

Projects funded in 2010 (Summaries)

N°	Full name
1000-001	International Research and Formation Project of one year in Health and Nutrition (Nutriform)
1000-002 Completed	Organisation of a conference of stakeholders within the European program "ARIMNet" (Agricultural Research In the Mediterranean), October 28 and 29 2010, Palma de Majorque, Spain
1001-001	Bioagressors and invasive species: from individual to population to species
1001-005	RHIZOPOLIS: A federative project for plant root research
1001-009	Ecological services of legumes for nitrogen and phosphorus biogeochemical cycles and c sequestration in cereal cropping systems in Africa and the Mediterranean basin
1002-003	Identification of nematode ( <i>Meloidogyne</i> spp.) effectors of pathogenicity in rice ( <i>Oryza sativa</i> )
1002-006	InfraRed Spectrometry as a tool to model inorganic and organic phosphorus availability in tropical soils under conservation systems
1002-008	Organization of a joint French-Brazilian-African training course for the construction of a sentinel network for Greening disease outbreak detection in peri-Mediterranean countries.
1002-009	Role of active retrotransposons (RT) In <i>Coffea canephora</i> and <i>C. Arabica</i> Genome Evolution
1002-012	Phenotyping, Genotyping and analysing genetic diversity and structure of a collection of <i>Coffea arabica</i> from Ethiopia, in relation with quality and drought tolerance (PHEGECO)

**Keywords:**

IPB-1 Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*

IPB-2 Integrative Plant Biology 2: *Plant pests and diseases, integrated crop protection, population ecology*

STDI-1 Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*

STDI-2 Socio-Technical Dynamics of Innovation 2: *Agri-food innovations, food and non-food use of plant crops*

STDI-3 Socio-Technical Dynamics of Innovation 3: *Innovation processes, social management of innovations*

**Year of CfP: 2010**

**Project N° 1000-001**

<b>Project title:</b> International Research and Formation Project of one year in Health and Nutrition (Nutriform)
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**Units managing the project:** IATE (Agropolymer Engineering and Emerging Technologies) (CIRAD, INRA, SupAgro, UMII)

**Project leader:** Valérie Micard (micard(a)supagro.inra.fr)

**Countries involved in the project:** Finland, Switzerland

**Research units from the Foundation's scientific network involved:** SQPOV, SPO

**Sub-thematic axes:** STDI-2 Socio-Technical Dynamics of Innovation 2: *Agrifood innovations, food and non-food use of plant crops*

**Objectives:**

The IATE unit is conducting studies on the relationship between food structure and its nutritional properties, also called the « matrix effect ». The present project is part of the 3 years "Phenomat" research project which aims at determining the relationship between the structure of a cereal matrix rich in ferulic acid and the bioavailability and effect of ferulic acid on mice metabolism (matrix effect). Ferulic acid is a natural wheat grain antioxidant, which can be associated with protection against oxidative stress. The structure of the cereal fraction could affect the antioxidant properties and the quality of health protective compound ferulic acid. Previous studies have demonstrated the very low bioavailability of ferulic acid from cereal fractions and thus the necessity to modify the structure of the cereal fractions in order to improve the bioavailability and health effects of the ferulic acid they contain. The experimental part of this project will be conducted in a nutrition team at the University of Eastern Finland.

During this year courses of the Master of Public Health and Nutrition will also be followed. This should allow the implementation of new courses on Food science and Nutrition at Montpellier SupAgro, which should benefit to the formation of engineers in Food Industries.

**Total Agropolis Fondation funding:** €20,000

**Funding category:** Agropolis Fondation small grants (release from teaching duties)

**Project duration:** 01 November 2010 - 27 February 2013

**Keywords:** nutrition – cereal matrix - ferulic acid – antioxidant

**Year of CfP: 2010**

**Project 1000-002**

**Project title:** Organisation of a conference of stakeholders within the European program "ARIMNet" (Agricultural Research In the Mediterranean), October 28 and 29 2010, Palma de Majorque, Spain

**Unit managing the project:** INRA SDAR (INRA)

**Project leader:** Michel Dodet (michel.dodet(a)paris.inra.fr)

**Countries involved in the project:** France, Italy, Algeria, Spain, Turkey, Egypt, Portugal, Morocco, Greece, Tunisia, Israel, Cyprus, Balearic Islands

**Subthematic axes:** IPB-1 (Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*), IPB-2 (Integrative Plant Biology 2: *Plant pests and diseases, integrated crop protection, population ecology*), STDI-1 (Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*), STDI-2 (Socio-Technical Dynamics of Innovation 2: *Agri-food innovations, food and non-food use of plant crops*), STDI-3 (Socio-Technical Dynamics of Innovation 3: *Innovation processes, social management of innovations*)

**Objectives:**

Agriculture in the countries of the Mediterranean basin is facing common issues and challenges (e.g. management of natural and genetic resources, plant and animal health, food security and food safety, sustainability of agricultural production in a context of climate change...). Agronomic research, however, is scattered within the EU members as well as in Mediterranean partner countries. There is thus a great need of coordination among the different research programs.

The ARIMNet project, financed by the European Commission, is expected to help coordinate national research activities and identify common research programmes among the countries of the Mediterranean area, address fragmentation of efforts and exploit synergies. As a first step, ARIMNet has collected information on the national research programmes that are currently implemented in the region. Analysis of these data is under way. On this basis, ARIMNet is organizing a Conference of Stakeholders. The event aims to contribute to the mobilisation of the Mediterranean Agricultural Research community (and beyond) and the various stakeholders to identify together and share research priorities.

Approximately 100 persons are expected to attend the conference, which should permit a good representation of different stakeholders, while allowing an open international debate and creating a space for a constructive dialogue among the different participants. The Conference should allow the definition of joint research actions as well as cross-cutting research programs.

**Action carried-out and results obtained:**

The conference of the stakeholders was organised under the responsibility of INIA (Spain) as member of the ARIMNet Project ([www.arimnet.net/](http://www.arimnet.net/)), an ERA-Net of the FP7, supported by the European Commission and coordinated by France (INRA). The objectives of this project are to promote synergies and raise cooperation between Mediterranean countries participating to it through a better and shared knowledge of agricultural research programmes and in carrying out ambitious research projects that cannot be undertaken at an individual level.

ARIMNet is gathering twelve countries (6 EU members, 1 associated country and 5 other Mediterranean countries), thirteen major institutions and two associated international institutions, the CIHEAM (Centre International des Hautes Etudes Agronomiques Méditerranéennes) and ICARDA (International Centre for Agricultural Research in the Dry Areas).

### *Aim and scope of the Conference*

In a first phase, ARIMNet has collected information on the national agricultural research programmes that are currently run in the region. This information deserved to be confronted to the priorities that have been set out for the region in the area of agricultural research. On this basis, the purpose of the Conference of Stakeholders that ARIMNet has taken the initiative to organise was to contribute to the mobilisation of the Mediterranean Agricultural Research community (and beyond) and the various stakeholders to identify together and to share research priorities in order to prepare the decisions of the Steering Committee of ARIMNet on the future calls that should be launched in 2011. The Conference of Stakeholders was a key event in the process of selecting agricultural research areas that could be opened for further calls to trigger coordination of national programmes in the Mediterranean basin. It was a good opportunity to get over the paradox of the region that concentrates almost all the main global issues concerning agriculture and agricultural international research without being visible at the global level.

### *Organisation of a conference:*

This conference was held at the Universitat Illes Balears (UIB), Palma de Mallorca, Spain, 28th-29th October 2010. It has gathered 78 participants from the 12 Mediterranean countries of ARIMNet and various stakeholders groups : National and regional agricultural research services, research councils, agricultural universities or university agricultural departments, agro and agro food industry, regional and international organizations, farmers organizations, NGOs (consumers organizations and other organizations involved in environmental issues).

It was organised in two parts: the first one aimed at giving to the participants a global picture of the stakes, challenges and opportunities in the Mediterranean for agriculture and agricultural research, the second one to debate on the priorities. This second part was considering both scientific areas – on the basis of the programmes that are currently run in the Mediterranean – and design of calls and management of research projects to better integrate the issues of innovation, capacity development and involvement of stakeholders in the design and run of the projects at the Mediterranean scale. It was prepared by an analysis of the current programmes (an outcome of the first phase of the ARIMNet project) and three parallel sessions devoted to innovation, capacity development and involvement of the stakeholders in the whole process.

### *Preparation of the recommendations to the Steering Committee of ARIMNet*

The major result of the conference of the stakeholders is the recommendations to the Steering Committee of ARIMNet defining the agricultural research areas that could be opened for further calls to trigger and strengthen coordination of national programmes in the Mediterranean basin. A document has been produced summarizing the scientific areas that should be considered for priorities, the common general objectives and the six common thematic areas identified together. The discussions of the conference also led to strongly recommend to the Steering Committee to add value to the current Mediterranean projects through promoting a more integrative approach, in science (scale and scope) and in the design of the call.

### **Prospects for the future:**

On the basis of these recommendations, the Steering and the Management Committees of ARIMNet have engaged the preparation of the call, defined the general orientations of the call and criteria of selection of the projects. A workshop gathering the ARIMNet members, the funding bodies that will support the call and scientific experts will be held in Athens, on April 12th and 13th, 2011. The aim of this workshop is to better elaborate on the scientific terms of reference of the future call and to define shared rules of management, accepted and agreed as a common basis by all the funding bodies. The ARIMNet call, integrating these recommendations of the conference of the stakeholders, should be then launched at the end of June 2011 and the projects should start at the spring 2012.

Furthermore, during the conference, the Secretary General of AARINENA proposed to set up a joint platform between AARINENA and EFARD on the Mediterranean stakes and challenges to overcome the deficit of visibility and presence of the region at the global level and to push it as a key area for addressing the global issues agriculture is facing. That is another result of the conference.

Beyond the ARIMNet project itself, the ARIMNet partners are thinking to various initiatives in a long term perspective to strengthen the building of a Mediterranean Agricultural Research Area and community.

**Total Agropolis Fondation funding:** €30,000

**Funding categorie(s):** Agropolis Fondation small grants: support for the organization of high-level scientific events (conferences, seminars)

**Project duration:** 28 July 2010 – 28 february 2011

**Keywords:** Mediterranean – conference – agriculture – research priorities -

**Year of CfP: 2010 Grand federative project**

**Project 1001-001**

<b>Project title:</b> Bioagressors and invasive species: from individual to population to species
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**Unit managing the project:** UMR CBGP Centre for Biology and Management of Populations (CIRAD, INRA, IRD, Montpellier SupAgro)

**Project leaders:** Arnaud Estoup and Jean-Yves Rasplus (estoup(a)supagro.inra.fr & rasplus(a)supagro.inra.fr)

**Countries involved in the project:** Liban, Cameroun, Brazil, Burkina-Faso, Ivory Cost, Cuba, China, Madagascar, Italia, UK, Spain, Sweden, Switzerland, Canada, Denmark, Netherlands, USA

**Research units from the Foundation's scientific network involved:** BGPI, CBGP, B-AMR, RPB

**Subthematic axes:** IPB-2 (Integrative Plant Biology 2: *Plant pests and diseases, integrated crop protection, population ecology*); STDI-1 (Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*); STDI-3 (Socio-Technical Dynamics of Innovation 3: *Innovation processes, social management of innovations*)

**Objectives:**

The main objective of this federative project is to develop, coordinate and communicate research actions on bioagressors in Europe (insects, mites, trees, fungi and virus) and on their associated natural enemies. By bioagressors we specifically refer to (i) local pest species - with respect to the European continent – that re-emerge due to changes in agricultural practices, (ii) *sensu stricto* invasive species (i.e. alien pest species introduced in Europe), (iii) potential invasive species, recorded as invasive and causing damages in non European countries (especially in Mediterranean and tropical areas) and that may settle and become damaging in Europe. By natural enemies, we refer to species that could be deliberately introduced to control these pests. BIOFIS research actions will address both applied and academic questions, and consider three biological levels (individuals, populations and species).

BIOFIS will focus on four complementary tasks:

**Task 1.** The detection and characterization of present or potential arthropod species damaging crops and their natural enemies. The development of a large Web database that includes various features (taxonomy, DNA barcodes, biological information, distribution and socio-economic risks).

**Task 2.** The experimental and theoretical studies of key evolutionary questions associated to the emergence of invasive populations. Regarding the experimental part, this task will focus on a subset of invasive species selected according to two main criteria: they are associated to important socio-economic, ecological and agronomical issues and they can provide answers to key evolutionary questions associated to the emergence of invasive populations. The theoretical part will be mainly based on generic modelling actions using mathematical and computer simulation tools.

**Task 3.** The specification and formalisation of recommendations for management practices against bioagressors and invasive species based on the applied and academic research actions developed in task 1 and task 2. This objective will involve a large number of the scientists involved in BIOFIS as well as additional (external) experts. This part of BIOFIS will take into account social, economical and bio-technological issues.

**Task 4.** The organisation of an international congress on bioagressors, invasive species, natural enemies, and the evolutionary biology of such species (and opportunistically the organisation of smaller national/local meetings/workshops in this field)

In conclusion, BIOFIS represents a unique opportunity to bridge the gaps on common scientific objectives between different experimental and theoretical approaches, between different scale studies (from individual to population to species), and between applied and academic issues. Furthermore, BIOFIS will be relevant to various socio-economic and sustainable developmental issues. Temperate (including Europe), peri-Mediterranean and tropical countries are indeed facing major socio-economic risks from invasive alien species, especially bioaggressor introduction.

**Total Agropolis Fondation funding:** €1,000,000

**Funding categorie(s):** 2 to 3 Post-doctoral fellowships (total duration = 36-48 months), 3 to 4 Doctoral fellowships (total duration = 144-180 months), 2 Visiting fellowships for short period of stay (total duration = 6 months), 2 small grants for support to scientific events

**Project duration:** 15 December 2010 – 15 December 2014

**Keywords:** bioaggressors and invasive species, biosecurity, arthropod, emergence of invasive populations, management practice, database, natural enemies

**Year of CfP: 2010 Grand federative project**

**Project 1001-005**

<b>Project title:</b> RHIZOPOLIS: A federative project for plant root research
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**Unit managing the project:** UMR BPMP Plant Molecular Physiology and Biochemistry (CNRS, INRA, Montpellier SupAgro, UMII)

**Project leaders:** Alain GOJON (alain.gojon(a)supagro.inra.fr)

**Countries involved in the project:** Japan, Deutschland, Chile, USA, Australia

**Countries involved in the project:** Japan, Deutschland, China, USA, Australia, United-Kingdom, Belgium

**Research units from the Foundation's scientific network involved:** AMAP, ECO&SOLS, DIADE, LSTM, AGAP, EMMAH, LEPSE, LAMETA

**Subthematic axes:** IPB-1 (Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*), STDI-1 (Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*), STDI-3 (Socio-Technical Dynamics of Innovation 3: *Innovation processes, social management of innovations*)

#### **Objectives:**

We propose a multidisciplinary project on the biology and ecology of the plant root that will address the broad roles of this organ in mineral nutrient and water acquisition. The green revolution that started in the 1960's was based on the combined use of high inputs (e.g., irrigation water and fertilisers) and high-yielding genotypes, and thereby dramatically improved crop yields worldwide. Most plant breeding schemes have thus been based on identifying best performing plant genotypes under optimal conditions, in particular in terms of water and nutrient availability. The global changes we are now facing and the need for an ecological intensification of agroecosystems require revising these breeding strategies towards the production of more water- and nutrient efficient genotypes, as pointed in the paper "Roots of the second Green Revolution" by Lynch (2007)

We will address central issues in this context:

(1) **Integration of membrane transport activity and structure-function relationships in roots and root symbioses.** We will exploit the molecular knowledge and the genomic resources acquired in two model plants, Arabidopsis and rice, to carry out, for the first time, an integrative study of the transport of major nutrient ions and water, and of their interactions. The approach will combine extended functional analyses and modelling of transport capacities, taking radial root structure and tissue localisation of transport systems into account. In parallel, we will develop a cutting-edge methodology, based on new pH sensing fluorescent proteins, in order to probe the pH in cell compartments. We will thus investigate the role of local pH gradients in membrane transport energization and interactions with symbiotic microorganisms favoring the mineral nutrition of the plant.

(2) **Root development and architecture and their responses to environmental signals.** Root growth and development crucially determine the plant efficiency to acquire water and nutrient resources, by optimizing the exploration of the soil areas where nutrients or water are available. A major objective of our consortium in this domain is to develop two key tools: (i) a world unique platform for 4D imaging of meristem activity and primordia formation in primary and lateral roots, and (ii) an innovative image analysis software for high-throughput phenotyping of root system architecture. These tools will be used to identify mechanisms and traits associated with root system efficiency and plasticity in response to environmental cues.

**(3) Integrating root-soil interactions in the rhizosphere at the whole root system level – application to water and nutrient acquisition by plants.** Current models of root-soil interactions and biogeochemical processes in the rhizosphere do not account for spatial or temporal heterogeneities of root-soil interactions and thus fail at predicting plant nutrition in nutrient-poor soils. In order to fill this gap, we will develop two major approaches: (i) to evaluate the spatial/temporal heterogeneity of water and nutrient (N, P, K) acquisition along the whole root system, and (ii) to assess its impact when up-scaling knowledge from root segment to the whole plant scale.

**Total Agropolis Fondation funding:** € 1,000,000

**Funding categorie(s):** Post-doctoral Fellowship (7); Visiting Fellowship for short period of stay < 12 months (15) ; Sponsorship of international training courses (2); Support for the organization of high-level scientific events (Conferences, seminars, workshops, etc.) (4); Support for the preparation of application to international Calls for Proposals (1); Overseas travel grants for Doctoral and Post doctoral scientists (15); Support for publication and dissemination of research results; Support to hosting pre-doctoral students (28)

**Project duration:** 01 January 2011 – 31 December 2013

**Keywords:** root, root symbioses, root development and architecture, rhizosphere, water and nutrient

**Year of CfP: 2010 Grand federative project**

**Project 1001-009**

**Project title:** Ecological services of legumes for nitrogen and phosphorus biogeochemical cycles and C sequestration in cereal cropping systems in Africa and the Mediterranean basin

**Unit managing the project:** UMR ECO&SOLS (Functional Ecology and Bio-geochemistry of Soils and Agro-ecosystems (CIRAD, INRA, IRD, Montpellier SupAgro))

**Project leaders:** DREVON Jean-Jacques (jean-jacques.drevon(a)supagro.inra.fr)

**Countries involved in the project:** Madagascar, Tunisia, Morocco, Senegal, Mali, Burkina-Faso, Algeria, Egypt

**Subthematic axes:** IPB-1 (Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*); STDI-1 (Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*); STDI-3 (Socio-Technical Dynamics of Innovation 3: *Innovation processes, social management of innovations*)

**Objectives:**

The Fabatropimed project is one of 3 major, collaborative projects being supported by the Agropolis Foundation from 2011 onwards. Over a four (4) year period it brings together 15 research teams from the Ecology & Soil, Innovation, and Tropical and Mediterranean Symbiosis Laboratory (LSTM) Mixed Research Units and the SCA Analytical Laboratory and Diascope units of the Montpellier campus, in partnership with Mediterranean and Tropical African agro-ecosystems.

The target of Fabatropimed is to enhance the benefit of pulses for cereal growing systems and the environment, by (1) reducing the use of mineral-based fertilizers and increasing carbon-dioxide sequestration, and by (2) promoting the interaction between soil micro-organisms for plants to acquire and use nitrogen and phosphorus. Fabatropimed is carrying out cooperative research in six agro-ecosystems using agricultural and environmental diagnostics (WP1) together with a sustainability and innovation survey (WP5), in interdisciplinarity with monitoring the C, N and P soil cycles and the atmosphere (WP2). To this is added the characterisation of the microbial, symbiotic and rhizospheric functional diversity (i.e. in the areas influenced by roots) (WP3) and research into genes for the effective acquisition and use of phosphorus for the symbiotic fixation of nitrogen (WP4). The research work is carried out as part of 12 doctoral projects, jointly organized by an Agropolis researcher and his African partner, generally co-supervised as part of international programmes.

These researches have in common a functional ecological approach to plant-micro-organism-soil-atmosphere interactions with three pulse species: *Phaseolus vulgaris*, *Vicia Faba* and *Vigna unguiculata*, in rotation or association with sorghum in the zai of Yatenga (Burkina Faso), rice and maize in the Ivory tanety (Madagascar), durum wheat in the Medjerda valley (Tunisia), the perimeter of Haouz (Morocco) and the Setif plateau (Algeria).

The alternative, biological and organic technologies that emerge will be assessed in a network of groups of producers where digital models, MOMOS and MIN3P will be applied simultaneously to simulate C, N and P cycles in the soil and the rhizosphere. The comparative approach to agro-ecosystems will distinguish the generic conservation and resilience mechanisms of the C, N and P biochemical cycles from those that are specific to the ecosystems. Fabatropimed treats pulses as ecological engineers of the biological operation of soils, in this way making a specific contribution within the context of international cooperation for food and environmental safety, together with the FAO, IAEA, CIAT, ICARDA, IITA and ICRISAT of the CGIAR, and projects such as Ripiecsa and N2 Africa.

**Total Agropolis Fondation funding:** €1,000,000

**Funding categorie(s):** Doctoral Fellowship, Post-doc Fellowship, Overseas Travel Grant for Doctoral and Post-doctoral scientists, Support for publication and dissemination of results

**Project duration:** 01 December 2010 – 31 March 2015

**Keywords:** phosphorus, nitrogen, rhizobial symbioses, microorganisms, legumes; soil, nitrogen fixation

**Year of CfP: 2010**

**Project 1001-009**

**Project title:** Ecological services of legumes for nitrogen and phosphorus biogeochemical cycles and C sequestration in cereal cropping systems in Africa and the Mediterranean basin

**Unit managing the project:** UMR ECO&SOLS (Functional Ecology and Bio-geochemistry of Soils and Agro-ecosystems (CIRAD, INRA, IRD, Montpellier SupAgro))

**Project leaders:** DREVON Jean-Jacques (jean-jacques.drevon(a)supagro.inra.fr)

**Countries involved in the project:** Madagascar, Tunisia, Morocco, Senegal, Mali, Burkina-Faso, Algeria, Egypt

**Research units from the Foundation's scientific network involved:** LSTM, INNOVATION

**Subthematic axes:** IPB-1 (Integrative Plant Biology 1: Genetics and genomics, plant breeding, ecophysiology); STDI-1 (Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*), STDI-3 (Socio-Technical Dynamics of Innovation 3: *Innovation processes, social management of innovations*)

**Objectives:**

The Fabatropimed project is one of 3 major, collaborative projects being supported by the Agropolis Foundation from 2011 onwards. Over a four (4) year period it brings together 15 research teams from the Ecology & Soil, Innovation, and Tropical and Mediterranean Symbiosis Laboratory (LSTM) Mixed Research Units and the SCA Analytical Laboratory and Diascope units of the Montpellier campus, in partnership with Mediterranean and Tropical African agro-ecosystems.

The target of Fabatropimed is to enhance the benefit of pulses for cereal growing systems and the environment, by (1) reducing the use of mineral-based fertilisers and increasing carbon-dioxide sequestration, and by (2) promoting the interaction between soil micro-organisms for plants to acquire and use nitrogen and phosphorus. Fabatropimed is carrying out cooperative research in six agro-ecosystems using agricultural and environmental diagnostics (WP1) together with a sustainability and innovation survey (WP5), in interdisciplinarity with monitoring the C, N and P soil cycles and the atmosphere (WP2). To this is added the characterisation of the microbial, symbiotic and rhizospheric functional diversity (i.e. in the areas influenced by roots) (WP3) and research into genes for the effective acquisition and use of phosphorus for the symbiotic fixation of nitrogen (WP4). The research work is carried out as part of 12 doctoral projects, jointly organised by an Agropolis researcher and his African partner, generally co-supervised as part of international programmes.

These researches have in common a functional ecological approach to plant-micro-organism-soil-atmosphere interactions with three pulse species: *Phaseolus vulgaris*, *Vicia Faba* and *Vigna unguiculata*, in rotation or association with sorghum in the zai of Yatenga (Burkina Faso), rice and maize in the Ivory tanety (Madagascar), durum wheat in the Medjerda valley (Tunisia), the perimeter of Haouz (Morocco) and the Setif plateau (Algeria).

The alternative, biological and organic technologies that emerge will be assessed in a network of groups of producers where digital models, MOMOS and MIN3P will be applied simultaneously to simulate C, N and P cycles in the soil and the rhizosphere. The comparative approach to agro-ecosystems will distinguish the generic conservation and resilience mechanisms of the C, N and P biochemical cycles from those that are specific to the ecosystems. Fabatropimed treats pulses as ecological engineers of the biological operation of soils, in this way making a specific contribution within the context of international cooperation for food and environmental safety, together with the FAO, IAEA, CIAT, ICARDA, IITA and ICRISAT of the CGIAR, and projects such as Ripiecsa and N2 Africa.

**Total Agropolis Fondation funding:** €1,000,000

**Funding categorie(s):** Doctoral Fellowship, Post-doc Fellowship, Overseas Travel Grant for Doctoral and Post-doctoral scientists, Support for publication and dissemination of results

**Project duration:** 01 December 2010 – 31 March 2015

**Keywords:** phosphorus, nitrogen, rhizobial symbioses, microorganisms, legumes; soil, nitrogen fixation

**Year of CfP: 2010**

**Project N° 1002-003**

<b>Project title:</b> Identification of nematode ( <i>Meloidogyne</i> spp.) effectors of pathogenicity in rice ( <i>Oryza sativa</i> )
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**Units managing the project:** UMR RPB "Plant resistance to pests and diseases" (CIRAD, IRD, UMII)

**Project leader:** Fernandez, Diana (diana.fernandez(a)ird.fr)

**Countries involved in the project:** Brazil and Benin

**Sub-thematic axes:** IPB-1 (Integrative Plant Biology 1: Genetics and genomics, plant breeding, ecophysiology)

**Objectives:**

The diseases caused by parasitic nematodes in plants are major factors that decrease production and quality of the agricultural products. Root-knot nematodes (*Meloidogyne* spp.) are one of the three most economically damaging genera of plant-parasitic nematodes on horticultural and field crops in all temperate and tropical areas (Trudgill and Block, 2001).

The main hypothesis of this project is that *Meloidogyne* nematodes secrete a rich assortment of effectors that interact with or manipulate host plants during infection. An exhaustive mass spectrometry analysis of *M. incognita* secretions allowed the direct identification of proteins that could play a role in the interactions between *M. incognita* and its host plants. We propose in this project to search for essential *M. incognita* proteins among a set of candidate secreted proteins and to assess their possible role as effectors involved in interactions with the host plant. This objective can be achieved by a multi-disciplinary project combining functional genomics (transcriptomics, reverse/forward genetics, biological assays), basic plant pathology (nematode sampling in fields and identification) and genetic variability analysis of candidate genes in nematode populations.

The proposed program will associate the functional analysis of *Meloidogyne* candidate genes with field surveys for the sampling of nematode populations and assessment of candidate gene variability at a regional scale in Brazil and Africa. A set of *M. incognita* secreted proteins has been selected in IRD and Embrapa-Cenargen as putative virulence effector candidates. Once these proteins are confirmed to be secreted during parasitism, functional analysis of candidate genes will be assessed through combined forward and reverse genetic approaches using genetic transformation of rice.

The study of proteins secreted during interactions with host plants should significantly widen our knowledge of molecular players contributing to nematode pathogenicity, opening new avenues for *Meloidogyne* spp. control strategies in rice and other crops of interest for Brazil and Africa which are highly susceptible to *M. incognita*. The major goals of this project will be (i) to identify and functionally characterize *M. incognita* effector proteins involved in virulence against the host plant, (ii) to assess *M. incognita* gene polymorphism among natural populations in rice fields from Brazil and Benin and (iii) to generate rice plants with potential anti-nematode activity against *Meloidogyne* spp.

**Total Agropolis Fondation funding:** €19,999

**Funding category:** Work mission of professors, faculty members, scientists and/or researchers

**Project duration:** 01 March 2011 – 28 february 2013

**Keywords:** *Meloidogyne* nematode, disease, virulence, effector proteins, reverse genetic approach.

**Year of CfP: 2010**

**Project 1002-006**

<b>Project title:</b> InfraRed Spectrometry as a tool to model inorganic and organic phosphorus availability in tropical soils under conservation systems
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**Unit managing the project:** UMR 210 Eco&Sols "Functional Ecology and Biogeochemistry of Soils and Agro-ecosystems" (CIRAD, INRA, IRD, Montpellier SupAgro)

**Project leaders:** Becquer Thierry (thierry.becquer@ird.fr)

**Countries involved in the project:** Brazil, Madagascar, Switzerland

**Subthematic axes:** STDI-1 (Socio-Technical Dynamics of Innovation 1: *Agri-environmental innovations, agri-ecosystems, resources management*)

**Objectives:**

This project, developed in partnership between the UMR Eco&Sols, of the "Institut de Recherche pour le Développement" (IRD), France, the Department of Agronomy of the University of Londrina, Brazil, and the Laboratory of Radio-Isotopes (LRI) of the University of Antananarivo, Madagascar, aims at understanding how conservation agriculture affects the availability of phosphorus (P) to crops in various soil conditions in the tropics. In a context of limited P availability and low mineral fertilizer inputs, as in most developing countries, we hypothesize that practices used in conservation agriculture systems, such as organic matter incorporation and implementation of appropriate crop rotations, including legumes, favor an increase of P availability. Nevertheless, the soil characteristics, notably their mineralogy, also regulate the availability of P.

The specific objective of this study is to investigate the potential use of infrared reflectance spectroscopy (IRS) as a tool for the assessment of the mineralogy, P forms and availability over a wide range of tropical soils. It has advantages over some of the conventional techniques of soil analysis, e.g. it is rapid, timely and less expensive, and does not use environmentally harmful chemical extractants. Nevertheless, if this methodology yielded good results for carbon analysis, relatively few analyses were realized at this time on the mineralogy and P forms and availability.

**Total Agropolis Fondation funding:** €19,760

**Funding categorie(s):** Work mission of professors, faculty members, scientists and/or researchers, Study missions for PhD students

**Project duration:** 01 Juin 2011 – 31 May 2013

**Keywords:** Availability of phosphorus (P), soil, infrared reflectance spectroscopy (IRS)

**Year of CfP: 2010**

**Project 1002-008**

**Project title:** Organization of a joint French-Brazilian-African training course for the construction of a sentinel network for Greening disease outbreak detection in peri-Mediterranean countries.

**Unit managing the project:** UMR RPB Plant resistance to pests and diseases (CIRAD, IRD, UMII)

**Project leaders:** Gatineau Frédéric (gatineau.frederic(a)cirad.fr)

**Countries involved in the project:** Brazil, Morocco, Tunisia, Egypt, Turkey & Cameroun

**Subthematic axes:** IPB-2 (Integrative Plant Biology 2: *Plant pests and diseases, integrated crop protection, population ecology*)

**Objectives:**

The purpose of this project is to organize in Montpellier an international training course of three days dedicated to Huanglongbing of Citrus (HLB or Greening disease). It will deal with symptoms recognition, detection in plants and insect vectors, for the risk management of the potential arrival of HLB disease and its insect vectors in Southern Mediterranean and North-African countries in particular.

HLB is a phloem-restricted bacterial disease associated with three species of *Candidatus liberibacter* (the Asian, American and African forms) and is vectored by psyllids (*Trioza erytreae* and *Diaphorina citri*). This is the most devastating disease of citrus worldwide because of the lack of effective and sustainable management strategies. To date, the disease is present in China, the Indian subcontinent, Madagascar, Mauritius, Reunion, Southeast Asia, North and South America and the Saudi Arabian peninsula.

The risk management of the potential arrival of the disease and its psyllid vectors requires the ability to detect and to recognize both the bacteria and the psyllid vectors soon after their arrival in a citrus producing area.

Hence, the two main goals of the proposed training course are:

- To gather regional collaborators (plant pathologists, entomologists, engineers from agricultural institutes) from the South of Mediterranean basin (Morocco, Tunisia, Egypt, Turkey) and to train them 1) to HLB symptom recognition 2) to psyllid vectors identification 3) to lab testing (sampling methods, DNA extractions, detection by molecular tools) and 3) to permanent surveying of psyllids for early eradication,
- To organize international collaborations with and between invited institutions for the implementation of a sentinel epidemiological network for the disease outbreak detection and early eradication.

**Total Agropolis Fondation funding:** €18,980

**Funding categorie(s):** Support for the organisation of high-level scientific events (conferences, seminars, workshops, etc.)

**Project duration:** 15 January 2011 – 30 June 2011

**Keywords:** risk management, Huanglongbing of Citrus, psyllid vector, training course, bacteria, epidemiological network

**Year of CfP: 2010**

**Project 1002-009**

<b>Project title:</b> Role of active retrotransposons (RT) In <i>Coffea canephora</i> and <i>C. Arabica</i> Genome Evolution
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**Unit managing the project:** UMR DIADE Diversity, adaptation and development of plants (IRD, UMII)

**Project leaders:** de Kochko Alexandre (alexandre.dekochko(a)ird.fr)

**Countries involved in the project:** Brazil & Uganda

**Subthematic axes:** IPB-1 (Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*)

**Objectives:**

The scientific objective of the project is to identify active retrotransposons (RTs) among the *C. canephora* and the *C. arabica* genomes and to use these particular elements to better define the genetic structure of the species and asses alleged role of *C. canephora* as a parental species of *C. arabica*. We will focus on one class of Transposable Elements (TEs), those belonging to type 1, which moves through an RNA intermediate according to a "copy and paste model". It has been shown that the movement of such elements can be induced by different type of stresses, biotic or abiotic. It is also this type of elements that will introduce differences in isogenic lines or clones and permit an individual and precise identification through fingerprinting.

We will identify such mobile RTs using available sequence data, genomic and transcriptomic, and analyze plants submitted to different stresses susceptible to induce their movement.

The identification of such elements will provide an extremely valuable tool for the survey of any coffee tree pedigree constituting thus a powerful tool of traceability and for the definition of interesting genotypes to be included in breeding programs. It will also allow a better view of recent genome dynamics, help the prediction of their movement and thus allow a better targeting for the search of genetic diversity.

**Total Agropolis Fondation funding:** €20,000

**Funding categorie(s):** Study missions for Post-doc students and researchers

**Project duration:** 1 February 2011 - 1 March 2013

**Keywords:** *Coffea*, retrotransposons, genetic diversity, phylogenetic relationships, genome dynamics, traceability

**Year of CfP: 2010**

**Project 1002-012**

**Project title:** Phenotyping, Genotyping and analysing genetic diversity and structure of a collection of *Coffea arabica* from Ethiopia, in relation with quality and drought tolerance (PHEGECO)

**Unit managing the project:** AGAP Genetic improvement and plant adaptation (CIRAD, INRA, Montpellier SupAgro)

**Project leaders:** Leroy Thierry (thierry.leroy(a)cirad.fr)

**Countries involved in the project:** Brazil

**Research units from the Foundation's scientific network involved:** DIADE, QUALISUD

**Subthematic axes:** IPB-1 (Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*)

**Objectives:**

Traditional coffee breeding has led to tremendous results in terms of productivity increase, and of tolerance to biotic/abiotic stress. However, the efficiency of conventional breeding is limited due to the perennial character of this crop, to its long juvenile period, and to the complexity of the genetic control of desirable traits which, for most of them, are polygenic, with high costs of characterization. Indeed, identifying molecular markers related to genes of interest would be extremely valuable, allowing major genetic gains for each selection cycle.

The phenotypic and genotypic characterization of this Ethiopian collection will constitute the start for the initiation of the mapping of genes or of markers of agronomic interest. Towards this goal two mapping techniques will have to be used. Studies will be initiated on the diversity and structure of this Ethiopian population, followed by mapping through linkage disequilibrium and association studies. Linkage mapping will be also based on the segregation of a biparental population.

Thus, keeping in mind the need for a better characterization of the existing diversity in *Coffea arabica*, with the use of mapping, this project aims at characterizing Ethiopian accessions phenotypically and genotypically regarding characters of quality and of drought tolerance. Within the duration of the project we assume we'll be able to:

- Evaluate in the field the phenotypic diversity of Ethiopian accessions in relation with quality and drought tolerance;
- Enhance our knowledge on the plasticity of a panel of contrasted accessions in controlled conditions, concerning phenotypic characteristics (morphology, anatomy, physiology) and molecular response (transcriptomics);
- Develop molecular markers, in line with analyses of the accessions;
- Start studies on the structure of the population with the aim of developing association studies;
- Contribute to the identification of specific molecular markers to be used in assisted selection (MAS) in *C. arabica* breeding;
- Train human resources in the fields of genetics and breeding with an experience in modern techniques of phenotyping, genotyping, and bioinformatics.

**Total Agropolis Fondation funding:** €19,978

**Funding categorie(s):** Work mission of professors, faculty members, scientists and/or researchers; Study missions for PhD students

**Project duration:** 01 April 2010 - 31 March 2013

**Keywords:** *Coffea*, diversity, Ethiopian accessions, molecular markers, phenotyping, genotyping