



Funded by
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EMPHASIS: The road towards a plant phenotyping community

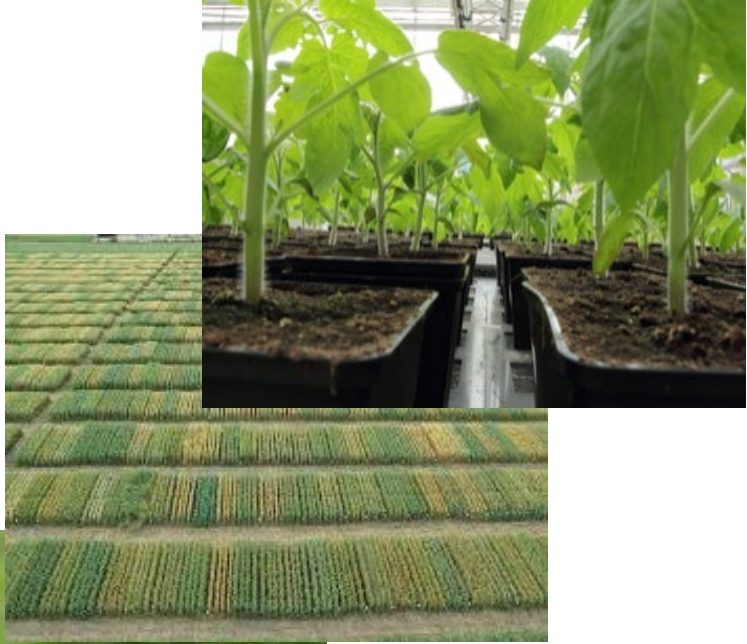
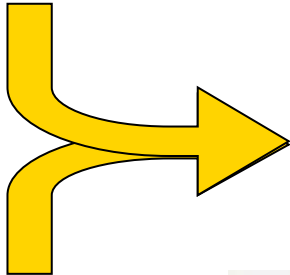
Roland Pieruschka
Forschungszentrum Jülich

Brussels, 27.06.2024

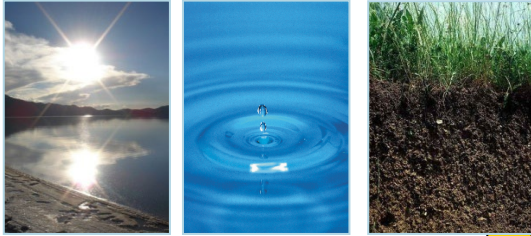
Global Challenges require sustainable agriculture



Sustainable agriculture

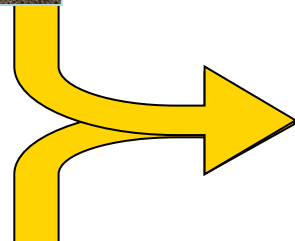
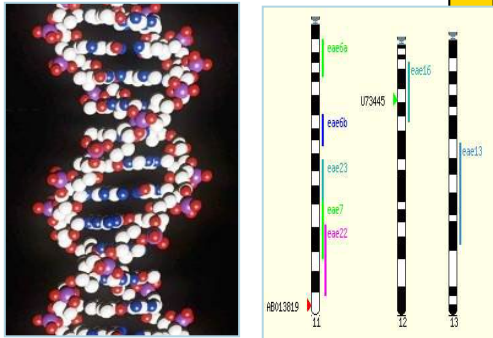


Plant Phenotyping key element of a sustainable agriculture



Environment

Genes



Plant performance and plant production

- Higher quantity and quality of plant biomass production
- Novel characteristics and products
- Yielding in stressful environments
- Sustainable production / intensification

nature x nurture → phenotype

Growing demand for quantitative plant phenotyping as a tool

- Addressing diverse crops and conditions
- Specialized infrastructure
 - plant characterization:
 - phenotyping
 - environmental simulation & monitoring
 - envirotyping
- Integrated (multi-disciplinary) approaches require dedicated technology and expertise
- Europe has been the global leader, but competition is growing



Plant phenotyping initiatives to address the demand



PPN-Ireland



EUROPEAN
NATIONAL
INFRASTRUCTURE



Belgian
Plant
Phenotyping
Network



EUROPEAN
REGIONAL
PROJECTS /
NETWORKS



EMPHASIS



Long-term and stable organization

- integrating and operating a pan-European infrastructure
- listed on ESFRI roadmap since 2016

Objectives

DEVELOPING INFRASTRUCTURE AND PROVIDING ACCESS



Develop an integrated
pan-European
infrastructure of
instrumented facilities

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

Develop, evaluate
and share knowledge
and novel technologies

The road to Operation:

legal, financial, operational
framework

Preparatory Phase (2016-2020)

- H2020 (€4m)
- Work undertaken as per the EC proposal
- Evaluate the phenotyping landscape develop a business plan



Implementation Phase (2021-2025)

- HE (€1.5m)
- Governed via interim agreement
- Official representation of ministries (11 countries)
- Set up of EMPHASIS pan-European Services
- Widen membership
- Set up of National Nodes



Operational Phase (2026 onwards)

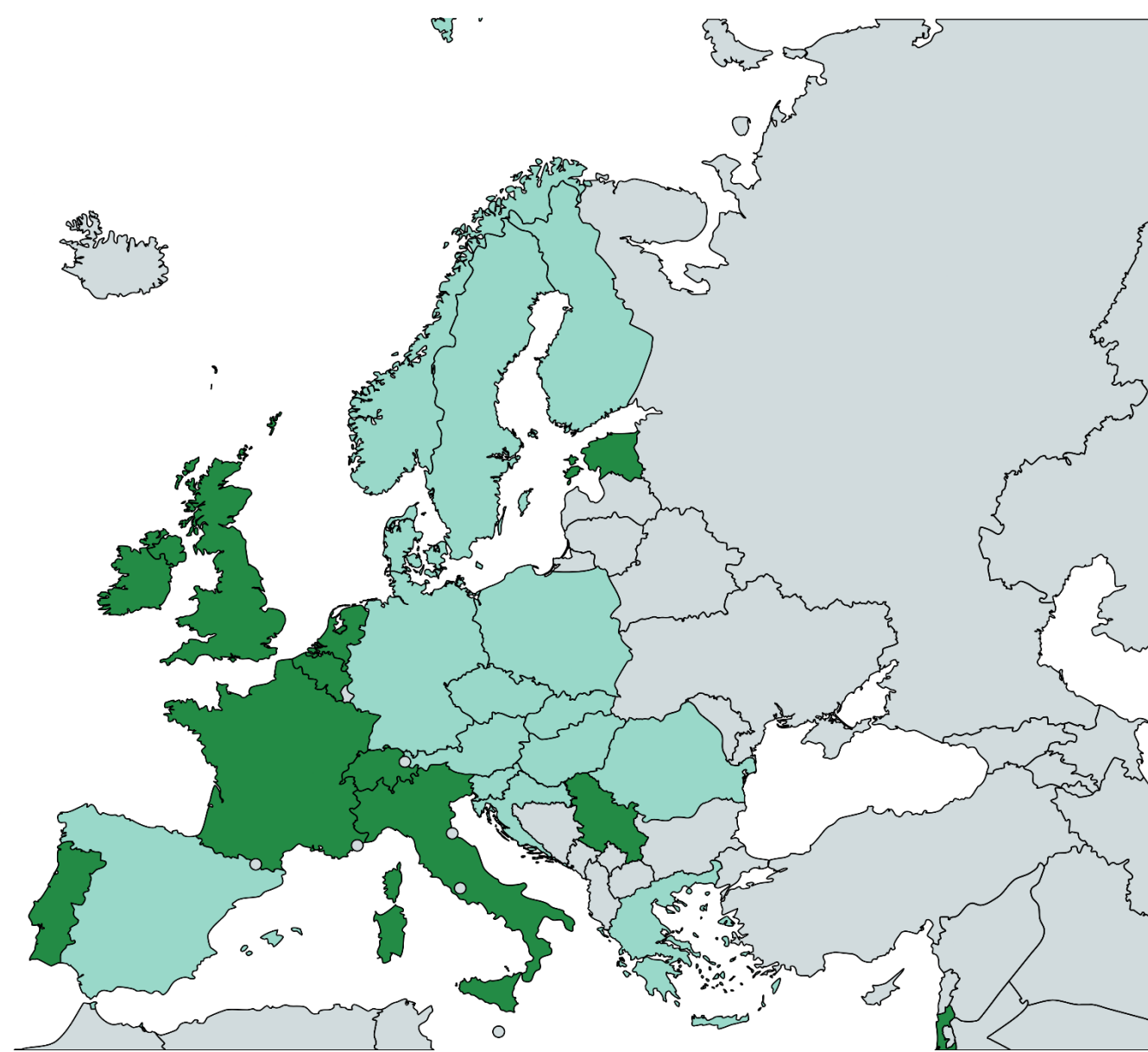
- Long-term legal framework (ERIC) in place
- Fully function governance bodies
- Annual membership contributions
- Full access for members to facilities and services

ESFRI

The road to Operation:

Plant phenotyping community in Europe

- 4 countries ESFRI Roadmap application
- 7 countries Prep. Phase
- 11 countries EMPHASIS Impl. Phase
- 15 countries with scientific communities (EMPHASIS Support Group)
- Support the development of
 - national communities
 - national roadmapping



The road to Operation:

Developing services



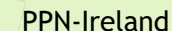
2012-2015: EU FP7 Transnational
Access 14 partners (5 ME)



2017-2021: EU H2020 Transnational
Access 22 partners (10 ME)

National infrastructures as a backbone for EMPHASIS and Infrastructure projects

2012 - ongoing:
Development of multiple national
RIs providing services



EPPN/EPPN2020 - access & community integration

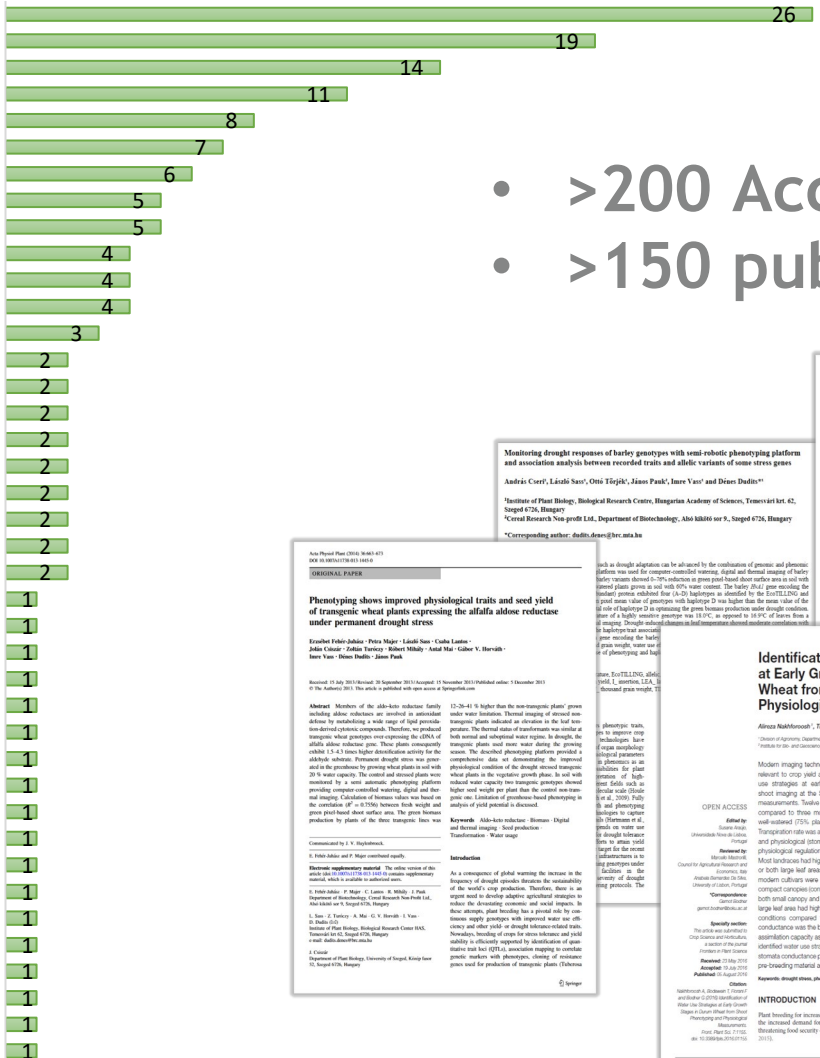


Starting community Advanced community



EPPN2020 Transnational Access projects

- Italy
- Germany
- Spain
- United Kingdom
- Portugal
- Sweden
- France
- Austria
- Poland
- Netherlands
- Serbia
- Belgium
- Croatia
- South Africa
- Jamaica
- Turkey
- Ireland
- Morocco
- Czech Republic
- Argentina
- Estonia
- Hungary
- Canada
- Egypt
- Uruguay
- Kazakhstan
- Australia
- Vietnam
- Tunisia
- Ecuador
- Brazil
- Ukraine
- Switzerland
- Romania
- Norway
- Cyprus
- Bulgaria
- Lithuania
- Luxembourg
- Nepal



- > 200 Access experiment
- > 150 publications

Phenotyping shows improved physiological traits and seed yield of transgenic wheat plants expressing the alfalfa allele under permanent drought stress

Authors: Fritsch-Jobin, Pratik Mody, Laili Nisar, Chaita Lantini, Julian Cavalet, Fabrice Favory, Robert Mikolaj, André Mal, Gilbert V. Hovavski, Ivan Yeo, Hiron Inaba, James Park

Abstract: Members of the alfalfa subfamily (Fabaceae) including alfalfa (Medicago sativa) are considered an important source of protein for livestock. The alfalfa allele (Alfa1) is a transgene that encodes a protein that confers drought tolerance to transgenic plants. We have generated transgenic wheat plants expressing the alfalfa allele (Alfa1) in wheat. The transgenic plants showed improved physiological traits and seed yield under permanent drought stress compared to non-transgenic plants. The alfalfa allele (Alfa1) is a transgene that encodes a protein that confers drought tolerance to transgenic plants. We have generated transgenic wheat plants expressing the alfalfa allele (Alfa1) in wheat. The transgenic plants showed improved physiological traits and seed yield under permanent drought stress compared to non-transgenic plants.

Monitoring drought responses of barley genotypes with semi-robotic phenotyping platform and association analysis between recorded traits and allelic variants of stress genes

Authors: Corral, Lucía San, Ori Tzurik, James Park, Irene Yano, and Dines Dalgaard

Abstract: Barley is a major crop in semi-arid regions. Drought is a major abiotic stress that limits barley production. We have developed a semi-robotic phenotyping platform to monitor drought responses of barley genotypes. We have also performed association analysis between recorded traits and allelic variants of stress genes. The results show that certain alleles are associated with improved drought tolerance.

Chlorophyll fluorescence emission can screen cold tolerance of cold acclimated Arabidopsis thaliana accessions

Authors: Anurika Mishra, And G Heppner, and Kamal M Mishra

Abstract: Chlorophyll fluorescence emission (Fv/Fm) is a sensitive indicator of photosynthetic efficiency and cold tolerance. We have screened Arabidopsis thaliana accessions for cold tolerance using Fv/Fm measurements. The results show that certain accessions exhibit higher Fv/Fm values under cold stress, indicating improved cold tolerance.

Identification of Water Use Strategies at Early Growth Stages in Durable Wheat from Shoot Phenotyping Physiological Measurements

Authors: Anika Nakhforoosh, Thomas Borchert, Anika Nakhforoosh, and Genet Bekele

Abstract: Durable wheat varieties are characterized by their ability to maintain high yields under drought conditions. We have identified water use strategies in durable wheat varieties using shoot phenotyping and physiological measurements. The results show that certain varieties exhibit improved water use efficiency and drought tolerance.

The Optimal Lateral Root Branching Density for Maize Depends on Nitrogen and Phosphorus Availability

Authors: Johnathan Paul Finkel, and Jonathan Paul Finkel

Abstract: Lateral root branching density (LRBD) is a key trait for nutrient acquisition in maize. We have investigated the optimal LRBD for maize under different nitrogen and phosphorus availability conditions. The results show that LRBD is optimized for nutrient acquisition under specific nutrient conditions.

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Regulation of growth by the trehalose pathway Relationship to temperature and sucrose

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The road to Operation:

widening the scope of plant phenotyping



2012-2015: EU FP7 Transnational Access 14 partners (5 ME)



2017-2021: EU H2020 Transnational Access 22 partners (10 ME)



2019-2023: Digital life sciences ~70 partners (26 ME)



2022-2027: EU HE Agroecology (15 ME) Transnational Access ~70 partners



2022-2025: EU HE AI4Life, AI (5ME) image analysis ~10 partners



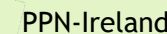
2023-2027: EU HE Agroecology (10 ME) novel tools, methods ~20 partners



2024-2028: EU HE Transnational Access, ~30 partners (15 ME)

National infrastructures as a backbone for EMPHASIS and Infrastructure projects

2012 - ongoing: Development of multiple national RIs providing services



Infrastructure projects

Providing services

AgroServ: sustainable and resilient agriculture and agroecological transition



- 1st call – closed
- 2nd call – opens 27th of June

<https://agroserv.eu/>

Microbial services addressing climate change risks for biodiversity and agriculture



- 1st call – opens at the end of 2024

<https://microbes4climate.eu/>

Developing services

Tools and methods for extended plant PHENotyping and EnviroTyping services



- Deliver new services for RIs



The road to Operation:

integration



since 2016: EMPHASIS-PREP / EMPHASIS-GO
 ESFRI infrastructure, currently 11 countries will establish an ERIC
 In total 25 national communities active in plant phenotyping



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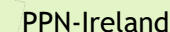
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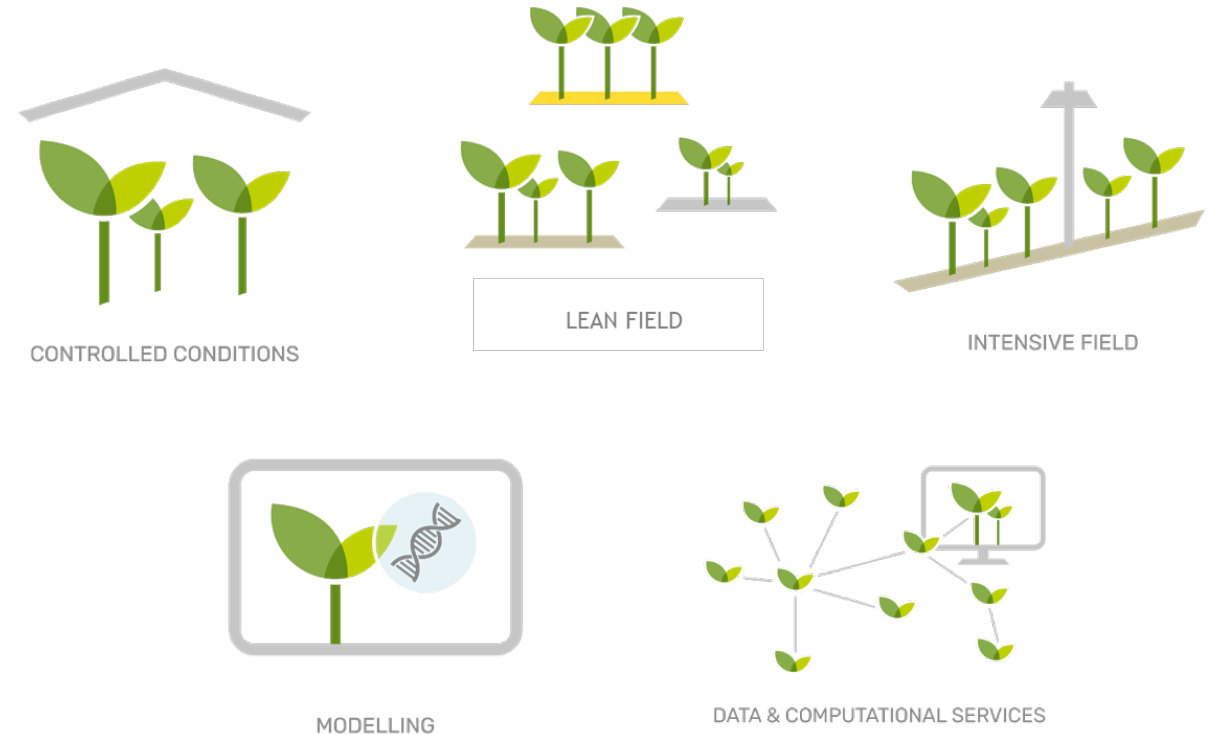
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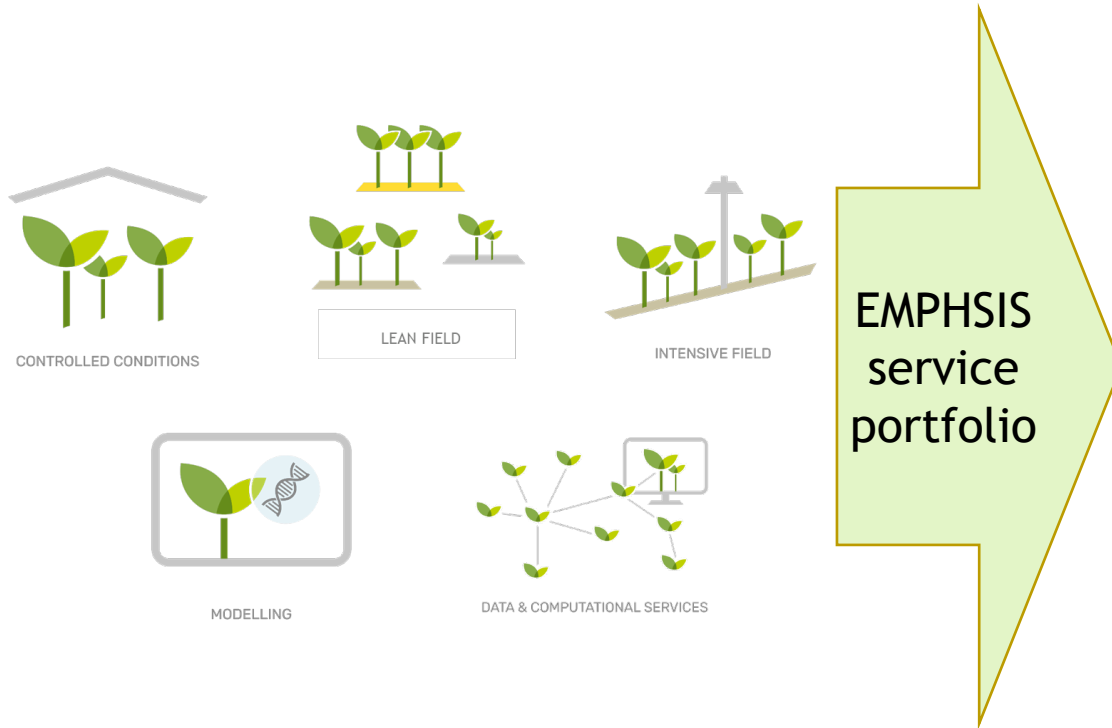
plant phenotyping requires integrated concepts to fully explore its potential



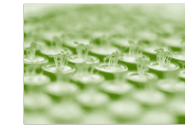
Source: EMPHASIS homepage

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

The road to Operation: sustainable services provision



User Access: facilitate user access to installations and facilitate under controlled and field conditions



Advancing phenotyping practices: develop and implement methods, tools for phenotyping workflow



Industry engagement: facilitate knowledge and technology transfer



Data management and modelling: establish FAIR data principles and a European information system



Communication: engage all relevant stakeholders in a research infrastructure environment



Training and education: develop and implement training activities

EMPHASIS is an ESFRI-listed project supported by the European Union.



Get In Touch

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