D 2.2 – Criteria list for user demands in different access modes

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This project has received funding from the European Union's Horizon 2020 Coordination and support action me under grant agreement No 739514. This publication reflects only the view of the author, and the European sion cannot be held responsible for any use which may be made of the information contained therein.

Document information

EU Project N°	739514	**Acronym**	EMPHASIS-PREP
Full Title	Preparation for EMPHASIS: European Infrastructure for multi-scale Plant Phenomics and Simulation for food security in a changing climate		
Project website	https://EMPHASIS.plant-phenotyping.eu/		

Deliverable	**N°**	D2.2	**Title**	Criteria list for user demands in different access modes
Work Package	**N°**	2	**Title**	User demand, user orientation and communication

Date of delivery	**Contractual**	31/08/2018 (Month 20)	**Actual**	07/10/2019 (Month 34)	
Dissemination level	X	**PU Public, fully open, e.g. web**			
		CO Confidential, restricted under conditions set out in Model Grant Agreement			
		CI Classified, information as referred to in Commission Decision 2001/844/EC.			

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Version log			
Issue Date	**Revision N°**	**Author**	**Change**
06/03/2019			First version revised by the WP leader

Executive Summary

Objectives

In its preparatory phase (EMPHASIS-PREP), the EMPHASIS project will develop a long-term sustainable strategy for the user-driven building, upgrading and operation of plant phenotyping infrastructures.
This deliverable deals with the definition of a criteria list to describe user demand with respect to EMPHASIS plant phenotyping infrastructures (RIs) and resulting services as well as different access modes to infrastructure and services. A criteria list for user demand is functional to the description of users requesting access to EMPHASIS infrastructures and services, and of the scopes for which access is requested. The deliverable is essential to provide concrete benefits to the community, and to help shaping the EMPHASIS-PREP catalogue of services.
The criteria list was developed after analysing the result of the EMPHASIS survey launched in 2018 by WP3 and WP2, concerning the mapping of users, of user demand and of the different access mode. This information was then matched with the list of infrastructures previously identified in deliverable 2.1, elaborated by WP2.

Main Results

The data collected by the 2018 survey “Do you need plant phenotyping?” were analysed to identify: a) the users involved/interested in EMPHASIS, b) their demands, and c) their expectations and needs towards EMPHASIS.

A large fraction of the participants in the survey were from the scientific community, which showed to be highly interested in the phenotyping opportunities offered by EMPHASIS-PREP. Twenty percent of the participants were from private companies, showing rising industrial interest in plant phenotyping.

For most of the participants EMPHASIS-PREP should support training in plant phenotyping and the expansion of their research network. In 47% of the cases the request was for access to installations.

On the basis of user demand towards the EMPHASIS–PREP infrastructures a criteria list was defined for the following types of access and services:

- ACCESS: access provision for user community to the phenotyping installations incl.: controlled environment installations, field installations, networks of field sites, modelling.
- QUALITY: measures to implement quality criteria at research infrastructure, specifically experimental design, standards, sensor calibration etc.
- DATA MANAGEMENT: approaches enabling data reusability embedded in a relevant data policy.
- INNOVATION: dissemination and utilization of technology and results from access and use of the phenotyping installations.
- COMMUNICATION: engaging all relevant stakeholders.
- TRAINIG: supporting the next generation of plant scientist.
- EXPERT ADVICE: assessment of the plant phenotyping landscape specifically to funders and decision makers

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EMPHASIS in the plant phenotyping landscape: the five infrastructure categories

In recent years, novel phenotyping technologies based on non-invasive approaches have become increasingly available. Sensors using the entire electromagnetic spectrum allow dynamic imaging of plant structure, growth and functionality, in parallel with accurate recording of environmental conditions in space and time. Such quantitative and qualitative data can be used to understand dynamic plant-environment interactions in crops and natural communities, to develop ideotypes that breeders can use to design cultivars that are more resilient to stress or more efficient in the use of available resources, and to predict how different plant genotypes, ecotypes and communities can adapt to climate change.

The EMPHASIS project, in its preparatory phase (EMPHASIS-PREP), aims to develop a long-term sustainable strategy for the demand-driven development, implementation, upgrading and operation of plant phenotyping infrastructures. The portfolio of phenotyping technologies is broad and includes high-resolution phenotyping and high-throughput systems able to increase the capacity in the field, in greenhouses and laboratories, as well as modelling facilities that allow dynamic environmental simulation. Very recently, low cost systems based on smartphones and other cheap and portable devices delivering information collected by Internet of Things (IoT) and other technologies have become increasingly available.
EMPHASIS intends to develop phenotyping pipelines across a wide range of spatial and temporal scales, and with different levels of precision, from laboratory to field, also including platforms for plant/crop modelling and management, data storage and processing facilities, with central access to a coordinated information system.

EMPHASIS-PREP not only aims to develop an integrated plant phenotyping infrastructure, but also to optimize access to installations with a set of services for a wide community of users.

As described in the *Criteria list for infrastructure* (D2.1), within EMPHASIS the different infrastructures have been categorized as follows:

- 1: Phenotyping installations for high-resolution and high-throughput phenomics in (semi-)controlled conditions;
- 2: Intensive field infrastructures for high throughput phenomics;
- 3: Field infrastructures using minimal or lean equipment;
- 4: Modelling platforms;
- 5: Data management and information systems platforms.

On the basis of the identified categories of infrastructures, a criteria list for user demand towards different services requiring different access modes needs to be defined. A criteria list for user demand is functional to the description of users requesting access to EMPHASIS infrastructures and the related services, and of the aims for which this access is requested.

Hence, the proposed criteria list for user demand with respect to different services and access modes has been developed through the following steps (Fig. 2):

1. Identification of EMPHASIS users
2. Description of the access modes and services
3. Definition of the criteria list for the user demand towards services in the different access modes

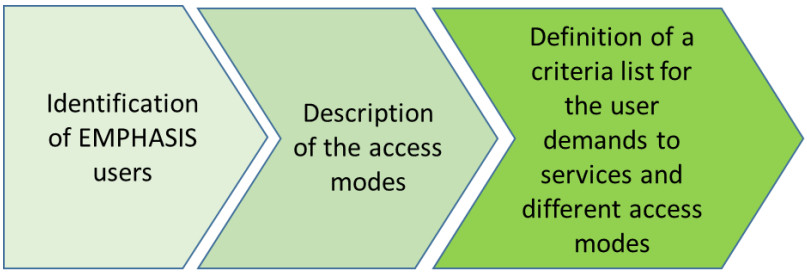


Fig. 1 Scheme of the approach followed in Deliverable 2.5

1. EMPHASIS USERS

The first step toward the identification of a criteria list for user demand is the mapping of the phenotyping community, both to understand the type of users already involved and to help engage new categories of users.

To perform this task, in September 2018, WP3 launched the EMPHASIS survey “Do you need plant phenotyping?” with the aim of collecting the following information:

- Identify and classify EMPHASIS user categories;
- Extend the list of EMPHASIS stakeholders;
- Explore the expectations of stakeholders towards EMPHASIS as an integrated infrastructure;
- Identify the demand for access to EMPHASIS infrastructures and related services

1.1 Identification of EMPHASIS users

Three hundred and twenty individuals participated in the survey. The most represented category was the scientific community (72 %, bringing together Junior Scientists, Senior Scientists, and PhD students), followed by Breeders (14%), Technology developers, Modellers (8 and 9% respectively) and Technical staff (5%) (Fig 2). It has to be kept in mind that researchers often answer as a person or for a small team, while companies (breeders, tech developers) answer as representatives for a larger group of users.

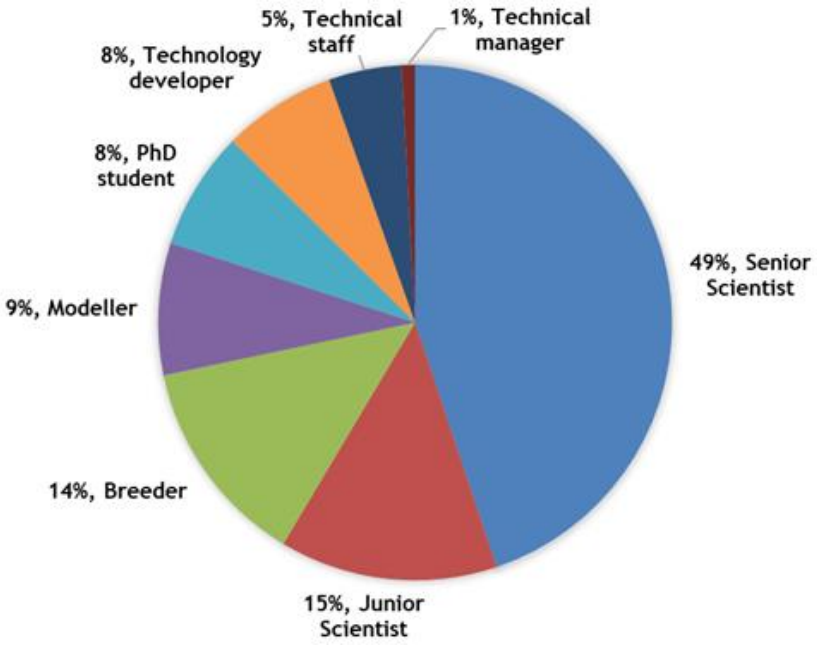


Fig.2 Background of participants in the survey (multi-choice answers allowed)

Amore precise definition of potential EMPHASIS users was obtained by deepening insights about the identified categories of participants with respect to their specific field of work/discipline (Fig.3). This shows some expertise that were not clearly highlighted at a first glance. For example, ecologists and plant pathologists have also shown interest on plant phenotyping research (Fig. 4). Plant biology with 314 responses (122 participants) is one of the main field represented in the survey.

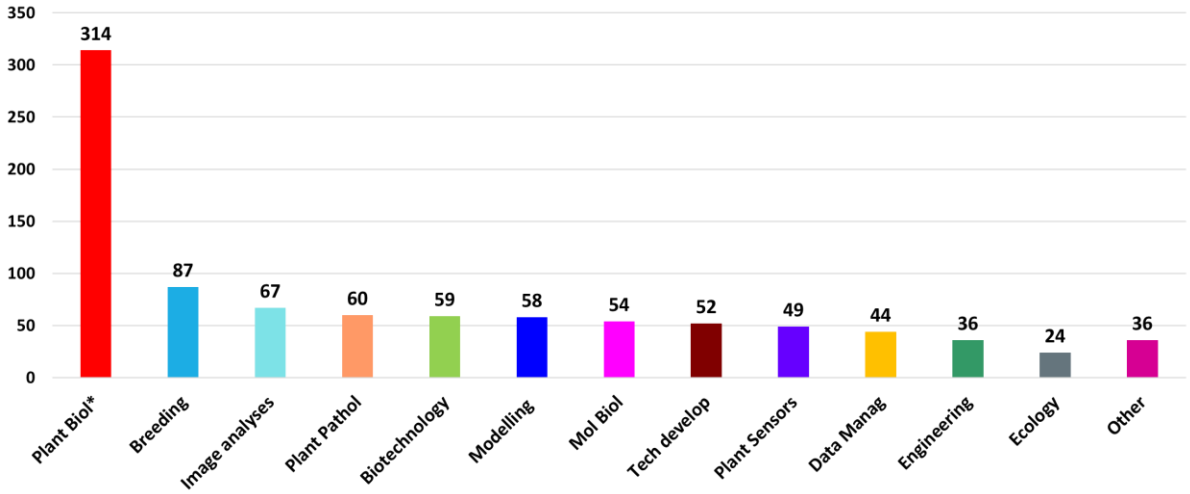


Fig 3. Field of work of the participants to the survey (multi-choice answers allowed). Numbers indicate the answers obtained for each category. *Plant physiology, plant genetics and plant biology have been arbitrarily grouped in the “plant biology” category.

When we specifically looked into the different fields of work within the **scientist category** (note that it was possible to choose one or more options among the ones that were proposed), the participants indicated to be involved in a wide range of activities, the main ones being shown in Fig. 4. Out of the 228 scientists that participated to the survey, 47 scientists declared to perform breeding, 46 image analyses, while 42

declared to be involved in modelling. Plant sensors development (35), technology development and data management (30 and 29) were also well represented. Finally, 25 scientists responded to be engaged in engineering.

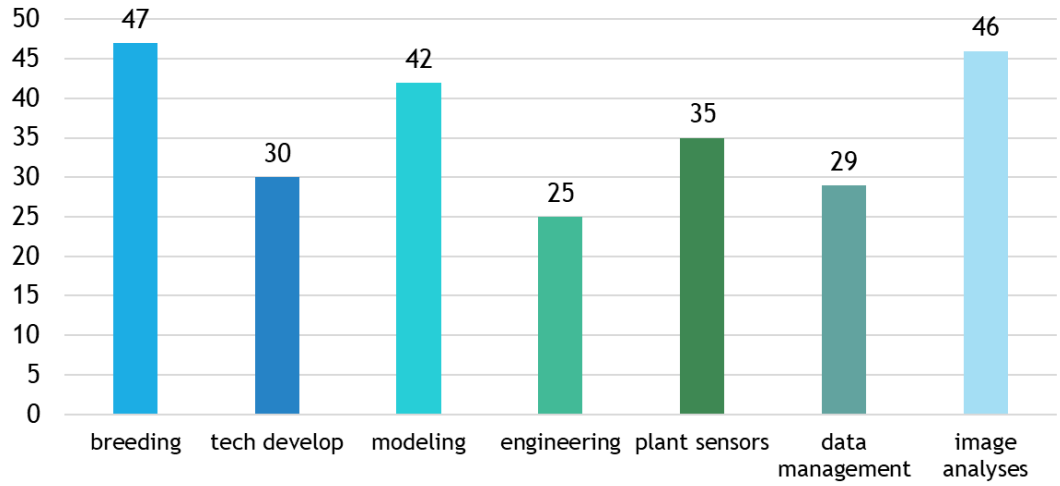
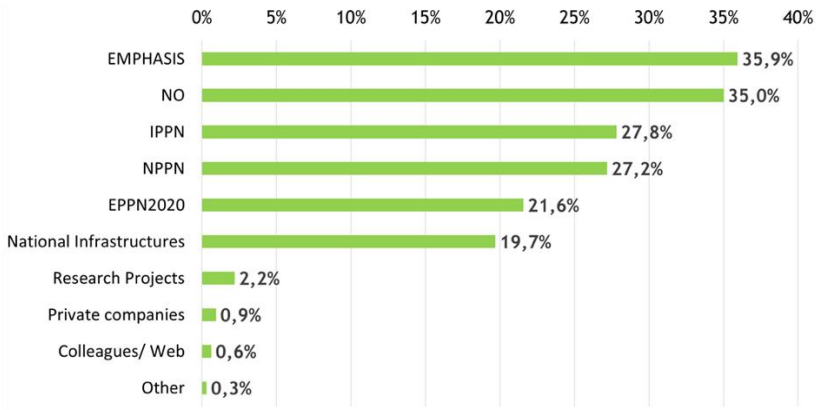


Fig. 4. Main fields of work within the "scientists" category (multi-choice answers allowed)

The survey was directed not only to the established phenotyping community, but also to other potential users not yet actively involved in phenotyping. More precisely, 35% of the participants were not in contact with any plant phenotyping community (Fig. 5A), and 26% had not been previously involved altogether in plant phenotyping (Fig 5B).



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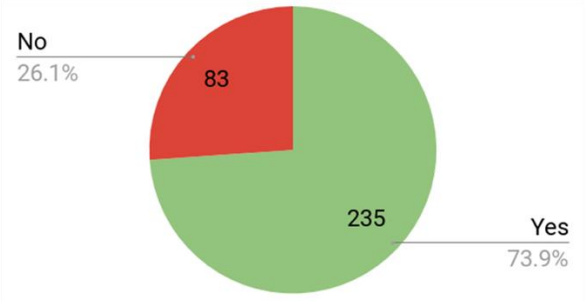

B

Fig.5. A) Contacts with the phenotyping community IPPN (International Plant Phenotyping Network); National Plant Phenotyping Networks; EPPN2020 (European Plant Phenotyping Network 2020); (multi-choice answers allowed); **B) Involvement in plant phenotyping.**

More than 280 participants declared that they plan to use plant phenotyping in the future, with an increased demand in terms of capacity requirements.

Most of the participants in the survey were from public research organizations (67% of the participants are from research institutes and universities) but a relevant fraction was from the private sector (20% of participants). This is a much higher share compared to the results of a previous (2017) survey, where only 5% of the participants were from the private sector.

The participants working in the private sector, the majority were involved in technology development, and in general plant science (66 and 63% respectively, Table 1). Twenty-two % of the participants were linked to breeding activities, while other declared to be involved in more specific fields such as image analysis (16%) and modelling (10%). Again it was possible to mention several activities, into which participants were involved.

Table 1. Field of work of participants from the private sector (multi-choice answers allowed)

Field of interest	% on the total hits
Plant science	66%
Technology development*	63%
Breeding	22%
Data management	19%
Image analyses	16%
Modelling	10%

*includes: technology developers, engineers plant sensors developers

Within the participants working in the private sector, 30% had not been previously involved in plant phenotyping, confirming the rising interest in the field, and highlighting the potential impact of the intense communication activity of EMPHASIS-PREP.

1.2 Which are the most required services or access types?

A specific question was asked to identify the main expectations of users toward EMPHASIS, and the most required services that could be provided by EMPHASIS infrastructures.

For a large fraction of the participants EMPHASIS should support training and education in plant phenotyping and expand their research network (62 and 50% of participants respectively, Fig 6, note that multi-choice answers were allowed).
In 47% and 39% of the cases the request was for access to installations and to data respectively. Forty-two percent of the participants identified support to innovation as one of the services EMPHASIS should provide.

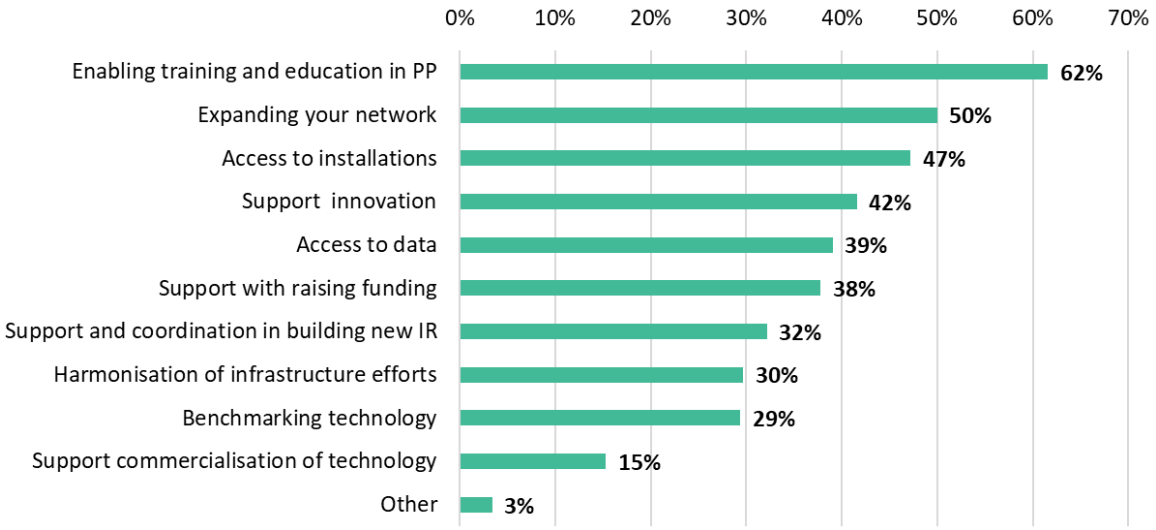

Fig 6. How can EMPHASIS support your work/ research? (Multi-choice answers allowed)

Access to phenotyping installations and dedicated training are highly requested activities. It has to be noted that IPPN (the International Plant Phenotyping Network) already carries out some activities at international level, and holds close connections with EMPHASIS. Clearly, training and education must remain a central activity in the EMPHASIS portfolio and will be further analysed in a subsequent section of this document (Section 3.6).

When only participants from the private sector were considered, training and education was again the most requested service, but support to innovation emerged as one of the main activities that are expected from EMPHASIS (Table 2). It is remarkable that 1/3 of even company representatives also mentioned access to installations and to data as a demand.

Table 2. How can EMPHASIS support your work/ research? (Private sector only - multi-choice answers allowed)

EMPHASIS Support	% of responses
Enabling training and education in PP	60%
Support- innovation	55%
Expanding your network	46%
Benchmarking technology	42%
Access to data	36%
Access to installations	34%
Support and coordination in building new IR	18%
Harmonisation of infrastructure efforts	18%
Support commercialisation of technology	18%
Support with raising funding	15%

2.Description of the access modes

Based on the analysis of user demand, EMPHASIS foresees to provide different services that require different access modes to the EMPHASIS infrastructure. The services focus on:

- ACCESS: access provision for user community to the phenotyping installations incl.: controlled environment installations, field installations, networks of field sites, modelling.
- QUALITY: measures to implement quality criteria at research infrastructure, specifically experimental design, standards, sensor calibration etc.
- DATA MANAGEMENT: approaches enabling data reusability embedded in a relevant data policy.
- INNOVATION: dissemination and utilization of technology and results from access and use of the phenotyping installations.
- COMMUNICATION: engaging all relevant stakeholders.
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- EXPERT ADVICE: assessment of the plant phenotyping landscape specifically to funders and decision makers

The Access modes and their relevance for different services are summarized in Table 3:

Table 3 EMPHASIS access modes

	Access mode	Purpose	**Service portfolio**	Cost model
Development Access (DevA)	**Internal Development Access(IDA)**	• exchange knowledge • standardization • technology transfer	• QUALITY • DATA MANAGEMENT • TRAINING	• exchange resources • cost recovery • exchange projects (eg. Marie Curie, etc)
	External Development access (EDA)	• test of new equipment form external groups (incl. industry)	• ACCESS • INNOVATION	• cost recovery (industry) • cooperation projects (academia and industry)
	User Access (UA)	• providing infrastructure to study GxMxE* • state-of-the-art technologies • specialized technology (e.g. tomography, modelling)	• ACCESS • QUALITY • DATA MANAGEMENT • INNOVATION • TRAINING	• cost recovery • cooperation projects • service, when appropriate
	Dissemination ACCESS (DissA)	• learning/training in phenotyping centres • learning about new technologies and modelling • evaluation of the European plant phenotyping landscape	• TRAINING • COMMUNICATTION • EXPERT ADVICE	• education program (e.g. summers schools, MC-ITN) • training, life-long-learning (cost recovery from industry)

*GxMxE Genotype x Managing x Environment

EMPHASIS goal, as an integrated infrastructure, is to optimize access to plant phenotyping infrastructures and services, and to facilitate the use of these same infrastructures across the whole phenotyping pipeline (sensors and imaging techniques, data integration, validation and calibration, data analysis in relation to environmental conditions, data organization and storage, data interpretation in a biological context, meta-analysis).

The implementation of the different services and access modes will give concrete benefits in terms of improved exchange of knowledge and technology transfer. A description of each access mode is provided in the following sections:

a) Development Access (DevA)

Development access will be implemented at two different levels:

- among EMPHASIS partners (Internal Development Access (IDA) that will focus on establishing quality standards that will specifically allow data reusability services focusing on:

    - QUALITY
    - DATA MANAGEMENT
    - TRAINING

- with external partners (External Development access (EDA). This is dedicated to external e.g. to validate new technologies with established methods under realistic scenarios. It, and will be ruled by Access Agreement between the external users and the service provider. The services specifically focus on:

    - ACCESS
    - INNOVATION

b) User access (UA)

User access will involve users who want to study the phenotype of plants to address upcoming challenges for plant agriculture. Different types of user access and services can be defined on the basis of the specific goal of the user:

- ACCESS (to installations, project calls aiming at rising funds, technology)
- QUALITY (access to standards)
- DATA MANAGEMENT
- INNOVATION (access to market)
- TRAINING

c) Dissemination access (DissA)

Dissemination access focuses on the following services:

- TRAINING
- COMMUNICATTION
- EXPERT ADVICE

As described in Deliverable 3.2 *Mapping training activities,* the EMPHASIS training strategy must:

- Coordinate and support training activities
- Orient the European scientists when dealing with the “jungle of courses”
- Develop and maintain an online platform with a catalogue of available courses and quality indicators
- Identify skills that are required in the plant phenotyping field
- Coordinate the design and execution of RI (Research Infrastructures) facility staff training courses

This strategy builds on the presence of outstanding plant phenotyping experts within national Nodes and of the overall EMPHASIS community, that can help promoting and coordinating high quality training activities.

The dissemination access to EMPHASIS infrastructures is therefore targeting a wide range of users (Master and PhD students, post-graduates, junior and senior scientists, technicians at industry and academia) as well as facility staff across Europe.

Additionally, the different stakeholders will benefit from dissemination activities e.g. reports on the plant phenotyping landscape that may support the European research agenda by supporting new infrastructures or services that address potential gaps or emerging user demand.

3. User demands

User demands were analysed on the basis of the type of infrastructure involved, and of the different access modes.

3.1 Access to (semi-)controlled conditions phenotyping installations

One hundred and twenty participants in the survey were interested in experiments under controlled conditions, being greenhouses or growth chambers their usual working space.

Considering the different categories of user, breeders, scientists and technology developers declared to perform more than half of their experiments in semi-controlled conditions, whereas modellers and technical staff declared to perform about half of their experiments in semi-controlled conditions (Fig.7).

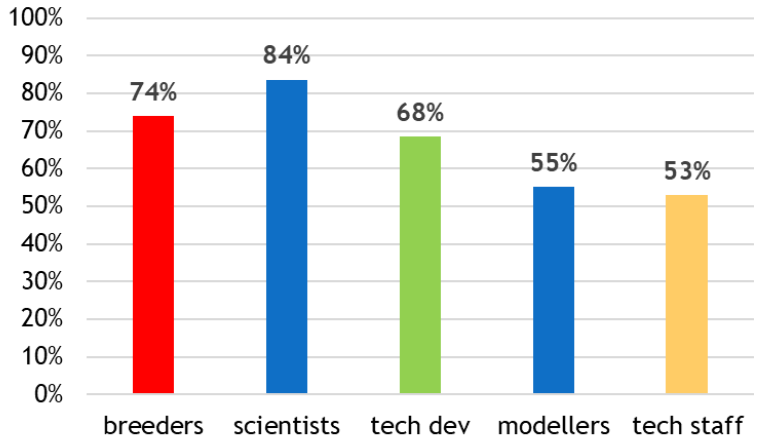

Fig. 7 Percentage of users interested in semi-controlled conditions within each category

Semi-controlled conditions allow users to perform a fine analysis of phenotypic changes in controlled plant growth conditions, also assessing the effect of specific stress treatments. Among the treatments of interest, drought and temperature stress were the most mentioned (64 and 52% of total hits, respectively), followed by nutrient and biotic stresses (48 and 43%, Fig. 8). This result reflects the main challenges that the agricultural sector has to face in the coming years.

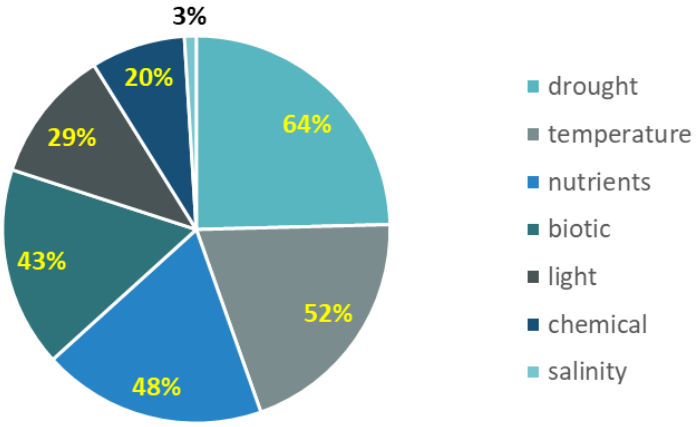

Fig. 8 Treatments applied in semi-controlled conditions (multi-choice answers allowed).

To classify the users of semi-controlled conditions infrastructure according to the requested analytical capacity in terms of plant per year, the following classes were identified:

- Small users (50 - 200 plants per year)
- Medium users (200 -1000 plants per year)
- Large users (> 1000 plants per year)

When the database was interrogated to determine how participants from the different categories can be classified as small/medium/large users (Fig. 9), we found that breeders are medium or large users, and are thus interested in infrastructures able to test a high number of plants per year. The more even distribution within the “scientists” category may reflect the variable requirements for basic research where the type and capacity of the infrastructure depends on the specific objectives of the project and on the species analysed. This has implications in the type of technology development required to satisfy the needs of the two categories of users.
Similar to breeders, modellers, showed an interest in using a medium/large number of plants per year.

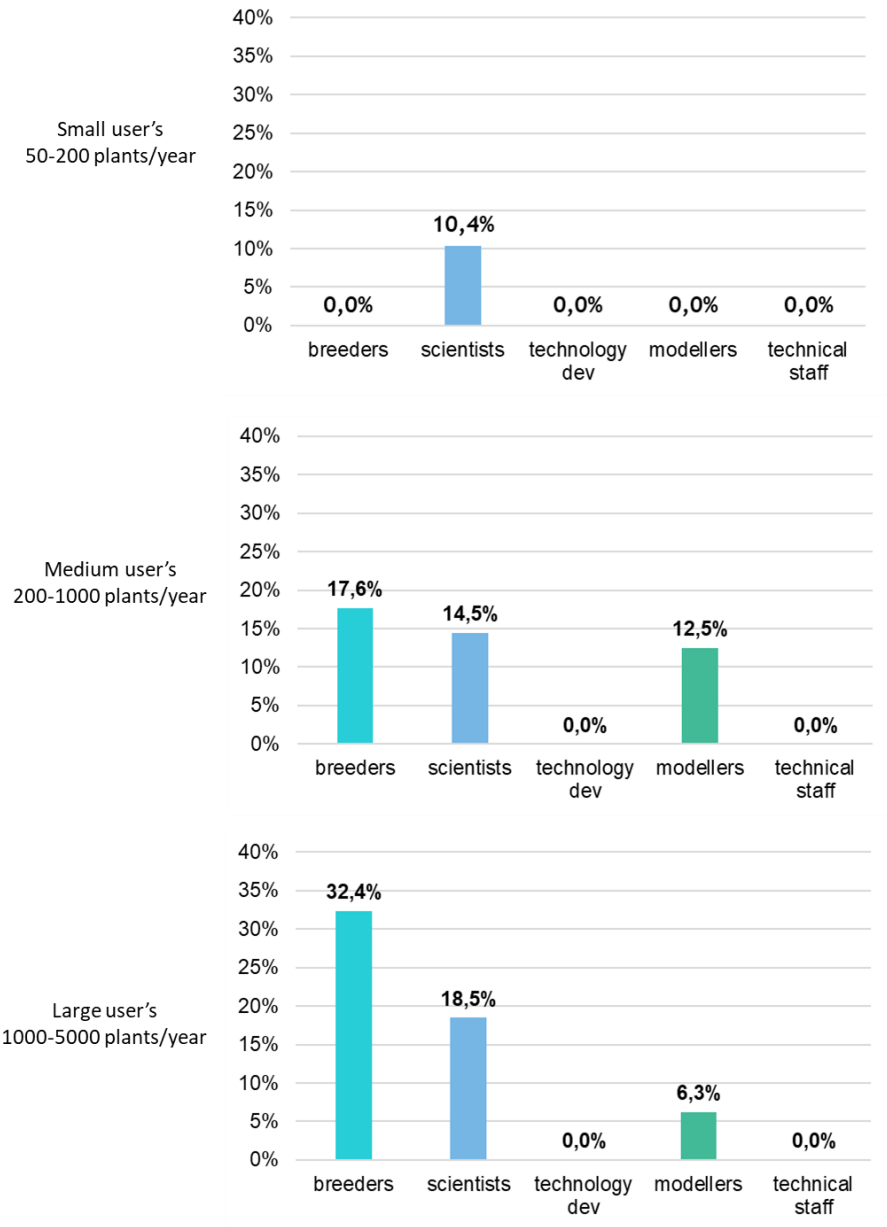

Fig. 9 Analysis of user demand on the basis of the number of plants per year (small, medium and large users) in semi-controlled conditions.

3.2 Access to intensive field installations

Intensive field are intended as field sites characterized by providing special environmental conditions or intensive analysis of environmental or field phenotyping conditions. Almost 60% of the participants in the survey plan to perform field phenotyping experiments in the next future.
When the different categories of users are considered, almost all breeders (98%) expressed interest in performing field phenotyping in the future. Scientists and technology developers shared a lower and similar interest (58 and 56% respectively). Field phenotyping emerged as a relevant activity for 71% of the technical staff (Fig. 10).

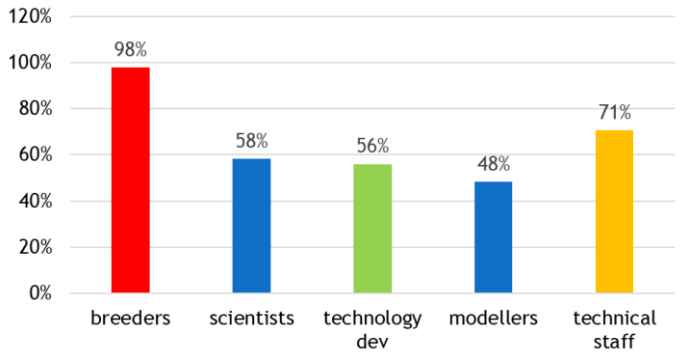

Fig. 10 Percentage of users interested in field phenotyping within each category

on the basis of a specific question regarding the size of the field plots required for future experiments, the users of intensive field installations were sorted according to low, medium and high number of plots per year:

- Small users (1-100 plots per year)
- Medium users (100-1000 plots per year)
- Large users (> 1000 plots per year)

The technical staff category did not show interest in access to small field trials and a low interest was also expressed by breeders. Scientist and technology developers shared a similar moderate interest (14 and 16% respectively) to access to small field experiments, and modellers were the most interested to this type of access (26%) (Fig.11).
Breeders and technical staff were instead well represented within medium/large users. Thirty-three percent and 48% of breeders, and 13% and 31% of technical staff were interested in medium and large field trials, respectively. Technology developers and scientists were well represented in all classes (Fig.11).

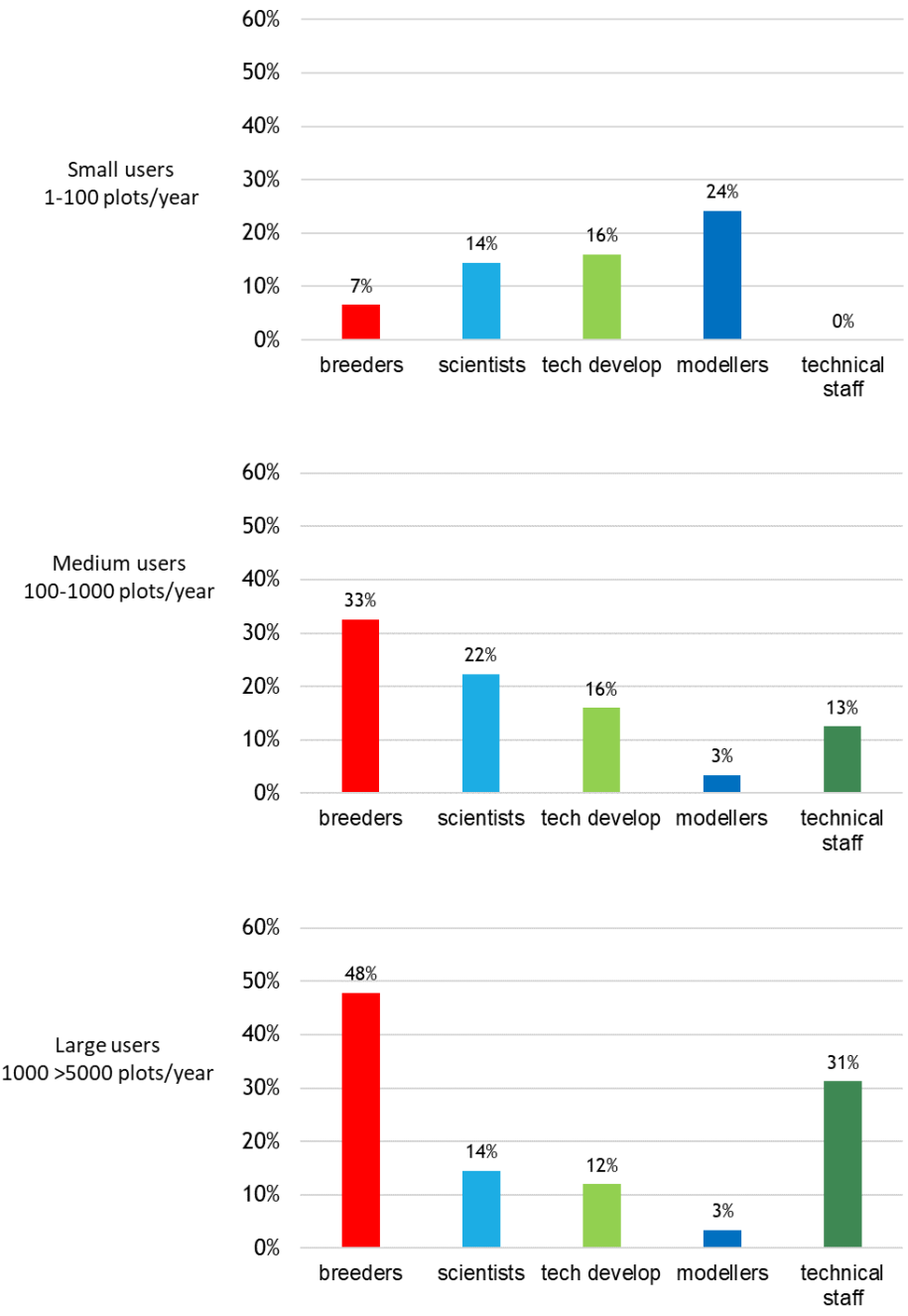

Fig 11 Analysis of user demand on the basis of the requirement of experimental size (number of plots per year: small, medium and large users) in field conditions

3.3 Access to field sites with minimal equipment

The survey allowed also us to map the technologies currently used in plant phenotyping (Fig.12). However, it did not allow us to clearly identify all users interested in access to field sites with minimal equipment (e.g. UAV equipped with RGB camera). Still,40% of the participants declared to use low-cost techniques, setting what could be considered a lower limit for the category of users interested in performing phenotyping with minimal equipment.
Fig. 12 gives a picture of the techniques adopted by plant phenotyping users. Note that multi-choice answers were allowed.

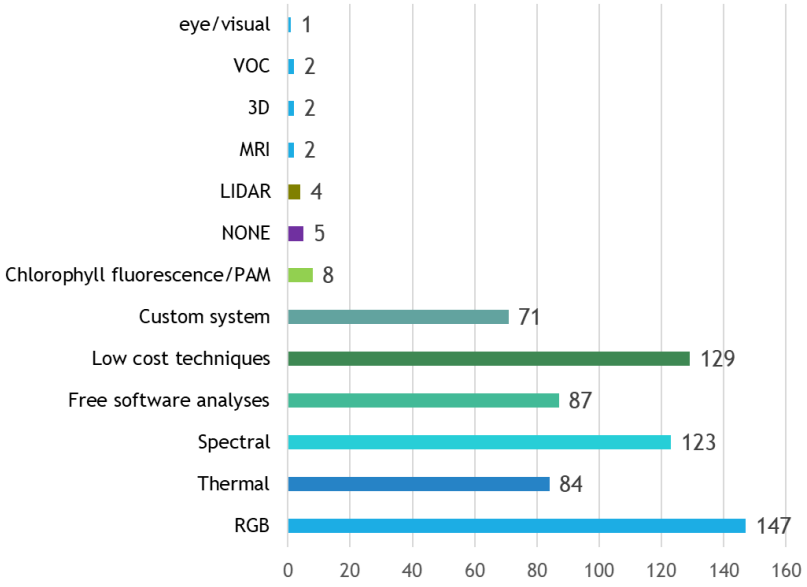

Fig.12 Analysis of the technologies used for plant phenotyping (multi-choice answers allowed). The number of participants in the survey adopting each technology is indicated.

Image based systems as RGB, thermal and Spectral still play a key role in PP (147, 84 and 123 choices). Use of custom systems and analysis using free software are also adopted by a large number or participants (71 and 87 choices).

3.4 Access to Modelling platforms

About half of the participants affirmed they currently use models to phenotype plant traits (47%, Fig. 13). This highlights that, despite the relative low number of modellers reached by EMPHASIS with the survey (see Fig. 2 and Table 2), modelling is widely used, probably thanks to the increasing availability of modelling platforms publicly available online. It is interesting to notice that a significant fraction of the participants was uncertain about the role of models in their current activities, or interpreted the question as also including future possible use of modelling in their work.

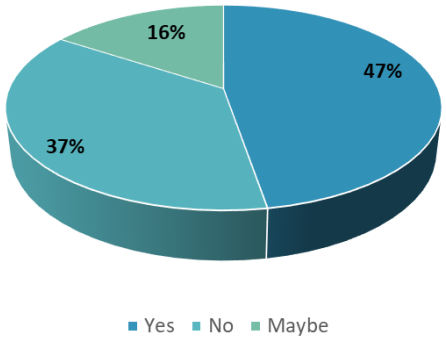

Fig 13. Have you been/are you using models for phenotyping?

Scientists, breeders, technology developers and technical staff make similar use of models to represent the traits of interest (48, 43, 52% and 50% respectively) (Fig. 14).

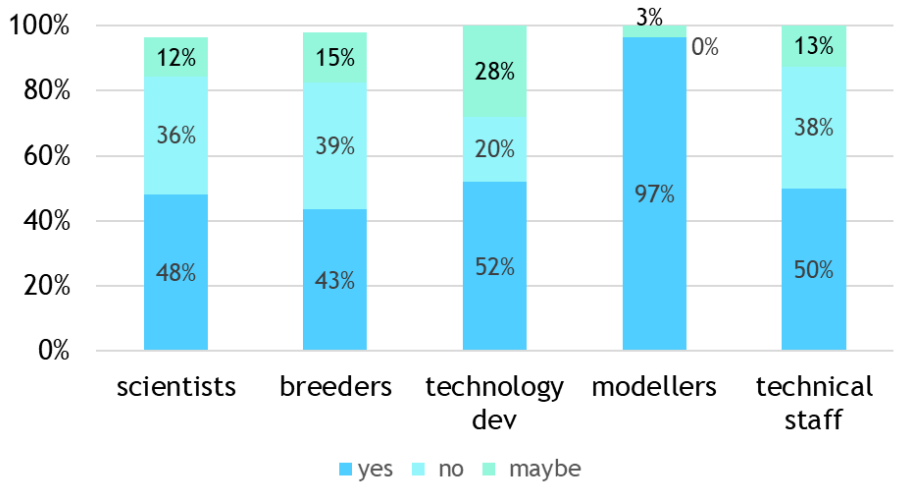

Fig. 14. Analysis of the modelling requirements among categories of users

However, there is ground to further expand the use of modelling within the community of plant phenotyping users, since more than 84% of participants declared they plan to use, in the future, models in combination with phenotyping experiments (not shown). For future activities of EMPHASIS-PREP on modelling, we also have to make sure that the obviously wide community using models in phenotyping (beyond the immediate modelling community), is addressed.

The major traits which are analysed taking advantage of models are reported in Table 4.

Table 4. Traits for which modelling is requested (multi-choice answers allowed)

Major plant traits analysed	% of participants
Plant Growth	44%
Yield	35%
Soil water or nutrients	24%
Plant Architecture	23%
Genomics	17%
Atmospheric conditions	16%
Plant hydraulic	10%
Not applicable	4%

3.5 Access to data management and information systems (e-infrastructure)

Among the participants to the survey, only 13.7% make use of data management infrastructures within their activities. As shown by Fig. 15, data management is more common among technology developers (44%) and less by modellers (24%), technical staff (19%), and breeders (13%). Only a low fraction of scientists (7%) is involved directly in data management (Fig. 15).

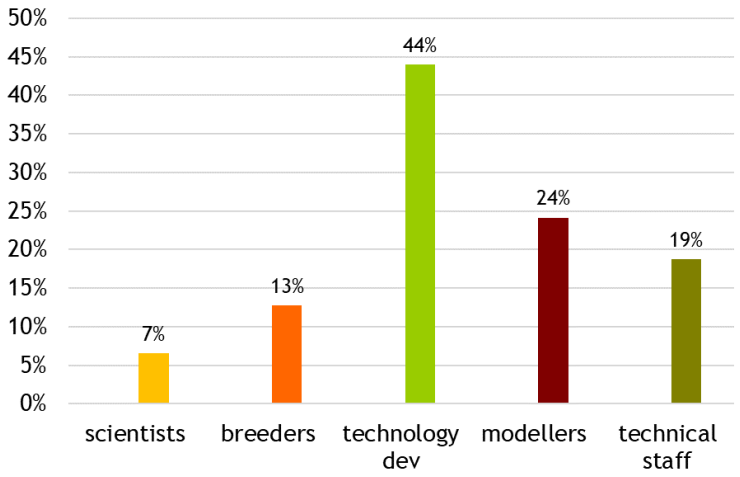

Fig. 15 Users performing data management. The percentage of participants performing data management within each category is indicated.

As plant phenotyping is going to produce big data from high-throughput measurements, the issue of data management and analysis is going to be a main bottleneck. A way to deal with such a problem, fostering data utilization, is to improve access to data. **Data access** is indeed requested by 39% of the participants (see Fig. 6).

When analysing the request for access to data within categories, as expected modellers were the main category requesting access to data (66%), followed by breeders (39%), technical staff (38%), scientists (30%) and technology developers (28%) (Fig. 16).

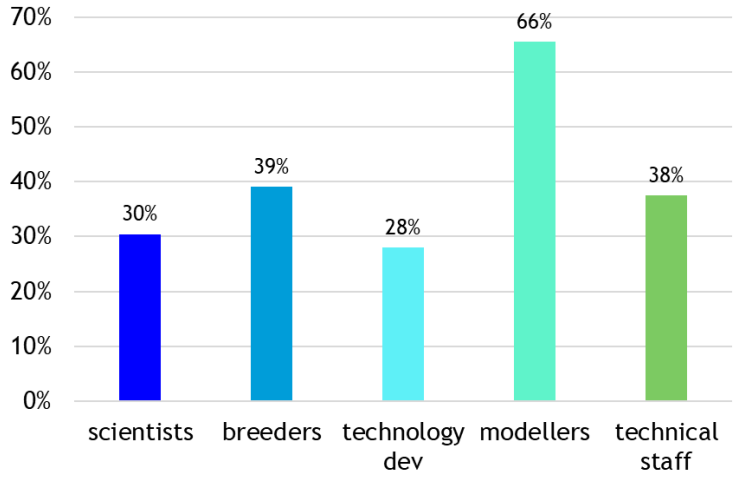

Fig. 16 Users requesting data access within different categories. The percentage of participants requesting access to data within each category is indicated.

3.6 Access to training and education

Sixty-two percent of the participants expect training activities to be a service provided by EMPHASIS (Fig. 6). In particular, training activities in imaging are highly demanded, followed by training in the generic use of plant phenotyping technologies and by training in bioinformatics (Fig. 17, but see also deliverable D 3.2).

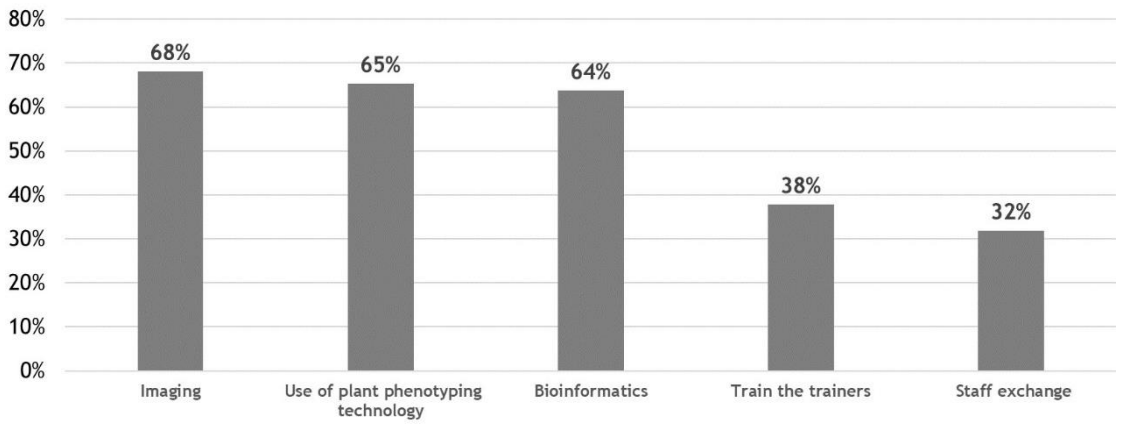

Fig. 17 Training activities requested by users (multi-choice answers allowed). The percentage of participants selecting the specific training activity is indicated

Looking at the preferences expressed for training activities within each category of users (Fig. 18), scientists were more interested in plant phenotyping technologies (PP technologies, 77%), imaging (72%) and bioinformatics (66%, Fig. 20). Breeders expressed interest in training in PP technologies (78%), bioinformatics (67%) and imaging (59%), while less interest was expressed for train the trainers and staff exchange. Technology developers showed high interest in imaging, use of PP technologies and bioinformatics (64, 56, 52% respectively). Modellers showed interest in training on PP technologies (79%) ad imaging (69% first) followed by bioinformatics (55%), while their interest in train the trainers and staff exchange was lower (28% and 38% respectively). The technical staff, was equally interested in bioinformatics and staff exchange (44%) and showed high interests in imaging and use of PP technologies (81 and 75%). The low request of “train the trainers” might be due to the effect that most participants of the survey are not involved in training today and do not see themselves as trainers. While a low number of participants are actively involved in training.

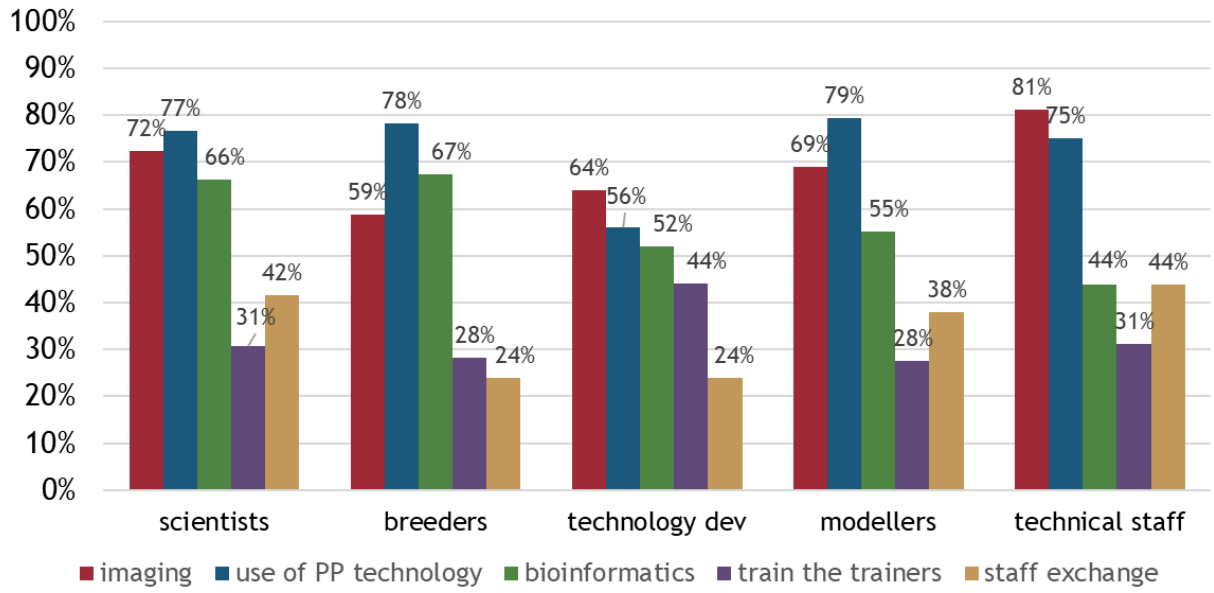

Fig 18. Analysis of the training requirements among categories of users ((multi-choice answers allowed)

5. Infrastructures and services made available in the different access mode

All the information collected from the users and user demand analyses, have been used to draw some hypothesis of access mode considering also the cost models and the main access demand. The results are summarized in Table 5.

Table 5. Mode of access for the type of service/infrastructure requested

Type of access requested to Infrastructure/service	Principal Users*	Access mode	Type of access
3.1 Access to (semi-)controlled conditions phenotyping installations	Scientists, breeders	UA, IDA, EDA	Joint trans-national calls with EPPN2020
3.2 Access to Intensive field installations	Scientists, breeders, modellers, technology developers, technical staff	UA, EDA	Development of EMPHASIS field service for multisite field experiments across Europe
3.3 Access to Field experiments using minimal equipment, linked as a network of fields	Scientists, modellers, technology developers	UA, EDA	Dedicated calls, dedicated projects, and link with data access
3.4 Access to: Modelling platforms	Scientist , modeller, breeders, technology developers	IDA, UA, Diss A	Access to the EMPHASIS modelling web portal; modelling training session; access through a runtime mode on a server
3.5 Access to: Data management and information systems	Scientist , technology developers, modellers, breeders	IDA, EDA , UA	Development of EMPHASIS Layer IR and regulated access
3.6 Access to training and education	Current and future users	DissA, UA	Web learning, training events, Exchanging program; See Deliverable 3.1 and 3.2

*ranked by the numbers of demand

5. Identification of a criteria list for the classification of EMPHASIS users and stakeholders

The information on the Emphasis users collected through the survey allowed to define a list of criteria that can be used to categorize the Emphasis users.
A classification of EMPHASIS stakeholders will also promote the planning of an effective communication strategy (See Deliverable 3.1) and help shaping EMPHASIS portfolio of services, following a demand-driven approach.

The users can be categorizing according to;

1. The mode of access (IDA, EDA, UA, DissA);
2. Infrastructure/Service requested within he emphasis infrastructures;
3. Type of institutions (Academic public, Research institute public, Research institute private, Foundation, EU authority, Private company, Cooperative, Ministry);
4. Background (Scientist, Technical staff, Breeder, Technology development, Modeller)
5. If previously involved in plant phenotyping (yes or no);
6. Country of activity (Emphasis partners' countries, Support group countries, other EU countries, non EU countries);
7. Country running a PP research infrastructure (yes, no);
8. Main Activities (Plant biology including physiology, genetics, plant pathology, breeding, image analysis, biotechnology, ecology, molecular biology, sensors, technology development, engineering, data management);
9. Traits analysed (biotic or abiotic);
10. Infrastructure already used (Lean field; Semi-controlled conditions; Modelling; e-infrastructure; intensive field);
11. Expectations from EMPHASIS (Enable training and education in PP; support innovation; expanding the research network; benchmarking technology; support and coordination in building new IR; harmonisation of infrastructure efforts; support commercialisation of technology; support with raising funds);
12. Required capacity in semi-controlled conditions (plants/year): small users; medium users; large users;
13. Type of technology used for PP (RGB imaging, Thermal imaging; Spectral imaging; LIDAR; Custom methods; 3D; MRI; VOC; Eye/Visual)

6. Next Steps

In this deliverable a criteria list was identified for the identification and mapping of the EMPHASIS users also in relation to different access modes and services. The list will be periodically updated in accordance with the engagement of the new users and emerging user demands, in an open and shared process with the PP community. The criteria list for users is thus a highly dynamic procedure, reflecting the continuous activities of EMPHASIS-PREP and the interaction with the community of users.
Moreover, a set of pilot services are currently under development, in order to specifically monitor access expectations by the users. This will likely lead to a revision of the criteria list while the EMPHASIS-PREP service portfolio is being developed.
EMPHASIS-PREP will establish a process for revision of the criteria list, fitting with the governance of EMPHASIS and with fixed time lines and responsibilities, also shared with other work packages.

Annex 1: Check list

Deliverable Check list (to be checked by the "Deliverable leader")

	Check list		Comments
BEFORE	I have checked the due date and have planned completion in due time		*Please inform Management Team of any foreseen delays*
	The title corresponds to the title in the DOW		*If not please inform the Management Team with justification*
	The dissemination level corresponds to that indicated in the DOW		
	The contributors (authors) correspond to those indicated in the DOW		
	The Table of Contents has been validated with the Activity Leader		*Please validate the Table of Content with your Activity Leader before drafting the deliverable*
	I am using the EPPN[2020] deliverable template (title page, styles etc)		*Available in "Useful Documents" on the collaborative workspace*
The draft is ready			
AFTER	I have written a good summary at the beginning of the Deliverable		*A 1-2 pages maximum summary is mandatory (not formal but really informative on the content of the Deliverable)*
	The deliverable has been reviewed by all contributors (authors)		*Make sure all contributors have reviewed and approved the final version of the deliverable. You should leave sufficient time for this validation.*
	I have done a spell check and had the English verified		
	I have sent the final version to the WP Leader and to the Project coordinator (cc to the project manager) for approval		*Send the final draft to your WP Leader and the coordinator with cc to the project manager on the 1st day of the due month and leave 2 weeks for feedback. Inform the reviewer of the changes (if any) you have made to address their comments. Once validated by the 2 reviewers and the coordinator, send the final version to the Project Manager who will then submit it to the EC.*