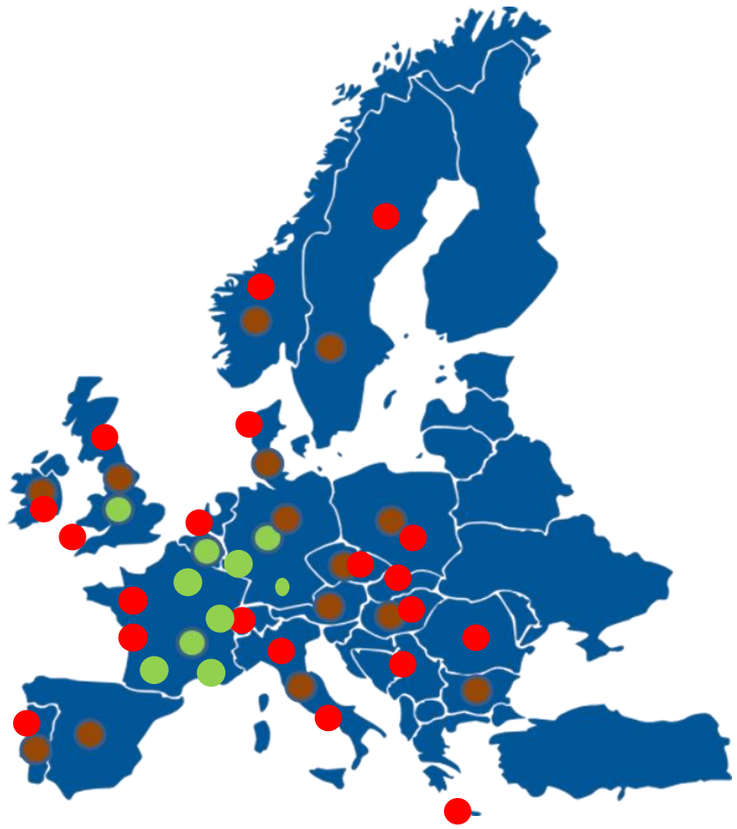
- Increased funding / investment
- Availability and access to infrastructure based demand
- Develop, apply and disseminate technology and analysis pipelines
- Develop standards – reusability of data

Sustainable pan-European plant phenotyping infrastructure

www.plant-phenotyping.eu

EMPHASIS: European Infrastructure for Multi-Scale Plant Phenotyping And Simulation for Food Security in a Changing Climate



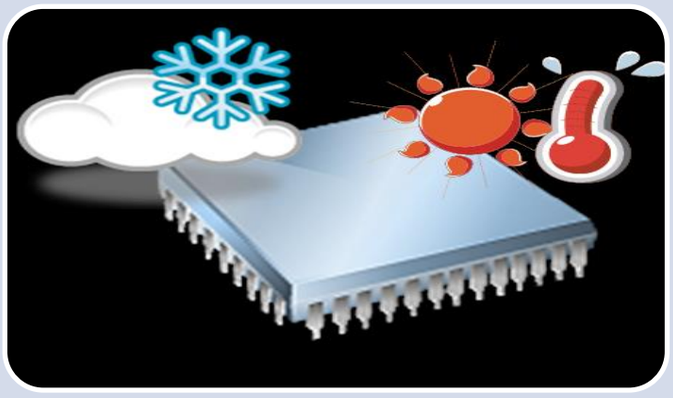


EMPHASIS mission

Developing infrastructures and providing access for multi-scale phenotyping to analyze genotype performance in diverse environments and quantify the diversity of traits

Objectives

Develop an integrated pan-European infrastructure of instrumented facilities available to the user community



Link data acquisition to a European-level data information system and modelling

Develop, evaluate and disseminate knowledge and novel technologies providing innovative opportunities for academia & industry

EMPHASIS – why going European?

SYNERGY

- Investments
- Data management
- Education/ Training

INNOVATION

- Unique installations
- From academia to industry

ACCESS

- Development
- Use
- Translation/ Dissemination

EMPHASIS: timeline

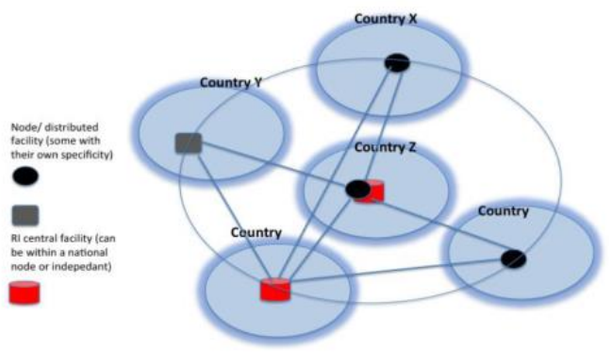
2015 - 2016	2017 - 2020	> 2021
EMPHASIS propsal	Preparatory phase	Implementation / Routine operation
ESFRI ROADMAP	**EMPHASIS-PREP**	**EMPHASIS - legal entity**
- EMPHASIS on ESFRI Roadmap	- legel framework - business plan - community building	- sustainable operation - RI life cycle: new infrastructure
		2026 EMPHASIS LANDMARK

Community Building

PHENOME EMPHASIS · NaPPI · Phen-Italy · Deutsches Pflanzen Phänotypisierungs-Netzwerk DPPN · APPN Austrian Plant Phenotyping Network · CZPPN Czech Plant Phenotyping Network · PPN-Ireland · UK Plant Phenomics Network

X

Plant Phenotyping Network



Central-shared coordination (OECD 2014)
http://www.oecd.org/

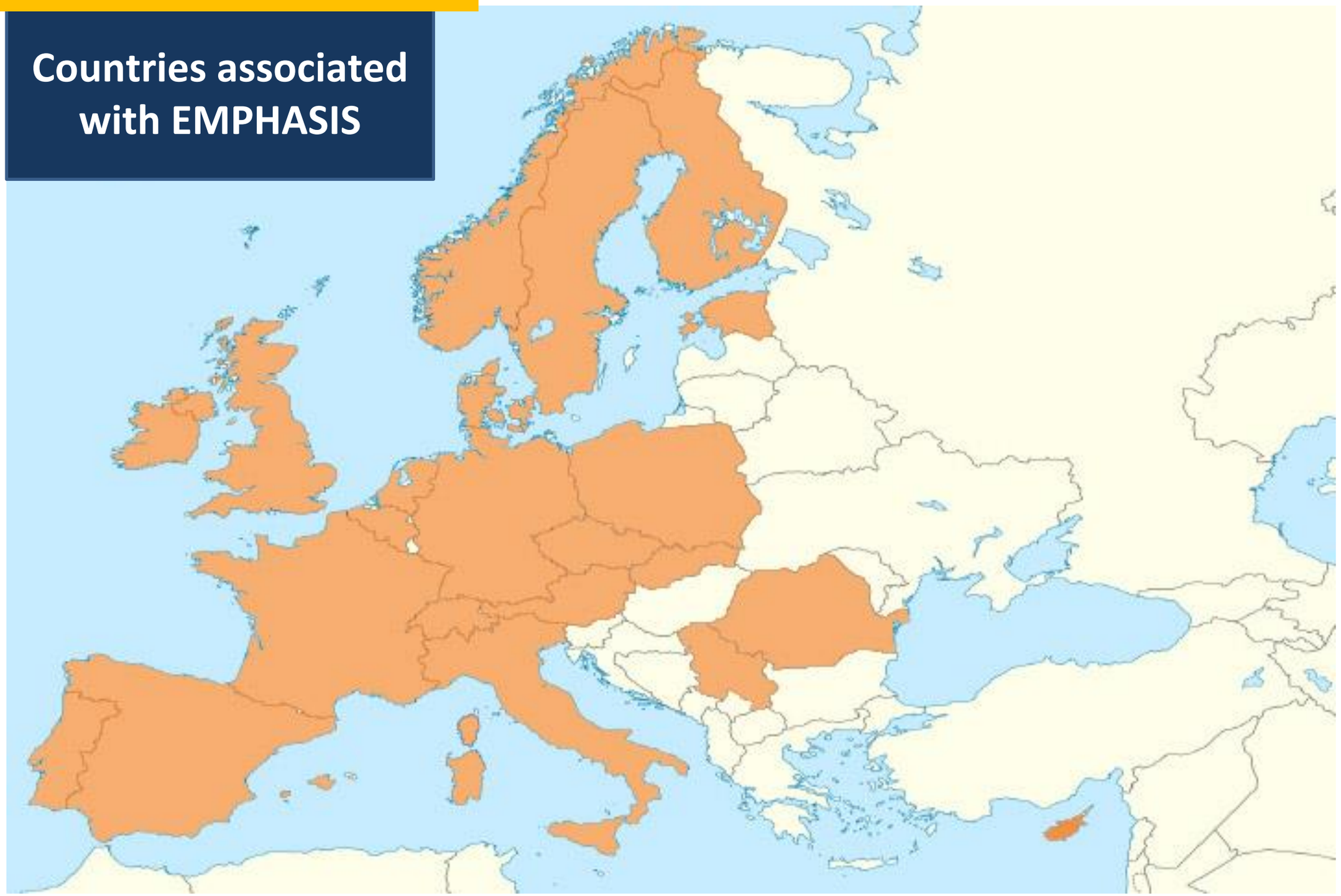
Pan- European integrated plant phenotypong infrastructure

ESFRI

EMPHASIS

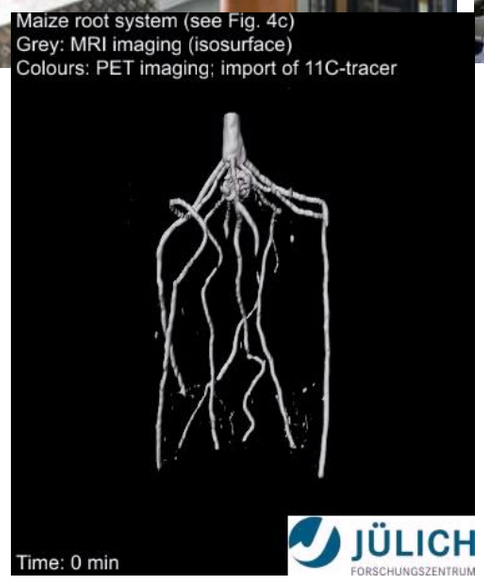
Open for new members

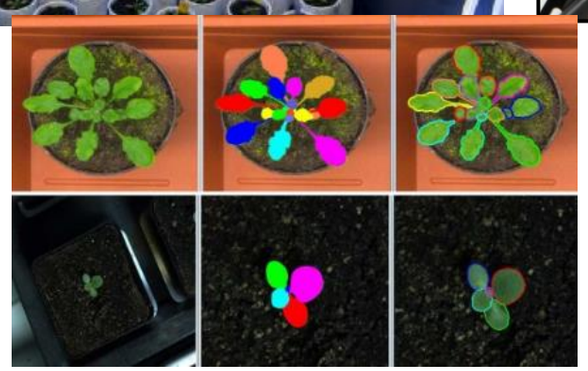
Countries associated with EMPHASIS

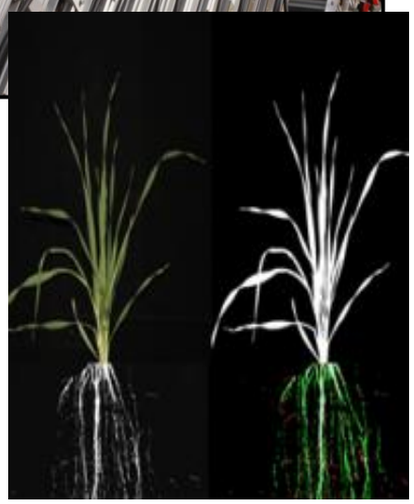


EMPHASIS infrastructure

1. Facilities for high resolution, high throughput phenotyping

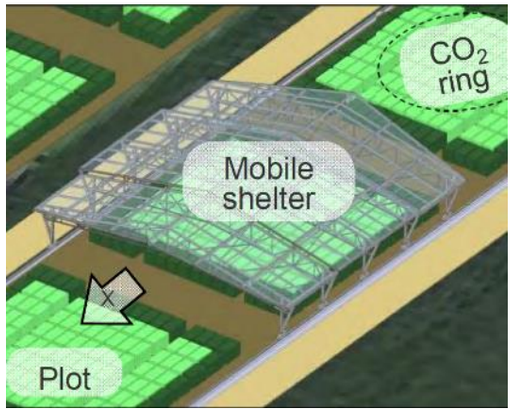




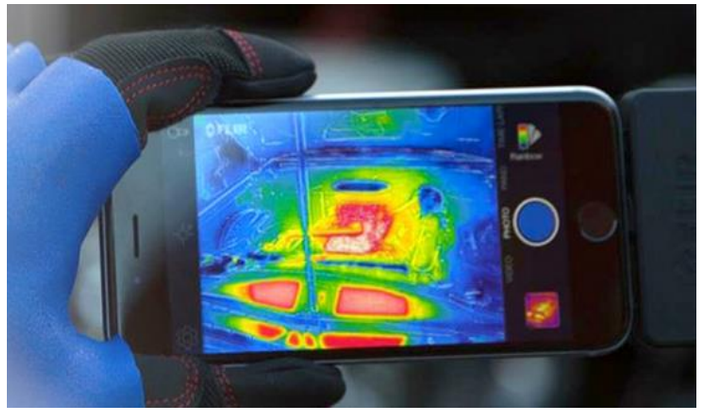


EMPHASIS infrastructure

2. Semi-controlled field systems for high throughput phenotyping



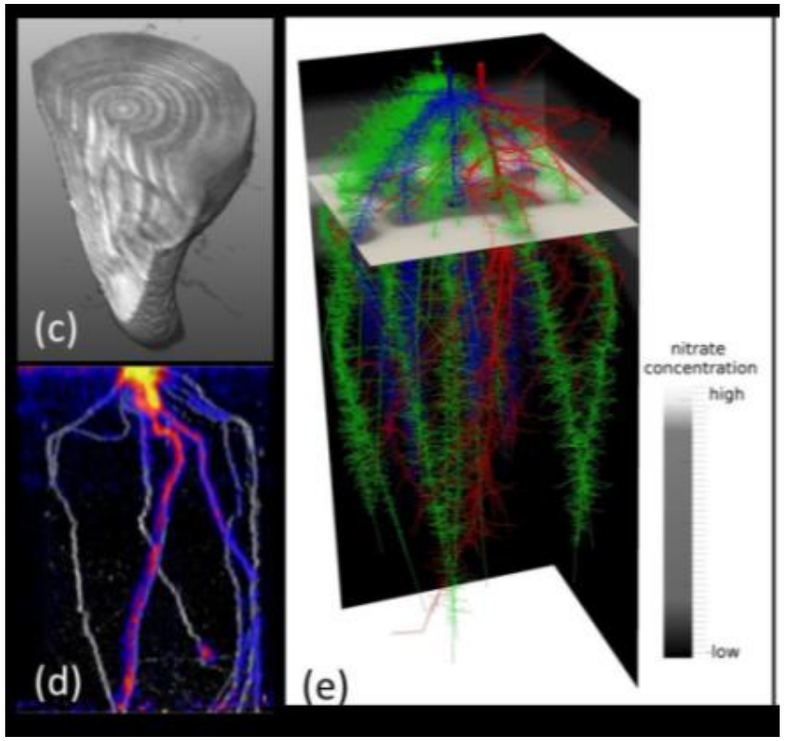
3. Network of field sites practical experiments



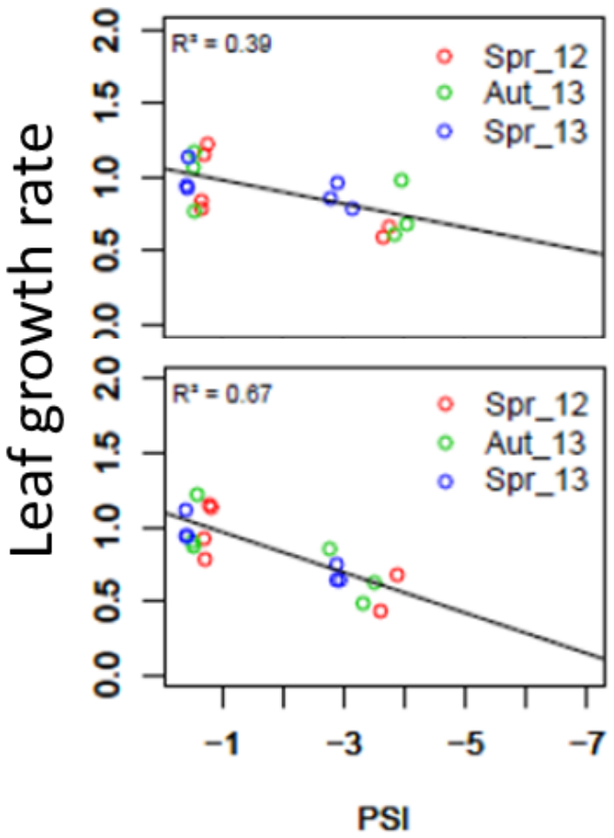
EMPHASIS infrastructure

4. Modelling platform

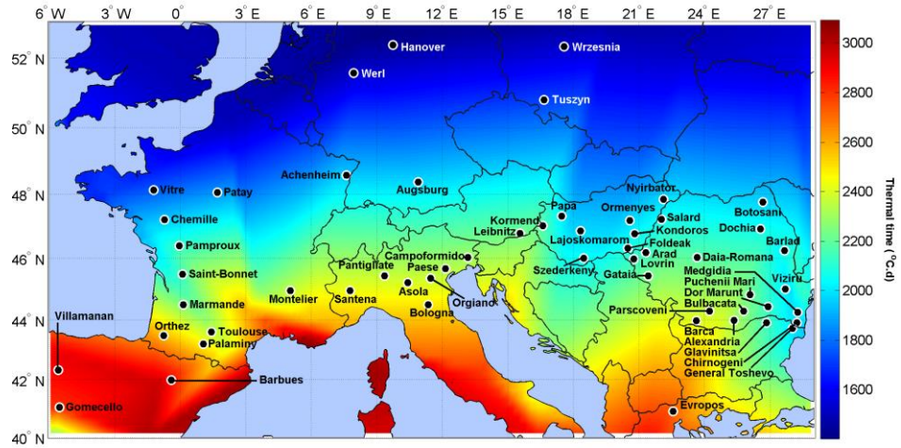
Disentangling complex traits



Genetic analysis of complex traits



Crop – climate optimisation

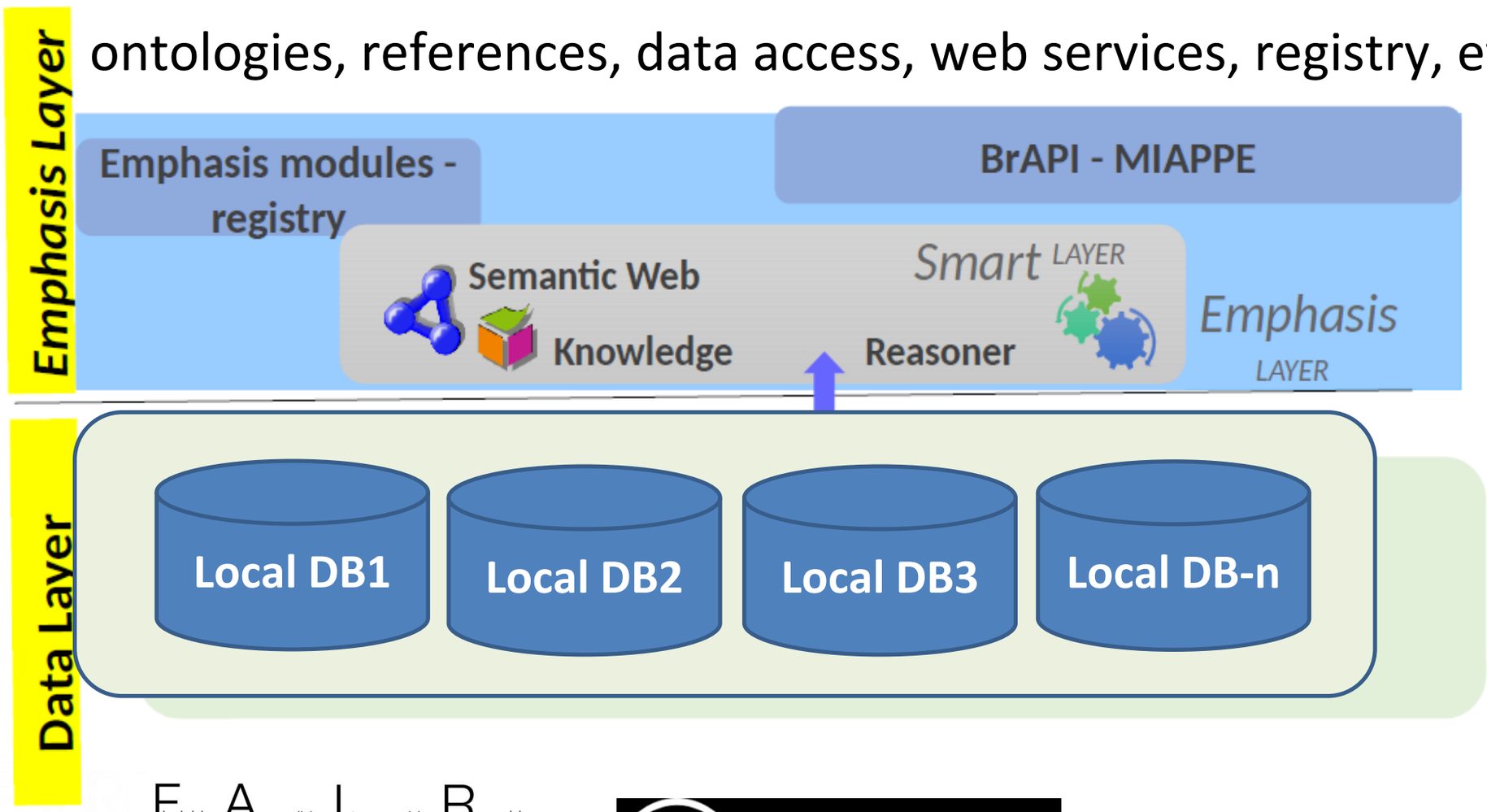


EMPHASIS infrastructure

5. Joint data management and e-infrastructure

Single web based entry point to query all databases

ontologies, references, data access, web services, registry, etc.



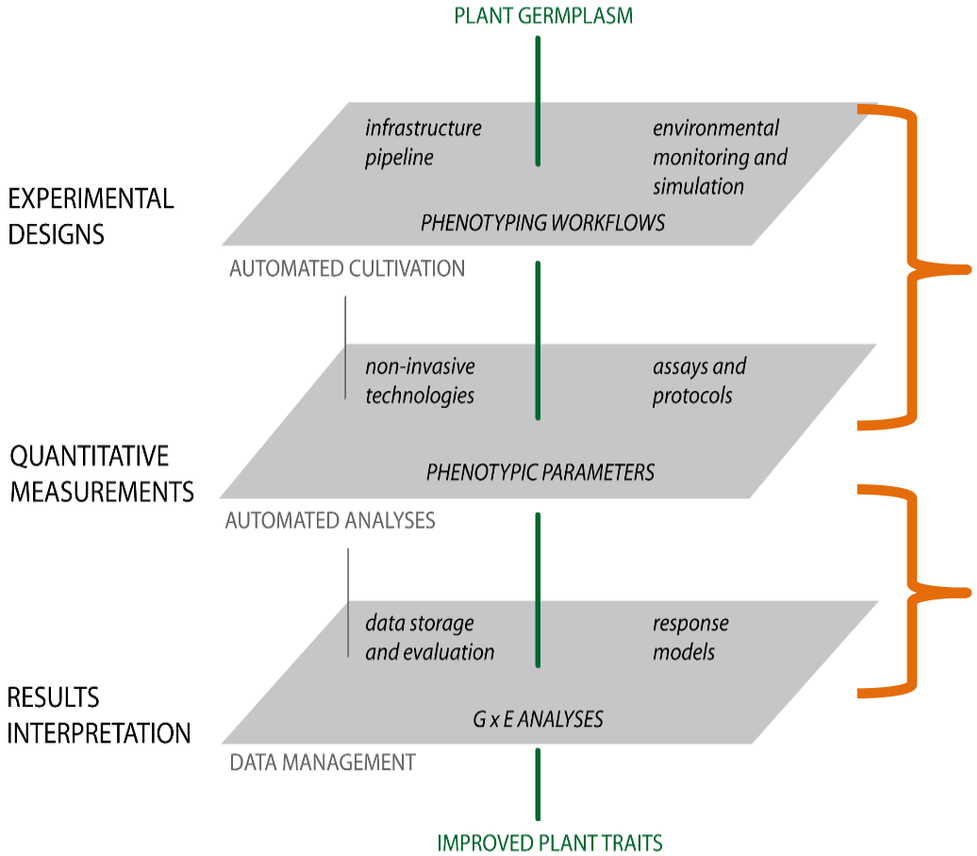
Findable Accessible Interoperable Reusable

miappe

EOSC-hub

elixir Data

EMPHASIS infrastructure mapping



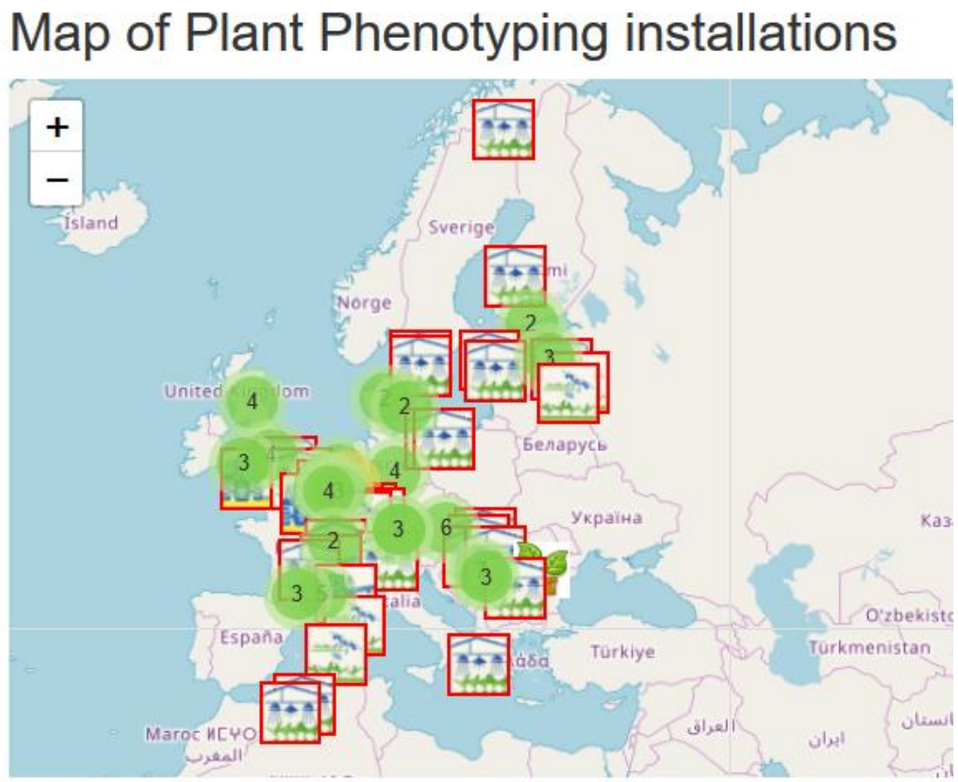
Modified after Fiorani & Schurr 2013

I. *Phenotyping installations for high resolution, high throughput phenomics*
II. *Semi-controlled field systems for high throughput phenomics*
III. *Network of practical field experiments for lean-phenotyping*

IV. *Modelling*

V. *Joint data management and e-infrastructure*

- >130 installations have beein identified so far
- Detailed characterisation is in progress



EMPHASIS User demand

User demand and service provision

User Group

I. Scientists and managerial staff operating the infrastructure

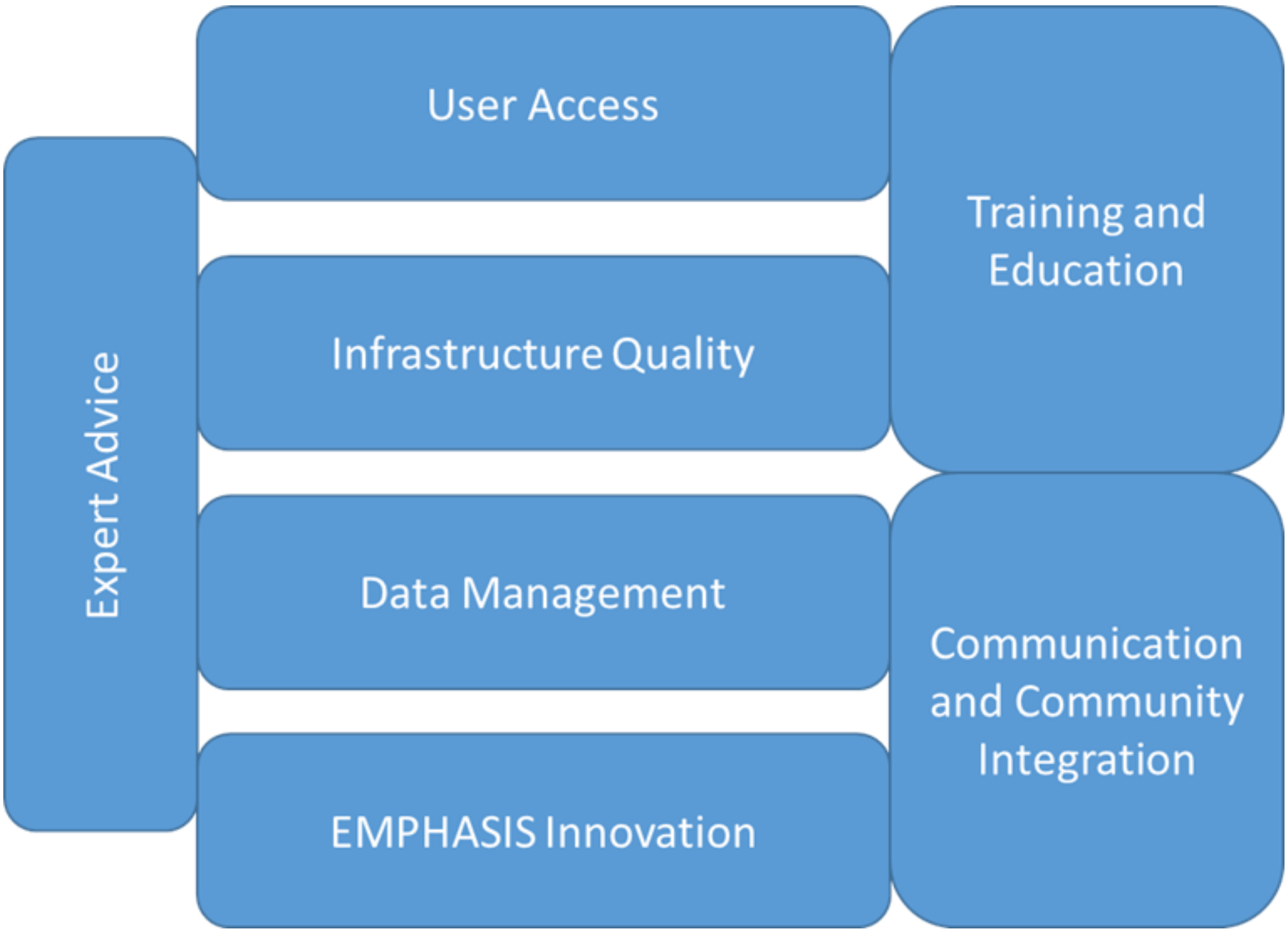
II. User from academia and industry interested in access to EMPHASIS services

III. Users developing technology

IV. Funders and Policy makers

V. Public

EMPHASIS Services



EMPHASIS Stakeholders

EMPHASIS-PREP will establish a transparent, open and inclusive process for the foundation of future operation of EMPHASIS

- EMPHASIS – PREP Group
  Members of EMPHASIS-PREP EU funded project

→Preparing the Business plan

- EMPHASIS – PREP Support Group
  National phenotyping communities
- Ministry mirror group (Min-MG)
- Funders board (F-AB)
- Industry advisory board (Ind –AB)

Consultation group

EPPN / EPPN2020 projects

Basis and testbed for EMPHASIS

EPPN: ‘ Starting Community‘

2012-2015
Access to 21 installations in Europe

5.5 M€, 14 partners

- Transnational access :

66 accesses

> 50 peer revied publications

interaction within the community

- Joint research activities :

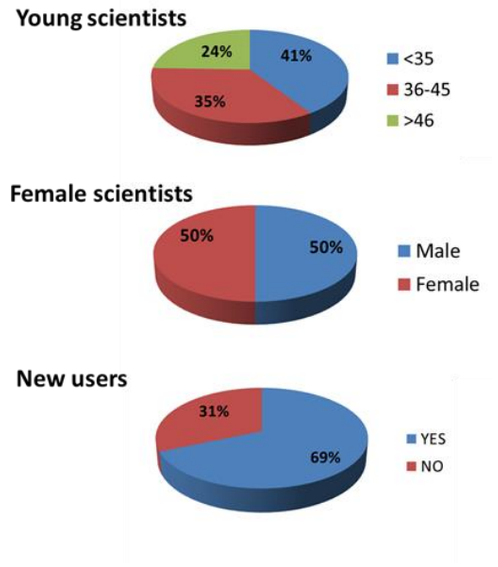
novel technologies

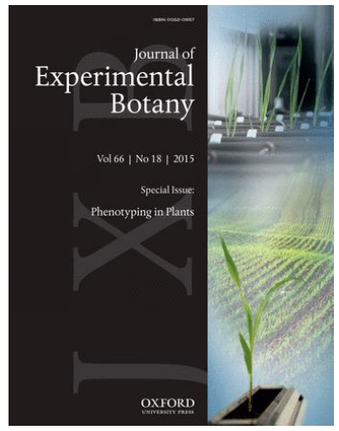
good phenotyping practice

information systems

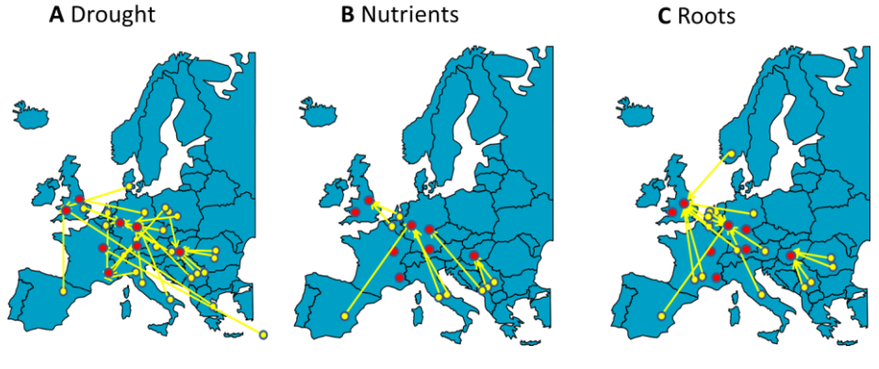
- Networking

Workshop, training schools, round table meetings…





~200 users directly involved in practical execution of TA experiments

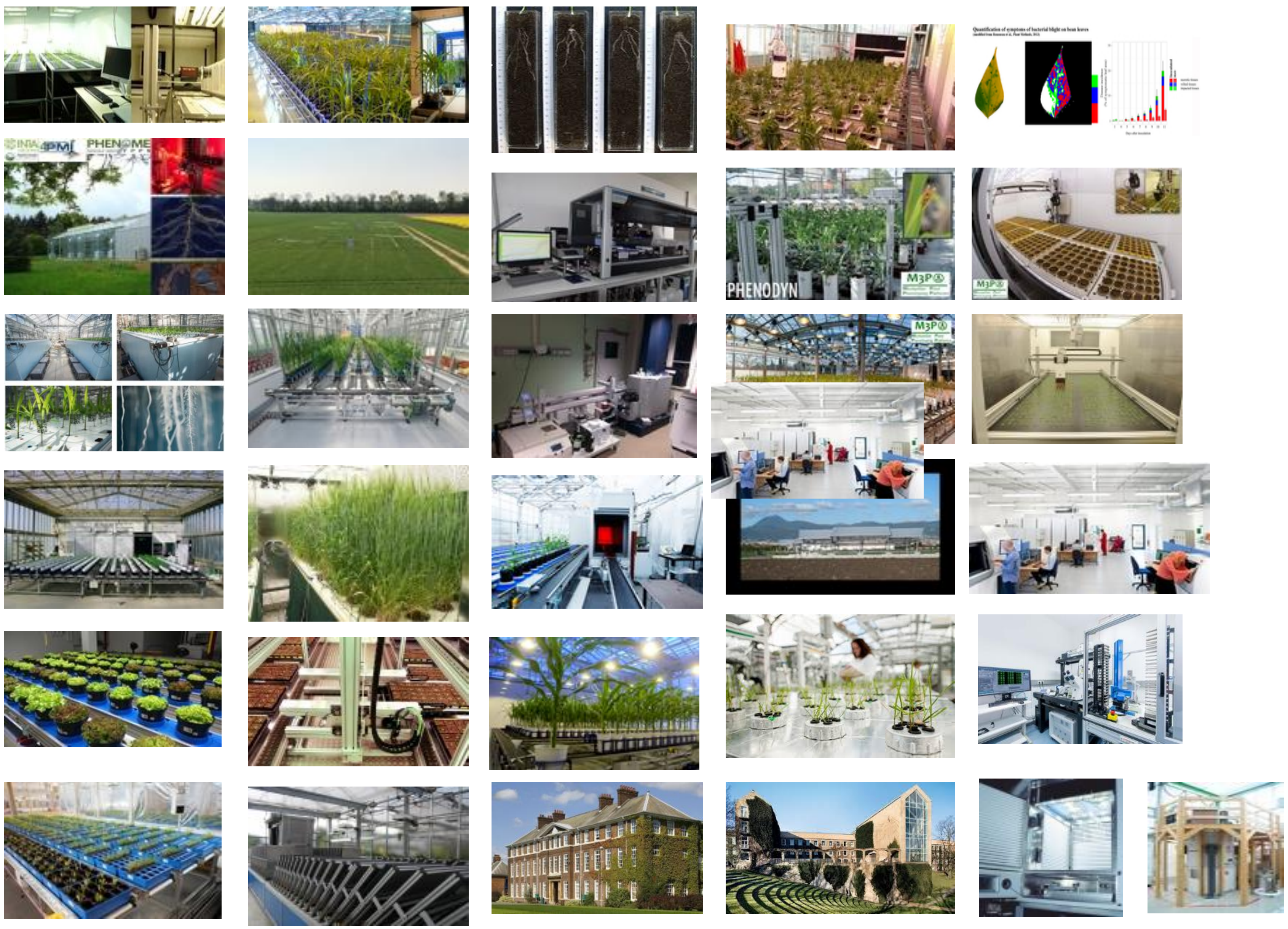


EPPN: ‘ Advanced Community‘

2017-2021

Access to 31 installations in Europe

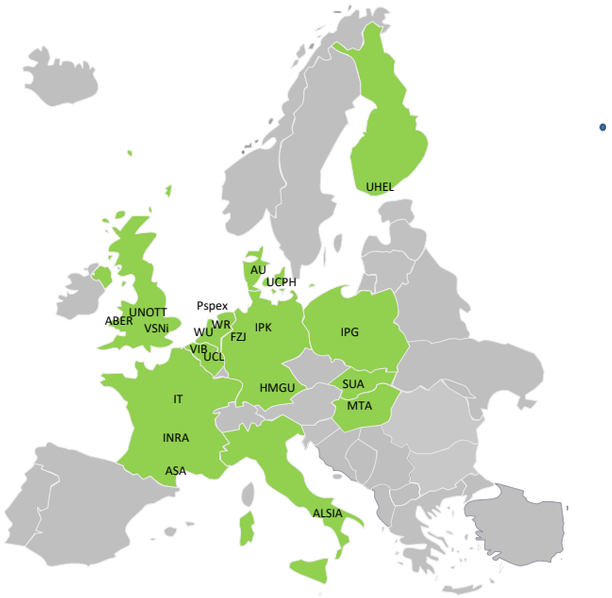
10 M€, 21 partners



EPPN: ‘ Advanced Community‘

2017-2020
Access to 31 installations in Europe

3rd Call for Transnational Access is open now:
Application deadline: 28th of January 2019, at 17:00 (German time)



https://eppn2020.plant-phenotyping.eu/

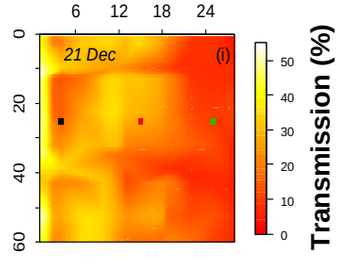
- Based on a simple application procedure
- Calls every 6 months
- Full cost of projects covered by the project, including travels
- 20% accesses for non-European

EPPN2020 : Joint research activities

Goal: Improve the quality of transnational access

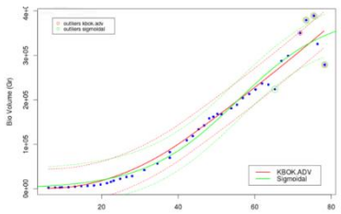
1. Methods for environmental and plant measurements

- *Progress in environmental characterization*
- *Calibration procedure*
- *Joint cross-platform experiments*



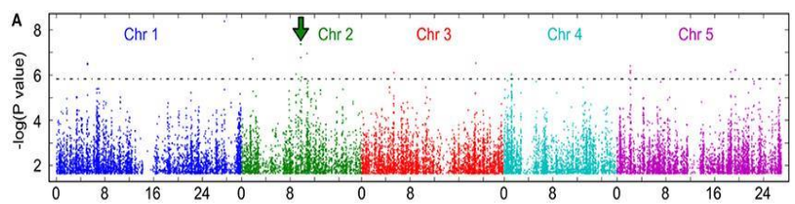
2. Design and analysis of experiments across multiple platforms

- *Outlier identification and statistical quality control*
- *Statistical design and analysis*
- *Data integration between platform*

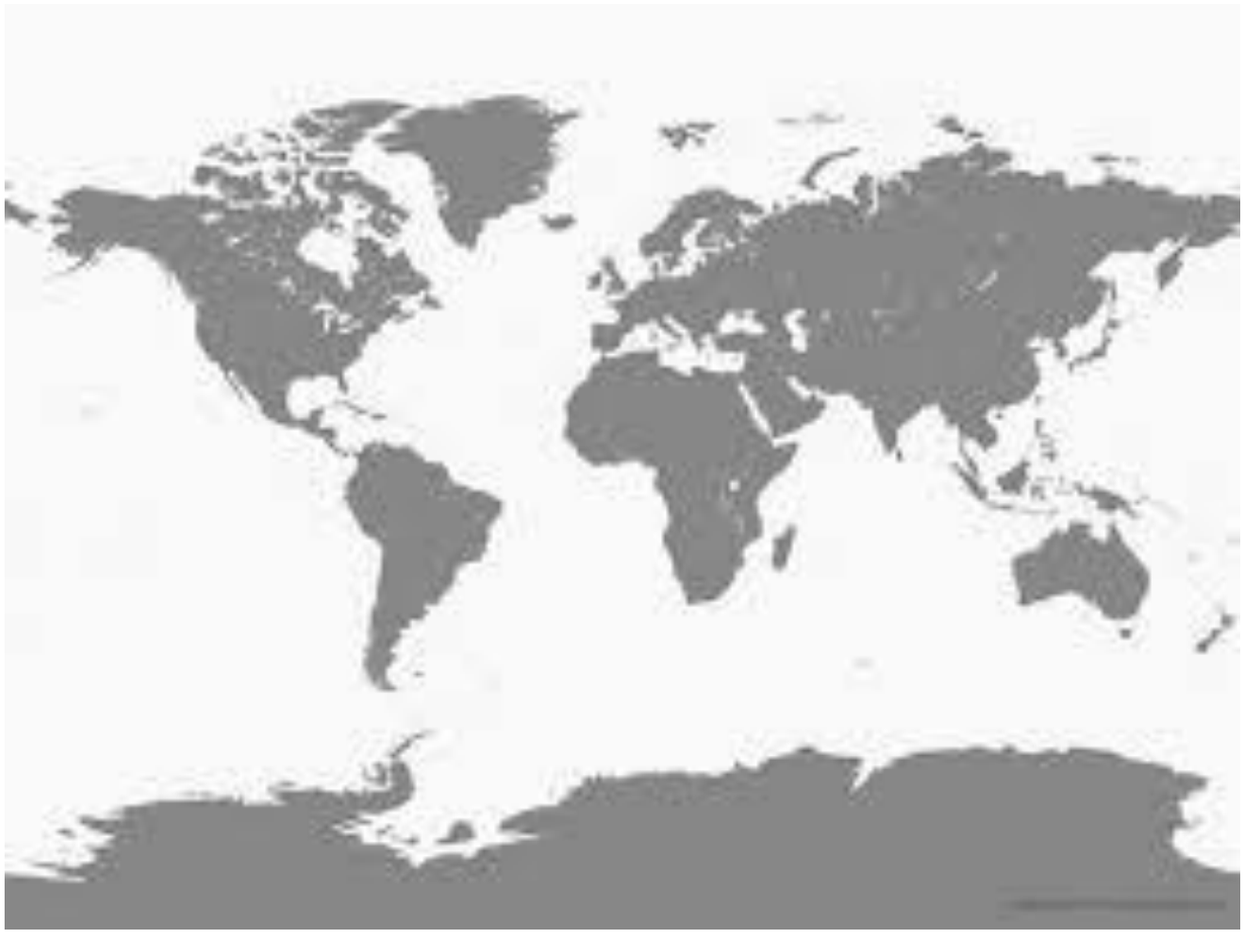


3. Building a consistent Information System in the different nodes and defining standardisation strategies

- *Data interoperability methods*
- *Local data management*
- *Data integration and high level webservices*
- *Deployment and assessment of a distributed information system*



Plant phenotyping beyond Europe



International
Plant
Phenotyping
Network

IPPN

IPPN - a global association for Phenotyping

www.plant-phenotyping.org/

IPPN - open for additional members

Linking 34 members from academia and industry

Goal:

- Integrating the globally fragmented activities
- Enabling exchange of knowledge, information, and expertise

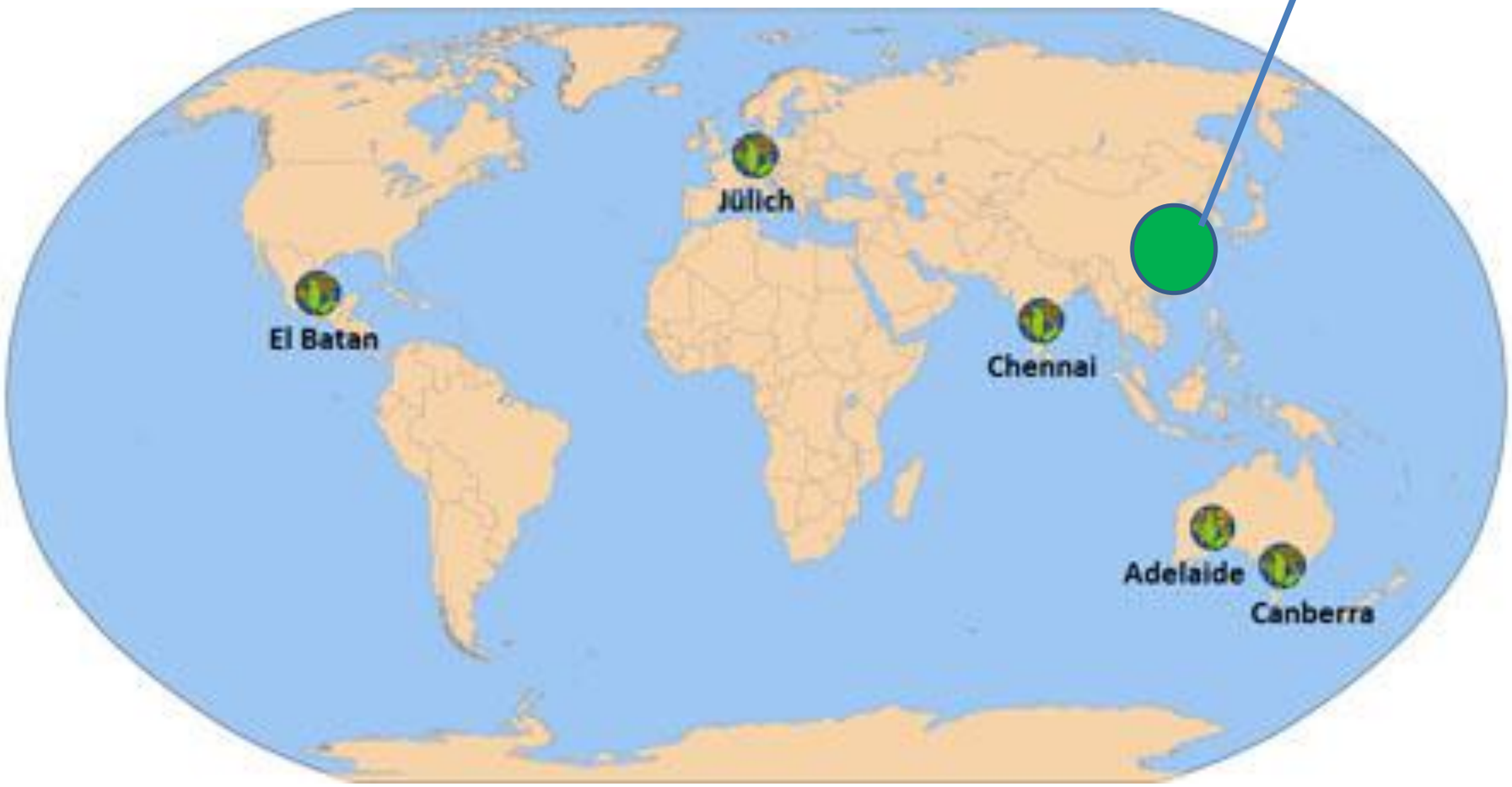
Instruments:

- Organizing International Plant Phenotyping Symposia
- Establishment of Working Groups on different topics
- Organization of workshops, meeting, summer schools, etc.
- Development of interactive communication platforms

Sixth International Plant Phenotyping Symposium

International Plant Phenotyping Network
IPPN

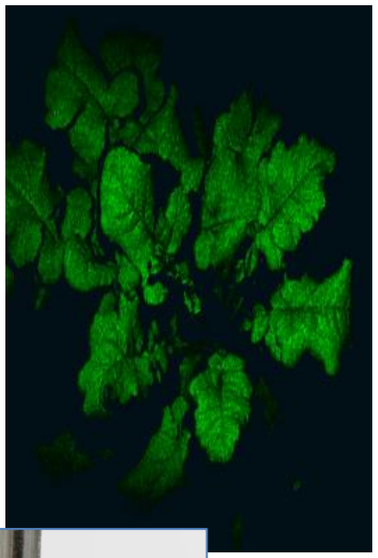
Nanjing Agricultural University
Date: 23-26 October, 2019

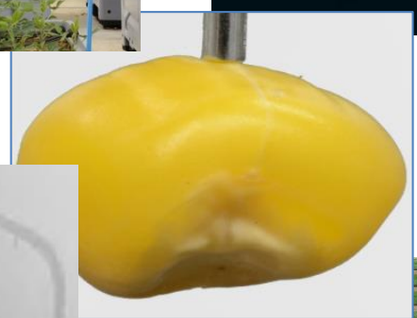


Addressing diverse questions to advance plant phenotyping

IPPN addresses a number of relevant questions in dedicated working groups

- Affordable Phenotyping Working Group
- Imaging Work Group
- Seed Phenotyping Workgroup
- International Controlled Environment Plant Phenotyping Group
- Root Working Group
- Forrest Phenotyping
- Data Management
- Sensor Systems





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Mitglied der Helmholtz-Gemeinschaft

JÜLICH Forschungszentrum