European Cooperation in the field of Scientific and Technical Research
- COST -

Brussels, 22 November 2013

COST 059/13

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action FA1306: The quest for tolerant varieties: Phenotyping at plant and cellular level

Delegations will find attached the Memorandum of Understanding for COST Action FA1306 as approved by the COST Committee of Senior Officials (CSO) at its 188th meeting on 14 November 2013.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action FA1306
THE QUEST FOR TOLERANT VARIETIES: PHENOTYPING AT PLANT AND CELLULAR LEVEL

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4114/13 "COST Action Management" and document COST 4112/13 "Rules for Participation in and Implementation of COST Activities" , or in any new document amending or replacing them, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to build an interdisciplinary network in plant phenotyping and to use this network to characterize gene bank collections and breeding programs, get insight into the basis of tolerance and to apply the knowledge for agricultural management.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 64 million in 2013 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of section *2. Changes to a COST Action* in the document COST 4114/13.

A. ABSTRACT AND KEYWORDS

Crops have been bred to improve production, paying less attention to stress. Stress is mitigated by treatments such as irrigation, pesticides and fertilizers. These managements have reduced the use of plant genetic resources in overcoming crop limitations so that some species/varieties containing useful sources of tolerance are forgotten. However, the use of pesticides, fertilizer and water must be reduced and agriculture must become more sustainable. While significant progress has been made in molecular and genetic analysis of model plants, the quantitative high throughput screening for crops is a major bottleneck. Reliable identification of tolerant varieties and the understanding of their genetic diversity are urgently needed. Phenotyping is an emerging science that characterises plant behaviour and quantifies features such as growth and stress tolerance in a way that allows linking to genetic control. This Action will create a network of European scientists with expertise on phenotyping, various –omics areas and/or physiology to (re)discover tolerant varieties and to understand tolerance. The Action will survey knowledge about plant biodiversity with respect to stress tolerance and will share and group existing expertise into discussions and conceptual development of new tools in phenotyping by integrating information from the cellular level to the whole plant level.

Keywords: biodiversity, breeding, crop species, phenotyping, stress tolerance

B. BACKGROUND

B.1 General background

In many European countries crops have been bred to improve their adaptability to local environments. Breeding during the last century mainly addressed increased production, paying less attention to other features (e.g. drought tolerance, nutrient use efficiency, durable pest and disease resistance, environmental repercussions etc.). The effects of these factors were mitigated by the use of treatments such as irrigation, pesticides and fertilizers. These managements have reduced the use of plant genetic resources in overcoming crop limitations so that some species/varieties containing useful sources of resistance or tolerance are now forgotten and not included in the parental material used to produce current varieties. However, the use of pesticides, fertilizer and water must be reduced and agriculture must become more sustainable. Recently, many European governments have taken initiatives to promote plant germplasm collections which increase the range of material that can be explored in search of genotypes less affected by stressors.

The European Commission organised a consultation for preparing future EU activities for integrating and opening national research infrastructures and published its Assessment Report in February 2013 (Consultation on possible topics for future activities for integrating and opening existing national research infrastructures Assessment Report). The experts recognise the need for strong EU dedicated infrastructures providing tools and resources for analysing the enormous genomic data available in animals, plants and microorganisms and link it to phenomic data. The experts consider this as one of the top priorities and advise to emphasize the links between genomics and phenomics. This is exactly what this Action aims for. Currently various high throughput phenotyping platforms have been or are being created in Australia, Belgium, Canada, France, Germany, Hungary, The Netherlands, UK and USA. However understanding plant behaviour and making the link with genetics and cellular reactions is a challenging task that cannot be tackled at the national level. Scientists from various disciplines (phenotyping engineers, IT and data management specialists, plant physiologists, geneticists, molecular biologists, biochemists, modellers and gene bank curators) need to join forces. An essential next step to implement phenotyping in the European Research Area on a larger scale is the establishment of a network of researchers, breeders and industry. Due to the flexibility of the COST Actions, allowing the co-ordination of nationally funded research on a European level, COST is the instrument of choice to bring together European scientists and use the current European infrastructure of plant phenotyping platforms. This can only be realized through a consortium of different institutes situated in different European countries bringing in experience on (i) phenotyping and remote sensing techniques for different plant species, (ii) plant physiology, (iii) genomics and cellular phenotyping (transcriptomics, proteomics, and metabolomics) and (iv) on growth modelling.

B.2 Current state of knowledge

Large numbers of landraces and wild relatives of cultivated crops have been sampled and stored in gene banks that have a valuable potential for breeders, but these collections are presently underexploited. Current studies in the field of remote sensing and phenomics are mainly empirically based and do not link the phenotypic parameters to the molecular level. On the other hand, many molecular studies do not correlate the data to the plant phenotype. While significant progress has been made in molecular and genetic analysis of the model plant Arabidopsis, the quantitative high throughput analysis of crop potential and behaviour during stress is a major bottleneck. Reliable identification of tolerant varieties and the understanding of the genetic diversity are urgently required.

Europe has some world-leading groups in plant phenotyping who support this Action. Several groups in Europe and Australia have worked on the challenge of establishing new methods for phenotyping. Several European projects in the FP6 and FP7 framework contained work packages on the development of new phenotyping methods and on their integration with “Omics” (e.g. FP6 Agron-Omics, Methaphor, FP7 Spicy, Drops, ABSTRESS) but there is still a long way to go until phenotyping in its broad sense finds its way to the general plant community and educational programmes. Note the still relatively low numbers of scientific papers devoted to plant phenotyping. According to ISI web of science using the term ‘plant phenotyping’ with no time restrictions, only 1010 papers are published so far. Only from 2009 on the number of published papers per year exceeds 100. Nonetheless, plant scientists start to realize that phenotyping will make an essential contribution to their research. Therefore the work published on plant phenotyping becomes highly cited. In 2009 the number of citations per years exceeded 1500 and was for 2012 > 3000. The total number of citations is currently around 15 000. Considering that plants form the basis of our food, environment and life, it is of outermost importance that phenotyping research continues to progress, that more researchers get access to a network and a platform and that Master and PhD students are getting acquainted with this interdisciplinary field. Concerted initiatives like COST Action networks have the power to unify those scientists and to facilitate interdisciplinary communication. Tools like Short Term Scientific Missions (STSM) and Training Schools are ideal to train young promising scientists. This Action will be innovating by developing concepts for novel phenotyping technologies through the exchange of knowledge from different disciplines of plant science and establishing communication between groups who would otherwise hardly ever meet. Phenotyping on both the plant and cellular level and integrating both is a novel scientific approach and a network unifying the different expertise does not exist yet.

B.3 Reasons for the Action

Considering the significant expertise present in different European countries and the great effort needed to accelerate the production of knowledge in plant sciences this Action will develop a united community in the field of phenotyping, where information and skills will be shared and young scientists will get an effective training and get access to the big phenotyping platforms and novel sensors. A critical mass will be obtained only through a consortium of institutes located in different countries bringing together their collective experience on (1) sensor technology, (2) data management, (3) transcriptomics, (4) proteomics, (5) metabolomics, (6) plant physiology, (7) plant pathology, (8) genetic diversity, (9) breeding, (10) growth modelling.

This Action is aimed both at European economic/societal needs and scientific/technological advance.

From an economical perspective, this Action will allow information exchanges contributing to a wider application of the techniques in the agricultural industry of Europe. Continuing technological development is required to sustain a rapid evolution of plant phenotyping and to bring novel sensors and techniques into practice. Extending this network to countries outside the EU (Reciprocal Agreement, Near Neighbours and International Partner Countries) will create an even bigger impact.

From the societal perspective, this Action will show the importance and utility of using technology to use the available plant genetic resources in overcoming crop limitations and to minimize the use of pesticides, fertilizer and water by interpreting at an early stage the signals/needs of the plant. This Action will lead to the necessary PR to inform the general public and stakeholders.

From a technical/scientific point of view, the Action will be aimed at understanding the biological basis of stress tolerance of several crops by integrating various technologies at different levels. The expected scientific outcomes of the Action will be to develop strategies, concepts and protocols for the identification of genetic/physiological markers and how the integration of plant phenotypic and other –omics data could be used to derive growth impact models for an appropriate agricultural management.

In summary, this COST Action will give an additional value to the nationally funded research and will produce important and useful information for breeding companies and growers, to minimize the impact of biotic/abiotic stresses on yield, to increase the use of genetic resources and to reduce agriculture's environmental footprint.

B.4 Complementarity with other research programmes

This Action will anticipate and complement the activities of the EU FP7 project "EPPN": "European Plant Phenotyping Network" that will end December 2015. The aim of EPPN was to develop novel sensors, methods and assays for plant phenotyping that will be implemented and spread through this COST Action with a much broader network of end users.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The aim of the Action is the improvement and exchange of scientific knowledge in plant phenotyping through the creation of a network between European interdisciplinary scientists and to use this network to: map valuable gene bank collections and breeding programs in Europe, train breeders and physiologists in screening techniques and data interpretation, get insight into the genetic basis of tolerance, to characterize current biodiversity and rank it according to tolerance levels and to apply the knowledge for agricultural management.

C.2 Objectives

1. Disseminate the results of high throughput phenotyping and novel sensor development.

2. Integrate results from different -omics levels (phenomics, metabolomics, proteomics, transcriptomics, genomics).

Systems biology is the ultimate aim of a plant scientist. Today sensitive sensors exist for (real-time) measuring physiological plant responses at the plant level. In order to interpret stress related physiological responses correctly, these variables should be linked to processes at the cellular level. Modelling methodologies that enable linking of stress responses at the cellular level with measurable physiological responses at the plant level are a key element in gaining insights in stress.

3. Map valuable biodiversity, disseminate the results of the characterization and publish a ranking according to tolerance levels

Many European Governments established a wide variety of plant germplasm collections to secure the long-term conservation of crop gene pools. This Action will disseminate the results of the biodiversity characterization toward drought, nutrient use efficiency and major pests and diseases with a special focus on important fruits, vegetables, cereals and energy crops. The Action will encourage the use of the different accessions.

4. Train young scientists in a multidisciplinary attitude

Phenotyping is an emerging interdisciplinary science that characterises plants in detail and quantifies features such as growth and stress tolerance in a way that allows linking to genetic control. Plant physiologists and breeders are confronted with the complexity of a genotype x environment x management approach and phenotyping engineers are not realizing enough the practical needs.

5. Apply the knowledge and bring it into practice for agricultural management

The goal of modelling is to provide a framework to forecast plant growth and development in relation to the changing environment. As such any deviation of projected growth and development indicates stress. Early and real-time measurement provide the basis to improve our understanding of how plants react at different scales of complexity.

C.3 How networking within the Action will yield the objectives?

Encouraging the use of biodiversity requires an in-depth knowledge of the variability among the accessions at the genome as well as the phenotypic (*i.e.* performance under different conditions) level. Currently, knowledge to combine those areas is scattered over diverse disciplines. By unifying people of diverse disciplines, starting discussions and exchanging students and expertise, this Action will create an overview of the various collections and breeding programmes and will initiate the characterization of the biodiversity of important fruits, vegetables, cereals and energy crops.

Plant and cellular phenotyping is in this Action defined as the acquisition of high-dimensional phenotypic data (accumulated biomass, commercial yield, resource use efficiency, etc.) on both an organism-wide and cellular scale. This network will join European physiologists, breeders, cellular biologists, bioinformaticians and phenotyping engineers aiming to (re)discover tolerant varieties and to understand stress tolerance.

The networking will yield the objectives by:

1. Structuring the Action into Working Groups. This enables the organization of specific both interdisciplinary and applied meetings.

2. Organising STSMs, workshops and Training Schools. Those are ideal to train young promising scientists and give them access to big infrastructures. Europe and the regional governments have funded big infrastructures and COST is an ideal incentive to provide the access and training.

3. Encouraging the members of the Management Committee to broaden the network and give priority for funding to Early Stage Researchers to join the meetings and to provide a good gender balance.

4. Setting up collaborations and publishing the results in peer reviewed journals.

5. Creating a website and using social media to provide information and facilitate discussion.

6. Drafting proceedings of technical recommendations for screening of biodiversity (possible parents/offspring) and early stress detection and appropriate agricultural management (remote sensing/“speaking plant”).

C.4 Potential impact of the Action

A better understanding of the mechanisms involved in stress tolerance will lead to the detection of genes/proteins/metabolites involved in tolerance of freezing, cold, nutrient, drought stress and pest & disease resistance which are essential components for developing future breeding strategies for marginal areas and climate change. The network will provide links between the various methods used to screen plant genetic resources. This application of screening techniques of European plant collections will ensure that European industries, farmers and consumers have ready access to previously uncharacterized plant germplasm. Farmers will have ready and fast access to more varieties which are (a)biotic stress tolerant and which will have unique features, like flower colour, disease resistance, cold tolerance,… As such they can respond quickly to disease outbreaks but also to the specific needs of the market. Inviting International Partner Countries with a Reciprocal Agreement like Australia and New Zealand and Near Neighbours like Russia who have a valuable experience with high throughput phenotyping and/or plant collections will create even a better exposure of this network.

C.5 Target groups/end users

The target groups and end users of the Action are:

- Researchers (both academic and practical institutes) and students
- Seed banks among them those belonging to the Consultative Group on International Agricultural Research (CGIAR)
- Breeders

- Private companies
- Policy makers

All groups except the breeders have already been consulted. Breeders will be targeted later in the dissemination plan and more private companies will be approached.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

This Action will coordinate three important research topics to enhance the collaboration of scientists:

- Phenotyping at plant level
- Phenotyping at cell level
- Integration of phenotyping results and link to good practices and applied end use.

Each topic will be organized in a Working Group (WG) to facilitate the coordination and exchange between and within each topic.

Most of the current studies in the field of remote sensing are mainly empirically based, rely on only a few parameters and do not link the phenotypic parameters to the molecular level. On the other hand, many molecular studies do not correlate the data to the plant phenotype. The originality of this network lies in the plant centric approach to try to understand the enigma of systems biology. By combining both levels, small phenotypic stress signals will be detected and understood and stress will be diagnosed at a very early stage. Currently sensors exist for sensitive real-time measurement of physiological responses at the plant level. In order to interpret small stress related physiological responses correctly, these variables should be linked to processes at the cellular level. Modelling methodologies that enable linking the stress responses at the cellular level with measurable physiological responses at the plant level are a key element of gaining insights into stress tolerance and its genetic origin. Additionally, the network aims to develop a protocol to

predict the growth of different genotypes in the field/greenhouse under “normal conditions”. Any “deviation” will point to stress. The goal of this modelling is to provide a framework to forecast plant growth and development in relation to the changing environment. As such any deviation of projected growth and development indicates stress and calls for appropriate agricultural management.
The network hypothesizes that a systems-level approach has the potential to unite the plant responses at different scales (organism and cells) and will enhance the understanding of a plant’s reaction to stress. Linking physiological measurements at the organism level to analysis at the cellular level will help to understand small changes by guiding the analyses (transcriptomics, proteomics, and metabolomics) to the right physiological moment.

D.2 Scientific work plan methods and means

To achieve the five objectives of the Action the work plan is subdivided into three Working Groups WGs each producing its deliverables and milestones for monitoring the progress of the Action.

Working group 1: Phenotyping at the plant level

WG1 is created to meet objective 1 and 4. WG1 will collect, discuss and evaluate information and novel developments in:

- Sensors & image analysis
- Plant physiology/pathology
- Modelling plant growth and real time monitoring
- Establishment of Good Phenotyping Practice (Experimental standards/protocols)
- Environmental monitoring and simulation

Working group 2: Phenotyping at the cell level

WG2 is created to meet objective 2 and 4.WG2 will collect, discuss and evaluate information and novel developments in:

-Metabolomics and flux analysis
-Proteomics

-Transcriptomics
-Genomics

Working group 3: Integration of phenotyping at plant and cell level and translation into good practices for applied end use

WG3 is created to meet objective 3, 4 and 5.WG 3 will follow up the developments made in systems biology by integrating phenotyping on different levels and will collect the developments in translational research:

-Data management & statistics
-Integration of different omics technologies
-Detecting early stress events in the field and green houses and adapting agricultural management (“speaking plant”)
-Defining relevant traits for the transition from greenhouse to the field
-Screening the parents and the offspring of breeding programs and different genetically modified plants
-Screening the biodiversity of European gene bank collections
-Inform and give policy advice to stakeholders

E. ORGANISATION

E.1 Coordination and organisation

This Action will be organized as described in the "Rules and Procedures for Implementing COST Actions" (doc. COST 4159/10). In particular, the Action will be coordinated by the Management Committee (MC) that is directed by a Chair and a Vice-Chair.

A WG meeting will be organized on a 10 monthly basis at different partner locations. These frequent gatherings are planned to stimulate an optimal exchange of ideas. The duration of the meetings will be two to three days. The first one to two days will be devoted to specific WG activities in parallel. The last day is a joint WG meeting to stimulate interaction and feedback between the WGs. This will allow the exchange of information and ideas, encourage the collaboration between scientists and institutes, stimulate the planning of joint experimental work and will address WG specific topics. This will enhance integration of activities from the different

fields, and promote interaction between WGs. Interaction between WG1 and WG2 and feedback to WG3 will be essential to define new challenges and technical requirements for translation into practice.

The MC that coordinates the Action will have as main responsibilities:

- Appointment of the Chair, Vice-Chair and WG coordinators and a coordinator of the Short-Term Scientific Missions (STSM)
- Plan and coordinate the different meetings: MC meetings, scientific meetings as well as Workshops/ Training Schools
- Assessment of the different activities (such as meetings, STSMs, publications and Training Schools) to meet the general objectives defined for this Action
- Report of the progress made by the different WG to meet their respective objectives in the framework of the Action
- Promote the collaboration and exchange of knowledge (and data) between the partners from the different WGs
- Promote and approve STSMs
- Create and update the Action website to enhance communication between partners and to disseminate the results generated in the different WGs to the general public
- Coordinate and facilitation of all efforts that can lead to the preparation of a new research project in the program of Horizon 2020.
- Prepare annual reports
- Deal with matters related to IP and the possibilities for exploitation and dissemination of project results.
- Communicate with appropriate ongoing COST Actions and research frameworks such to address problems of common interest (see E.4).

An Executive Committee (EC) will be established who will consist of members of the MC: the Action Chair, Vice Chair, the WG and STSM coordinators.

Meetings of the EC will take place adjacently linked with the WG meetings. This will ensure efficient coordination of the activities and to critically evaluate the past meeting.

Meetings of the MC will take place at least once per year.

STSMs will enhance exchange of knowledge (technology transfer) and moreover strengthen the collaborations between partners. An STSM evaluation committee will be appointed by the MC with one coordinator and one representative of each Working Group. This committee will encourage the mobility and training of young researchers, with special attention for EU regions below 70% of EU's GDP average).

Training Schools and summer courses have already been organised in some laboratories that will join this Action upon approval. Training Schools will be organised on different technical aspects such as sensors, data management and statistics, -omics, image analysis, etc. The aim of Training Schools will be to build up and share good phenotyping practices.

The researchers (scientists and engineers from institutions/companies) willing to take part in this COST Action are representing a unique panel of experts in plant -omics, plant development, plant stress physiology, modelling, sustainable agriculture and food safety assessment. Based on their track records, it can be concluded that this consortium of both academic researchers and institutional partners has the necessary expertise, updated technical infrastructure, technological know-how and funding to successfully address all scientific aspects of this Action.

E.2 Working Groups

For organisational purposes, three Working Groups (WGs) will be established as described in section D. WG1 Phenotyping at the plant level, WG2 Phenotyping at the cell level and WG3 Integration of phenotyping at both levels and translation into good practices for applied end use and information to stakeholders.

Each of the WGs will be managed by a WG coordinator. These WG coordinators will have as main tasks:

- Participate in the plenary WG meetings and of the meetings of the MC
- Plan the appropriate scientific WG meetings
- Coordinate the activities (e.g. Training Schools) within their WG to meet the objectives that are defined in the scientific programme
- Promote the set-up of joint research (e.g. by establishing STSMs)
- Promote the writing of joint publications
- Report the WG progress to the Action Chair and MC

E.3 Liaison and interaction with other research programmes

Since the following Actions are focussing on crops and production a particular liaison could be made: FA0905 (Mineral-improved crop production for healthy food and feed), FA1006 (Plant Metabolic Engineering for High Value Products), FA1105 (Towards a sustainable and productive EU organic greenhouse horticulture) and FA1204 (Vegetable grafting to improve yield and fruit quality under biotic and abiotic stress conditions). Researchers from the other Actions will benefit from this Action to characterize their crop of interest and this Action will benefit from the crop specific knowledge disseminated by the other Actions.
To establish a liaison and interaction the Chair of the particular Action will be invited to join the meeting of this COST Action to exchange and integrate (see time table).
In section B.4 the complementarity with other EU projects is given.

E.4 Gender balance and involvement of Early-Stage Researchers

Specifically, during the composition of the EC there will be special attention to reach a good gender balance and during the WG meetings Early Stage Researchers (ESRs) will be encouraged to present their work. For the selection of STSMs absolute priority will be given to ESRs and after the visit, the researchers will have to present their results and experiences in the respective subsequent WG meeting.

F. TIMETABLE

- The duration for this Action is 4 years.
- During the Kick-off meeting, the Executive Committee will be elected (Chair, Vice Chair, WG coordinators and STSM coordinator).
- The homepage will be created soon after this kick-off meeting and will be updated on a regular basis (at least 4 times per year).
- Each WG will hold a meeting every ~10 months. WG meetings will have a one day overlap.
- At least three Training Schools will be organised.
- EC meetings will be linked to the WG meetings.
- STSMs will be selected after each MC meeting.
- Inter-COST Meetings will be held to address problems at the interface of WGs and ongoing

COST Actions, and will allow for the cross-fertilisation of high quality outputs and ideas.

- The Action will be closed with a final conference, combining a meeting where all the partners involved will present their results.

	Year 1			Year 2			Year 3			Year 4		
Coordination												
Kick-off	M1											
Homepage	D1											
Reporting			D2			D3			D4			D5
MC meeting	M1				M5				M11			M15
EC meeting		M2			M5		M7			M13		
WG 1 meeting		M2			M5		M7			M13		
WG 2 meeting		M2			M5		M7			M13		
WG 3 meeting					M5		M7			M13		
Training Schools				M4			M8		M12			
STSM		M3			M6		M9			M14		
Inter COST meeting					M5							M15
Mid-term review						M10						
Final conference												M15

Milestones (M) / Deliverables (D):

M1: The kick-off meeting with the MC members has taken place, the EC with the Chair and Vice-Chair has been elected as well as the representatives of WG1-3 and STSMs.

D1: The homepage of the Action has been created and is running.

M2: The first WG meetings have taken place,

M3: The EC has selected young researchers to go on STSM and the MC approved them; announcement of the first Training School.

D2: First year report published.

M4: First Training School is organized.

M5: Second WG1-2 meeting and first WG3 meeting is organized in the form of an Inter COST meeting.

M 6: The results from the STSMs are presented at the WG meetings. The EC has selected new young researchers to go on STSM and the MC approved them, announcement of the second Training School

D3: Second year report is published.

M7: Third WG1-2 meeting and second WG3 meeting is organized.

M8: Second Training School has been organized.

M9: The EC has selected young researchers to go on STSM and the MC approved them.

M10: A mid-term review has been organized in the presence of an external reviewer.

D4: Third year report is published.

M11: Third Training School is organized.

M12: Third MC has been organized.

M13 Fourth WG1-2 meeting and third WG3 meeting is organized.

M14: The EC has selected young researchers to go on STSM and the MC approved them.

M15: Final meeting has been organized,

D5: Final report and the developed protocols (good practices) are published.

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: BE, CY, CZ, DE, DK, ES, FR, HU, IL, IT, LU, NL, NO, PT, TR, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 64 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

The target audiences of this COST Action can be categorised as researchers, advisors, certifiers, policy makers and the industry (seed and plant breeding companies, companies producing phenotyping platforms & sensors) (see chapter C.5).
Finally, the general public will be targeted as the public awareness of the attainments of this research and the degree of sustainability of the agriculture contributes to the image of the industry and agriculture and its products.

H.2 What?

The dissemination methods intended to use are:

- Press releases

The first press release will be organised on the occasion of the kick-off MC meeting in all the participating countries.

- Publications

Research articles, technical guidelines, common review articles and book chapters

- Website

Content of the website:
-General information about COST and this Action (activities, meetings, …)
-Publications and contact information for Action participants
-On-line courses, proceedings of meetings, talks and posters from meetings
-STSM Calls and Reports
-Teaching tools (e.g. slides, course notes, protocols)
-Links to the websites of the participating institutions and websites
-Job announcements

- Workshops/ Training School

A Training School will be organized for PhD students and post-docs on (i) high throughput plant phenotyping and data management, (ii) omics techniques, (iii) sensors.

- WG meetings

- STSMs

- International Conferences

Knowledge and data resulting from the COST Action activities will be integrated and presented at International Conferences. This will promote the European know-how and increase the international collaboration.

- Teaching activities

Teaching activities in Universities at undergraduate and post-graduate level will also take advantage of the knowledge and experience acquired during this COST Action. Young scientists and engineers will thus be trained and informed on the latest developments.

- Social media

An account will be created for Twitter, facebook, google+ and linked in to keep the people updated about the developments of the Action.

H.3 How?

The developed protocols (good practices) will be published as Technical Guidelines that will be actively promoted during the end-of-project workshop/conference. The results will be published in peer reviewed journals and the content will be made open-access. Those open access publications (manuals and journal articles) will also be uploaded on the website and disseminated broadly through different media. The Action will work closely with the communication offices of the universities and institutes and make use of their experience. The local communication offices will translate research-related messages to news sites, press communications, electronic newsletters, social media, etc. The CGIAR research programs are another avenue for broader dissemination of the results to the R&D community at large.
Communication will not only focus on the protocols and research results, but include key messages that are of broader interest to a large audience.