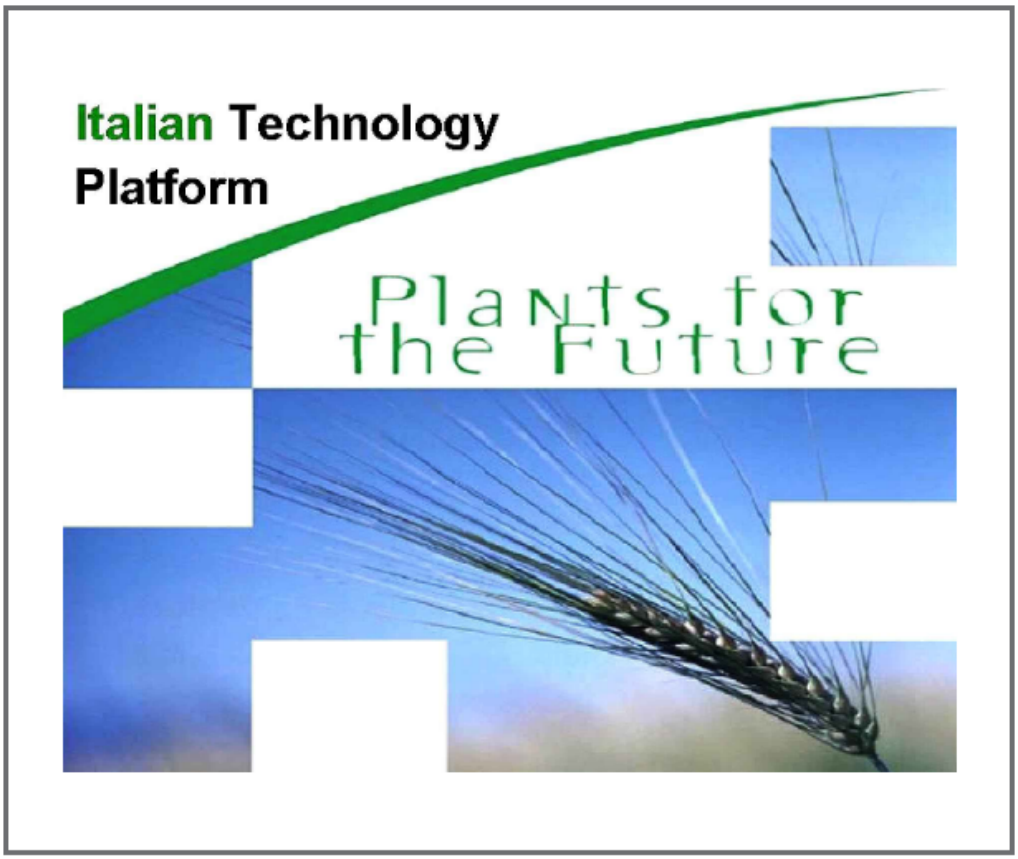
Italian Technology Platform

Plants for the Future

IT-Plants



Implementation Action Plan

September 2009

Piattaforma Tecnologica Italiana “Plants for the Future”

IT-Plants (www.itplants.it)

Mission. Le piante, oltre ad essere la fonte primaria di alimenti per l’uomo e gli animali e svolgere un ruolo fondamentale nell’ecosistema, rappresentano anche un’importante risorsa per la produzione di biomateriali. L’aumento della domanda di alimenti salubri e di qualità, la crescita della popolazione mondiale con la conseguente necessità del soddisfacimento delle esigenze alimentari ed energetiche fanno sì che le piante acquistino sempre più un ruolo chiave e strategico per lo sviluppo economico e sociale a livello nazionale, europeo e globale. In questo contesto, la competitività e sostenibilità delle filiere agroalimentare ed agroindustriale dipenderanno in misura crescente dal progresso scientifico e tecnologico nel settore delle biotecnologie e della genomica vegetale e dalle loro applicazioni. L’ottenimento di piante più resistenti alle fitopatie e alle avversità ambientali causate dai mutamenti climatici consentirà un’agricoltura più sostenibile e rispettosa dell’ambiente (es. riduzione nell’uso di fertilizzanti, acqua, fitofarmaci, ecc.) ed un aumento delle rese e della qualità del prodotto finale. In questo contesto, la Piattaforma Tecnologica Italiana "IT-Plants" svolgerà un ruolo trainante per definire progetti di ricerca in grado di aumentare la competitività delle filiere agroalimentare ed agroindustriale. Punti cardine di questa, come delle altre Piattaforme Tecnologiche, sono l’integrazione e la stretta collaborazione tra ricerca pubblica e industriale per perseguire obiettivi ritenuti prioritari per l’industria e per il sistema produttivo nazionale.

Governance. “IT-Plants” riunisce rappresentanti dei principali attori delle filiere agroalimentare ed agroindustriale nazionali. La Governance è assicurata dalla stretta collaborazione tra il Consiglio Direttivo (coordinato dal Presidente di Assalzoo) ed il Comitato Scientifico. Il Comitato Direttivo riunisce rappresentanti di: AIS (Associazione Italiana Sementi), Assalzoo, Assobiotec, Barilla, Centrale Cesena, CRA (Consiglio per la Ricerca e la sperimentazione in Agricoltura), CNR (Consiglio Nazionale delle Ricerche), ENEA (Ente per le Nuove tecnologie, l’Energia e l’Ambiente), INRAN (Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione), IPGN (Italian Plant Genomic Network), Parco Scientifico e Tecnologico della Sicilia, Parco Tecnologico Padano e Università di Bologna. Il Consiglio Scientifico, che ha curato la stesura del testo del Vision Document della Piattaforma, si avvale dell’operato di un coordinatore e di 15 ricercatori dei settori pubblico e privato nonché di ca. 100 consulenti che operano nelle filiere agroalimentare ed agroindustriale. Sulla base del Vision Document, il Consiglio Scientifico ed il Consiglio Direttivo hanno elaborato il testo dell’Implementation Action Plan (IAP) qui allegato.

Vision. Il Vision Document (reperibile al sito www.itplants.it) identifica cinque Pilastri per future attività di ricerca di pertinenza della Piattaforma: 1) Produzione in quantità sufficiente di cibo e mangimi salubri e nutrienti; 2) Prodotti vegetali per l’industria chimica e la produzione di energia; 3) Agricoltura sostenibile, produzione forestale e paesaggio; 4) Competitività della ricerca di base; 5) Scelte dei consumatori e governance.
Le colture di maggiore rilevanza per la dieta Mediterranea saranno considerate prioritariamente per i risvolti produttivi, ambientali e salutistici che nuovi prodotti e know-how acquisiti grazie alla ricerca potranno avere nel promuovere ulteriormente il “Made in Italy”. Grazie ai progressi della genomica è oggi possibile identificare i geni preposti al controllo delle principali caratteristiche produttive, nutrizionali ed organolettiche dei prodotti vegetali su cui si basa la nostra dieta e quella degli animali domestici e, per quanto riguarda la filiera agroindustriale, la produzione di biocarburanti ed altri prodotti di interesse industriale e farmaceutico. Le applicazioni della genomica permettono inoltre di ottimizzare le procedure di selezione (es. selezione assistita con marcatori molecolari) per realizzare nuove varietà migliorate da offrire agli agricoltori e che meglio soddisfino le esigenze del consumatore. Altre biotecnologie e ricerche agronomiche forniranno contributi rilevanti per ottimizzare i livelli produttivi e la qualità delle principali colture e al tempo stesso migliorare il grado di sostenibilità delle pratiche agricole, nel rispetto delle tipicità locali. Presupposto fondamentale affinché il tutto si possa concretizzare sarà la disponibilità di un’appropriata infrastruttura di ricerca e dei fondi richiesti per realizzare le ricerche di laboratorio e la sperimentazione in campo e per consentire un’adeguata formazione di giovani ricercatori.

Il presente documento è stato approvato dal Consiglio Direttivo e dal Consiglio Scientifico di IT-Plants.

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Roberto Tuberosa (Coordinatore del Comitato Scientifico di IT-Plants)

ITALIAN TECHNOLOGY PLATFORM "PLANTS FOR THE FUTURE" (IT-PLANTS)

IMPLEMENTATION ACTION PLAN

Pillar 1

Healthy, safe and sufficient food and feed

In affluent countries, the combination of high-fat, energy-dense diets and sedentary behavior increases the incidence of chronic diseases such as obesity, diabetes, cardiovascular diseases, hypertension and some cancers. Scientific evidence indicates that some food has the potential to prevent the onset of chronic diseases. Therefore, a healthier diet, specifically tailored to target the needs of specific consumers groups, might reduce the incidence of such diseases. The range of plant-based products consumed in Italy is rather large compared to other developed countries. Among them, pasta, tomato-derived products, olive oil, vegetables and fruits are key ingredients for the renowned Mediterranean diet and its beneficial effects on our health.

On the other hand, animal husbandry is an area of strategic importance for our diet and for the export of "Made in Italy" typical products. More than 8.5 million tons of feed are produced in Italy every year, with maize and barley accounting for the prevailing portion of such feed. Nonetheless, our internal production is not sufficient to meet the demand of the feed industry.

Plant science, particularly genomics, can help us to identify new health-related compounds and more effectively map key genes and quantitative trait loci (QTLs) for improving yield potential of crops able to produce more nutritious and healthier food and feed. Clearly, the seed industry will play a key role in transferring to the consumer, through new improved cultivars, the health benefits derived from the findings of research.

To meet these demanding challenges, five research priorities have been identified. The research activities herein suggested would deliver:

- new sources of raw materials for the production of functional foods;
- genes/QTLs affecting the biosynthesis of carbohydrates, proteins, lipids, protective metabolites and allergens;
- new advanced lines and improved cultivars with enhanced nutritional and post-harvest characteristics and better consumer acceptance;
- new methodologies to assess the quality of cereals, fruits and vegetables as to their nutrient content, absence of anti-nutritional factors and sensory characteristics;
- improved quality, safety and traceability of plant raw materials for feed and food and increased use of locally produced feedstuff.

Research Challenges (listed in order of priority from Vision Document) for Pillar 1 - Healthy, safe and sufficient food and feed.

Goal, Research Challenge, Deliverable and Species	Project participants and type	Source of funds	Duration & funding request	Human resources
Goal 3. TAILOR PLANT RAW MATERIALS FOR CERTAIN HEALTH BENEFITS AND SPECIFIC CONSUMER GROUPS. Research Challenge 1. Study of plant diversity and related genes/QTLs with regard to metabolites that might play a role both in the improvement of nutritional value of plant-derived food and in chronic disease prevention. Deliverables. New sources of raw materials for the production of functional foods. Genes/QTLs affecting the biosynthesis of carbohydrates, lipids, protective metabolites and allergens. Species. Tomato, durum wheat, barley, minor crops.	Industry 30% Academia 70%	National funds 50% EU funds 50%	3 years € 15 M	
Goal 2. PRODUCE, TRACE AND CONTROL SAFE PLANT RAW MATERIALS FOR FEED AND FOOD. Research Challenge 1. Develop improved cultivars to reduce mycotoxins and anti-nutrients in food. Deliverables. Durum wheat genotypes resistant to *Fusarium* Head Blight for safe food production. Species. Durum wheat.	Industry 50% Academia 50%	Industry 25% National funds 75%	5 years € 5 M	
Goal 1. DEVELOP AND PRODUCE SUFFICIENT, DIVERSIFIED AND AFFORDABLE HIGH-QUALITY PLANT RAW MATERIALS FOR FOOD PRODUCTS. Research Challenge 4. Selection of new varieties through conventional breeding and/or non conventional approaches (e.g. marker-assisted selection, TILLING), with healthier characteristics and improved quality. Deliverables. New lines and cultivars with enhanced nutritional and post-harvest characteristics and better consumer acceptance. Species. Durum wheat, barley, olive tree, tomato, artichoke.	Industry 50% Academia 50%	Industry 25% National funds 75%	5 years € 15 M	
Goal 1. DEVELOP AND PRODUCE SUFFICIENT, DIVERSIFIED AND AFFORDABLE HIGH-QUALITY PLANT RAW MATERIALS FOR FOOD PRODUCTS. Research Challenge 2. Development of new methodologies for assessing quality of cereals, fruits and vegetables in terms of content of nutrients, absence of anti-nutritional factors and sensory characteristics. Deliverables. New methodologies to assess the quality of cereals, fruits and vegetables as to their nutrient content, absence of anti-nutritional factors and sensory characteristics. Species. Tomato, olive tree, barley, durum wheat.	Industry 30% Academia 70%	National funds 50% EU funds 50%	3 years € 10 M	
Goal 2. PRODUCE, TRACE AND CONTROL SAFE PLANT RAW MATERIALS FOR FEED AND FOOD. Research Challenge 2. Identification of chemical, biochemical, DNA sequences or Near Infra Red profiles which could be used as quality markers and to improve traceability of the food supply chain. Deliverable. Improved quality, safety and traceability of plant raw materials for feed and food. Goal 4. HIGH-QUALITY, SUFFICIENT AND SUSTAINABLE FEED. Research Challenge 4. Optimization of agronomic practices to improve the sustainability of producing high quality and safe raw materials. Deliverables. Improved cultivation practices to lower the environmental impact of feed production. Species. Maize and other relevant species.	Industry 50% Academia 50%	Industry 30% National funds 70%	3 years € 10 M	

ITALIAN TECHNOLOGY PLATFORM “PLANTS FOR THE FUTURE” (IT-PLANTS)

IMPLEMENTATION ACTION PLAN

Pillar 2

Plant-based products: chemicals and energy

The development of the knowledge-based bio-economy (KBBE), involving a global industry based on renewable plant-derived products as an alternative to the current fossil fuel-based industry, constitutes by far the most challenging and promising opportunity for the Italian chemical sector in terms of economic, environmental and societal potential.

The benefits of the uses of new plant-based raw materials may range from cheaper, safer or more environment-friendly production methods to the ability to develop new and better products for the consumer. Plant-based resources can provide far more functionalities than society and industry are currently exploiting. These may relate to commodity-scale products and as yet unknown utilities of major plant components, as well as to new uses for materials and molecular components, whether in native form or following post-harvest modifications. These new plant-based raw materials may include: peptides, proteins, fatty acids and oils, starches, fibres and secondary metabolites, with applications in the health, nutrition, packaging, bioenergy and materials industries.

Because Italy is also particularly vulnerable to energy production from non-renewable sources, a massive effort will be required to meet the EU standards to reach by 2030 the goal of 25% replacement of non-renewable energy sources with biomass. This formidable challenge can only be met with energy crops with a very high yield per hectare, more water- and nutrient-use efficient and with improved compositional quality.

In consideration of the fact that in Italy the cultivated lands are essentially dedicated to food crops, and taking into account the land property fragmentation, R&D activities on plant-based products can be focused on specialties with high added value.

Moreover, the recent sanitary emergency related to the outbreak of new pandemics, raises the possibility of developing new and alternative production systems for therapeutic molecules and vaccines. Plant-based production systems represent ideal platforms for the rapid and low-cost production of therapeutic molecules which can be adopted by extant pharmaceutical companies and can drive the establishment of a new “green” industry.

The intense use of model crops and the knowledge derived from systems biology approaches (see Pillar 4) will be particularly relevant to the success of this Pillar.

Research Challenges (listed in order of priority from Vision Document) for Pillar 2 – Plant-based products: chemicals and energy.

Goal, Research Challenge, Deliverable and Species	Project participants and type	Source of funds	Duration & funding request	Human resources
Goal 1. BIOCHEMICAL PRODUCTION. Research Challenge 2. Screening and selection of new/indigenous plants producing natural pharmaceutical and medicinal compounds (also in collaboration with partners in developing countries). Development of innovative technologies for the efficient production of heterologous proteins in plants and microalgae. Modification of metabolic pathways for the production of new plant-based raw materials through the identification of the key regulatory steps and the exploitation of environmental stimuli applications. Deliverables. • Pharmacological compounds or recombinant plant-derived peptides and proteins with anti-inflammatory, anti-cancer, anti-nociceptive, anti-viral, anti-bacterial (new generation of antibiotics), anti-degenerative and antioxidant activities. Low-cost and safe therapeutics and vaccines suitable for a rapid production. • Production of biochemicals for industrial uses such as fibres, intermediate for biopolimers, fatty acids for detergents, lubricants, coatings, enzymes, proteins to be used, for example, as safer additives, etc. Species: Case by case.	Industry 50% Academia 50% 	Industry 50% National funds 50%	3 years € 15 M	
Goal 2. BIOENERGY AND BIOFUELS. Research Challenges 5 and 6. Develop new high-energy plant biomass production systems with minimal energy input requirements (improvement of agricultural practices) and higher energy retention (biorefinery of plant cell wall “energy” polymers such as cellulose and lignin). Develop third-generation “green” systems (plants or microalgae) for coupled production of biochemicals and energy. Deliverables. • Microalgae cultures for energy and biochemical production. • Low-input plant varieties for the production of raw materials suitable for biorefining. Species. Case by case.	Industry 50% Academia 50% 	Industry 50% National funds 20% EU funds 30%	3 years € 15 M	
Goal 3. ENABLING RESEARCH: GREEN FACTORY DEVELOPMENT. Research Challenge 1. Development of plants, plant cell, tissue cultures and microalgae suitable for fermentor-like applications and definition of the standard operating procedures (SOPs) for the production of the desired compounds. Deliverables. Plant-derived platforms optimised for single or multifunctional uses. Species. Case by case.	Industry 20% Academia 80% 	National funds 20% EU funds 80%	5 years € 10 M	

ITALIAN TECHNOLOGY PLATFORM “PLANTS FOR THE FUTURE” (IT-PLANTS)

IMPLEMENTATION ACTION PLAN

Pillar 3

Sustainable agriculture, forestry and landscape

Advances in plant sciences and agricultural technologies have increased plant productivity and quality, thus enhancing the quality of life. However, our current challenge is to develop strategies for reshaping the lives of the next generations in a more sustainable manner. This challenge faces contrasting aspects, some of which are particularly relevant in Italy: pressing requests of high quality agricultural products, uncertainties originating from climate change and the need to protect biodiversity which is also relevant to forest trees and landscape management.

To meet these demanding challenges, four interdisciplinary goals have been identified, each with its own specific research strategy:

1. Improve plant productivity and quality;
2. Reduce the environmental impact of agriculture;
3. Preserve and boost biodiversity;
4. Enhance the sustainability of the landscape.

The activities listed for Goal 1 (i.e. identification of factors that govern plant architecture and development, crop and tree productivity and stability under unfavourable environmental conditions) are of crucial importance. They require a sound knowledge and expertise of basic research and “-omics” technologies (e.g. transcriptomics), the availability of high-throughput platforms and strong interaction with Pillars 1, 2 and 4.

Goal 2 identifies a list of research strategies aimed at reducing the environmental impact of agrochemicals, improving the management of phytoprotectants and identifying new, active and safe compounds for plant defense. A strong interaction between the scientific community and industrial partners is envisaged to reach the expected results on target crops.

Biodiversity, another crucial factor for the sustainability of agricultural practices, is pursued in Goal 3, which defines protocols for assessing biodiversity of plant-beneficial organisms as well as mini-core collections for preserving local diversity.

In order to define research priorities, multiple factors have been considered: i) selection of plant species important for Italian agriculture, ii) the identification of key molecular determinants which control growth and stress resistance, and relevant for reducing chemical inputs; iii) biodiversity, considered as starting point not only for a germplasm inventory, but also for metagenomics studies that will offer new tools to harness biodiversity for a more sustainable agriculture.

Research Challenges (listed in order of priority from Vision Document) for Pillar 3 - Sustainable agriculture, forestry and landscape.

Goal, Research Challenge, Deliverable and Species	Project participants and type	Source of funds	Duration & funding request	Human resources
Goal 2. REDUCE THE ENVIRONMENTAL IMPACT OF AGRICULTURE. Research Challenge 4. Identification of genes and QTLs for a) resistance/tolerance to pests and pathogens; b) responsiveness to beneficial mycorrhizal fungi; c) water- and nutrient-use efficiency. Deliverables. • Genes/QTLs for resistance to biotic and abiotic stresses. • Gene and metabolic networks influenced by root-beneficial microbes and leading to improved qualitative traits. • New environment-friendly methods of crop protection based also on novel bioactive ingredients. Species: Tomato, model legumes (*Medicago*, *Lotus*), artichoke, asparagus, garlic, citrus, rice and other species This goal overlaps with Goal 1 (see below) and will require a strict interaction with Pillars 1, 2 and 4.	Industry 50% Academia 50% 	Industry 50% National funds 50%	3 years € 10 M	
Goal 3. PRESERVE AND BOOST BIODIVERSITY. Research Challenge 3. Assemble and characterise mini-core collections and introgression lines (using wild species as donors) suitable for identifying genes/QTLs for target traits. Deliverables. • Mini-core collections for the main crops of local interest, and their genomic or proteomic characterisation. • Increased crop biodiversity by introgressing traits from wild relatives. Species. Tomato, durum wheat, model legumes (*Medicago*, *Lotus*), artichoke, asparagus, garlic, citrus, fruit trees.	Industry 30% Academia 70% 	Industry 30% National funds 40% EU funds 30%	3 years € 10 M	
Goal 3. PRESERVE AND BOOST BIODIVERSITY. Research Challenge 1. Defining protocols for assessing biodiversity of beneficial insects, spontaneous plant species, mycorrhizal fungi, soil living micro-organisms based on DNA sequence inventories in order to monitor and compare the impacts of different agricultural and forest practices on agro-ecosystems. Deliverables. • Innovative strategies (e.g. DNA bar-coding) for safeguarding microbe biodiversity in agricultural soils. • Improved knowledge of host-pathogen and host-symbiont interactions on the basis of new genome sequencing projects. Species. Grapevine, tomato, maize. Soil biodiversity with particular attention to specific environments.	Industry 10% Academia 90% 	National funds 80% EU funds 20%	5 years € 10 M	

Goal 1. IMPROVE PLANT PRODUCTIVITY AND QUALITY. Research Challenge 1. Identification of the key factors controlling plant architecture and development, quality of plant products, crop and tree productivity and stability under unfavourable environmental conditions by using genomic and systems biology approaches in collaboration (e.g. projects cluster) with Pillars 1, 2, 4 and connected with Goal 2 of this Pillar. Deliverables. • New cultivars with improved yield/yield stability and quality under environmental constraints or decreased nutrients and suitable for more sustainable farming practices. • New natural or synthetic active products able to improve plant productivity and quality. • New technologies for the induction of reliable plant defence mechanisms against abiotic and biotic agents and for an optimized uptake of nutrients and water. Species. Tomato, durum wheat, maize.	Industry 30% Academia 70% 	National funds 50% EU funds 50%	5 years € 10 M	
Goal 2. REDUCE THE ENVIRONMENTAL IMPACT OF AGRICULTURE. **Research Challenge 3.** Use of living organisms (bacteria, fungi, plants) as source of novel substances to use for plant health or for the design of synthetics and/or semi-synthetic useful analogues. Development of new approaches for reducing stress-induced damages in crops based on natural/synthetic messengers able to induce plant-defence machinery. Deliverables. • Microorganisms with improved properties for a more sustainable and reliable crop management. • New environment-friendly methods of crop protection. Species. Model species (e.g. Arabidopsis, others), tomato, maize.	Industry 50% Academia 50% 	National funds 50% EU funds 50%	3 + 2 years € 10 M	

ITALIAN TECHNOLOGY PLATFORM "PLANTS FOR THE FUTURE" (IT-PLANTS)

IMPLEMENTATION ACTION PLAN

Pillar 4

Vibrant and competitive basic research

In the coming years, plant biotechnology will be essential in improving food production and agriculture sustainability, in the production of raw materials and 'smart' molecules in plants, in developing valuable 'green' products and in providing cheap, reliable and durable sources of bioenergy and biofuels. As the fundamental biological processes are controlled essentially by the similar sets of genes in all plants, basic research on model plants will play a key role in future biotechnological activities, and new tools, platforms and paradigms derived from basic research will contribute to the competitiveness of plant-based industries.

Arabidopsis research has already abundantly highlighted the importance of basic research and "-omics" technologies for the progress of modern plant science. The knowledge gained on the Arabidopsis and rice systems is also helping the development of similar approaches on cultivated plant species. Furthermore, the development of new model systems, such as *Brachypodium*, is now boosting our knowledge for the improvement of cereals for the production of food and biofuel.

A long-term goal of basic research in plant biology is to provide information on how plants grow and respond to changes in their environment, and on the molecular basis of variation between and within species in the field. Essential tools for these goals are the genomics and functional genomics approaches, platforms and technologies. Genomics provides the backbone for transcriptomics studies; these in turn, provide experimental validation of gene function as well as the identification of alternative splicing modes and transcribed non-coding sequences, which play a fundamental role in regulating gene expression. Based on their relatively low cost, high-throughput and simple data analysis, microarrays remain the method of choice for gene expression analysis, whereas next generation sequencing technologies will represent the method of choice for a more detailed characterisation of the transcriptome.

Data generated by these and other "omics" (e.g. proteomics, metabolomics, phenomics, etc.) will facilitate the identification of candidate genes and key molecules regulating one or more aspects of plant development and physiology. Particular attention will be devoted to plant development, and to abiotic and biotic stresses, which represent major limitations for crop production. Collections of mutants suitable for TILLING will be developed to facilitate the identification of novel allelic variants of loci affecting key traits in major crops.

The Italian scientific community working on plant model systems is highly competitive at the international level. However, Italy still needs the coordination and common infrastructures necessary to keep up with the fast pace of other developed (and also developing) countries.

An appropriate management of intellectual property issues will also be critical to enhance the competitiveness of Italian basic plant research in a rapidly changing world.

Research Challenges (listed in order of priority from Vision Document) for Pillar 4 - Vibrant and competitive basic research.

Goal, Research Challenge, Deliverable and Species	Project participant and type	Source of funds	Duration & funding request	Human resources
Goal 4. FROM GENE TO PHENOTYPE. Research Challenge 1. Identification and functional analysis of regulatory networks at genetic and epigenetic levels controlling yield stability and quality. Use of mutants already existing or to be developed in this project. Deliverables. • New mutants for functional analysis of candidate genes. Novel genes controlling relevant agronomic traits, both in model plants and crops. • Patents. Research Challenge 2. Conservation and diversity in transcriptional regulation in model and crop species. Identification of cell- and stage-specific promoters and their functional conservation/diversification in crops. Deliverables. • Novel plant promoters for the tissue/cell- and stage-specific expression of target genes in crops. • Patents. Species. Trait-specific model plants.	Industry 20% Academia 80% 	EU funds 20% National funds 80%	5 years € 10 M	
Goal 2. UNDERSTANDING THE DYNAMICS OF TRANSCRIPTS, PROTEINS, METABOLITES AND RELATIVE INTERACTIONS. Research Challenge 1. Characterisation of transcripts (coding and non-coding) and regulatory networks that control development, metabolic pathways and stress responses in the whole plant or in single cells. This activity includes the (i) refinement of gene annotation by integrating transcriptomics data into existing gene models, (ii) the characterisation of proteins and metabolites during plant development and stress responses and (iii) the use of mutants already existing or to be developed in the frame of this project. Deliverables. • Genes and regulatory mechanisms that control plant development, metabolic pathways and stress responses in the whole organism or in single cells. • Accurate gene models based on transcriptomic data. • Catalogue of proteins and metabolites identified during plant development and stress responses in model species and important crop plants. Species. Trait-specific model plants.	Industry 10% Academia 90% 	National funds 70% Industry 10% EU funds 20%	5 years € 10 M	
Goal 6. BUILDING HUMAN RESOURCES, INFRASTRUCTURE AND NETWORKING. Research Challenge 1. Centres specialised in high-throughput phenotyping under controlled conditions handling thousands of plants for forward screening of mutant collections and mapping populations. Deliverables. Mutants and genes for agronomically important traits. Species. Trait-specific model plants.	Industry 20% Academia 80% 	EU funds 20% National funds 80%	5 years € 10 M	

ITALIAN TECHNOLOGY PLATFORM "PLANTS FOR THE FUTURE" (IT-PLANTS)

IMPLEMENTATION ACTION PLAN

Pillar 5

Consumer choice and governance

This Pillar includes horizontal issues of general interest that are intimately interconnected with vertically focussed issues of Pillars 1 to 4. Public and consumers involvement, ethical and legal aspects of technological innovations, financial and incentive mechanisms clearly have an impact and strongly influence the research activities specifically oriented toward food production, sustainability of agriculture and production of raw materials and 'smart' molecules in plants.

Pillar 5 considers the main actors in the production chain as well as consumers and related socio-economic issues. Although the Italian position on the production chain is similar to that of other EU countries, it does have some peculiarities. From the producers' point of view, Italian agriculture has suffered in recent decades from lack of competitiveness. Alternative strategies based on high-quality production have proven successful to face such difficulties for some products, but are likely unable to respond to the global needs of all branches of the sector.

The opinions and positions of the consumer and the general public have been largely driven by a lack of knowledge of the real advantages/disadvantages and benefits/risks of new technologies in plant breeding (e.g. genetic engineering), sometimes leading to uninformed and unilateral advocacy of the precautionary principle in its strictest terms. At the same time, social demand for specific foods and/or environmental features (e.g. healthier food, reduction of pesticide use, reduction of irrigation water and fertilizers, etc.) would benefit from the new technologies dealt with in this Technological Platform.

The challenge here is to adequately support basic research at the national level while enabling it to contribute to society's goals in a participatory and consensual manner. Accordingly, the specific goals that will be explored under this Pillar are:

1. Public and consumer involvement.
2. Ethical, safety, legal and financial environment.

Research Challenges (listed in order of priority from Vision Document) for Pillar 5 - Consumer choice and governance.

Goal, Research Challenge, Deliverable and Species	Project participants and type	Source of funds	Duration & funding request	Human resources
Goal 1. PUBLIC AND CONSUMER INVOLVEMENT. Research Challenge 2. Analysis of the contribution of new technologies and varieties on technical developments in agriculture and the food chain, and on their role in contributing to consumer welfare, economic growth and rural/regional development. Deliverables. Prospective studies on expected diffusion, rationale, cost/benefit analysis of prospective technologies from a social, economic and environmental point of view. Species: Case by case.	Industry 50% Academia 50% 	Industry 50% National funds 50%	3-5 years € 5 M	
Goal 1. PUBLIC AND CONSUMER INVOLVEMENT. Research Challenge 4. Analysis of potential contribution of new research to consumer welfare, economic growth and rural/regional development, in order to identify future research priorities for Italy. Deliverables. Prospective studies on expected diffusion, rationale and cost/benefit analysis of the products of new plant research from a social, economic and environmental point of view. Species: Case by case.	Industry 50% Academia 50% 	Industry 30% National funds 70%	3 years € 5 M	
Goal 1. PUBLIC AND CONSUMER INVOLVEMENT. Research Challenge 3. Development of methodologies and activities for effective stakeholder involvement, and communication strategies to bridge the research community with the stakeholders involved in the food chain, promote informed decisions and more socially acceptable technology development. Deliverables. Events and networks aimed at information exchange and participatory decision-making in order to strengthen the connection between plant researchers and all relevant stakeholders. Species: Case by case.	Industry 50% Academia 50% 	Industry 30% National funds 70%	3 years € 5 M	

Legend

Project participants and type

Research projects
Projects ranging from frontier/basic research to applied, pre-competitive research which primary aim is to generate scientific and technical knowledge which can be further used for the development of new innovative products and/or improving the sustainability of existing production. These projects will benefit from collaboration efforts and networks.

Demonstration / Pilot project:
Projects with the aim of demonstrating the industrial and economic feasibility, and the sustainability of a concept.

Studies:
These projects, including surveys, feasibility studies, LCA or eco-efficiency analysis, aim at generating knowledge/information allowing stakeholders and decision-makers to make informed choices.

Network / Coordination:
Networks and coordination projects will allow better coordination between stakeholders in a field, interdisciplinary cooperation, exchange of information and coordination between European and Member States level.

Training:
Exchange/mobility of researchers, courses, projects influencing curricular programmes in Member States

Human resources

Activities require human resources with adequate training and expertise. A blue symbol depicts that sufficient research expertise is or is likely to be available in Europe; a orange symbol means that such a skill base needs to be actively developed for a sufficient number of researchers.