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

Brussels, 21 November 2012

FA1206

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action FA1206: Strigolactones: biological roles and applications

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 186th meeting on 20 - 21 November 2012.

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

COST Action FA1206
STRIGOLACTONES: BIOLOGICAL ROLES AND APPLICATIONS

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 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The aim of this COST Action is the advancement and dissemination of knowledge on strigolactones and their use both in basic science and applied science to promote biomass and yield production of agricultural crops while simultaneously reducing the input of agrochemicals.

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 2012 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 Chapter V of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

Strigolactones (SLs) are newly discovered phytohormones that contribute to define plant morphology, also in response to environmental conditions, and to the dialogue with organisms in the rhizosphere. As a consequence, SLs have become a cutting-edge topic in plant biology and agronomy, having a great potential in modern agriculture. However, little is known about how they act, their biosynthesis and signaling pathways. Because of their both endogenous and exogenous role as signaling molecules, SLs are well placed to mediate both adaptive changes in the plant architecture and beneficial rhizosphere interactions. Even though SLs are a prime interest for many laboratories across disciplines, there is no official network, neither in Europe nor in the rest of the world, on this subject. An outcome of a European network on this subject would be sustaining and promoting the European leadership in SLs-related sciences, the coordination of SLs research activities and a transfer of knowledge which may lead to the development of targeted and sustainable agro-technologies. The aim of this Action is the creation of such a multidisciplinary network of experts, of both basic and applied sciences, who can share expertise through the flexibility of the COST framework.

A.2 Keywords: Strigolactones, crop improvement, arbuscular mycorrhizal fungi, plant hormones, pest management

B. BACKGROUND

B.1 General Background

Strigolactones (SLs) are a class of structurally related carotenoid-derived compounds with multiple functions in plant physiology and plant-biotic interactions. They are produced in all plants examined so far, including eudicot, monocot and primitive plants. SLs are produced mainly in plant roots and are secreted to the soil, thus present in the rhizosphere. Their benefit to agriculture may be derived from their association both with beneficial and detrimental plant biotic interactions, and their function as plant hormones that regulate both shoot and root development. The consortium will form a network of collaborations that will facilitate finding SLs-related alternatives for field use. SLs were first identified as root-exuded host factors that stimulate the germination of the seeds of parasitic plants (e.g.: *Orobanche, Phelipanche* and *Striga* spp.). Parasitic “witchweeds” and “broomrapes” are causing massive damage to cereal, legumes, solanaceous crops, sunflowers and to many other crops produced in the Mediterranean area and in the developing world; overall they are

among the most destructive weeds in agriculture around the world. They represent a serious risk for food security, because they substantially reduce yield, and may lead in some of the regions to increase poverty and hunger. This threat led the UN to state that *Striga* infection alone is the largest impediment to poverty alleviation in Africa and the Gates Foundation to support a *Striga* control project in 2011. Moreover, weed management of parasitic plants is extremely difficult. This is because almost all the traditional methods of control were proven to be scarcely effective. A better knowledge on their mode of action may lead to development of ways to block the SLs-related seed germination signal, and thus to prevent parasitic weed seed germination.

SLs act also in the rhizosphere as signalling molecules in the interaction with beneficial arbuscular-mycorrhizal fungi (AMF) and nitrogen-fixing bacteria of the genus *Rhizobium*, facilitating the establishment of these symbioses. In agricultural systems, SLs may be used for promoting these beneficial associations. For that purpose, a structure-activity relationship allowing reducing the molecular complexity to minimum structures while maintaining the essential functionalities and bioproperties is desired. The design and synthesis of analogues of SLs that are more potent or have longer sustainability in the soil is strongly needed. These may be used to specifically promote these beneficial symbioses in agricultural systems.

An additional agriculturally relevant aspect of SLs is related to nutrition balance. Since SLs are promoted under nutrient limiting conditions (mainly phosphorus and nitrogen), they are proposed to play a key role in the regulatory network for adaptation of shoot and root architecture to poor mineral nutrient supply, including the fostering of rhizosphere associations for added nutrient acquisition. An example for the usage of SLs in this regard is development of biotechnological means for treating plants in the field with SLs, with the aim of regulation of their shoot and root development. This will reduce the need for development of genetically modified crops, and may promote sustainable solutions to nutrient poor environments.

To conclude, a more comprehensive and coordinated knowledge on SLs, will facilitate the possibilities of implementing SLs usage in sustainable agriculture. In this sense, coordinated research on SLs, termed **STRigolactones Enhanced Agricultural Methodologies** (**STREAM**) consortium, in the frame of the COST program will provide a unique opportunity to create a forum for meetings and discussions on the concepts and understanding of SLs, as well as their potential use in agriculture for a variety of plant species and crops in Europe, but also in developing countries. Also, the network might be joined by people that have never worked directly on SLs, but their expertise could be very useful for opening new research frontiers: e.g. experts in parasitic weed managements and parasite biology, plant-microbe interactions, chemistry, bioinformatics, etc. Likewise, scientists from the industry may join the Action: their integration will promote further

collaborations financed by EU Framework Program and other European organizations, both as basic and applied research as well as the opportunity to jointly develop new means for efficient and specific application of SLs for agricultural usage.
As this is a coordinating network, it will foster collaboration rather than internal competition, avoid redundancies in research efforts, and allow the emergence of synergies in this highly competitive field of research. In later stages this network might lead to discover innovative research areas and to the ability to co-ordinately submit joint proposals for European research funds (e.g. the EU Framework Program).

B.2 Current state of knowledge

Strigolactones (SLs) have jointly been recognized as plant hormones by European groups and their collaborators quite recently (Gomez-Roldan et al., 2008; Umehara et al., 2008). They were first identified over 40 years ago as stimulants of parasitic plants (*Striga, Orobanche* and *Phelipanche*) seed germination (Cook et al., 1966, reviewed by Xie and Yoneyama, 2010; Rochange, 2010). Later, their activity as stimulants of hyphal branching for the symbiotic arbuscular mycorrhizal fungi (AMF) was discovered (Akiyama et al., 2005), showing a dual role for SLs in the rhizosphere (reviewed by Bowmeester *et al*., 2007; and Rochange, 2010). As plant hormones, SLs have been shown to act as long-distance branching regulators, suppressing the outgrowth of pre-formed axillary shoot buds (Gomez-Roldan et al., 2008; Umehara et al., 2008). This triple action of strigolactones as germination inducers of parasitic plant seeds and of AM fungal spores, and as inhibitors of lateral branching in plants, is a remarkable and intriguing plant signalling story (Tsuchiya and McCourt, 2009). Activities of SLs could be detected at concentrations as low as 10^{-13} M on AM fungi, $^{10-12}$ M on seeds of parasitic weeds and 10^{-8} M on lateral buds. Unexpectedly, although they belong to two different kingdoms, AM fungi and parasitic weeds, seem to share ecological and physiological similarities; for both, SLs serve as critical host recognition signals. SLs were initially characterized as sesquiterpenoid lactones but their biogenic origin from carotenoids was only discovered later on by a member group of this Action (Lopez-Raez and Bouwmeester, 2008; Matusova et al., 2005). SLs that have been isolated and identified so far invariably possess three annulated rings (the ABC ring system) connected with a five-membered -unsaturated lactone (the butenolide D-ring). The ABC unit has a variety of substituents. According to SAR (Structure-Activity Relationship) studies the bioactiphore of the molecule resides in the enol ether bridge connecting the C and D rings (Zwanenburg et al., 2009). The stereochemistry is also important. According to recent reports both the configuration of the tricyclic lactone and the D-

ring are essential structural requirements for induction of germination in *S. gesnerioides* seeds (Ueno et al., 2011). These compounds are present in root exudates of many plants in very small amounts (picogram level) and are extremely difficult to isolate and characterize. At the moment there are about 15 natural SLs known, but more to come. Only a few have been synthesized. Their presence has been demonstrated in a wide variety of plant species, including dicots, monocots and primitive plants, in which mixtures of several SL compounds have been found (Liang et al., 2008; Proust et al., 2011). They are synthesized in multiple plant parts, but roots are considered to be the main site of SL biosynthesis (reviewed by Xie *et al*., 2010). In agreement with their role of signaling molecules in the rhizosphere, their production is promoted under nutrient deficient conditions, mainly under phosphorous starvation (Lopez-Raez et al., 2008; Yoneyama et al., 2007). There is also some evidence of the presence of the SL orobanchol in the xylem sap of *Arabidopsis* (Kohlen et al., 2011), suggesting that root-derived SLs are transported to the shoot. It has been proposed that SLs and/or derivatives, or other unknown secondary messengers in the root-to-shoot direction might confer the observed reduction in shoot branching (Dun et al., 2009). Accordingly, an SL transporter has been recently identified in *Petunia hybrida*. The ABC transporter PDR1 was identified and suggested to have a key role in regulating the establishment of axillary branches and arbuscular mycorrhiza symbiosis by functioning as a cellular SL exporter (Kretzschmar et al., 2012).

A number of SL-associated mutants have been characterized in several plant species. These include both SL-synthesis and SL-signalling mutants. Mutations in MAX1, (More axillary grow 1), a cytochrome P450, and in two carotenoid cleavage dioxygenase (CCD) enzymes (CCD7/MAX3 and CCD8/MAX4) result in a hyperbranching phenotype and reduced levels of SLs, suggesting that they catalyze SL biosynthesis (e.g., Liang *et al*., 2010; Vogel *et al*., 2010; reviewed by Dun *et al*., 2009; Leyser, 2009). In addition, rice mutants in the iron-binding protein Dwarf27 (D27) are also deficient in SL levels (Lin et al., 2009; Waters, 2012). Recently, D27 has been suggested to be a β-carotene isomerase that converts all-*trans*-β-carotene into 9-*cis*-β-carotene. The latter may serve as a substrate for cleavage by CCD7, followed by a further cleavage by CCD8. The sequential action of these three enzymes produces carlactone, a compound with SL-like biological activities (Alder et al., 2012). As for potential master regulators, the GRAS-type transcription factors NSP1 and NSP2 have been shown to mediate SL biosynthesis pathways in rice and *Medicago* (Liu et al., 2011).

Other mutants have been found to be insensitive to SLs. Mutations in MAX2 which encodes an F-box protein that might be part of the ubiquitin-mediated degradation of as-yet unknown protein targets (Stirnberg et al., 2007), confer an over-shooting phenotype (Stirnberg et al., 2002). In these mutants, conversely to the other SL mutants, the branching phenotype was not repressed by

application of exogenous GR24 (Johnson et al., 1981) and was not associated with reduced levels of the SL orobanchol (Kohlen et al., 2011). Hence, MAX2 was suggested to be a component of SL signalling pathway (Umehara et al., 2008). Another gene associated with the SL response, or possibly SL processing to form a bioactive compound, is *DWARF14* (D14), encoding a protein of the alpha/beta-fold hydroxylase superfamily (Arite *et al*., 2009). Mutants in D14 of both rice and Arabidopsis showed a hyper-branching phenotype and insensitivity to SLs (Arite et al., 2009; Waters et al., 2012).

Additional roles for SLs in plants, including regulation of secondary growth (Agusti et al., 2011), adventitious root formation (Rasmussen et al., 2012) and root development (Kapulnik et al., 2011; Ruyter-Spira et al., 2011) were discovered. Moreover, several studies have demonstrated a role for SLs in shoot responses to low Pi conditions (Kohlen et al., 2011; Umehara et al., 2010).

Up to date, a considerable leadership in SL research is present within the consortium.. Even before the initial discovery of SLs as host recognition signals for AMF (Besserer et al., 2006, Akiyama *et al.* 2005) and as plant hormone regulating shoot branching (Gomez-Roldan *et al*., 2008), multiple European research groups (including the participants of this Action) have taken the lead, identifying the bioactiphore of the molecule and performing the first SAR studies for seeds (Zwanenburg et al. 2009 and references therein), characterizing the SLs activity on AMF cells (Besserer et al., 2008; Besserer et al., 2009), the presence and roles of SLs in diverse plant species (e.g., Liang *et al*., 2011; Proust *et al*., 2011), SLs origin in the green lineage (Delaux et al., 2012), their way of transport (Kohlen *et al*., 2011; Kretzschmar et al., 2012), the cross talk with other plant hormones (Boyer and et, 2012; Kapulnik et al., 2011; Leyser, 2009), their biosynthesis (Alder *et al*., 2012, Matusova *et al*., 2005), their activity in diverse plant processes (Agusti *et al*., 2011; Kapulnik *et al*., 2011; Ruyter-Spira *et al*., 2011; Kohlen *et al*., 2011) and the first structure-activity relationships for the control of shoot branching (Boyer and et, 2012) as well as deepening in their signalling role in the rhizosphere and use in sustainable agriculture (Koltai et al., 2010; Lopez-Raez et al., 2011). This COST Action will definitively help to maintain this leadership and may lead to advances in the global understanding of the biological role of SLs. The COST Action, by promoting discussion and coordination between the different research groups, will pinpoint the challenges of future SLs-associated research, priorities and opportunities from basic to applied aspects. Due to its novelty, major advances and breakthroughs can be expected to occur rapidly. Therefore, the results of the suggested network, which will stem from coordination between research groups, integration of skills from different disciplines and vigorous research collaboration, are likely to lead to innovations in identification of new roles of SLs in plants and their interaction with other hormones; completion of the elucidation of SLs biosynthesis, regulation, distribution and the transport of SLs

within the plant and specificity, identification of the SLs' receptor/s, new SL-like molecules and SL agonists and antagonists; as well as extended knowledge on the role of SLs in the rhizosphere for beneficial and parasitic associations.

B.3 Reasons for the Action

According to Horizon 2020 guidelines **(**"Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions", Innovating for Sustainable Growth: A Bioeconomy for Europe, Brussels, 13.2.2012 COM(2012) 60 final, http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=me&video=ne, http://ec.europa.eu/research/bioeconomy/), one of the most important aims for Europe is to increase agricultural production according to emerging concepts of sustainability. This imposes the need for investigations leading to the identifications of agricultural procedures allowing better exploitation of both water resources and soil nutrients or resistance to pests, including parasitic weeds. The development of new management solutions and the assessment of their cost-effectiveness as an alternative to more traditional approaches require serious efforts for trans-sector and European-wide coordination and research. Since SLs are at the interface between plants, microorganisms and a changing environment, they may offer a potent tool for sustainable agricultural developments. For example, the use of SLs may reduce the need for herbicide due to SLs activity in controlling parasitic weeds germination. Another example is that SLs use may reduce the need for phosphate fertilizers by increasing AMF symbiosis. Even though SLs are a growing hot-topic for many laboratories across disciplines, there is no official network, neither in Europe nor in the rest of the world. Therefore, **STREAM** goal is to contribute substantially to the coordination and defragmentation of research across Europe and to the strengthening of Europe's scientific networking capacity.

The main objective of this COST Action is the creation of a network of researchers studying the biology and potential exploitation of the SLs. This Action will allow the exploration of synergies, the investigation of promising new ideas and research projects, the development of new research lines, the expansion of multidisciplinary research capacity in Europe, and the generation of scientific and technical knowledge.. To this regard, **STREAM** is expected to further strengthen the current strong leadership of European scientific groups in this field, while establishing an interdisciplinary top-level coordinated network bringing advances in the global understanding of the biological roles of SLs. **STREAM** aims both at scientific/technological advancement and at answering European economic/societal needs, as it is expected to unveil the knowledge base to

exploit the potential of SLs as a new and innovative tool in sustainable agriculture. Thus, the specific objectives of the COST Action are: (a) to create a forum for discussion to integrate different expertise and knowledge on SLs, to promote synergies and to pinpoint areas where knowledge or research is lacking and to fill these gaps; (b) to train skilled young scientists to work on the various multidisciplinary aspects of SLs biology in order to contribute to the European Research Area; (c) to create a European community focused on SLs within which innovative research areas can be generated. Expected results are: (a) establishment of an effective and efficient network able to cope with the technical challenges of SLs-associated sustainable agriculture, (b) education of scientists from diverse disciplines long after the Action is finished; (c) knowledge, in the forms of new, active research approaches, long lasting collaborations, publication in applied and basic science journals, patents, public website, and future development of agricultural products, to support the exploitation of SLs as crop enhancing agents through its action on root symbioses and parasites and as plant growth regulators in line with the movement towards low impact agricultural practices.

The networking funded by COST will provide excellent opportunities to integrate on going and new research areas, as well as different expertise and is therefore the best funding scheme to meet the objectives aimed at by the proposers. The specific means are: a) conferences, workshops, thematic training courses to disseminate and integrate knowledge on SLs; b) a public website for internal management and for dissemination of activities and outcomes and; c) patents and scientific publications, including reviews and perspectives in prestigious, basic and applied sciences, scientific international journals.

B.4 Complementarity with other research programmes

The Action is in line with the strategic objective of 7th Framework Programme and the **Theme 2: Food, Agriculture and Fisheries, and Biotechnology,** that is Building a European *Knowledge-Based Bio-Economy*. In this sense, the novel control and biofertilising management approaches should meet **the growing demand for safer, healthier, higher quality food and for sustainable use and production of renewable bio-resources**.

Furthermore, the project would make available novel and safer methods of control against **threats to the sustainability and security of agricultural production** giving an important support to the **increasing demand for high quality food.**

The aim of, and the activities of the Action fit perfectly within the main objective of the recent calls of the 7th EU FP within Activity 2.1, that is: **Sustainable production and management of**

biological resources from land, forest and aquatic environments.
Moreover, the Action fits perfectly with the requirements of the programme, i.e. safe and environmentally friendly method of management in conventional and **low input farming systems for integrated productions** as well as in **organic agriculture**.
The Action is in line with some of the aims of the "ENPI CBC Mediterranean Sea Basin Programme 2007/2013", a multilateral cross-border cooperation programme co-financed by the European Union under the European Neighbourhood and Partnership Instrument (ENPI).
The Programme provides the framework for the implementation of cross-border cooperation activities in the context of the European Neighbourhood Policy, complementing efforts exerted within the framework of the Euro-Mediterranean Partnership, with the final aim of developing an area of peace, stability, prosperity and good neighbourliness involving EU Mediterranean Countries (EUMC) and Mediterranean Partner Countries (MPC).

Several ongoing research programs show complementarities with the multi-faceted topic of this COST Action.
A collaborative project on comparative genomics of shoot branching (COGS) was completed in 2010. The project was funded as part of the ERA-Net in Plant Genomics and included analysis of the SL pathway. Related interests in this project regard the modulation of shoot branching in vegetable crops.
Work on the environmental control of shoot branching, particularly in response to nutrient supply, has recently started, funded by an ERC funded advanced investigator award (EnCoDe 294514, Jan12-Dec16). Additional work on the molecular mechanism of SL action is currently funded by the Gatsby Foundation.
A participant in this Action is currently carrying out a nationally (DFG) funded project entitled “Uncovering the role of apocarotenoids in the arbuscular mycorrhizal symbiosis via mutation and knockdown of biosynthetic genes”. These colleagues are further involved in a pending Leibniz-PAKT proposal on “Plant Adaptive Networks: Coping with Global Change” in which a project focuses on SL biosynthesis in responses to phosphate limitation.
Projects such as EAU4FOOD or SUNRAY financed by the European Commission in the frame of the FP7 calls KBBE.2010.1.2-03 (Sustainable water resources management and Soil fertility conservation for food production in Africa) and KBBE.2010.2.2-03 (Identifying research needs on malnutrition in Africa) also will give ample opportunities for interaction and productive cross-feeding.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The aim of this COST Action is the creation of a multidisciplinary network of experts, of basic and applied sciences, who can share expertise and developmental knowledge about the multifaceted biological role of Strigolactones. The coordination of the research activities is aimed at the exploitation of SLs in the development of new agro-technologies. The research in this field has a strong interdisciplinary nature, as chemists, biochemists, plant biologists, mycologists, biotechnologists and agronomists will cooperate by means of the flexibility of the COST Action and will overcome the fragmentation of the rapidly increasing number of research projects currently ongoing on this topic. STREAM will represent a dynamic network of scientists and stakeholders who will apply new understandings to develop novel concepts for parasitic plant control and for the improvement of plant production in a more sustainable framework. The outcome of the Action will be the creation of an integrated strategic community focused on SLs and their use both in basic science and applied science to promote biomass and yield production of agricultural crops while simultaneously reducing the input of agrochemicals. The networking funded by COST will provide excellent opportunities to generate new research areas and capabilities, being therefore the best funding scheme for the objectives aimed at by the proposers.

C.2 Objectives

The objectives of the STREAM Action can be summarized at three main levels.

a) Scientific:

i) **Objective:** Coordination in rising to the challenges of research in the SL field, the priorities and opportunities for further research on SLs from basic to applied aspects, building synergies and eliminating duplication. **Outcome**: Sharing and increasing basic knowledge on SLs biology.

ii) **Objective:** A common and shared scientific approach to investigate the multiple roles of SLs. **Outcome**: Coordination in the standardization of experimental procedures, protocols, methods, evaluation and interpretation of results.

iii) **Objective**: Widen the common view on roles and potential of SLs both in basic and applied science to scientists from all over the world. **Outcome**: Integration into the network of scientist from non-EU countries.

Numbers of publications and presentations to international congresses by partners will be chosen as criterion to evaluate the implementation of the Action.

b) Technological:

i) **Objective:** Highlighting new perspective and opportunities for potential SL application. **Outcome**: Interaction between researcher from academia and industry.

ii) **Objective**: evaluation of the potential of SLs applications in identifying innovative and unified management strategies to combat pests plague in whole European area, Mediterranean and Africa. **Outcome**: Addressing the problem of root parasitic weed infestations that affect vast region in the Mediterranean area and Africa.

iii) **Objective**: Evaluation of the potential of SLs applications in identifying innovative approaches for regulation of both root and shoot development for improved agricultural productivity. **Outcome**: Addressing the utilization of SLs for regulating of plant development and production.

iv) **Objective:** New opportunities for the reduction of agrochemicals in agriculture. **Outcome**: Addressing the utilization of SLs to improve the efficiency and quality of AMF and rhizobial inocula used as biofertilizers to reduce chemical fertilization.
Involvement of industries, patent applications will be chosen as criterion to evaluate the implementation of the Action.

c) Training:

i) **Objective:** Increased knowledge and expertise for young researchers from different fields and disciplines that will persist beyond the end of this Action. **Outcome:** Capacity building of young researchers in the field of plant biology.

ii) **Objective:** In addition to coordinating existing research groups and projects, the opportunity to share knowledge stimulate the emergence of new research ideas, projects and tools and skills. **Outcome:** Establishing regular meetings and conferences discussing the progresses in the field.

iii) **Objective:** Increasing accessibility of communication and interaction between COST participants, creating a prompt, updated and reliable network of information and coordination while expanding the network and collaboration beyond borders and disciplines. **Outcome**: Establishment of communication tools (websites, online platforms, forum of discussions.

Number of Early Stage Researchers (ESRs) involved; number of Training Schools and STSMs will

be chosen as a criterion to evaluate the implementation of the Action.

The objectives of this Action require a support to foster the dialogue between the research communities working on SLs across Europe and the COST funding scheme will permit to create this suggested, coordinated and connected series of activities. A supervised series of activities and coordination actions provide significant means to open a fruitful exchange of ideas, transfer of tools and generation of new research lines. A special effort will be dedicated to Outreach Activities n order to make the general public informed about the **STREAM** Action, activities as dissemination by means of interviews, articles on newspapers, presentations at scientific events aimed at the general public such as “The researchers Night”, ESOF (Eurocience Open Forum).

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

- Networking is one of the most important keys to success in achieving the objectives defined in this Action and detailed above. Surprisingly, even though SLs are a prime interest for many research groups around the world, there are no official networks associated to this topic. The interest in this COST Action was enormous with an estimated size of more than 100 scientists interested in participating to **STREAM**. The high impact and potential of SLs as crop enhancing agents and plant growth regulators, as well as ongoing research collaborations within Europereflects the large number of institutions already actively involved in research on SLs, and the great interest in timely initiation of this Action, i.e. the need for a joint networking approach and for developing sustainable management measures that can be applied throughout Europe. The scientists and institutions that have expressed the interest in the Action have very well equipped and organized laboratories for chemistry, biology, molecular biology, etc. Some of the equipment is very expensive (E.G., LCMS-MS, Genomic infrastructure, etc). Within the Action facilities and expertise could be shared for increment of research capabilities of the group as a whole. Thus, a strong and multidisciplinary backbone is expected to be created by the Action, covering all key aspects in the field of SLs’ research, from biology to chemistry, from parasitic weeds to AM fungi, from genetics to secondary metabolism.
The objectives will be achieved by establishing an interacting network of scientists currently involved in national and international projects on various aspects of SLs in Europe. Additionally, scientists working in other fields of study, as breeders, or chemists working on synthesis, or plant physiologists, or weed managers could find an interest in this network and join the Action. The

networking will be strengthened by the organization of Working Groups (WG). The WG will allow a dynamic organisation with numerous interactions among the different WGs in order to build an interdisciplinary approach aimed at a full understanding of the biological role of SLs and their potential in developing new sustainable agricultural methodologies. A strong emphasis will be given for coordination between WGs to exchange research directions, information and expertise. Each WG will have a WG Coordinator responsible for the whole coordination of the WG. In addition, within the COST activity, workshops, research exchanges, Training Schools, mobility, conferences and joint publications will initiate new scientific collaborations and identify research priorities that will lead to funding applications at the national and international level, with the specific objective of providing doctoral or post-doctoral research opportunities.
There will also be a strong emphasis on knowledge and technology transfer by including stakeholders from the beginning of the Action. A final high-profile international meeting will disseminate the Action outcomes to policy-makers, conservation managers and stakeholders.

C.4 Potential impact of the Action

I. **Impact on increased plant production according to emerging concepts of sustainable agriculture**. The STREAM network may lead to new plant management solutions and the assessment of their cost-effectiveness as an alternative to current agronomical approaches. This include the identifications of agricultural procedures allowing better exploitation of both water resources and soil nutrients or resistance to parasites, with the final goal of reducing the use of agrochemicals.

II. **Impact on advances in scientific/technological understanding of SLs.** The **STREAM** Action is expected to create a network of researchers studying the biology and potential exploitation of the newly identified plant hormone SL. This Action will permit exploration of synergies, structuring of promising new ideas and research projects, development of new research lines, increases in the multidisciplinary of European researchers, and generation of scientific and technical knowledge. Moreover, the Action is aimed both at scientific/technological advance and to European economic/societal needs, as it is expected to unveil the knowledge basis to exploit the potential of SLs as a new and innovative tool in sustainable agriculture. In this regards, several advances may be foreseen:

1. **SLs as plant hormones** for e.g., regulation of both root and shoot development in response to growth conditions, adventitious root formation during propagation of certain horticultural plants by cuttings, which need to set new roots.

2. **SLs and parasitic plants (signalling)** for promotion of the combat against the devastating effects of witchweed and broomrape root parasites with novel ideas like suicidal germination of weed seeds by synthetic germination stimulants derived from SLs, which induce seed germination in the absence of a host root so that seedlings are unable to develop further.

3. **SLs and soil biota (signalling)**, for evaluation of the efficacy of SLs as promoters of root symbioses in the field.

4. **SLs chemistry and biochemistry**, for discovery of the mode of action of SLs, identification of the specific receptor/s involved in the perception and in the signalling processes as well as in the endogenous hormonal function, and for the development of new SLs analogous with improved efficiency and sustainability. Importantly, suitable analogous could be used for the needs of all above expected advances, for exploitation of the potential of SLs in agriculture.

III. **Impact on maintenance of the strong leadership in this field currently held by European scientific groups**. The **STREAM** network will help to maintain this leadership and will set up an interdisciplinary top-level coordinated network bringing advances in the global understanding of the biological roles of SLs. Partners involved in STREAM come from academy, public and private research centres and from industry. Therefore, the outcome of the Action will be the creation of an integrated strategic community focused on Strigolactones and their employment both in basic science and applied science.

C.5 Target groups/end users

The COST Action is aimed at the following target groups:

- § Scientists and students researching/teaching in the areas of plant physiology, biology, management, nutrition, genetics, chemistry, ecology, pathology, agronomy, weed science, biological control.

- § ESRs (Early-Stage Researchers) who will be involved in an international, multi-disciplinary research framework that will stimulate their creativity and professional growth. The Action will thus provide practical support to build on their successful career with gender balance. ESRs will be involved from the inception of the project and the preparation of the Action proposal, including especially women.

- § SMEs, spin-outs and agrochemical industries involved in weed management and crop nutrition.

The Action will bring benefits for the following end-users:

- § The scientific community by providing a framework where new progress in the understanding of SLs challenges, priorities and opportunities for further research, development and application in sustainable agriculture will be obtained; standardization of research protocols and methods will be agreed; better access to research results leading to effective knowledge transfer to the industry and related policy issues will be facilitated; interactions between researchers from academia and industry that highlights new opportunities and perspectives for the potential applications of SLs will be strengthened.

- § The private sector, especially SME's and spin-outs, and agrochemical industries by providing opportunities for establishing collaborative projects to develop efficient, safe and reliable and advanced methods for improving crop quality and safety.

- § Consumers, asking for safe and healthy food. The presence of residues of chemicals represents a risk for the human health, particularly for those crops, such as vegetables, that are used as fresh products. Consumers desire reduce levels of residues of synthetic compounds in food products, and many have increased their interest in products obtained by organic or low input farming systems, such farming systems may be enhanced by the use of SLs.

- § Low-input and conventional farmers, needing to lower chemical inputs for their crops, in order to reduce the impact of the agricultural expectations of practices on the environments; meet the expectations of consumers for safe food; and respect the more restrictive laws banning the use of several well established and hazardous synthetic pesticides. SLs are the most important signal in the crop-parasitic weed interactions and thus understanding their biology their knowledge can offer novel strategies in parasitic plant management and effective alternative to the methods now available, some of which very efficient but with tremendously negative environmental effects.

- § Organic farmers, asking for natural and effective alternative to the synthetic fertilizers and pesticides as most chemical control and fertilization strategies are forbidden in organic agriculture.

National and European Policy makers, needing on one side to withdraw dangerous agrochemicals from the market, and on the other side to make satisfactory alternatives available to farmers.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The Action is structured into four Tasks:

1. The COST Action will be focused on the creation of a network of researchers studying the biology and potential exploitation of SLs and facing the inevitable technical and scientific challenges involved in every new field of research. SLs have become a cutting-edge topic in plant biology and agriculture. Due to the novelty of the topic, the research in this field is still in its infancy, as a consequence major advances and breakthroughs can be expected to occur rapidly. The research on SLs should have a strong interdisciplinary nature. However, so far the different research groups are working rather independently with a consequent lack of expertise and knowledge transfer.

2. STREAM will promote the Interaction between researchers from academia and industry. Scientists from the industry, besides those already apart of the suggested network, will be welcomed to join the Action: their integration will promote further collaborations financed by for example, the

EU Framework Programme and other European organizations, both as basic and applied research as well as the opportunity to jointly develop new means for efficient and specific application of SLs for agricultural usage. Moreover, this kind of cooperation will highlight new and additional opportunities and perspectives for the potential applications of SLs.

3. The study of SLs study is a young and very dynamic field. As such, the suggested COST Action will be open for integration of additional research groups, from Europe and worldwide. An aspect that will be strongly emboldened is the capacity-building of young scientists in the field of SLs research. Young researchers will be encouraged to participate in the **STREAM COST Action** by presenting their work and exchanging ideas with other scientists; this is expected to encourage them to develop their independent research activity. SLs are highly relevant to presumably all higher plants, many of which are important agricultural crops that provide basic nutritional needs for a large part of the human population. Hence, the creation of a European network as suggested here represents not only a strong European added value for farming, but may promote crops and regulate their development in low input agricultural systems in non-European countries as well. As signalling cues in the rhizosphere, SLs promote AM symbiosis establishment, association which is being implemented in environmentally friendly agricultural systems. Moreover, because of their dual signalling role belowground, SLs have been proposed as a target for pest management. As mentioned above, root parasitic weeds are a serious threat to agriculture causing enormous crop losses not only in Europe, but especially in developing countries. With this perspective in mind, this COST Action will be open for participants also from other parts of the world, aiming to promote SLs as crop enhancers, plant growth regulators and biological control agents.

4. The broad spectrum of SL functions requires the integration of researchers with different expertise. A COST Action is an ideal framework to combine and integrate these various competences and to provide a forum for meetings and discussions on the concepts and requirements of SLs and their potential use in agriculture. This will be done by scheduling regular meetings and conferences discussing the progress in the field, and by the establishment of communication tools (such as websites and online platforms).

"In order to fulfil the scientific focus and to achieve proposal's aims", the following human and technical means are needed:

(a) **to create a forum of discussion to integrate different expertise and knowledge on SLs, to**

promote synergies and to pinpoint lacks in knowledge or research and to fill them: conferences, workshops for each of the WPs, training courses and scientific missions will be employed.

(b) **to train skilled young scientists to work on the various multidisciplinary aspects of SLs biology:**, thematic training courses, congresses and conference to disseminate knowledge on SLs will be employed. In these, young scientists will be encouraged to present, in a supportive and positive atmosphere, their work, their views and future plans.

(c) **to create a European community focused on SLs within which applications for European projects funding can be generated**: a public website for internal management and for dissemination of activities and outcomes and scientific publications will be created, including reviews and perspectives in prestigious, basic and applied sciences international journals will be published.

D.2 Scientific work plan methods and means

Synergies are the *raison d'être* of **STREAM**. This network has been built around complementary research teams exerting their activities in different domains of plant, fungi and bacteria biology and biochemistry. Having this in mind, the suggested COST Action will be focused on the following tasks. SLs in plant as hormones (Task 1, PH), SLs in parasitic weeds (Task 2, PP), SLs and soil microbiota (Task 3, SM) and the chemical/biochemical aspects of the SLs biology (Task 4;CB).

The Action aims to integrate the expertise from different areas of study to extend and deepen knowledge on the biological roles of SLs and to assess their potential in low-input agricultural methodologies. It will be essential, therefore, to establish a dynamic organisation with much interaction among the different WGs in an inter- and trans disciplinary way.

E.1 Coordination and organization

The **Management Committee** (**MC**), formed by the national representatives (NR) of the participating countries will coordinate the **STREAM** COST Action and will meet twice a year preferably in relation to other activities of the Action and will create and maintain contacts with appropriate ongoing COST Actions for synergies. During the first MC meeting, leaders of Working Groups (WG), a Training Coordinator (TC) and a Dissemination Coordinator (DC) will be appointed. A Chair and a Vice Chair person (to be elected within the MC participants), the WG leaders, the TC and the DC will form the **Steering Group (SG)** whose tasks will be to assess the deliverables (workshop reports, mid-term reports, and the annual reports), monitor the

budget, evaluate the financial situation, evaluate Short Term Scientific Missions and report to the MC. The SG will meet twice per year (including an annual meeting with the MC) and in addition will solve most of the issues by email and phone/video conference. The coordinating Institution (University of Turin, Italy) has a long record in coordinating European projects, previous successful projects which have been coordinated by UniTO are:

Project ID	Acronym	Call
235141	AlpineFragmentation	FP7-PEOPLE-IEF-2008
247852	ANGIOFISH	FP7-PEOPLE-2009-RG
295854	BABE	ERC-2011-ADG_20110406
253534	cmads	FP7-PEOPLE-2009-IEF
259015	COLTHERES	FP7-HEALTH-2010-two-stage
273518	DECODER	FP7-PEOPLE-2010-IOF
269327	EPSEI	FP7-PEOPLE-2010-IRSES
293406	LisGenOmics	FP7-PEOPLE-2011-CIG
242965	LUNELY	ERC-2009-StG
201862	MetaFight	FP7-HEALTH-2007-A
220005	NEURALSTEMIMAGING	FP7-PEOPLE-2007-4-1-IOF
318899	PHOTOMAT	FP7-PEOPLE-2012-IRSES
219350	PHOTONIT	FP7-PEOPLE-2007-4-2-IIF
261752	PLANTFOODSEC	FP7-SEC-2010-1
200239	ReaSON	FP7-PEOPLE-2007-5-1-1-NIGHT
281072	RSSCEMSR	ERC-2011-StG_20101109
256653	SSH2S	FCH-JU-2009-1
251854	SYMBIOJETS	FP7-PEOPLE-2009-RG
298821	UHMSNMRI	FP7-PEOPLE-2011-IIF
255333	Unlawful Profits	FP7-PEOPLE-2009-IEF
CIP	HAPPI	Funded under CIP programme-Call 2011

The management knowledge which has been acquired by the coordination of previous European

networks of similar nature ensures to correct management of **STREAM**.
In particular, the TC will take care of the organization and coordination of **Short Term Scientific Missions (STSMs)** to enhance the mobility of Early-Stage Researchers (ESRs) and foster collaborations between institutes and laboratories of the participants' countries. The TC will also be in charge of organizing Training Schools **(TS)** for both students and scientists involved in the Action. In these TS activities will include hands-on and workshops, for training and acquisition of methods and expertise. Also, time will be given to informal discussions. Such events will strengthen the connection among the participants and especially among ESRs. In the course of the Action, as new developments in research will be witnessed, new topics will be identified and integrated. Moreover, to enhance international networking and capacity building activities, other than thematic Working Groups, various means will be implemented such as state-of-the-art communication methods that are well suited for various aspects of science and communication.

The DC, nominated during the first MC meeting, will supervise all the dissemination activities involved during the implementation of the Action. He/She will also be responsible for setting up the Action fact sheet, the Action Leaflet and the Action Poster at the beginning of the Action. He/She will coordinate the work of the Editorial Board (EB) nominate by MC in the elaboration of the State-of-Art Report, Final Report and Special Reviews. The DC will prepare and update the **website o**f the **STREAM** COST Action. The connection among participants between the meetings will be strengthened by preparing, collecting and editing information about partner groups, research activities, conference/workshops/symposia, list of potential host groups for short visits and training, forthcoming activities, mutual publications, common participations and provide a complete list of **STREAM** MC members and a short CV of each member.
A scientific discussion forum will be included in the site. Most of the areas will be made available to general public to ensure wide dissemination of the Action results, while access to other parts will be restricted to participants only. The website will be updated regularly with the help of graduate students involved in the Action.

The MC is responsible for planning and controlling the activities within the available budget, will monitor and evaluate the achievement of objectives and all ongoing activities. The MC will make the priorities within the frame of the WGs-descriptions.

- Participants will specify their own aims and contribution to the Action through the Expression of Commitment scheme recommended by the Domain Committee.

Milestones:

Milestones	**Month**
Nomination of the National Delegates to form the MC	M1
Launching MC meeting during which a Chair and a Vice chair, leaders of WGs, a TC and a DC will be appointed.	M3
Organization of regular meetings of the WGs	(M4-6, M10-12, M16-18, M22-24, M28-30, M34-36, M37-39, M43-45)
Organization of an annual international summit conference where the results achieved in the four Tasks will be presented.	(M11, M23, M35)
Organization of Training schools of the four WGs	M10-12, M22-24, M34-36, M43-45
Approval of annual report Separate or combined meetings of WGs and STSM	M14, M26, M38
Final Stakeholder Conference and Final Plenary Meeting, MC Meeting, Approval of the final results and reports of the Action	M46-48

E.2 Working Groups

This COST Action will be coordinated as a dynamic organisation with numerous interactions among the different Working Groups (WGs) to build an interdisciplinary approach to a full understanding of the biological role of SLs and their potential in developing new sustainable agricultural methodologies. Research in this COST Action will be primarily based in the WGs with a strong emphasis in horizontal contacts across the Action and coordination between Working Groups to exchange research directions, information and expertise. Each WG has a Working Group Coordinator responsible for the day-to-day coordination of the WG itself. Many participants in the Network will participate in more than one WG since reaching the objectives of the Action needs different combination of experts in different areas at different times.

The work in this COST Action will be organised in four Working Groups:

WPs	Acronym	Title	Task
WG 1	**PH**	SLs as Plant hormones	Task 1
WG 2	**PP**	SLs as signals for parasitic plants	Task 2
WG 3	**SB**	role of SLs in the soil biota	Task 3
WG 4	**BC**	Biochemistry of SLs/design and synthesis of analogues	Task 4

The four Working Groups will coordinate the activities in these research areas, but also new areas resulting from ideas sparked by the dialogue that will be created and sustained between the research communities of plant science, chemistry and biochemistry.

Examples for WGs interactions may include transfer of data regarding plant SL receptors (WG1) to better design SL analogues (WG4); on the other hand WG4 will support design of SL analogues for affecting plant biological traits (WG1). WG1 will examine SLs biosynthesis pathways that may attenuate the symbioses and parasitic association in the rhizosphere (WG3 and WG2), whereas WG3 may unveil what might be the effect of symbiosis on SLs-related plant biology (WG1). WG4 may design and synthesize SLs analogues for promotion of beneficial symbiosis between plants the soil biota (WG3). WG3 may examine the effect of symbiosis on plant parasitism by parasitic plants (WG2), whereas WG2 may unravel specific requirements for SLs analogues synthesis (WG4) that may serve for suicidal germination of parasitic plant (WG2).

The new ideas emerging from the activities of the Action will be analysed collaboratively by the experts from plant science and agronomists. The specific outputs of the scientific programme will arise from the actual dialogue and analysis carried out by the WGs and between them, following a bottom-up approach.

E.3 Liaison and interaction with other research programmes

With a number of related COST Actions synergies are expected and should be promoted by joint workshops or publications. The following Actions are likely to offer opportunities for collaboration:
1) The recently completed COST Action 849 on Parasitic Plant Management in Sustainable Agriculture. 2) COST Action FA1105, 'Towards a sustainable and productive European organic greenhouse horticulture', 3) COST Actions Metabolic Engineering, FA1006, PlantEngine and the "EU-ROS" (oc-2011-2-11049) respectively – partners are already involved in the projects.
In addition, interactions will be established with 1) the European Networking Summer School (Plant Genomics & Bioinformatics) (ENSS), which is organized by the ESF, in order to attract a broader group of students and young researchers to the **STREAM** workshops and conferences; 2) A two- year project whose aim is to use click chemistry to label SLs with specific tags for microscopy imaging supported by a French regional funding, 3) The ANR "Blanc" project: 'Strigolactone (and/or derived molecules) signalling pathways in land plants" – one of the participants is the coordinator of the project, 4) The WP focused on SLs in the Regional project on Converging Biotechnologies (BIOBIT-CIPE) http://www.biobits.di.unipmn.it/. The project puts together groups from Plant Biology, Informatics, Chemistry, Agricultural School, as well as many private companies- one of the participants is the leader of the WP.
Moreover, one of the participants is the supervisor of a Marie-Curie IEF fellowship on "Age Related changes in Strigolactone control of adventitious root initiation"

Also it is envisaged that interactions with the International Parasitic Plant Society, European Weed Research Society, and American Chemical Society will be established.

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.
The coordinator of this COST Action is female, the *vice*-coordinator and 35% of the group leaders that expressed their interest in **STREAM** so far are female. At the moment of the

nomination of the WG leaders, the chair and vice-chair person of MC, the TC and DC a special attention will be devoted to the gender balance. Therefore, contacting female to become participants will be of highest priority in order to maintain the balance of female experts in the leadership of the Action. Each of the participating institutions will be requested to comply with an appropriate gender balance in recruiting its personnel for the participation in the Action. For this, the Action will **include a gender Action plan** to promote gender equality in all forms within the network.

The involvement of ESRs in order to enforce capacity building efforts within European Science is one of the main aims of this Action. Furthermore, due to the strong interdisciplinary aspect of the Action, **STSMs** will be offered to young scientists and scientists from developing regions. STSMs will facilitate transfer-of-knowledge and training in new techniques or shared use of critical equipment or field sites. To facilitate exchanges and STSMs a special attention will be devoted to accommodation and facilities for young ESR with children as this aspect has been often been claimed to be a limiting factor for exchanges especially for young female scientists. The general aim is to foster personal connections that will bridge gaps in know-how and open doors for future career development on the world stage.

F. TIMETABLE

The proposed duration for this Action is **4 years**.

- The **Launching MC meeting** will start the Action and during this meeting, the WG coordinators will be selected. WG will be discussed and refined, and time table for activity will be scheduled. STSM plans and event announcements will be advertised immediately following the launching Meeting.

The specific coordination activities of this COST Action will be decided at the first MC meeting, in the first month of the Action, when preparations for the first conference, Workshops and WG meetings will be made.

- The **homepage** will be created soon after the launching meeting and will be updated on regular basis.

Each WG will hold two meetings every year.

The Action will finish with an international summit conference where the results achieved in the 4 Tasks will be presented. Each year there will be at least two meetings of the MC, at least one meeting of the SG and at least two meetings of each WG, with meetings of the MC, SG and

WGs coinciding with an annual workshop.

- **Training schools** of the four WGs will be organised every year.
- **Plenary Management Committee meeting** will take place twice a year. It will be linked to the meeting of the Working Groups and organized possibly in connections with major scientifically related international events.
- Reports will be generated at the end of every year
- **Short-Term Scientific Missions** can be requested at any time after the first WG meeting.

	YEAR 1				**YEAR 2**				**YEAR 3**				**YEAR 4**			
Coordination	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Website	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
launching meeting	x															
MC meetings		x		x		x		x		x		x		x		
SG meetings		x				x				x				x		
WGs meetings		x		x		x		x		x		x	x		x	
Training Schools				x				x				x			x	
STMSs			x	x	x	x	x	x	x	x	x	x	x	x	x	x
Reporting				x				x				x			x	
Final conference																x

- **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 outputs and ideas.

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

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, CH, CZ, DE, EL, ES, FR, IL, IT, NL, PL, PT, RO, SK, 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 findings and results of the COST Action will be disseminated to the various target groups including other researchers in the field; other research frameworks; research and agricultural institutes and universities; practitioners such as farmers, advisory services, municipalities, plant protection services; national authorities and policy makers in the ministries of health, environment, agriculture and traffic; European level policy makers in the DG for Agriculture & Rural Development, DG for Research, DG for Environment and DG for Health and Consumers of the European Commission, European and International organizations dealing with IAS, and not least the general public.

Targeted communities	*Communication strategies*
Project partners	Daily exchange by electronic means, annual meetings and reports, topical intermediate meetings, internal reports, exchange of personnel, website
Academics	Articles, patents, conferences, websites
Industries and SMEs	Articles, conferences, patents, consultants, web sites

Finance	Project showcases, reports, websites
National Contact Points	Reports, website
Journalists	Reports, interviews, websites
Governments	Reports, website, expertise
General Public	Website, interviews, articles on newspapers

H.2 What?

The Action will prepare a dissemination and sustainable operation plan that will be updated throughout its duration to transfer results to different target audience and communities.
During the Action the following dissemination activities are expected:
Press releases and publications for the general public.
An action Brochure will be designed at the beginning of the Action.
Public access website and password protected website for working documents.
Publications: articles in peer-reviewed scientific and technical journals, state-of-the-art reports and proceedings, guidelines and best practice manuals, interim and final reports acknowledging the COST Action.
Events: workshops and conferences of the Action (key international experts in the field will be invited as speakers, when appropriate); organization of, and contributions to, other national and international conferences and symposia (to promote the European know-how and expertise in the area).
STSMs, Training Schools and other teaching activities.

H.3 How?

Project web-site
The World Wide Web has become a major information channel and it has become indispensable for producers of information, particularly in the scientific and technical domains, to publish on the web. As soon as the project will start, an official project web-site will be realized and published on the net. It will contain details on aim of the project,

background on the partners involved, work-packages, programme, meetings, activities, forecast and obtained results, calls for STSM; reports of workshops and meetings; links to other COST Actions and framework programmes; job and fellowship availability. It will be updated on a regular basis and it will contain continuously updated information.
Within the official project Website a special form for request of information and suggestions will be created, in order to allow interested end-users to contact the research group for specific purposes and needs. An open moderated blog will be created under the responsibility of the project manager, in order to easily express opinions, give suggestions, and comment the information available, addressing them to a wider audience. Advanced social networking options (moderated mailing list, Twitter, Facebook) will be managed for a free, open and on-time circulation of the news related to the COST Action.

Project brochure

A brochure of project will be prepared in sufficient amounts to be distributed to each partner. It will work as a calling card for presentation to influential readers, such as European policy-makers, international, national and local authorities, potential partners, investors, industrial end-users, technology licensees, media representatives. It will provide an overview of the consortium, highlighting the reputation/strengths of individual partners; it will summarize the background and technological rationale for undertaking the initiative and indicated the results, emphasising the scale of breakthrough/innovation expected to be achieved.

Press releases and publications for the general public

The activity of the COST Action will be drawn to the attention of the scientific community, governments, policy makers and the citizens of Europe by production of a press release at the commencement of the Action at the launching Meeting and at the Final Conference. These will be released in all the countries taking part in the Action. For this, contacts with media via press offices and communication services of each participating institution will be established.

Publications

The scientific results of the project will be published in refereed peer reviewed scientific journals, joint publications are encouraged.
State-of-the-art reports and proceedings will also be encouraged in order to disseminate results to a broader, less specialized public to provide information to end-users.
Interim and final reports will be produced as part of the requirements of the COST Action and to communicate our findings among the participants of the Action.

Events

Workshops and conferences of the Action: the Action will run open sessions at the Workshop

Meetings and the Final Conference to inform interested scientists, regulatory bodies and policy makers about the results of the project. Efforts will be made to have the proceedings of the conferences published in special issues of appropriate international peer-reviewed journals. Members of the Action are either on editorial boards of such journals or have contact with the editorial boards.

Conferences of associated learned societies**:** participants of the COST Action will present the concepts and achieved results at international and national conferences (e.g. European Weed Research Society Symposium, International Parasitic Plant Congress, etc.) or organize specific session at European or international conferences in order to disseminate the knowledge and data resulting from the COST Action activities. This will increase the knowledge base in COST countries and will further lead to increased international visibility and collaboration.

Short-Term Scientific Missions and teaching activities

Short-Term Scientific Missions will allow the dissemination of accumulated knowledge on SLs to early-stage as well as senior scientists who require such knowledge for the first time. Thus, the STSM will facilitate technology and knowledge transfer within the Action and increase the opportunities for synergies between experts and early-stage researchers.

The COST Action will generate substantial knowledge and material, which can be used for teaching activities in Universities at undergraduate and post-graduate level, and these will be made available through the website. Participating ESRs and scientists of the Action as well as associated researchers and students will have the opportunity to attend the Training Schools to become fully acquainted with the theories, approaches and technologies to understand SLs.