

EMPHASIS – a ESFRI proposal

European Infrastructure for **M**ulti-Site Plant **P**henotyping **A**nd
Simulation for Food **S**ecurity in a Chancing Climate

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Plants are in the center of major challenges to mankind

Climate Change



Energy



Food and Feed

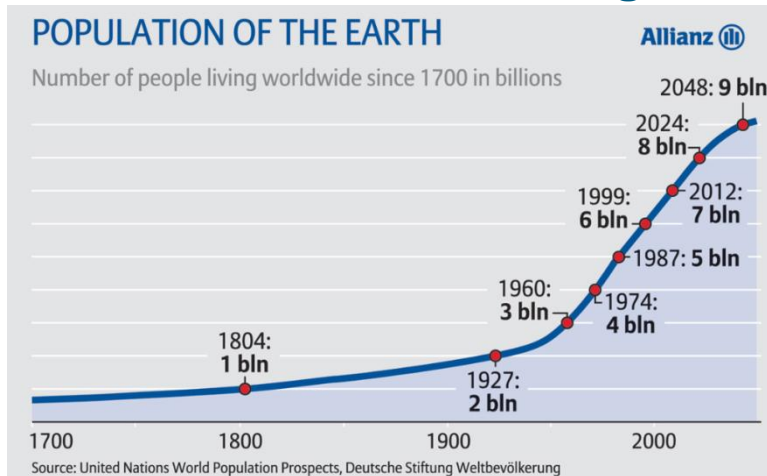


Natural Resources



Plants are in the center of major challenges to mankind

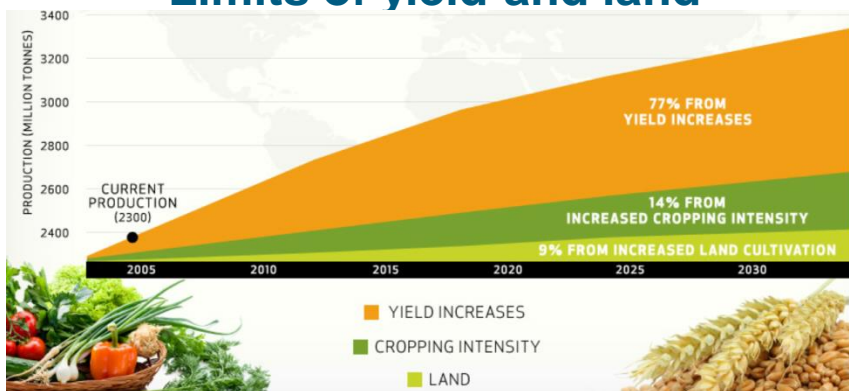
Global and climate change



Biodiversity at threat

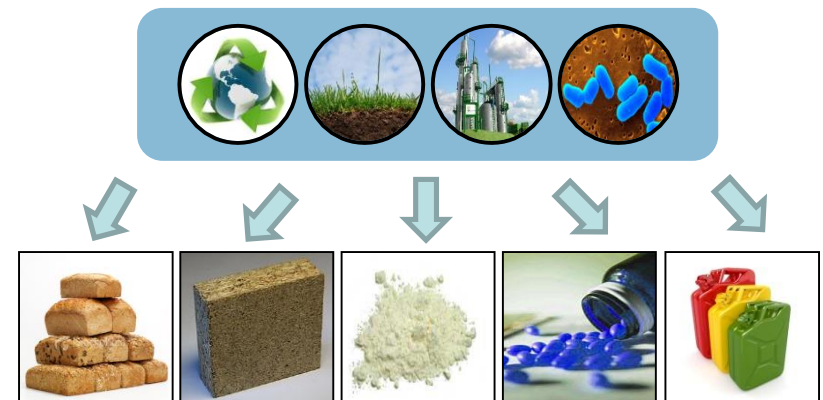


Limits of yield and land



Need for sustainable intensification
(Resource outlook, J. Bruinsma, 2013)

Novel demands in quality and scale



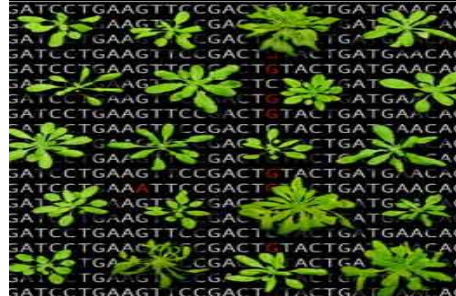
Need for diversification

Quantifying plant structure and function

Breeding



Functional genomics



Identification of
heritable traits

Agricultural production



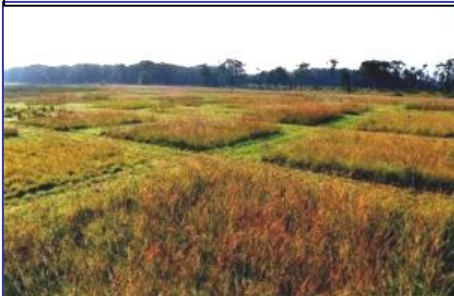
Horticultural production



Acute plant
status

Plant Phenotyping

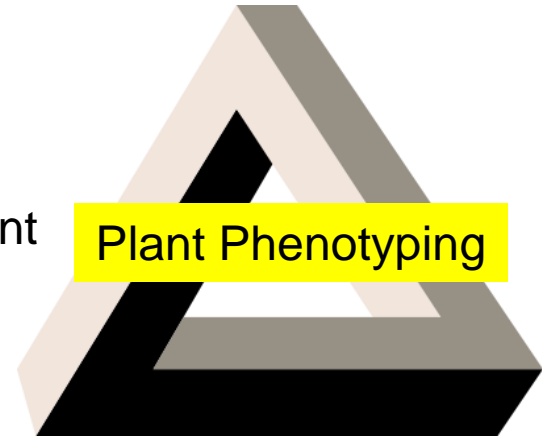
Biodiversity



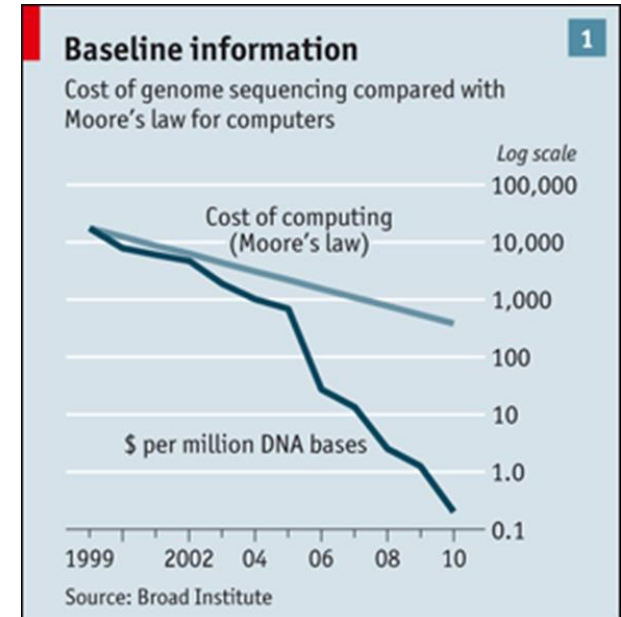
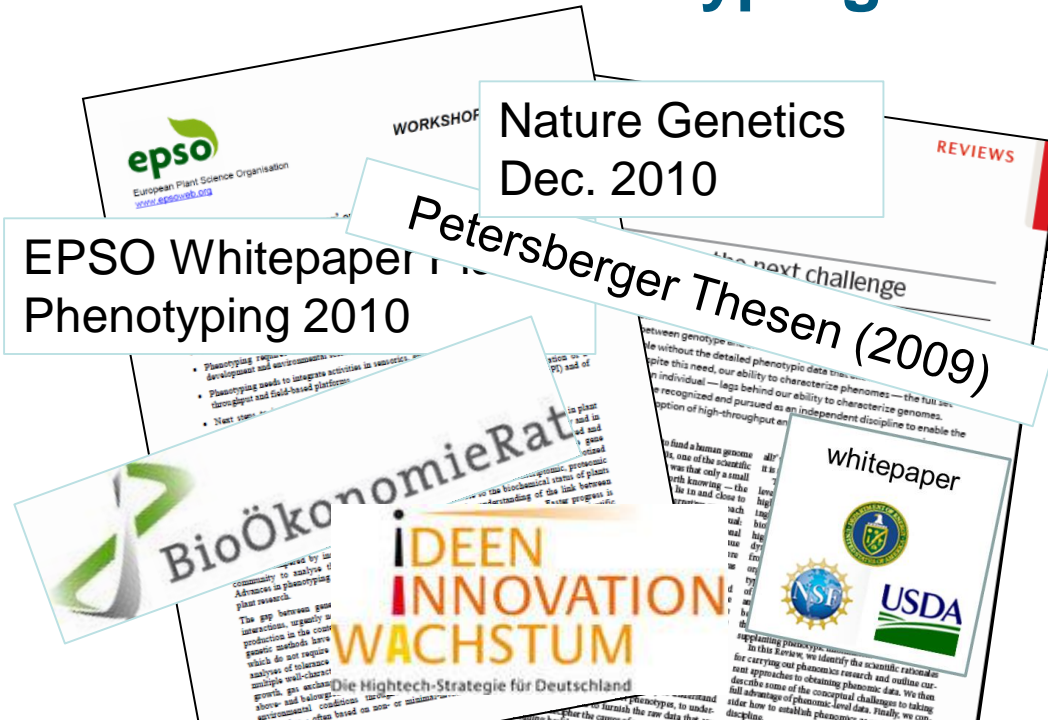
Global Change



Field
environment



Bottleneck Phenotyping



Key Messages

- Plant phenotyping has become a **bottleneck for progress in basic plant science and plant breeding**
- Novel opportunities** for phenotyping develop from **interdisciplinary approaches** of plant scientists, (bio)informatics, sensorics and environmental sciences and simulation.
- Phenotyping needs to integrate activities for establishing **mechanistic, high-throughput and field-based platforms**
- Europe has a very strong position in plant phenotyping** relative to other plant science nations/ continents

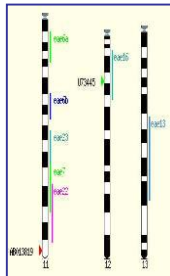
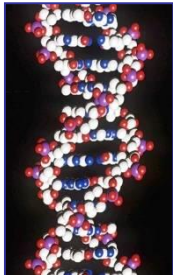
Plants are in the center of major challenges to mankind



Environment

Dynamic interaction

Genome

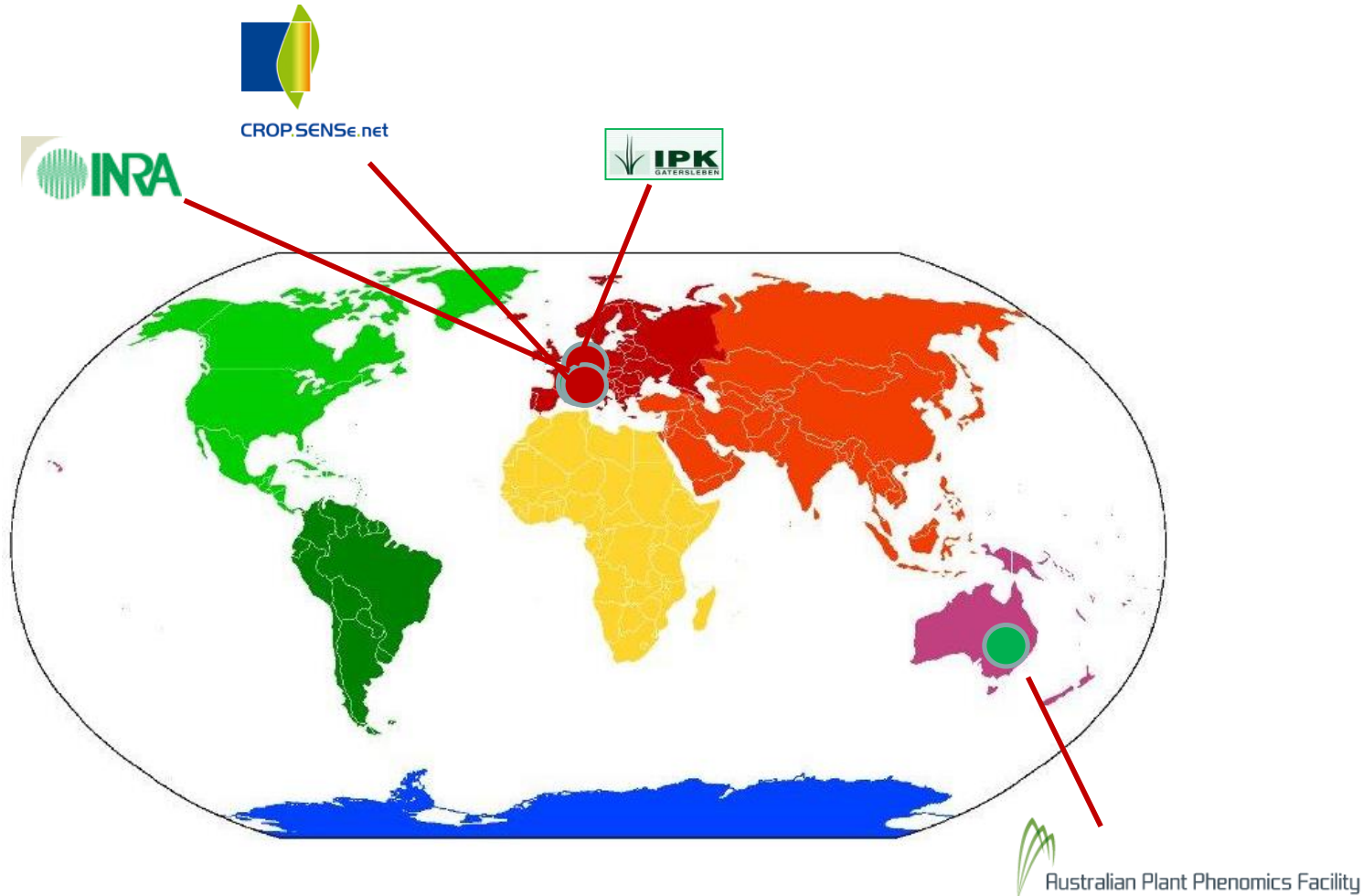


Performance of and
products from plants

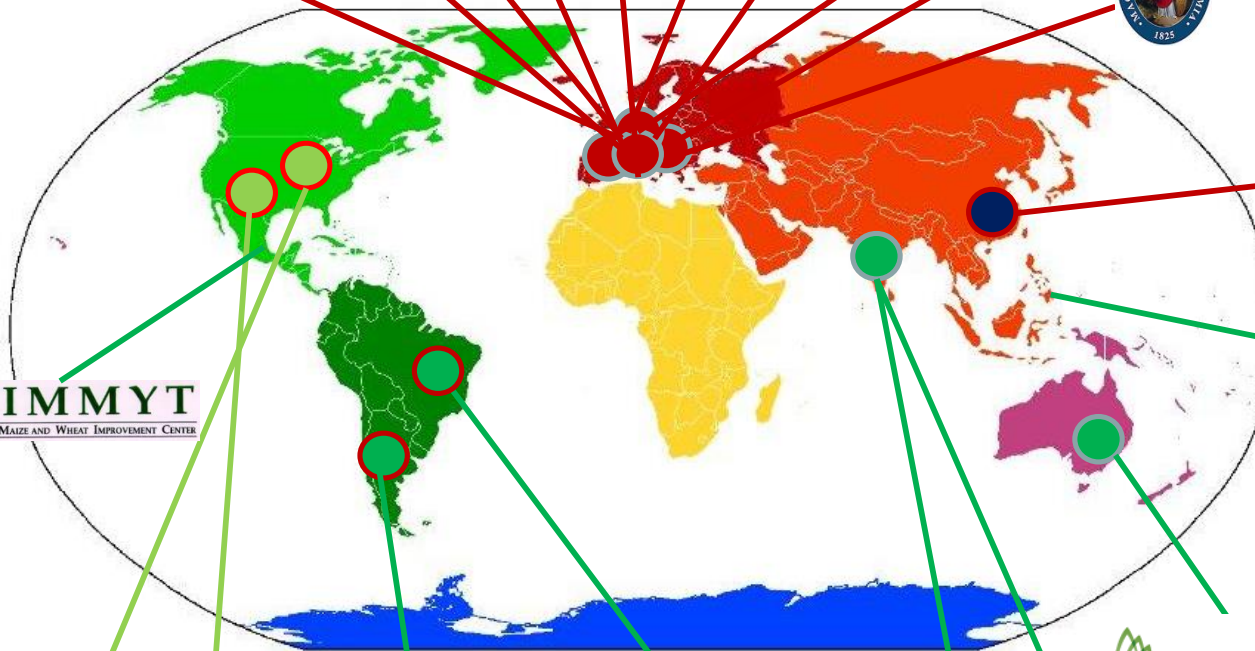


Plant phenotyping – in 2008

(Inter)national projects and cooperation networks



Plant phenotyping – in 2015: (Inter)national projects and cooperation networks



State-of-the-Art Phenotyping

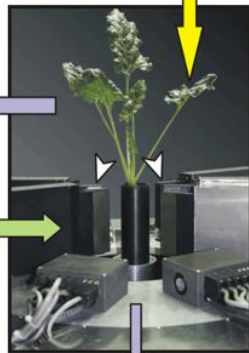
Deep phenotyping - tomographic

Plant MRI-PET Center,
Jülich

MRI
(4.7T)



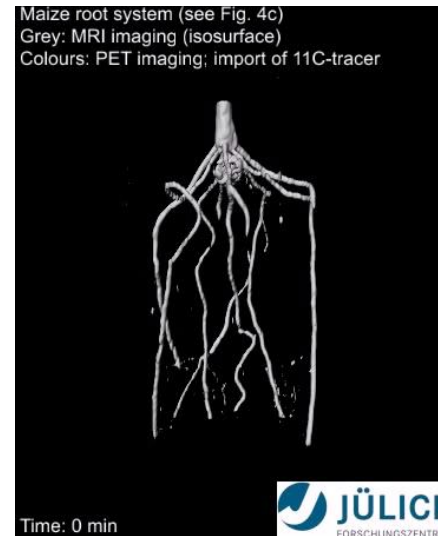
Reconstruction



Reconstruction

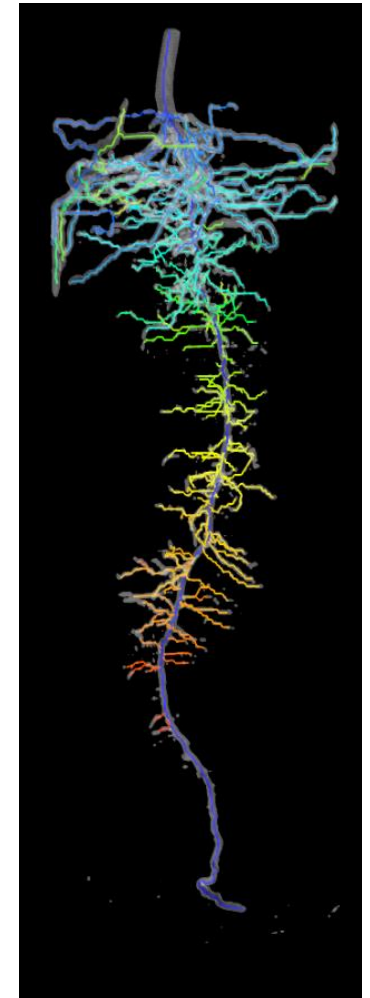
PlanTIS
(PET)

Live imaging of carbon flow



3D-structures

Root parameters



Hounsfield micro-CT,
Nottingham

State-of-the-Art Phenotyping

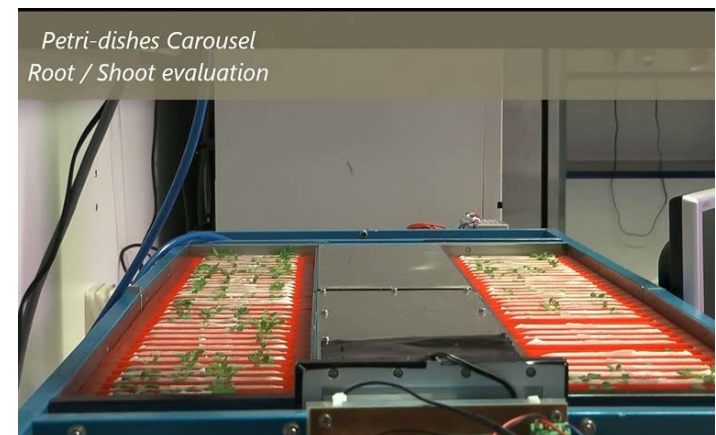
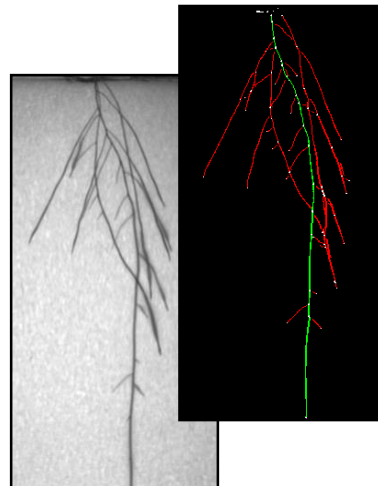
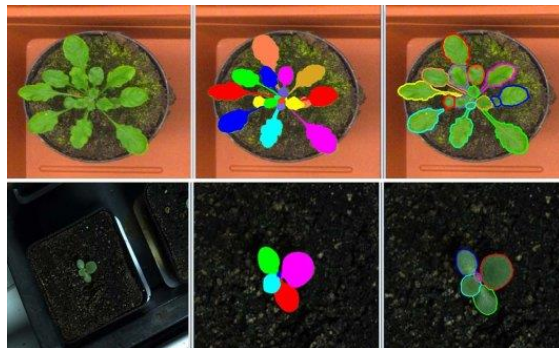
High-throughput in controlled conditions



WHIWAM Gent



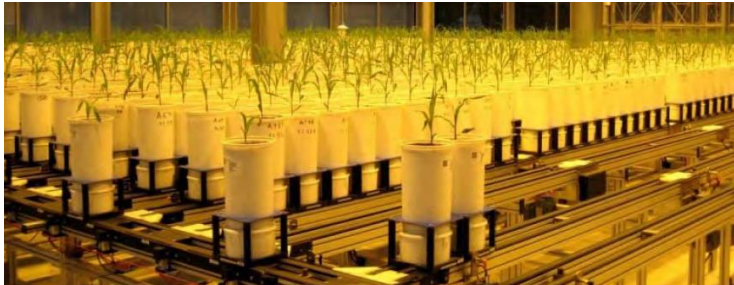
Fluogrowscreen
Jülich



Root Carousel
Jülich

State-of-the-Art Phenotyping

High-throughput in controlled conditions/ greenhouse

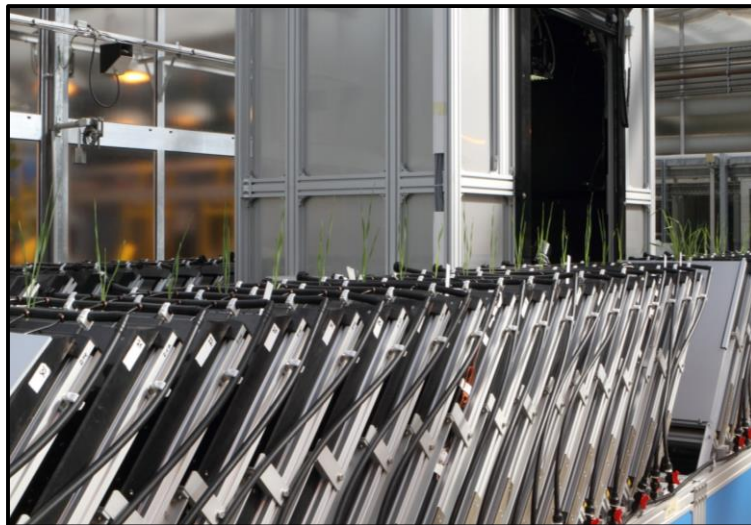
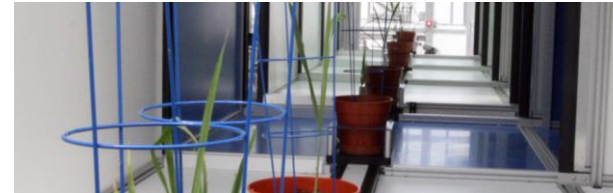


PhenoArch,
Montpellier



Extended Lemnatec,
Gatersleben

Lemnatec,
Aberystwyth



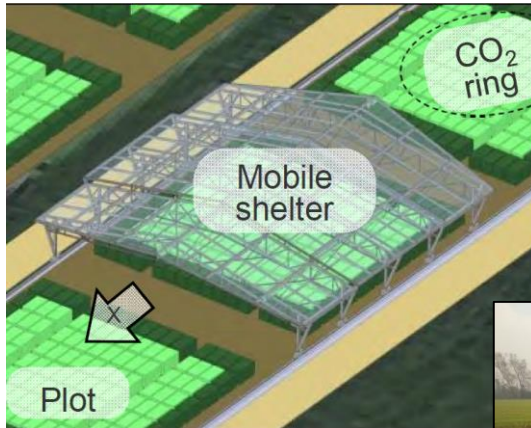
GrowScreenRhizo,
Jülich



PPHD,
Dijon

State-of-the-Art Phenotyping

Field sites



Mobile Shelters
Clermont

BreedFace
Jülich/ Bonn



Stationary field sensor networks



Phenomobiles



Avignon
Jülich
....

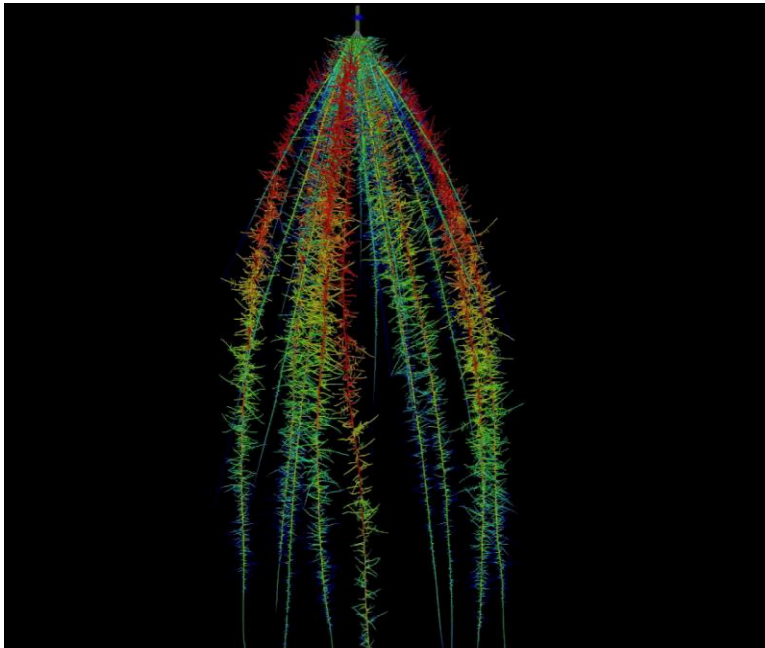
Flying platforms



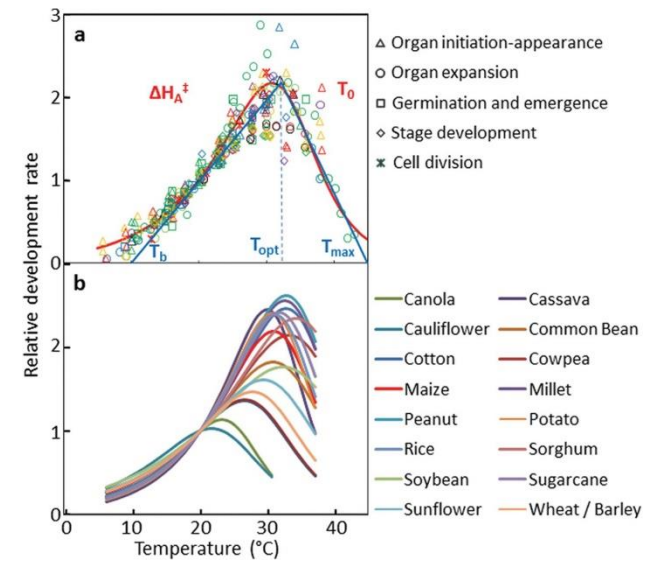
State-of-the-Art Phenotyping

Modelling

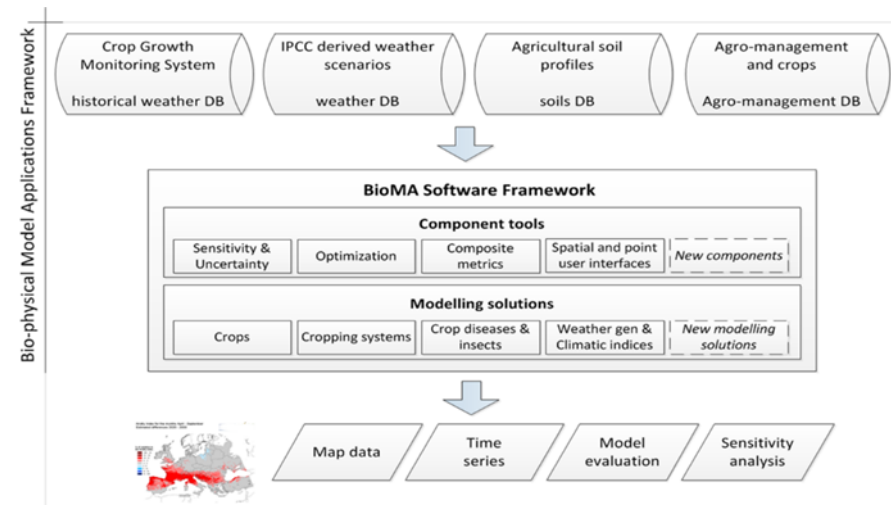
Structure – function models



Integrating crop models



Crop – climate models



Phenotyping – in Networks



National platforms



European projects/
networks

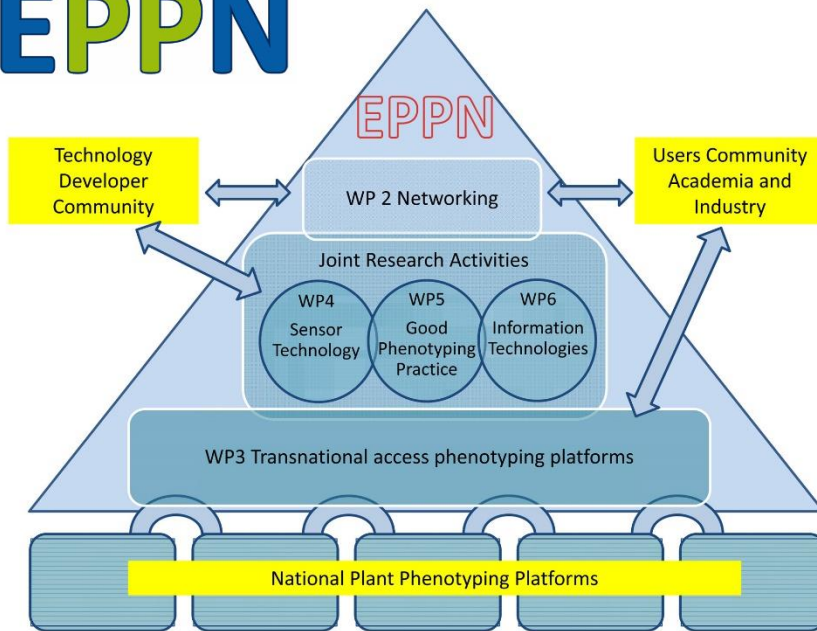


International networks

European Plant Phenotyping Network

www.plant-phenotyping-network.eu

European Plant Phenotyping Network



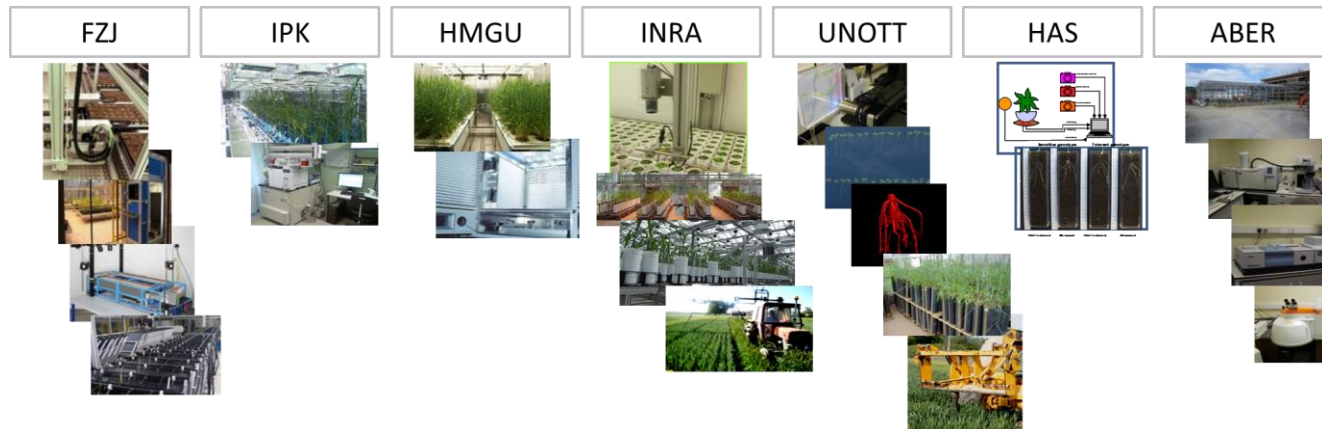
Goals

- Transnational Access (TA)
- Integrative Research Topics (IT, Standards, Sensors)
- Networking and Dissemination

European Plant Phenotyping Network

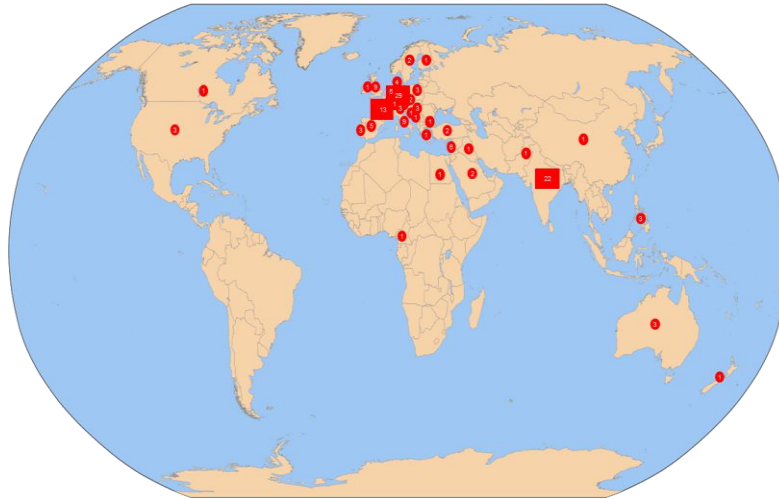


- 23 phenotyping installations across Europe
- Easy access (http://www.plant-phenotyping-network.eu/eppn/select_installation)
- Transparent, peer-evaluation based access procedure
- >60 approved access projects from 18 countries (80% new users)
- 29 (33) publications by mid 2015 (Access budget 3 Mio€)
- Finishes December 2015



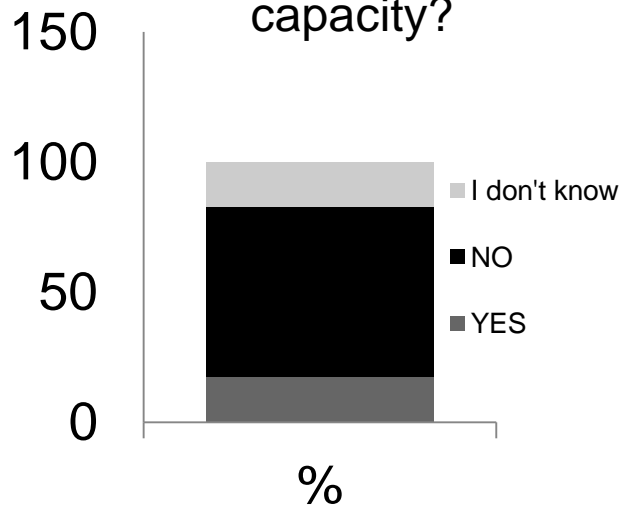
Plant Phenotyping Survey:

197 participants from 38 countries

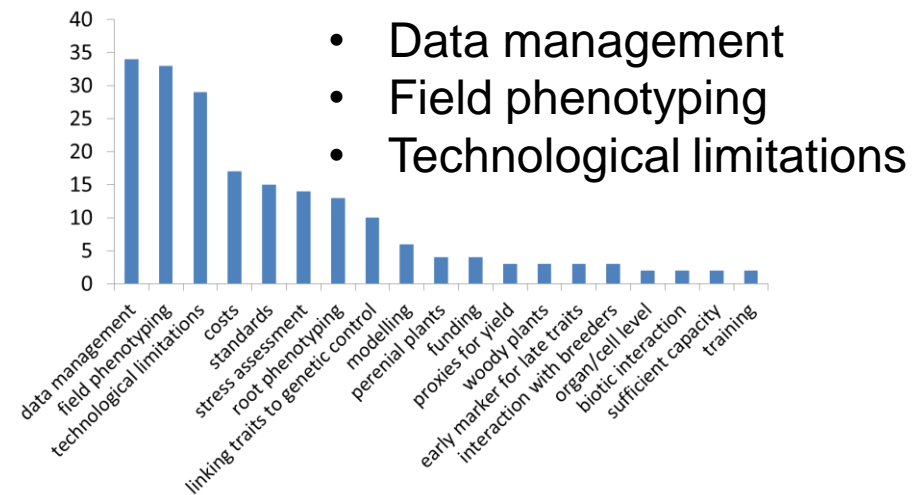


Some results

Is there enough capacity?



What is the next challenge?



- Data management
- Field phenotyping
- Technological limitations

Phenotyping – in Networks



National platforms



European projects/
networks



EMPHASIS

European Infrastructure



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

European Strategy Forum on Research Infrastructures

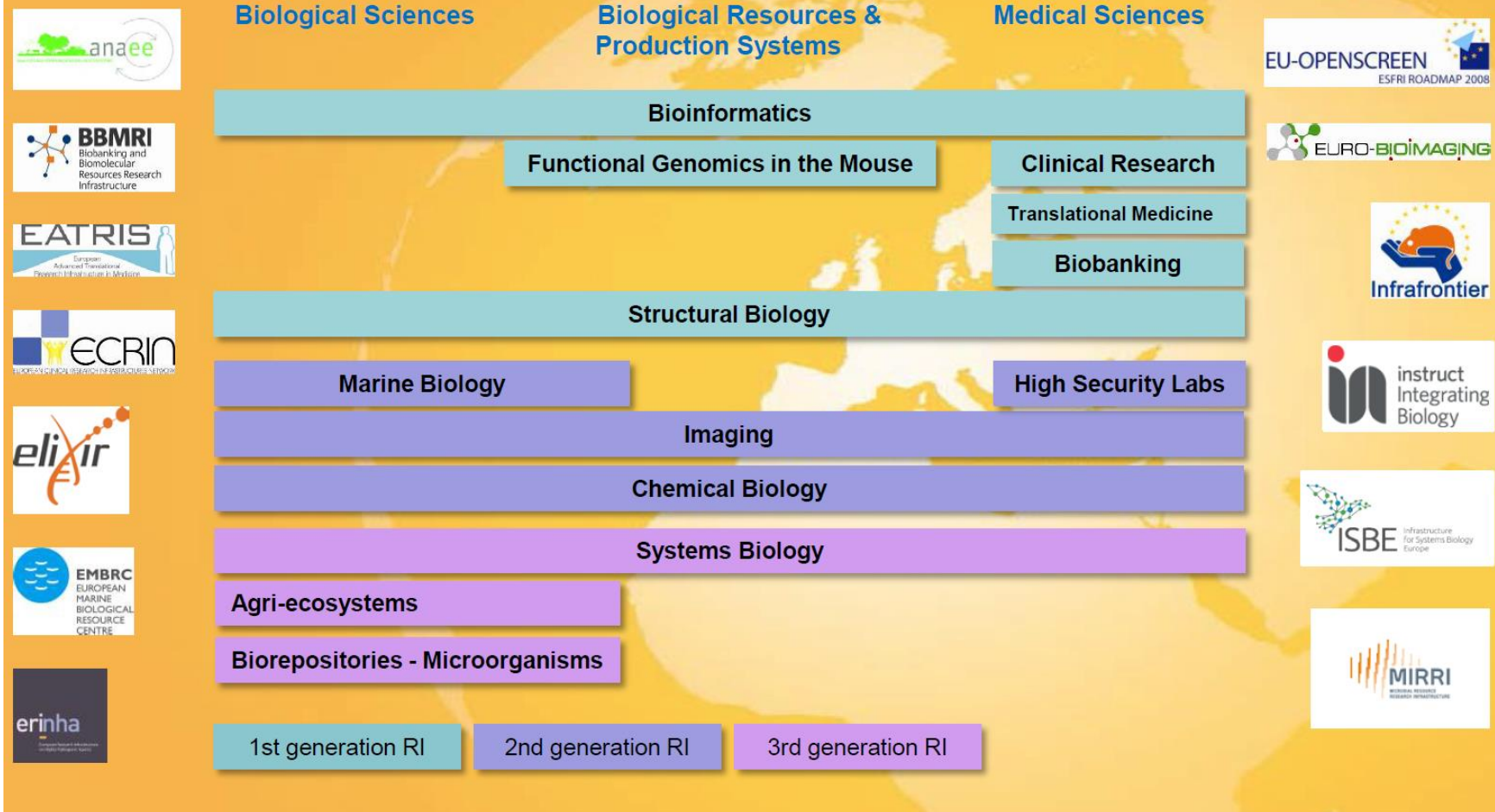
with the following mandate:

- To support a coherent and strategy-led approach to policy-making on research infrastructures in Europe;
- To facilitate multilateral initiatives leading to a better use and development of research infrastructures.

Organisation in Strategy Working Groups (SWG) on major challenges

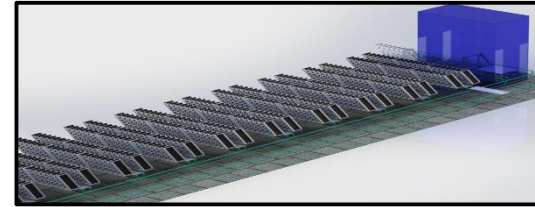
- Energy
- Environment
- Health and Food
- Social and Cultural Innovation
- Physical Sciences and Engineering

Health and Food Research Infrastructures



European Plant Phenotyping Infrastructure (EMPHASIS)

Phenotyping platforms for high resolution, high throughput phenomics



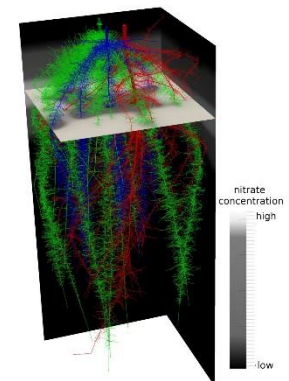
Semi-controlled field systems for high throughput phenomics



Network of practical field experiments for lean-phenotyping



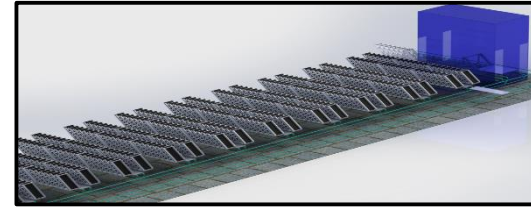
Modelling for improving phenotypic processes and for testing existing or virtual combinations of alleles in a variety of climatic scenarios and management practices



European Plant Phenotyping Infrastructure (EMPHASIS)

Phenotyping platforms for high resolution, high throughput phenomics

- Joint technology development and implementation
- Synergies in high-tech infrastructures (incl staff)
- High-end technology (- link to industry)
- Access to academia and industry



Semi-controlled field systems for high throughput phenomics

- Provide access to unique field testing for genotypes
- Screening genotypes at high CO₂, soil temperature, drought simulation, etc.
- Protected sites (in discussion)
- Unique protocols/ technologies in multi-site setups with unified access



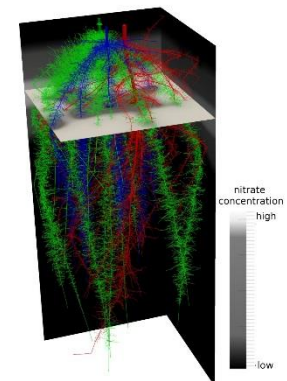
Network of practical field experiments for lean-phenotyping

- Tech-transfer to users (academia, public bodies and industry)
- Bilateral transfer of knowledge and questions
- Expansion of impact to users



Modelling for improving phenotypic processes and for testing existing or virtual combinations of alleles in a variety of climatic scenarios and management practices

- Sharing information and integration
- Link with major national, EU and global projects in modelling
- Experimental design and modelling
- Links to IT and bioinformatics networks



European Plant Phenotyping Infrastructure (EMPHASIS)

Why going European?






- Generating synergies between national platforms
 - Special equipment
 - Joint protocols/ exchange – interoperability (-> EWG Standards and Data)
 - Education and training
- Access
 - Development access
 - Use access
 - Dissemination access
- Generating novel opportunities
 - Unique installations
 - Diverse climate zones
 - Interaction of academia and industry across Europe
- Competitiveness
 - Overcoming fragmentation to maintain global leadership in PP

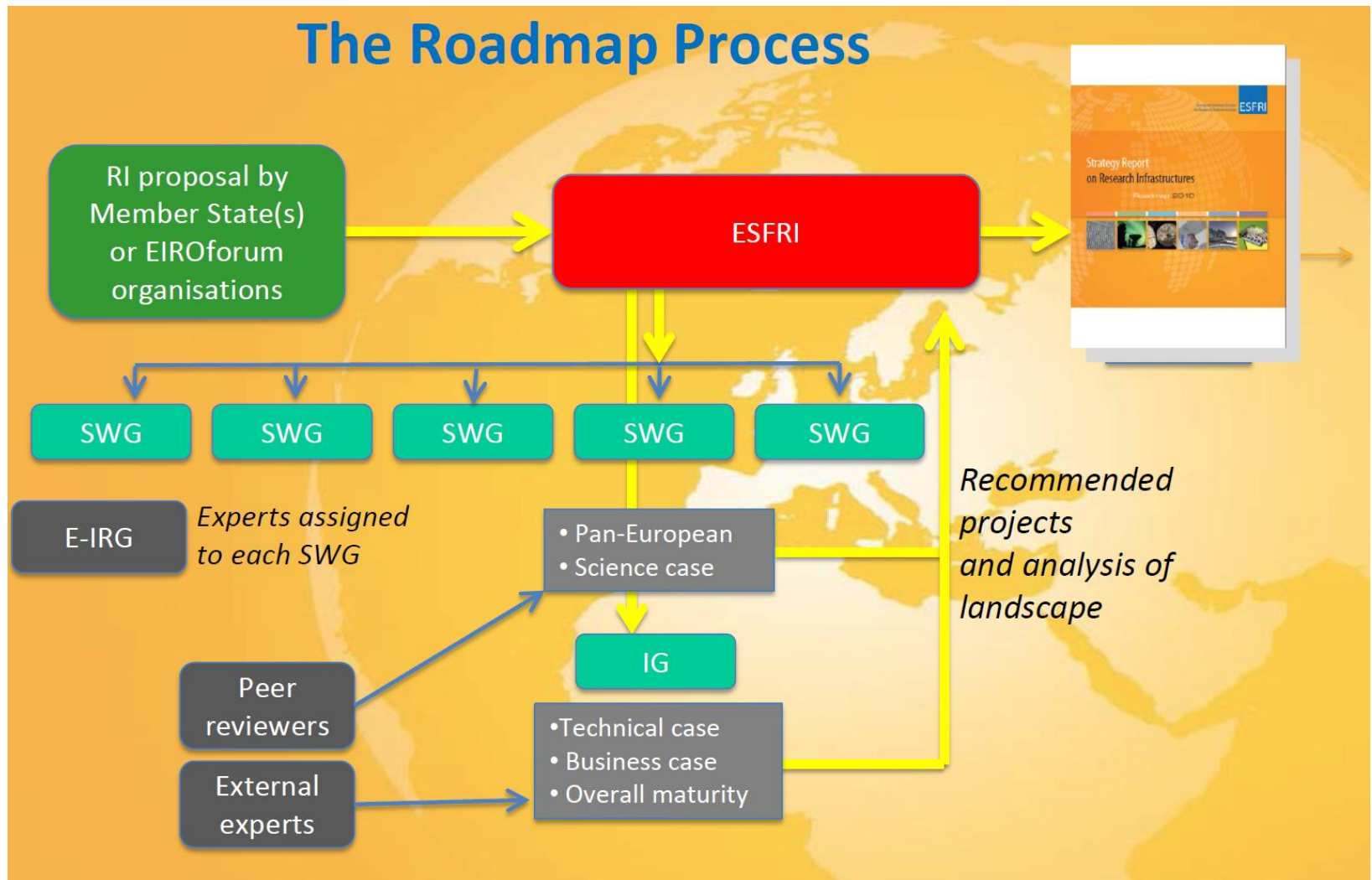
European Plant Phenotyping Infrastructure (EMPHASIS)

European Research Area

- National platforms
- European users
 - Academia
 - Industry
 - breeders; biotech
 - Sensing
 - IT

Links within ESFRI

-  -> biogeochemical cycles
-  -> bioinformatics
-  -> biodiversity
-  -> microbe – plant interaction
-  -> mouse phenotyping



6-8 new projects will be selected for the 2016 roadmap

European Plant Phenotyping Infrastructure (EMPHASIS)

What is needed now?

- Discussion and gaining support of the academic and industrial community
- Development and „maturation“ of further national platforms
- Expansion of the partnership from member states
- Maturation of the organisation