From Brazil to Europe:
10 years of Labex Program,
EMBRAPA's laboratory without walls
Agropolis International brings together institutions of research and higher education in Montpellier and Languedoc-Roussillon in partnership with local communities, companies and regional enterprises and in close cooperation with international institutions.

Agropolis is an international campus devoted to agricultural and environmental sciences. There is significant potential for scientific and technological expertise: more than 2,300 scientists and lecturers in over 80 research units in Montpellier and Languedoc-Roussillon, including 400 scientists conducting research in 60 countries. Agropolis International is structured according to a broad range of research themes corresponding to the overall scientific, technological and economic issues of development.

Agropolis International promotes the capitalisation and enhancement of knowledge, personnel training and technology transfer. It is a hub for visitors and international exchanges, while promoting initiatives based on multilateral and collective expertise and contributing to the scientific and technological knowledge needed for preparing development policies.

Further information:
p. 42-43 & www.agropolis.org

EMBRAPA
Research at the service of Brazilian agricultural development

EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária), the Brazilian Agricultural Research Corporation, linked to the ministry of Agriculture, Livestock and Food Supply, has the missions of 'providing technological solutions for sustainable agricultural development in Brazil to the benefit of the Brazilian society'.

Founded in 1973, it has thus developed thousands of technologies of use in Brazilian agriculture, reduced production costs and helped Brazil to increase its food security while conserving natural resources and the environment.

With more than 9,500 employees including more than 2,400 research scientists, Embrapa has built up a network of 42 research centers, 5 service centers and 15 central divisions.

Present in all the Brazilian states, it additionally serves as a link between the institutions that are part of the national agricultural research system.

Embrapa is also involved in numerous international cooperation projects, in particular through the virtual laboratories abroad, 'Labex' (today in the United States, Europe and Asia), and thanks to technological transfer offices in Africa and Latin America.

Further information:
p. 11-12 & www.embrapa.br and www.agricultura.gov.br
Building scientific partnerships today: EMBRAPA’s Labex Program in Europe and over the world

Partnership is an essential component of research today. To say that no major question can be settled by a single institute is no novelty. Building up and managing multilateral partnerships forms a difficult operation requiring good knowledge of capacities and of the complementary features of those involved. It can be optimised, however, by sending experienced scientists to work with partners with the twin aim of sharing knowledge and prospecting. Sharing knowledge, using their own competences and making partners discover those of the institute that they represent. Prospecting, outside the host team, to find new partnership opportunities within their field of competences that are relevant for the strategy of their institution.

Embrapa has implemented this strategy through ‘Labex’, ‘virtual laboratories abroad without walls’ (from Laboratórios no Exterior, in Portuguese), in the United States, Europe and more recently in Asia.

Senior scientists are posted to ‘cutting-edge’ teams to work two-thirds of their time on an ambitious project of joint interest. They use the rest of the time for prospecting and for seeking new opportunities. Information flows from these Labex to Brazilian research institutes. After the first decade in Europe, we can observe a strong increase in collaborative projects.

This special Agropolis International Dossier devoted to ‘Partnership’ describes results and experiences of Labex-Europe’s 10 years of functioning. Experiences that Embrapa and Agropolis International wish to share.
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From Brazil to Europe: 10 years of Labex Program, EMBRAPA’s laboratory without walls

EMBRAPA’S Labex Program

International scope of EMBRAPA

Natural resource management

Agrifood technologies

‘Advanced biology’ and molecular plant-microorganism interactions

Main publications

Agropolis International

Agropolis Fondation

An Argentinian Labex set up at Agropolis International

Prospects of the EMBRAPA Labex Program

Acronyms and abbreviations

On the cover © Lygia Akemi/EMBRAPA
The information presented in this Dossier was valid on 01/08/2012.
EMBRAPA'S Labex Program

Labex-Europe is now 10 years old, so it is time to learn from and share this unique international scientific cooperation experience.

The idea emerged from Brazil.

In the late 1990s, EMBRAPA explored a new partnership concept, i.e. the 'laboratory without walls' or 'external laboratory (Labex)', with Francisco Reifschneider, Eliseu Alves and Alberto Portugal being the main architects.

Senior researchers are posted for 2-4 years in top-notch research laboratories abroad to foster exchange of their experience with other researchers. The ultimate aim is to generate new knowledge that will serve to develop innovative technologies for tropical agriculture. They join a high-level team and collaborate in a joint research project that will serve to create a research cluster through Brazilian and European scientific networks.

These researchers must also devote a third of their time to exploratory activities (scientific monitoring, visits, participation in conferences, etc.) and to information activities geared towards coordination and supervision of the program.

Four years after the first Labex was set up in the United States in 1998 (in collaboration with USDA-ARS*), a second one was launched in Europe. The French research centers CIRAD (Agricultural Research for Development), INRA (Institut National de la Recherche Agronomique) and IRD (Institut de Recherche pour le développement) mandated Agropolis International to sign an agreement between EMBRAPA and the regional multi-institutional consortium (28 research and higher education establishments) hosted in the Agropolis International facilities in Montpellier, France. Labex-Europe was inaugurated in 2002. Labex has also set up offices in other regions of the world (South Korea in 2009, China in 2012).

* United States Department of Agriculture, Agricultural Research Service.
EMBRAPA’s Labex Program

A successful partnership experience

Brazil is now the main scientific partner of the Montpellier agroenvironment cluster, in which one research unit in four is involved in an ongoing cooperation with one or more Brazilian research and training institution. In this setting, the Labex-Europe Program is an instrument to pave the way to new synergies for the scientific teams. The presence of experienced Brazilian researchers and network leaders, who are highly familiar with the Brazilian research system, is a direct and high quality source of information.

Joint interest projects are proposed by hosted Brazilian researchers. These projects were found to be excellent contributions as these scientists are aware of the strengths and weaknesses of the stakeholders in both countries. The established collaborations are ongoing and even being diversified. The Labex Program is thus an instrument for the strengthening and diversification of established partnerships but especially an opening towards collaborations with excellence research teams. One of the tangible results is the creation of the International Advanced Biology Consortium (CIBA, p.36), which pools Brazilian and French partners for the purpose of improving plants of interest for tropical and Mediterranean agriculture. Labex is therefore also a complement to standard cooperation tools. Although virtual communication, with all of its advantages, is now omnipresent, joint work as part of a team within the same laboratory can bind links of a completely different type.

A model that can be used for other partnerships in Montpellier, Europe and elsewhere

Based on the work started by researchers of the Labex-Europe Program, EMBRAPA is now developing this strategic partnership model not only in France but also in other European countries, especially England (Rothamsted Research Station, p. 34-35) and Germany (Julich Institute, p. 13). A Labex researcher was hosted in the Netherlands (Wageningen University, p. 32) for 4 years and other host countries are targeted in the future.

As EMBRAPA’s Labex Program has been efficient in one direction, it could also operate well in the other—this is the aim of the ‘Inverse Labex’ project, tested by foreign senior researchers in EMBRAPA research centers in Brazil. In addition to the many IRD and CIRAD researchers posted in various EMBRAPA centers in Brazil, a Korean RDA researcher, two ARS/USDA researchers and an English researcher from the Rothamsted Research Station, associated with the Biotechnology and Biological Sciences Research Council (p. 35), have been hosted in different laboratories. Soon, a German researcher from Julich Institute (p. 13) may come to an EMBRAPA research centre as well. The Brazilian Labex model has also inspired other countries: in March 2012, Agropolis International signed a partnership agreement with INTA (Instituto Nacional de Tecnologia Agropecuaria) in Buenos Aires to host the first LabIntex offices in Montpellier, which is based on EMBRAPA’s Labex Program (p. 45).

Pedro Arcuri (EMBRAPA, Brazil), Yves Savidan (IRD, France) & Paula Dias (Agropolis International, France)

"We want our EMBRAPA researchers, and not just our students, to 'rub shoulders' with leading top-notch scientific research teams in programs that are at the cutting-edge, each in its specific field, as regards new technologies and innovation."

Eliseu Alves & Francisco Reifschneider (EMBRAPA)
Some key dates in the history of EMBRAPA's Labex Program

1998
Beginning of EMBRAPA's Labex Program—First laboratory without walls set up in the United States

2002
Inauguration of EMBRAPA's Labex-Europe at Agropolis International (Montpellier, France)

2005 - 2008
Agrifood technology—New sources of plant enzymes isolated from Brazilian biomass (Regina lago)

2006 - 2010
Plant-microorganism interactions. MusaForever Program (Manoel Sousa)

2007 - 2009
Natural resource management—Assessment of the agroenvironmental impacts of perennial crop based farming systems (Geraldo Stachetti Rodrigues)

2008
Founding of the International Advanced Biology Consortium (CIBA)—Franco-Brazilian scientific collaboration

2009 - 2011
Agrifood technology—Impact of information and innovations on consumer food choices and on their willingness to pay (Rosires Deliz a)

Agrifood technology—Bacterial spore resistance to thermal stress (Amauri Rosenthal)

2009
Inauguration of EMBRAPA's Labex-Korea—Partnership with the Rural Development Administration

2010 - 2013
Genomics, plant biotechnology and molecular plant-microorganism interactions—Functional genomic analysis of interactions between Mycosphaerella graminicola and wheat (Alexandre Amaral)

2010
Natural resource management—Dynamics of rural areas based on landuse change interpretation (Margareth Simões)

2012
Beginning of a Labex-Europe position at Jülich Institute (Germany). Development of high throughput plant phenotyping methods (Paulo Herrmann Jr.)

2012
Inauguration of Labex-China—Partnership with the Chinese Academy of Agricultural Sciences

2006
Beginning of a Labex-Europe position at Wageningen University (Netherlands)

2005 - 2008
Agrifood technology—Possible alternatives to chemical methods for the conservation of minimally processed plant products (Heloísa Filgueiras)

2002 - 2005
Natural resource management—Spectral reflectance used to map soil properties (José Madeira)

Plant genomics and biotechnology—Functional analysis of drought and salt tolerance in rice (Ana Brasileiro)
A word from Dr Elisio Contini, the first coordinator of EMBRAPA’s Labex-Europe

The Labex-Europe Program institutionalizes long-term scientific and technical cooperation between EMBRAPA, Agropolis International institutions and other European centers of excellence in agricultural research. The presence of Brazilian researchers in these research centers highlights EMBRAPA’s strategic decision to advance its knowledge as well as Brazil’s interest and dynamism in terms of partnerships in joint research projects and monitoring new scientific discoveries on this continent.

The scientific links remain established via research networks and clusters after the scientists return to Brazil, often giving rise to new projects. The Labex-Europe Program is an international cooperation instrument which, with the support of the Agropolis International, frees it from the long bureaucratic procedures required for the approval of international scientific cooperation projects. The Labex-Europe Program has shown its strategic asset of being able to strengthen the quality of research carried out by EMBRAPA by allowing its researchers to work in centers of scientific and technological excellence. Although it’s a small program, a feature to be kept as it is essential for effective coordination, the Labex-Europe has enabled European researchers to deal with new research issues and with challenges associated with emerging countries undergoing technical and scientific development.

By being involved in looking for new technologies and responses to problems affecting tropical agriculture, they have made progress in gaining the knowledge required to cope with global agricultural challenges in a setting of climate change, urban population growth and a need to develop technologies to ensure sustainable agricultural intensification while also being environment-friendly. Finally, application of knowledge generated by international cooperation will contribute to combating poverty worldwide.

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A word from Dr Pedro Arraes Pereira, Director-President of EMBRAPA

Since EMBRAPA was founded, research and scientific cooperation capacity building has been pivotal to fulfill its vision of natural resource management associated with innovative knowledge-based technologies as the basis for intensive, sustainable and highly efficient agriculture.

Our most valuable asset is thus our team of more than 2000 PhD researchers (or scientists) and their scientific networks. This is why EMBRAPA developed the ‘virtual laboratories abroad’ concept, the Labex Program, about 15 years ago.

As a former coordinator of its US branch, I have witnessed its symmetrical scientific cooperation performance. Now that we are celebrating the 10th anniversary of the Labex-Europe office being set up in Montpellier, the results presented in this publication are evidence that the decision taken by our former directors to count on the support of Agropolis International and its members, in order to coordinate the presence of our researchers throughout the continent, was strategic.

EMBRAPA is therefore extremely thankful for their acceptance of the Labex concept. Scientific cooperation explains part of the Brazilian agricultural achievements. In 40 years, EMBRAPA became a network of 47 research centers, spread throughout Brazil and covering our five biomes.

Over this period, crop yields increased steadily by up to 4% per year in Brazil, representing an overall increase of 200%, whereas the increase in land available for agriculture only increased by around 30%.

Brazil preserves land from agricultural use. It has around 50% of its territory legally classified as indigenous land, biological reserve or natural park, while at the same time it is one of the leaders in biofuel, plant fiber and food production.

Nevertheless, in a global setting where there is increased demand for agriculture that has to cope with climate change, soil acidity, emerging diseases and many other urgent challenges, R&D institutions must now work together towards developing sustainable intensification practices and biotechnologies in order to increase productivity and provide environmental services such as biodiversity preservation and water quality.

Labex-Europe, despite its small size, has already obtained results that fulfill EMBRAPA’s vision by creating or strengthening scientific networks and new scientific knowledge. Therefore, Labex-Europe’s results significantly contribute to harmonizing economic development and environmental conservation. In this setting, agriculture becomes a solution, not a problem, towards building a more sustainable future.

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"LABEX-EUROPE’S RESULTS SIGNIFICANTLY CONTRIBUTE TO HARMONIZING ECONOMIC DEVELOPMENT AND ENVIRONMENTAL CONSERVATION"
A word from Dr Bernard Hubert, President of Agropolis International

The world is changing, thus implying that what we currently call globalization is simply a transition from a Western oriented world to a multipolar world within which emerging countries are claiming their rightful place. Is this not what Southern Cone countries are doing with their high ambitions of becoming global stakeholders in agriculture and food sectors? And is it not what they are involved in doing by encouraging their agricultural research institutions to collaborate more effectively with the best research teams worldwide, and by setting up platforms in the United States, Europe and Asia? EMBRAPA is a remarkable forerunner in this sense—it has been thriving in France and throughout Europe from its base in Montpellier (France) for 10 years now! And now the Argentinian Instituto Nacional de Tecnología Agropecuaria (INTA) is preparing to do the same.

I am delighted by these initiatives, as a result of which Brazil has become a key scientific partner of Montpellier research teams, and the relevance of its performance record is recognized and shared joint programming initiatives, researcher mobility, renewal of research focuses, all through the pooling of temperate and tropical research resources. Agricultural research is becoming globalized to come up with appropriate solutions to food security and malnutrition questions that are still pending at the outset of the 21st century. Population movements and subsequent behavioral changes, the threat of climate change, the need to reconsider the allocation of water resources for different uses, and other imminent uncertainties, will inevitably contribute to renewing our research agenda.

Agriculture is still vital for humankind, but keep in mind that this is not a disembodied activity—it involves men and women worldwide who care for their crops and livestock every day. We also need to focus on what happens to these people as a result of the changes that are underway—their professional and family lives, workload, income, the future of rural areas in different regions, marked by the specific historical and geographical settings, relationships between the countryside which feeds them and the cities where populations throughout the world are increasingly concentrated. Agricultural research should be focused on all of these issues so as to be able to foresee future trends and investigate ways to safeguard the future in suitable ways. Technological development alone will not guarantee that the development will be sustainable, respectful of the environment and the societies that it impacts. It is my sincerest hope that all of these questions will be addressed in our collaborations with the Brazilian teams and facilitated by the presence of Labex EMBRAPA in Montpellier!

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International scope of EMBRAPA

EMBRAPA, since its inception, has been acting in close collaboration with different international institutions. It also created a Secretary for International Affairs (SIA) in 2009, which is directly linked to the cabinet for the Director-President as a result of the increased worldwide demand for agricultural technologies and partnership proposals.

EMBRAPA’s international cooperation mechanisms

The Secretary for International Affairs (SIA) set up three coordination areas: scientific, technological businesses and structuring projects.

The aim of scientific coordination, or knowledge interchange coordination, is to enhance scientific partnerships while consolidating EMBRAPA’s image as a top quality agricultural research and innovation corporation. This coordination encompasses the entire Labex Program (USA, Europe, South Korea, China) and bilateral agreements with other agricultural research institutes, universities and private companies. It also encompasses multilateral agreements with the CGIAR Consortium (Global Agricultural Research Partnership), participants in PROCISUR (Cooperative Program for Agrifood and Agroindustrial Technological Development of the Southern Cone of the Instituto Interamericano de Cooperación para la Agricultura) and other mechanisms involving several countries. The Labex Program addresses the need for institutional tools to enhance international cooperation, and to create means to tighten strategic relationships with influential agricultural R&D institutions in countries most concerned by this theme.

The technological business coordination team created technology transfer offices in Africa and South and Central America. These mechanisms play important roles in positioning EMBRAPA as a public corporation able to discuss and provide technological solutions to major challenges in areas such as sustainable agricultural production, global food security and climate change.

The structuring project coordination team seeks funding opportunities from governments, institutions and international organizations in order to promote initiatives, programs and projects of interest for EMBRAPA and to manage project implementation in partnership with international funding agencies.

Since 2012, EMBRAPA's new status facilitates these activities and strengthens its international strategy by increasing the flexibility of SIA in scientific and technological business (patents, licenses) fields, and with respect to technical cooperation activities managed by the Cooperation Agency of the Brazilian Ministry of Foreign Affairs.
International scope of EMBRAPA

Ongoing EMBRAPA projects: Labex-USA, South Korea, China

The Labex Program, as an international scientific cooperation mechanism, has its research themes determined by the EMBRAPA Directorate on the basis of its Strategic Plan, Brazilian governmental priorities and the results of future scenario analyses. The priority Labex research themes are listed below:

USA
- Mechanisms for promoting innovation and new approaches to intellectual property issues
- Genetic resource conservation, organization and exchange of material stored in germplasm banks
- Genetic resources for 1st and 2nd generations biofuel production
- Global climate change - Soil carbon dynamics and alleviation
- Integrated pest and disease management
- Precision agriculture
- Animal health, integrated control of livestock diseases (avian and porcine viruses, resistance to gastrointestinal parasites of sheep)
- Innovative uses for agricultural products
- Plant breeding and biotechnology (resistance to bean and soybean diseases)
- Food safety in dairy products
- Adaptation to climate change (drought-tolerance of crops)
- Nanotechnologies applied to agriculture and livestock production
- Native Brazilian biodiversity prospecting for bioactive compounds
- Climate change - Impact of agriculture upon water resources

SOUTH KOREA
- Plant genetic resource exchange and regeneration, cryopreservation (strawberries and mushrooms)
- Assessment, selection and development of porcine germplasm to enhance pork meat quality and weight gain of male pig breeding strains
- 1st and 2nd generation biofuel production from sweet sorghum
- Medicinal and aromatic plants and phytomedicines

CHINA
- Genetic resource exchange for germplasm banks
- Other themes, including biotechnology (to be outlined in 2013)

EMBRAPA’s plan to develop low-carbon agricultural systems², attached to a broader program coordinated by the Brazilian Ministry of Agriculture, Food and Livestock Production, is a driving force behind its sustainable agricultural technology development strategy. In this program, it is deemed that the increasing demand for food, biofuels and fibers (in terms of quantity and quality) provides opportunities for the Brazilian agrifood industry, if it is focused on ensuring sustainability. The Brazilian government strongly urges investment in R&D while strengthening capacities to develop expertise and innovations for sustainable agricultural production. International scientific cooperation in this field is carried out within the framework of the Green Economy Initiative of the United Nations Environment Program (UNEP)².

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From Brazil to Europe: 40 Years of EMBRAPA
Innovative international scientific cooperation mechanisms: Labex-USA and clusters

The next ten years are open for the improvement of the Labex Program as an innovative mechanism for scientific international cooperation. New institutional tools will enhance its high quality scientific partnership potential.

Two new operational mechanisms will soon be implemented:

- **Closer interaction between Labex Europe and Labex USA** through new institutional alliances and joint projects to address global agricultural challenges. The Labex Program may act as EMBRAPA's scientific interface with its main partners on both sides of the Atlantic and Asia. This interface will be linked to other EMBRAPA international cooperation mechanisms through the Coordination for Knowledge Exchange office of the International Secretariat. Some examples of such dynamic institutional interactions are: the STAR-IDAZ Program coordinated by the UK Department of Environment and Rural Affairs (DEFRA) in which EMBRAPA coordinates activities in the Americas, with animal health being one of the research themes of Labex-USA; INRA's metaprograms; the Global Research Alliance on Agricultural Greenhouse Gases (GloRAG); the Global Research Alliance on Food Security Research (GR4C).

- **Creation of researchers' clusters**, i.e. a tool that is being designed to promote operational synergy between Labex researchers currently working abroad and research teams in Brazil working on the same theme. Previous experience has already demonstrated the potential of research clusters. The idea is simple: Labex researchers begin their research as described in a joint interest project. Depending on how the work progresses and/or funding opportunities that arise, the concerned researcher may contact the International Affairs Secretariat which, in collaboration with EMBRAPA's R&D Department, will look for other researchers within the Brazilian National Agricultural Research System who could be potentially suitable for the new opportunity. This type of cluster mechanism enhances resource use efficiency and improves research governance.

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**The Brazilian researcher**

Paulo Hermann Jr. (EMBRAPA) is the most recent researcher for the Labex-Europe, selected in June, 2012. Paulo Hermann Jr. is an electrical engineer and M.Sc. with a PhD in Physical Chemistry who has been selected to start the new research theme. Development of high throughput phenotyping methods. His work as an EMBRAPA researcher deals with instrumentation applied to agriculture, like application of atomic force microscopy, development of low cost sensors using conducting polymers to better evaluate fruit ripeness as well as nano-bio-sensors with microcantilevers. He explained that the opportunity to be a Labex researcher positioned at the Forschungszentrum Jülich will be used to better characterize biological functions and processes needed for phenotyping crop species, especially those for tropical environments.

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**The host laboratory**

**Forschungszentrum Jülich - Plant Sciences Institute**

The Plant Sciences Institute is a world-leading institute in the emerging field of plant phenotyping-the quantitative analysis of plant structure and function by using non-invasive methods.

The aim is to bridge the gap between genetics and molecular technologies on the one hand, and the breeding and knowledge-based plant management on the other hand.

Important to note, the Jülich’s Institute of Plant Sciences will reversely implement a ‘Labex Germany in Brazil’. The contract was signed during the visit of the German Minister for Education and Research Prof Dr Annette Schavan in Brazil, October 5th, 2012.

Contact: Ulrich Schurr, u.schurr@fz-juelich.de

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Labex-Europe in Germany

Labex-Europe is being hosted at Forschungszentrum Jülich close to Aachen in Germany, which is one of the largest research centers of the Helmholtz Association, which includes 18 research centers in Germany. The agreement was signed in Berlin in January 2012. The scientific cooperation themes will focus on the development of advanced high throughput plant phenotyping methods and on sustainable development in a green economics setting (bioeconomics).

The Labex Program will provide a platform for cooperation between Brazilian and German researchers from the Jülich Research Center, the Bioeconomy Science Center and other research institutions. The aim is to increase crop yields and quality while minimizing the resource footprint. “The implementation of the Labex shows the intensity of the science partnership between Germany and Brazil, leading science nations in Europe and Latin America, concentrating their efforts to address future challenges and to contribute to a sustainable supply of food, renewable materials and bioenergy. The Brazilian-German Year of Science, Technology and Innovation 2010/11 has strengthened this partnership and led to this concrete cooperation supporting agro-research in the context of bioeconomy” (Annette Schavan, German Minister for Education and Research).

The results will be used to design integrated and sustainable production systems for the bioeconomy of food, for renewable resources and bioenergy.

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The Labex operational mechanism

The Labex Program is structured through agreements signed between EMBRAPA and its international partners:

1. A framework agreement with the partner institution enables coordination of the program, defines the intellectual property conditions and eventual conflict solution mechanisms.
2. EMBRAPA directors preselect the institution to potentially host the Labex researcher.
3. EMBRAPA launches an in-house call to select senior researchers on the basis of their Vision Statement action plan, professional qualifications and knowledge of foreign languages.

4. Discussions are then engaged between the Labex researcher, his/her scientific correspondent and the Labex coordinators with respect to signing a renewable 2-year Common Interest Project contract.
5. The researcher's overall performance is assessed once yearly by an evaluation committee made up of staff from EMBRAPA, the partner institution and invited scientists.
6. The overall coordination of each Labex is also evaluated yearly by a commission.

Research activities of Labex-Europe Program Coordinators

Labex Program Coordinators must devote up to 30% of their time to research, in addition to their administrative and prospecting tasks. The research themes that Labex-Europe Coordinators have focused on so far include agricultural economics, organizational arrangements in public research and rumen microbiology, as described in the publications list. This research has been accomplished directly or through the supervision of graduate or postdoctoral students.

Another important activity is the creation of opportunities for further international research cooperation. One example is the International Colloquium for Rumen Microbiology, organized by the Labex-Europe within the largest Brazilian animal science congress, i.e., the Annual Meeting for the Brazilian Animal Science Society in July 2012.

This event brought together nine scientists from four continents to present the state-of-the-art in this field, which is crucial for the development of technologies allowing for high animal productivity with a reduced environmental impact (methane emissions, land use) and higher efficiency (low production costs and high feed conversion).

Through this event, several direct contacts were made between the many Brazilian research groups present and the leaders of some of the most important research teams in the world, thus creating potential research, training and technological development opportunities.
Natural resource management tailored to and associated with knowledge-based technologies is a prerequisite for sustainable, efficient and intensive agriculture. This association provides a unique opportunity for development in harmony with environmental conservation. Agriculture thus becomes a solution—not a problem—when biodiversity and environmental conservation are taken into full account.

Over the last 40 years, crop yields and agricultural area have increased by 4% (200% overall) and 30%, respectively, in Brazil. Agricultural technology development has reduced extensive agricultural land use. Indigenous land, biology reserves and natural parks officially account for 60% of all land in Brazil. The Low-carbon Agriculture Program that has been under way for 2 years in Brazil has provided the necessary funding and incentives for farmers to adopt sustainable agricultural practices and technologies.

The Brazilian agricultural research system, coordinated by EMBRAPA and including over 70 universities and agricultural research institutions, is developing sustainable agricultural intensification practices to boost productivity while generating environmental services. New technologies and policies are being developed under this system to ensure that this Low-carbon Agriculture Program becomes an economic reality. Research has contributed to the development of other forest protection policies and impact reduction practices, leading to a reduction in deforestation in the Amazon region.

The Labex Program has contributed to natural resource management through the work of three scientists:

- **Dr José Madeira**, the first Labex scientist focusing on this theme, joined the research team of the Laboratory for the Study of Interactions between Soil, Agrosystems and Water Systems (INRA, IRD, Montpellier SupAgro) to study the hydrology of cultivated environments. His work involved modeling interactions between agricultural management practices and environmental indices through model development and validation and the development of vegetation indices for crops with a discontinuous canopy (vineyards, orchards, etc.). Image analysis data, obtained in collaboration with the Remote Sensing Center in Montpellier (France), were used in this research. The developed models describe water flows and the impact of management practices in microcatchments where intensive agricultural land use is under way.

- The Labex Program then hosted Dr Geraldo Stachetti Rodrigues in the Performance of Tree Crop-Based Systems research unit (CIRAD) to carry out an impact study and develop integrated system indicators for environmental management of rural activities. The team used an integrated approach to assess palm oil according to international environmental certification standards and *senso strictu* sustainability criteria. This research was aimed at developing indicators for tree crop-based systems: ecological integrity, economic vitality, social equity of rural production activities geared towards promoting local sustainable development. This work consolidated the partners’ scientific advance with respect to agricultural sustainability.

- Remote sensing and image analysis methods are now essential tools for agricultural and land-use monitoring. The Labex Program hosted Dr Margareth Simões to share expertise and methods with Territory, Environment, Remote Sensing and Spatial Information joint research unit (AgroParisTech, CIRAD, IRSTEA) in Montpellier and study land use and land cover dynamics assessment for a sustainable agriculture. The results will generate reliable tools to support public policymaking during the crucial transition from extensive agriculture to an ecologically intensive model.
Natural resource management

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The Brazilian agricultural research system, coordinated by EMBRAPA and including over 70 universities and agricultural research institutions, is developing sustainable agricultural intensification practices to boost productivity while generating environmental services. New technologies and policies are being developed under this system to ensure that this Low-carbon Agriculture Program becomes an economic reality. Research has contributed to the development of other forest protection policies and impact reduction practices, leading to a reduction in deforestation in the Amazon region.

The Labex Program has contributed to natural resource management through the work of three scientists:

- **Dr José Madeira**, the first Labex scientist focusing on this theme, joined the research team of the Laboratory for the Study of Interactions between Soil, Agrosystems and Water Systems (INRA, IRD, Montpellier SupAgro) to study the hydrology of cultivated environments. His work involved modeling interactions between agricultural management practices and environmental indices through model development and validation and the development of vegetation indices for crops with a discontinuous canopy (vineyards, orchards, etc.). Image analysis data, obtained in collaboration with the Remote Sensing Center in Montpellier (France), were used in this research. The developed models describe water flows and the impact of management practices in microcatchments where intensive agricultural land use is under way.

- The Labex Program then hosted **Dr Geraldo Stachetti Rodrigues** in the Performance of Tree Crop-Based Systems research unit (CIRAD) to carry out an impact study and develop integrated system indicators for environmental management of rural activities. The team used an integrated approach to assess palm oil according to international environmental certification standards and *senso strictu* sustainability criteria. This research was aimed at developing indicators for tree crop-based systems: ecological integrity, economic vitality, social equity of rural production activities geared towards promoting local sustainable development. This work consolidated the partners’ scientific advance with respect to agricultural sustainability.

- Remote sensing and image analysis methods are now essential tools for agricultural and land-use monitoring. The Labex Program hosted **Dr Margareth Simões** to share expertise and methods with the Remote Sensing Center in Montpellier (France), were used in this research. The developed models describe water flows and the impact of management practices in microcatchments where intensive agricultural land use is under way.

- **Remote sensing and image analysis methods are now essential tools for agricultural and land-use monitoring.**
José Madeira stayed for nearly 3 years at LISAH (April 2002-February 2005) to study the contribution of the spectral reflectance of soils in the mapping of soil properties.

**Contact:** jose.madeira@embrapa.br

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**ACTIVITIES**

**José Madeira**

- Modeling 'management practice–environmental quality' interactions
  Models developed to calculate vegetation indices of deciduous crops (vines) via remote sensing enable simulation of complex systems (microcatchments with intensive agricultural land use) for the purpose of assessing water flows, associated inputs and the impact of management practices.

  **Contact:** José Madeira, jose.madeira@embrapa.br

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**Marc Voltz** is a former Director of the French Laboratoire d'étude des Interactions Sol–Agrosystème–Hydro syntème which hosted a Brazilian researcher for 3 years.

**Host laboratory**

LISAH joint research unit
Laboratoire d'étude des Interactions Sol, Agrosystème et Hydro système (INRA/IRD/Montpellier SupAgro)
70 scientific and technical staff
Director: Jérôme Molenat, j Jerome.molenat@supagro.inra.fr
www.uml-lisah.fr

**Scientific correspondent:**
Philippe Lagacherie, lagacherie@supagro.inra.fr

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**ACTIVITIES**

**Geraldo Stachetti**

- Integrated index of palm oil crop sustainability
  An environmental management method integrated with a sustainability index was developed for palm oil cropping (CIRAD/Labex collaboration). This evaluation tool was tested in Brazil and then on large estates and smallholdings in Indonesia to verify its relevance in different production settings. It was presented at various workshops as a decision aid for preparing plantations for certification. It was also the focus of international negotiation for the improvement of the palm oil sector.

- Performance indicator system for traditional agroforestry (TAPIS)
  The 'Characterization and evaluation of the agroecological performance of associated cropping systems in the humid tropics' project developed the TAPIS indicator system (CIRAD/Labex collaboration) using data from Cameroonian agroforestry systems. It incorporates agroeconomic and agroecological performance indicators that are used to classify plantations and provide recommendations to enhance sustainability.

- Methodological platform for sustainability assessment
  As part of the Environmental Accounting, Sustainability Indicators and Environmental Management of Rural Activities program (Labex/INRA collaboration), this platform was developed to study the energy and economic performance of the banana sector in Guadeloupe.

  **Contact:** Geraldo Stachetti Rodrigues, stacheti@cnpma.embrapa.br
**INTERVIEW**

Jean-Luc Battini and Éric Gohet are respectively the former and current Director of the French internal research unit Performance of Tree Crop-Based Systems which hosted a Brazilian researcher for 2 years.

- **Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?**

  In recent years, without developing formal collaborations, our internal research unit has had regular contacts with Brazilian research institutions such as CEPEC/CEPLAC (cocoa tree research), the Campinas Agricultural Institute (coffee tree research), as well as with EMBRAPA research centers in the Amazonian region of Manaus (natural rubber and oil palm research, Rio Urubu research station). Our research unit also provides agricultural expertise to oil palm and natural rubber agroindustries in the Amazonian region of Bahia.

- **What conclusions do you draw from the experience? What has this collaboration contributed to your team?**

  This experience was highly positive, but too short. The active collaboration of Geraldo Stachetti within our team, working on agroenvironmental impact assessment, opened our eyes to the importance of taking socioeconomic factors and integrated analysis of all types of indicators into account. We tested the agroenvironmental impact management program developed by Geraldo at EMBRAPA (APOIA method) on some of our oil palm agroindustrial partners' estates.

- **Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?**

  Yes, of course. I am no longer the Director of this internal research unit, but this morning I spoke with Dr Maria do Rosario Lobato Rodrigues, one of the heads of the EMBRAPA oil palm research program at Manaus, who is currently being hosted by the research unit for a stay to conduct sabbatical research in ecophysiology.

**Contacts:**
- Jean-Luc Battini, jean-luc.battini@cirad.fr
- Éric Gohet, eric.gohet@cirad.fr

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**APOIA-NovoRural method:**

**Environmental Impact Assessment of Rural Activities**

Environmental performance indices obtained in many case studies (n=177) carried out using the APOIA-NovoRural method give rise to an interesting hypothesis and a valuable environmental management working premise. A broad range of different production scales and agricultural sectors were taken into account in these studies, while considering five sustainability dimensions: (i) landscape ecology, (ii) environmental quality, (iii) economic values, (iv) sociocultural values, and (v) management and administration.

The results show that the relatively greater importance of the management and administration dimension could be explained by the influence of the farmer profile, the managerial capacity and institutional relationships on all of the environmental impact factors. This means that the development and adoption of environmental management tools, such as the APOIA-NovoRural indicator system, could be a priority initiative for promoting sustainable agriculture.

For further information: Rodrigues G.S. et al., 2010.

**Contacts:** Geraldo Stachetti Rodrigues, stacheti@cnpmn.embrapa.br
INTERVIEW

Jean-Luc Battini and Éric Gohet are respectively the former and current Director of the French internal research unit Performance of Tree Crop-Based Systems which hosted a Brazilian researcher for 2 years.

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What conclusions do you draw from the experience? What has this collaboration contributed to your team? This experience was highly positive, but too short. The active collaboration of Geraldo Stachetti within our team, working on agroenvironmental impact assessment, opened our eyes to the importance of taking socioeconomic factors and integrated analysis of all types of indicators into account. We tested the agroenvironmental impact management program developed by Geraldo at EMBRAPA (APOIA method) on some of our oil palm agroindustrial partners' estates.

Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions? Yes, of course. I am no longer the Director of this internal research unit, but this morning I spoke with Dr Maria do Rosario Lobato Rodrigues, one of the heads of the EMBRAPA oil palm research program at Manaus, who is currently being hosted by the research unit for a stay to conduct sabbatical research in ecophysiology.

Contacts: Jean-Luc Battini, jean-luc.battini@cirad.fr & Éric Gohet, eric.gohet@cirad.fr

APOIA-NovoRural method: Environmental Impact Assessment of Rural Activities

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For further information: Rodrigues G.S. et al., 2010.

Contact: Geraldo Stachetti Rodrigues, stachetti@cpnma.embrapa.br
Contributing to the Labex program was a rewarding experience, especially via: i) capacity building (supervision of African, Brazilian and French students), ii) participation in an international research network on land-use change dynamics, and iii) project submission for European funding. These initiatives enabled EMBRAPA researchers and universities to participate or have a leadership role in projects undertaken within the framework of this network and will lead to an extension of this scientific partnership in future Labex activities.

Three cooperation priorities were delineated with the European partners, associating advances in remote sensing with the guidelines of the Brazilian 'Low Carbon Agriculture' program:

- **Remote sensing-based agricultural land-use dynamics**: use of low-cost temporal satellite imaging data to:
  - monitor agricultural land-use change dynamics;
  - locate areas where sustainable agricultural production systems are set up, including integrated forestry-agriculture-livestock production systems or two-crop systems.

This work is carried out by semiautomatic generation of land-use maps and by satellite image indexing with the aim of analyzing variations in agricultural practices and the sustainability of the Brazilian agricultural system.

**Approved project:** 'Qualification of MODIS phenological products via agroclimatic modeling and field data', funded by the National Spatial Remote-sensing Program EMBRAPA, CIRAD UMR TETIS, IRD UMR Espace-DEV, UMR GETS (CNRS, IRD, CNES, University of Toulouse).

Margareth Simões (EMBRAPA) stayed for 2 years at the joint research unit TETIS (October 2010-October 2012) to study the potential of using remote sensing data for monitoring agricultural systems and low-carbon agriculture land use dynamics.

**Biodiversity and agricultural production**: biodiversity, as a sustainable agricultural practice component (as defined by EMBRAPA in the Amazon region), and its role in mitigating climate change, are studied through a multiscale approach involving remotely-sensed temporal profiles combined with sustainability indices and land-use modelling.

**The approved ROBIM (Role of Biodiversity in Climate Change Mitigation) project**, funded by the European Commission (FP7) and involving 12 international research institutions, is important for the financing of REDD+ tropical forest projects.

The international workshop on 'Territorial dynamics in the Amazon by remote sensing' (Montpellier, January 2012) led to the set up and submission of joint research projects geared towards enhancing the integration of Franco-Brazilian teams working in the Amazon and broadening current scientific networks.

**Environmental indices for agricultural system sustainability assessment**: research carried out by the EMBRAPA scientist Rodrigo Ferraz, as part of a cosupervised doctoral thesis (Labex, University of Rennes 2/Costel in France and the Rio de Janeiro State University in Brazil), generated a system of indicators to assess the hydrological sustainability of sugarcane plantation development and its impact on environmental services. This is especially important for Brazil, where biofuel production is rapidly expanding.

Contact: Margareth Simões, margareth.simoes@embrapa.br

**Interview**

Jean-Philippe Tonneau is Director of the Spatial Information and Analysis for Territories and Ecosystems joint research unit which hosted a Brazilian researcher for 2 years.

- **Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?**
  - Some CIRAD and TETIS researchers have been collaborating with EMBRAPA for over 25 years, but on topics (agroecology, territorial development, production systems) that differ from those accounted for in the Labex agreement. One of our scientists is placed at a research site in the Amazon region, in partnership with EMBRAPA Eastern Amazonia (Para). The goal was to integrate spatial information obtained by remote sensing in programming and planning activities carried out within this framework (agroecological zoning, citizenship territories).

- **What conclusions do you draw from the experience? What has this collaboration contributed to your team?**
  - The results together with Margareth have been highly positive. We have established closer ties with EMBRAPA research centers through workshops organized towards information exchange and the development of international projects. From a more operational standpoint, this collaboration fostered exchanges on methods for image analysis and processing (small plot patterns in Africa/large plot patterns in Brazil). She also enabled us to focus on operational ways to combine spatial and landscape analysis methods.

- **Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?**
  - Many cooperation initiatives are underway. Involvement of a hosted scientist in cosupervision of the doctoral studies of a Kenyan researcher. The remote sensing methods developed could be tailored to smallholdings in Brazil. A project was submitted under the Fondation Agropolis/CAPES call for projects on 'interactions between agricultural practices and biodiversity'. A project on the qualification of MODIS phenological products via agroclimatic modeling and field data was approved by the French Programme National de Télédétection Spatiale.

Contact: Jean-Philippe Tonneau, jean-philippe.tonneau@cirad.fr
1. Sustainable development reserve of Uatumã (Amazon)
2. National forest reserve of Tapajós (Pará)
3. Agricultural region with sugarcane plantations, South of Goias
Agrifood technologies

Brazil is a major global player for several staple food products and an exporter of manufactured food products. One of EMBRAPA’s priorities is thus to enhance the competitiveness of Brazilian agriculture via the added value of agricultural products while ensuring food security and safety. Agrifood technologies was an obvious choice as a Labex-Europe research theme because of EMBRAPA’s long-standing tradition of excellence with respect to food processing and security.

Labex-Europe has contributed to food technology research through four researchers:

The first researcher, Dr Regina Lago, a fat and oil specialist, collaborated with the joint research unit Agropolymer Engineering and Emerging Technologies (CIRAD, UM2, INRA, Montpellier SupAgro), whose overall aim is to gain greater insight into the functionalities of plant products and their constituents so as to enhance their food and nonfood performances. The Brazilian castorbean plant, *Ricinus communis*, was selected due to its biofuel potential or as a source of vegetable oil of high quality and value for industrial chemistry.

Then, Dr Heloisa Filgueiras, a postharvest physiology specialist, was the first Labex-Europe researcher posted outside of Montpellier. After a brief collaboration with Patrick Varoquaux (INRA), she worked at the University of Avignon and INRA on a joint interest project entitled the ‘Effects of vegetable conservation pretreatments under modified atmospheric conditions’. A research partnership was established with the Laboratoire de Physiologie des Fruits et Légumes (UAPV), with Huguette Sallanon as scientific correspondent, to improve the quality of vegetable products ‘from farm to fork’ by developing the entire Fruit and Vegetable sector. There were two research focuses: studying the response of plants and their fruit to environmental conditions, and enhancing postharvest fresh fruit and vegetable conservation. The work spanned a broad range, from mangoes to endives, with the aim of studying possible alternatives to chemical conservation of minimally processed vegetables. The objective was to control metabolic processes in order to hamper enzymatic darkening and senescence while preserving the functional constituents.

Lastly, two scientists took charge of the Agrifood Technologies theme in Dijon. Dr Rosires Deliza joined the team of the Centre des Sciences du Goût et de l’Alimentation (CNRS, INRA, University of Burgundy) which studies food behavior and its control. The proposed approach involved comparative sensorial physiology. Her work, carried out in collaboration with Dr Sylvie Issanchou, dealt mainly with assessing consumer reactions to new food products with improved nutritional qualities. Their work included participation in the TrueFood project*, partially sponsored by the European Commission, and the use of advanced experimental economics tools.

Concomitantly, Dr Amauri Rosenthal worked with the Laboratoire de Génie des Procédés Microbiologiques et Alimentaires (INRA, AgroSup Dijon) headed by Prof Patrick Gervais. The aim was to study the effects of high pressure and microwaves on bacterial spores, which represent a major challenge in food processing as outbreaks of these organisms could lead to a public health hazard. This research generated insight into the role of the spore water content on cell viability and spore inactivation mechanisms.

* www.truefood.eu
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*www.truefood.eu*
COMMENT
Regina Lago

"BECOMING A MEMBER OF A LABEX TEAM IS AN IMPORTANT CHANGE OF LIFE. We are senior scientists with a family and career and therefore have much to gain, but we also leave much behind.

The establishment of Labex in France enabled the development of prospecting activities aimed at enhancing the dialogue with other EMBRAPA stakeholders, especially by producing notes and drawing up technical reports on new findings and disseminating them within networks in Brazil. Discussions have been under way but the reactions have not measured up to the actions despite the fact that the information is always read and analyzed.

The choice of a theme for selecting a researcher must take into account the relevance and position of the theme at the frontier of knowledge and the existing or growing critical mass at EMBRAPA and of the Brazilian research system. The researcher's work thus has more chance of success, which does not mean that he or she does not need to be proactive. The EMBRAPA's International Relations management and the scientific management thus have a role to play so that the Labex scientists can contribute to developing scientific relations with Europe.

As the technology of oils and fats was my research field, Jean Graille (CIRAD) was my French correspondent. He retired a month later. The IATE joint research unit was then contacted. The laboratories and the pilot plant that were set up still host the Lipid Technology Laboratory (CIRAD).

We provided support for a CAPES-COFECUB project coordinated by the Agricultural Instrumentation Center (EMBRAPA). We worked on the castorbean plant which became very popular a year later in Brazil on account of its bioenergy and fine chemistry potential. The results led to publications even after my return to Brazil. A student (University of Rio de Janeiro) worked on the project for 6 months and a patent request was submitted (see Publications, p. 38-41). A doctoral student (University of Campinas) received training from the Lipid research team at the Institut des Membranes in Montpellier.

At that time, the centre did not have sufficient research potential with respect to oils and fats and the impact of my stay could have been more significant. After my return to Brazil, I focused more on international relations and became Director of the EMBRAPA Food Technology Center in April 2008. I still have links with the IATE joint research unit. We presented a joint project at the Conselho Nacional de Desenvolvimento Científico e Tecnológico. I was invited to Paris by the Association Francaise pour l'Etude des Corps Gras to give a talk on castor and jatropha oils. Two researchers specializing on oils and fats were hired to be able to develop joint projects and establish closer relations with CIRAD and other French teams in the sector.

Contact: Regina Lago, lago@ctaa.embrapa.br
* CAPES: Coordinação de Aperfeiçoamento de Pessoal de Nível Superior - Brazilian Ministry of Education / COFECUB: Comité Français d'Evaluation de la Coopération Universitaire et Scientifique avec le Brésil

INTERVIEW

Pierre Villeneuve and Michel Pina are researchers at the Agropolymer Engineering and Emerging Technologies joint research unit which hosted a Brazilian researcher for 3 years.

Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?

Not with Brazil in general. However, before the arrival of the Labex researcher, the IATE joint research unit conducted a contractual study in collaboration with Prof. Daniel Barrera-Arenal of the University of Campinas on sugarcane bagasse development.

What conclusions do you draw from the experience? What has this collaboration contributed to your team?

This experience was a source of mutual enrichment, especially on account of Regina Lago's in-depth understanding of the chemistry of fats and oils.

This collaboration was also highly productive in terms of publications and papers presented at international conferences, and with respect to student exchanges and human relations.

Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?

We are still in contact and exchanges with Prof. Regina Lago are ongoing. However, no concrete initiatives are currently under way due to our current focus of research, especially with respect to castorbean plants, which is no longer one of our priorities.

Contact: Pierre Villeneuve, pierre.villeneuve@cirad.fr, and Michel Pina, pina@cirad.fr
tenders. We developed many exchanges with other Brazilian partners and hosted eight confirmed researchers, post-doctoral fellows and doctoral candidates from Brazil for stays of a few weeks to several months. Heloisa Filgueiras’ stay was highly beneficial for us, both scientifically and culturally. The entire laboratory has discovered Brazil, stayed there and everyone hopes to return. We would all have liked her to stay longer and the laboratory was sad when she returned to Brazil.

Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?

Yes, we have remained in contact with Heloisa Filgueiras and with other Brazilian researchers with whom we have had exchanges. A professor from our laboratory is currently on a trip to Brazil, which is now a preferential country for the development of UAPV’s international relations and, of course, we hope to continue this partnership.

Contact: Heloisa Filgueiras, heloisa@cnpat.embrapa.br

**Host laboratories**

**SQPOV joint research unit**

Sécurité et qualité des produits d’origine végétale (Plant product safety and quality) (INRA/UAPV)

- 49 scientific and technical staff
- Director: Catherine Renard, catherine.renard@paca.inra.fr
- http://tinyurl.com/umrsgpov

Scientific correspondent: Patrick Varoquaux (retired)

Laboratoire de Physiologie des Fruits et Légumes (Fruit and vegetable physiology laboratory) (UAPV)

- 10 scientific and technical staff
- Director: Huguette Sallanon, huguette.sallanon@univ-avignon.fr
- http://agrosciences.univ-avignon.fr/fr/mini-site/minilabo/recherche.html

Scientific correspondent: Huguette Sallanon

**INTERNATIONAL RELATIONS HAVE BEEN ONGOING WITH SEVERAL EMBRAPA CENTERS AND BRAZILIAN UNIVERSITIES SINCE MY RETURN.** A project to promote Brazilian tropical fruits (CAPES/WUR) made it possible to continue research by scientists from EMBRAPA and different Brazilian and European universities until 2010 (Fluminense Federal University, Paraiba Federal University, two WUR laboratories, the European LaserLab platform).

Labex Europe enabled UAPV to become part of the Franco-Brazilian doctoral school and to draw up the agreements required for joint thesis supervision. The partnership activities of EMBRAPA and CIRAD have been followed up by a postdoctoral position and visits by EMBRAPA researchers and Brazilian partner institutions. I also participated in the Labex Master’s and Doctoral programs on Produce Quality Management and in several steering committees for doctoral students.

Contact: Heloisa Filgueiras, heloisa@cnpat.embrapa.br
I became involved in different European research projects right after my arrival at the Centre des Sciences du Goût et de l'Alimentation (CSGA). The TrueFood project was aimed at gaining further insight into consumers' perceptions, expectations and attitudes concerning innovations in traditional product manufacturing processes and their willingness to pay for them (e.g., using high hydrostatic pressure to lower the salt content in Serrano ham).

Experimental economics tools, combined with sensorial analysis, enabled an assessment of consumers' willingness to pay for low-fat, low-salt chips (CSGA partnership with the Alimentation et Sciences Sociales research unit and six private French laboratories). French consumers' attitudes towards foreign meat were also studied in a project (partnership with the Purpan Engineering School). The ongoing VinPest project is aimed at understanding consumers' views concerning pesticide use in wine production (collaboration with the École de Commerce de Dijon, Institut de Management du Vin, Bureau Interprofessionnel des Vins de Bourgogne, Bureau Interprofessionnel des Vins de la Bourgogne, Universidad de la Republica, Uruguay). This research is being continued through a Brazilian postdoctoral fellow. Labex also enabled me to submit several proposals after my return to Brazil.

My participation in European projects improved Brazilian research networks, including those of different EMBRAPA research centers and universities. Coorganization of the 6th Ibero-American Sensory Analysis Symposium (2010) and the 10th Sensory Science Symposium (2013, Brazil), highlights the cooperation capacity of Labex. Dr Sylvie Issanchou and I have visited several EMBRAPA research centers, which has given rise to new collaboration opportunities. I have established contacts through the INRA network, especially with the INRA Clermont-Ferrand-Theix center, supplying information derived from the Brazilian scientific community conducting research in the human nutrition field and open to capacity-building opportunities.

Contact: Rosires Deliza, rodeliza@ctaa.embrapa.br

*Traditional United Europe Food: www.truefood.eu
Patrick Gervais is the Director of the Procédés Alimentaires et Microbiologiques joint research unit which hosted a Brazilian researcher for 2 years.

Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?

No.

What conclusions do you draw from the experience? What has this collaboration contributed to your team?

From a research standpoint, Dr Rosenthal co-ordinated the work of two Brazilian scientists. He also initiated an International Food Safety workshop within the framework of a working group of the International Commission of Agricultural Engineering, which was attended by around a hundred scientists. All of these activities fully contributed to the scientific outreach of our team and I am delighted with our participation in EMBRAPA’s Labex-Europe program.

Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?

Two Franco-Brazilian cooperation programs (BRAFAGRI and BRAFTEC) involving EMBRAPA and AgroSup Dijon are under way. We are also collaborating with Dr Marcia Pedrinh, Natal University, who worked for a year as a postdoctoral fellow on the cellular vectorisation of active molecule and plasmids via osmoporation.

Contact: Patrick Gervais, gervais@u-bourgogne.fr

Host laboratory

PMB research team
Microbiologiques et Biotechnologiques (Microbiological and biotechnological processes) (formerly the Laboratoire de Génie des Procédés Microbiologiques et Alimentaires of Burgundy University)

Director of PAM joint research unit:
Patrick Gervais, gervais@u-bourgogne.fr
www.umn-pam.fr

Scientific correspondent: Patrick Gervais

The 'brokerage events' of the European Commission Biocircle™ program should also be mentioned. A research proposal in partnership with the Cyted™ program aimed at promoting Ibero-American native fruits as a source of functional ingredients was submitted by the University of Monterey (Mexico) and the Instituto del Frío (Spain) in order to facilitate cooperation and interaction between research groups working on functional foods in Latin America. As a Labex researcher, I also organized missions (scientists and Brazilian manufacturers in the fruit processing sector) in industries and European research institutions as AN INTEGRAL PART OF THE BRAZILIAN GOVERNMENTAL INNOVATION AND TECHNOLOGICAL DEVELOPMENT PROGRAM™ WHICH IS AIMED AT CREATING TECHNOLOGY PARKS.

Contact: Amauri Rosenthal, amauri.rosenthal@embrapa.br

**http://capes.gov.br/cooperacao-internacional/franca/capesbrafagri
http://www.biocircle-project.eu
http://www.cyted.org
http://www.abdi.com.br/Paginas/Default.aspx**

Amauri Rosenthal (EMBRAPA) spent nearly 2 years with GPMA (2009-2011) to study bacterial spore resistance to thermal stress.

Contact: heloisa@cnpv.embrapa.br

Amauri Rosenthal (EMBRAPA)

The International Food Safety Group, linked with the International Commission of Agricultural Engineering, was founded and organized its first workshop entitled 'Food sanitary security: advances and trends', with around a hundred participants from all continents.

Because of the presence of Brazilian researchers, discussion meetings were held on scientific cooperation opportunities and new research proposals concerning new food conservation technologies and the encapsulation of bioactive molecules. The 2nd workshop was held in Valencia (Spain, 2012) and another is planned for 2013 in Brazil.

The inactivation of spores of Bacillus subtilis with different water activities by heat treatment at different pressures.

(A) 1 bar and (B) 5 bar (Tiburski, Rosenthal & Gervais, 2012, submitted).
‘Advanced biology’ and molecular plant-microorganism interactions

World population growth, especially in poor countries, the continuous degradation of arable land, reduced access to drinking water and climate change are major challenges for agricultural production and food security. Plant improvement is a key approach to address the need to increase agricultural production while reducing the use of pesticides and fertilizers, thus enabling the development of sustainable agricultural practices.

In the light of these global challenges, EMBRAPA decided to develop an advanced plant biology program, in line with the rapid progress in molecular tools and the development of ‘omic’ science. Over the last 10 years, three Labex-Europe researchers have been working on this theme with three crops that are crucial with respect to food security in Brazil and elsewhere:

- **Rice** is a staple food in Brazil. Many initiatives have focused on improving its tolerance to different abiotic stresses (drought, salinity, etc.). This trait is hard to improve in conventional genetic selection programs. Enhanced molecular insight into genes involved in the resistance/susceptibility to abiotic stress should facilitate the development of new varieties that are better adapted to environmental constraints.

- **Diseases—leaf streak, Panama disease**—threaten banana production in most growing regions. Their monitoring is costly and the pesticides used are toxic to humans and the environment. These threats also include banana bacterial wilt, Moko disease and banana weevils. Most bananas and plantains are susceptible to at least one disease or pest and no farmers currently grow improved banana or plantain varieties.

- **Rothamsted Research (UK)** is investigating virulence and pathogenicity mechanisms of *Mycosphaerella graminicola*, a pathogenic fungus of wheat of the same genus causing Black Sigatoka in banana, thus extending this first study. Brazil is still a net importer of wheat, so this is a priority crop for EMBRAPA. The research is geared towards understanding fungal virulence on wheat plants, by means of functional and comparative genomics, to better manage crops under warm temperate conditions in the South as well as tropical climate like in the central savanna-like Cerrado regions of Brazil. In addition, high temperatures are conducive to wheat infestation by *Magnaporthe oryzae* in Brazil, which is related to Rice Blast, a major disease worldwide. Climate change scenarios forecast European summer to be warmer, posing a wide range of challenges to UK crops thus warranting collaborations between British and Brazilian scientists to develop international networks and enhance insight on this crop.

This theme is now associated with the development of high throughput phenotyping procedures, which will be the first Labex theme to be studied in Germany from 2013 (p. 13). EMBRAPA is extending Labex-Europe by developing this theme in collaboration with the Julius Kühn Institute (JKI), Federal Research Centre for Cultivated Plants (Germany), in order to merge Brazilian tropical plant science expertise with the plant health and productivity expertise of JKI. This research will be aimed at developing noninvasive methods and processes (image analysis, NMR, sensors, etc.) to enhance plant breeding, assess the biological resource potential and identify biological traits and functions that could be applied in agriculture.

*New methods for interpreting genotyping and phenotyping data derived from the germplasm of major crops.*
**Comment and Research Activities**

**Ana Cristina Miranda Brasileiro**

Labex-Europe was an extremely rewarding personal and professional experience even though I was faced with challenges almost daily. I realized in my first months in France that my mission would reach beyond just the ‘work’, that is, research—it was necessary to ‘create credibility’ within the Montpellier scientific community and to perpetuate it, which was an even tougher task about the Labex Program concept. This was the first time that the ‘South’ was on a mission to oversee scientific projects in laboratories in the ‘North’. We had to show our partners that we were there to set up a new type of scientific cooperation but, like all novel approaches, there was some resistance.

I was lucky to have Jean-Christophe Glaszmann as counterpart. He immediately understood the scope of Labex and opened all the doors for us. The AGAP joint research unit was a very successful choice and Emmanuel Guiderdoni and his team provided a suitable scientific environment to develop the project of common interest (PIC).

I returned to Brazil 6 years ago but still have very close links with my colleagues in Montpellier. The CIBA Consortium (p. 36) is our ‘challenge’ for the long-term development of France-Brazil scientific cooperation networks focused on the advanced biology of tropical species.

The adaptation of plants to abiotic stresses is a complex phenomenon with numerous genes directly or indirectly involved in signal perception and transduction chains and in mechanisms regulating the expression of other genes.

Functional genomics techniques can now be used to analyze an entire plant as a system while enhancing insight into the biological function and interactions of genes expressed under certain stress conditions, such as water deficiency and salinity. EMBRAPA has a long tradition of plant breeding and genetic resource conservation research and has a leading edge position in scientific plant genomics research in Brazil.

The joint interest project ‘Functional genomics of the response to abiotic stresses in rice’ was conducted jointly by EMBRAPA and the former Plant Development and Improvement joint research unit between 2002 and 2006 within the ‘Biotechnology and Plant Genetic Resources’ program (CIRAD, Montpellier). The main aim of the project was to characterize genes involved in the response to abiotic stresses—drought and salinity—using rice as a cereal plant model.

**Contact:** Ana Brasileiro, ana.brasileiro@embrapa.br

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**Interview**

Jean-Christophe Glaszmann is Director of the ‘Genetic Improvement and Adaptation of Mediterranean and Tropical Plants’ joint research unit which hosted a Brazilian researcher for 4 years.

Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?

EMBRAPA has been collaborating with EMBRAPA for a long time in various fields such as rice varietal improvement, eucalyptus genetics and natural resource management in the Amazon region. However, as EMBRAPA is a complex organization with specialized centers, our relations have not been very coordinated and are more opportunistic than strategic.

What conclusions do you draw from the experience? What has this collaboration contributed to your team?

Making a list of all of the interactions and collaborative work undertaken would take too long. These initiatives have, however, encompassed the genetics and genomics of more than 10 crops. Projects have been developed and some have benefited from international funding.

A process has been launched. We have organized meetings in Montpellier and Brasilia and the communities are getting acquainted. French scientists now know who to contact at EMBRAPA, and vice versa, with respect to projects that could lead to collaborations.

Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?

We set up CIBA (p. 36), which undertakes regular monitoring via staff of our unit. Ana Brasileiro is a member of the program committee of CIRAD’s ‘Biological Systems’ department, Some projects are ongoing and others are being prepared. This initiative will last if it is in the teams’ interest, funding is found, and a new type of partnership is set up—for example, a three-way partnership with African partners—and if there is a flow of students to strengthen links and lay the foundation for new future networks.

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*This joint research unit integrated the former Plant Development and Improvement joint research unit*
Identification of genes involved in the abiotic stress response in rice

The joint interest project ‘Functional genomics of the response to abiotic stresses in rice’ aimed to identify and characterize genes involved in the response of rice to drought and salinity. The CIRAD ‘Plant genomics’ team considers this to be a pilot project since some of the methods developed enabled the team to launch other functional genomics projects: a hydroponic system for large-scale osmotic and saline treatment, developing and validating subtractive gene banks, etc.

101 rice genome sequences were identified as being expressed early and differentially in response to water stress. Of the 43 candidate genes validated by Q-RT PCR and root architecture association studies (phenotyping), the four most interesting ones were selected for the final transgenesis validation phase. The biological function of the candidate genes was further validated by the construction of RNAi type vectors for the four candidate genes and the use of Agrobacterium to insert them in transgenic rice plants (Nipponbare and Nona Bokra varieties). T1 lines of these plants were subjected to molecular analysis to confirm that the respective genes were no longer being expressed.

The selected genetically modified rice lines are being phenotyped under controlled conditions (greenhouses) in Brazil and Vietnam to assess the phenotypic effects of the suppressed expression of the four candidate genes and confirm their role in the plant response to water and salt stress.

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The main steps in the identification of genes involved in the rice plant response to osmotic shock (100 mM mannitol)

A - Microarray analysis display on a glass slide of overexpressed (red) and underexpressed (green) transcripts under osmotic shock conditions (performed at the IGH transcriptome platform). The differentially regulated transcripts were applied as annotation layers on the rice genomic sequence.

B - Osmotic stress regulation of the candidate genes was confirmed by Q-RT PCR prior to their functional validation via the analysis of mutants and/or overexpressors.
Labex in the Netherlands and Belgium: the MusaForever program

Because of the importance of the banana production sector—with Brazil being one of the top producers in the world—EMBRAPA developed a genetic improvement program to obtain banana varieties resistant to yellow and black Sigatoka leaf spot as well as Panama disease. This program includes a bank of agronomically and molecularly characterized genetic material, and preselected genotypes are evaluated through a national network. A banana genomics program was launched by EMBRAPA in 2001 and DataMusa, a database on this theme, was launched in 2005.

Dr Manoel T. Souza, the Brazilian scientist posted to Wageningen (Netherlands) in 2006, represented the first European experience of Labex outside of France. He coordinated the joint interest program MusaForever involving European (WUR, KU Leuven, CIRAD) and Brazilian (EMBRAPA, Lavras Federal University) partners in the genetics, genomics and biotechnology of black Sigatoka and Panama disease. This program was aimed at building genome libraries and using them for the development of biotechnology tools that optimize genetic control of the targeted pathosystems.

The lines of research were: (a) the development of genetic maps and genome libraries for hosts and pathogens, (b) the identification and validation of molecular markers for the diagnosis and study of intra- and inter-population genetic variability, (c) the production of genetically modified pathogens for early detection of biotic stress states and for studies on the infection process, (d) the development of in vitro and in vivo phenotyping systems, and (e) molecular characterization of host-pathogen interactions. Seven R&D projects were approved within MusaForever and 18 Brazilian researchers worked in associated projects in Europe.

A specific cooperation program (2010-2015) was then initiated in the ‘Laboratory of Tropical Plant Improvement’ in Belgium (KUL) to boost knowledge and develop banana genetic improvement biotechnologies. This laboratory also hosts the ‘International Transit Centre’, i.e. the largest Musa germplasm collection in the world. Labex enabled enhancement of the Global Musa Genomics Consortium*, a partnership that has been under way since 2001, involving 38 institutions from 24 countries.

Contact: Manoel Souza, manoel.souza@embrapa.br

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INTERNATIONAL COLLABORATION WITH EMABRA

Gert Kema is a researcher at the ‘Biointeractions and Plant Health (WUR) which hosted a Brazilian researcher for 4 years.

Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?

No. I was not involved in any collaborations with Brazil prior to Manoel Souza’s arrival.

What conclusions do you draw from the experience? What has this collaboration contributed to your team?

The MusaForever program strengthened our research on banana. Before this alliance, we had launched major initiatives such as sequencing of the causal pathogen of black Sigatoka disease (Mycosphaerella fijiensis). The collaboration with EMBRAPA enhanced my know-how and experience on this theme, as well as on hosting a senior scientist within the framework of this type of partnership.

Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?

There is no follow-up so far, but interest has been shown on developing MusaForever 2.0. Meanwhile, we managed to develop several global and regional banana research programs. EMBRAPA and Wageningen University have signed a framework agreement with a much broader scope to facilitate mobility and training.

Note also that the molecular diagnosis of the Fusarium oxysporum f. cubense tropical race 4 (Labex-Europe - Plant Research International collaboration), the causal agent of Panama disease which is devastating Cavendish banana plantations in Southeast Asia, attracted funding for several ongoing research initiatives by the industry and Wageningen University. This program has contributed to controlling Panama disease and hampered its spread into uninfected areas. It also participates in training, with seven interdisciplinary doctoral projects and a platform of 14 MSc courses. EMBRAPA and Plant Research International are again collaborating on the latest discoveries concerning plant-pathogen interactions, with the ultimate aim of producing resistant bananas for the world market.

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Manoel Teixeira Souza Júnior
(EMBRAPA)

set up three EMBRAPA postdoctoral research postings at the Laboratory of Tropical Plant Improvement over a total period of almost 4 years (2007–2009) to test genes and promoters and develop transgenic banana plants resistant to fungal diseases.

Contact: manoel.souza@embrapa.br

Laboratory of Tropical Plant Improvement
(Catholic University of Leuven)

36 scientific and technical staff

Director: Pr Rony Swennen,
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Scientific correspondents: Rony Swennen,
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What conclusions do you draw from the experience? What has this collaboration contributed to your team?

This collaboration generated many scientific and personal contacts with Brazilians. Secondly, it highlighted Brazil’s huge potential to advance rapidly in the field of science and applications. Thirdly, it showed that the two teams are complementary and that there are lots for both sides to gain through new research collaborations. All the credit goes to Manoel Souza and the excellent scientists who were a real driving force and got things moving quickly.

Now that the Brazilian scientist has returned home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?

Labex supported my participation in the 17th Brazilian Symposium on Horticulture and Ornamental Plants and the 4th Brazilian Symposium on Plant Tissue Culture. We are also coordinating the bilateral CNPq–FWO project*, have signed a Memorandum of Understanding with Lavras Federal University and hosted two Brazilian doctoral students. KUL hosted three EMBRAPA postdoctoral fellows with whom we tested banana DNA sequences by transferring them into banana plants, and a joint patent is being prepared with respect to this work. Several peer-reviewed scientific publications were coauthored by EMBRAPA-KUL research teams. Manoel Souza clearly collaborated intensively, resulting in joint publications (*p. 30) and exchanges that will be followed-up for a long time.

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Interview

Rony Swennen
is Director of the ‘Laboratory of Tropical Plant Improvement’ (Catholic University of Leuven) which hosted Brazilian researchers for 4 years.

Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?

My laboratory had no research collaborations with Brazil prior to Manoel Souza’s stay. He prompted our collaboration after being nominated to the Labex post at Wageningen University. Because of our mutual interest in conducting research on fungal resistance in bananas and once our discussions had been set in writing in joint agreements, EMBRAPA and the Catholic University of Leuven (KUL) developed a highly active research collaboration, with many exchanges of plant material and researchers. The research culminated in the launching of a technical cooperation project (MusaForesee, p. 32), the banana biotechnology platform jointly with EMBRAPA-KUL), several biological material transfer agreements, exchange visits between KUL and three EMBRAPA research stations in Brazil.
INTerview

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Contact: Rony Swennen, rony.swennen@biw.kuleuven.be

Brazilian scientist hosted

Manoel Teixeira Souza Júnior (EMBRAPA) set up three EMBRAPA postdoctoral research postings at the Laboratory of Tropical Plant Improvement over a total period of almost 4 years (2007-2009) to test genes and promoters and develop transgenic banana plants resistant to fungal diseases.

Contact: manoel.souza@embrapa.br

Host laboratory

Laboratory of Tropical Plant Improvement (Catholic University of Leuven) 36 scientific and technical staff

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Scientific correspondent: Rony Swennen, rony.swennen@biw.kuleuven.be
'Advanced biology' and molecular plant-microorganism interactions

Labex-Europe in the UK: wheat pathogens and climate change

In the United Kingdom, Labex signed a common interest project with Rothamsted Research, Harpenden (Biotechnology and Biological Sciences Research Council, BBSRC), to investigate fungal virulence and pathogenicity. Mycosphaerella graminicola is the causal agent of Septoria tritici blotch (STB) of wheat, which is a major disease of wheat in Europe. A long initial asymptomatic intercellular colonization period occurs after wheat leaves are infected with this fungus. Functional genomics and gene expression profiling studies highlighted the production of virulence effector proteins which are secreted and facilitate this initial phase. Studies on these secreted proteins (secretome) are essential to gain insight into their role. The secretome of proteins having enzymatic and nonenzymatic functions in M. graminicola was identified, analyzed and classified. The function of different sequences was studied by combining different bioinformatics approaches in order to increase the probability of identifying proteins that are actually secreted.

298 proteins with functional annotations were selected out of an initial 556 proteins. Then 163 proteins having a TM domain predicted in the signal peptide sequence or in the mature protein were excluded. Finally, 492 secreted proteins were identified. The characterization of nonannotated proteins included an analysis of characters associated with known fungal effectors (small sized, cysteine content etc.). Gene expression profiling during in vitro and in planta fungal growth enabled the identification of candidate genes, which were subjected to functional genomic analysis to determine their impact during the leaf tissue colonization process.

Dr Alexandre Amaral, the Brazilian scientist hosted at Rothamsted, joined the cereal pathogenomics team led by Dr Kim Hammond-Kosack. His research focused on fungal pathogens of wheat—a key socially and economically important crop in Brazil—and on genes and processes involved in the disease, especially the first steps of infection by the causal pathogen of Septoria tritici blotch (STB) of wheat (Mycosphaerella graminicola). Dr Amaral analyzed a collection of around 11 000 genes using in silico techniques.

ACTIVITIES

Alexandre Amaral

After a Labex-Europe position was opened in the UK in 2010, a Brazilian-British workshop was held at Londrina (Paraná) in 2011, with the participation of British scientific wheat specialists and delegates from Brazilian institutions, including the EMBRAPA Wheat Research Center. Research topics were identified and joint projects planned (including three on wheat diseases and/or wheat drought tolerance) and a CNPQ-BBSRC call for tenders was launched in 2011 (EMBRAPA/John Innes Centre/Rothamsted Research/University of Exeter projects). The Brazilian-British consortium on pathogenic fungi includes EMBRAPA centers (informatics, genetic resources and biotechnology, fruits and cassava, wheat, and rice and beans), Campinas and Brasilia Universities, as well as Rothamsted Research, the European Bioinformatics Institute and LORIA France.

Another workshop was held in Brazil in June 2012 to discuss joint metagenomics research proposals.

Contact: Alexandre M. do Amaral, alexandre.amaral@embrapa.br
Interview

John Lucas is a researcher from the Cereal Pathogenomics group (Rothamsted Research) which hosted a Brazilian researcher for nearly 3 years.

Did you work in collaboration with Brazil in general and with EMBRAPA in particular before a Labex researcher joined your team?

Rothamsted Research has had links with Brazilian scientists and EMBRAPA for a long time. My first collaboration was as early as 1996 and concerned diseases and pests of cashew, crops in northeastern Brazil. The project involves several university partners and EMBRAPA (agri-food industries, Fortaleza). This momentum increased after the UK-Brazil Year of Science in 2007.

What conclusions do you draw from the experience? What has this collaboration contributed to your team?

The collaboration has had positive outcomes for the team, particularly by highlighting common priorities for wheat research in both the UK and Brazil. We held a workshop on this topic (Londrina, 2011). And of course it has been good to have an experienced Brazilian scientist with us for the past 3 years.

After the Brazilian scientist returns home, is there any follow-up and/or consequences in terms of partnerships between your team and Brazilian institutions?

Alexandre Amaral will be with us for a few more months and this will ensure that we can further progress on the project and complete several publications. This year I also had the opportunity to spend four and a half months at the EMBRAPA Genetic Resources and Biotechnology Center (CENARGEN) under an Inverse Labex arrangement (see below). And Natália Martins of the Bioinformatics group in CENARGEN has just joined us for a year. We also developed a bilateral project—FunBUC (UK-Brazil Consortium on Functional and Comparative Genomics for Fungi)—with UK and Brazilian groups to study fungal pathogens of wheat and beans. So there is a follow-up and we hope that the partnership will continue growing.

Contact: John Lucas, john.lucas@rothamsted.ac.uk

The Inverse Labex experience: from the UK to Brazil

It has been obvious since Labex-Europe was launched in the United Kingdom in 2010 that two conditions are required to ensure a sustainable partnership. The first was that the collaboration should extend beyond Rothamsted to other BBSRC institutions, and more broadly to the entire British university community. Networking was part of the program. The second was a need for two-way scientific exchanges. In October 2011, I was the first British scientist hosted in Brasilia through an Inverse Labex initiative sponsored by Rothamsted and BBSRC. I was based at the National Centre for Genetic Resources and biotechnology (CENARGEN) on the campus of the EMBRAPA headquarters and close to the recently opened Agroenergy center.

This was a real ‘parallel lives’ experience—I was supposed to work on a research project in a laboratory while also visiting EMBRAPA centers and universities. This was quite a challenge since EMBRAPA has 47 research units spread throughout the 5th largest country in the world! I managed to visit 11 during my stay (14 if those visited in a previous trip to Brazil are included). I held a video conference that was broadcasted at EMBRAPA. I joined the ‘Molecular Plant-Pathogen Interactions’ group (CENARGEN), headed by Patricia Messenberg, whose main line of research is focused on biotic and abiotic stress in groundnut (Arachis) and its wild parents. I worked on the disease caused by the Passalora personatum fungus. This has an impact on groundnut crop productivity throughout the world and involves a host-pathogen system that differs from that of Septoria in wheat, but with common aspects in terms of fungal phylogenesis and experimental approaches. For plant diseases, comparative genomic analyses are carried out to identify plant pathogen attack avoidance and defense mechanisms.

The transformation of Brazilian agriculture raises sustainability and environmental impact questions, which European researchers regularly address. Agroscience research in Brazil is rapidly growing, with fresh investments and a new generation of scientists who are intending to focus their careers in this field. There are collaboration opportunities due to new joint funding arrangements with BBSRC, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and other agencies, and thanks to the Brazilian government funded ‘Science without walls’ initiative. It was a privilege to participate in this project and I hope that other British scientists will be able to do the same.

Contact: John Lucas, john.lucas@rothamsted.ac.uk

Brazilian scientist hosted

Alexandre Morais do Amaral (EMBRAPA) stayed for nearly 3 years in the Cereal Pathogenomics group (Rothamsted Research) (March 2010-February 2013) to conduct a research project on the 'Functional genomic analysis of interactions between Mycosphaerella graminicola and wheat: investigating genes related to early stages of infection.'

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Host laboratory

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Scientific correspondent: John Lucas,
john.lucas@rothamsted.ac.uk
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Contact: alexandre.amaral@embrapa.br

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Contact: John Lucas, john.lucas@rothamsted.ac.uk
The International Advanced Biology Consortium (CIBA)

Strategies for high-throughput studies of genomes and their expression, combined with functional genomics approaches, enable the characterization of plant genetic resources. Using cutting-edge technologies and conventional breeding approaches, this knowledge facilitates breeding of new varieties with the aim of reducing the impact of stress on crop productivity and improving the nutritional safety and quality of produce. No single research institution is, however, capable of mobilizing the expertise required to use them in varietal breeding programs while making effective use of the available biological resource diversity. This observation prompted EMBRAPA and Agropolis International, with the support of CIRAD, to found CIBA in 2008.

CIBA involves Brazilian and French partners (see below) and their scientific networks, who pool their resources, capacities, knowledge and expertise to develop and use these innovative advanced biology and genetic improvement tools to conduct research on tropical species of agricultural interest. CIBA has a portfolio of some thirty collaboration projects and also serves as a place for exchange, training and a forum for discussions that will give rise to the development of new bilateral research projects. Some CIBA activities (funded by CIRAD, EMBRAPA, Agropolis Fondation, French Embassy in Brazil, UESC, CAPES) include the organization of four bilateral workshops, support for the organization of French-Brazilian workshops on advanced biology topics: two bioinformatics symposia (2010, 2011), the First Meeting on Functional-Structural Plant Modeling (2011), and near-infrared spectrometry analysis training. CIBA also promotes exchanges of French and Brazilian researchers, which has led to the submission and acceptance of research projects, especially by CIRAD, EMBRAPA and Agropolis Fondation. In the future, CIBA will be further strengthened by joint self-funding arrangements for research projects that are strategic for its partners.

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CIBA Brazilian partnerships

- EMBRAPA Research centers

- Institutes involved in the Agricultural Research National System
Genetic resources, genome analysis and varietal improvement of groundnut

The cropped groundnut species is an allotetraploid resulting from a recent hybridization between two wild diploid species, which led to reproductive isolation of the cropped species from other species. The resulting genetic base is narrow, thus limiting the impact of breeding on responses to the main cropping constraints. In 2004, CPG funded a 3-year project (collaboration EMBRAPA, UCB, CIRAD, ICRISAT, CERAAS, IBONE and Aarhus University collaboration) aimed at:

- breeding synthetic wild varieties with the same ploidy level as the cropped species in order to gain access to the diversity of the wild compartment,
- developing the molecular tools required for studying the genome and implementing modern breeding approaches.

Synthetic varieties of wild origin developed by EMBRAPA were transferred to the groundnut development program of ISRA (Senegal). Scientific exchanges between EMBRAPA and CIRAD have resulted in the development of genome resources (BAC libraries) specific to the two wild species.

With the support of CPG, the partnership was continued through scientific visits, exchanges of plant material and supervision of a doctoral thesis. The resulting germplasm and molecular tools led to an approach involving marker-assisted selection and genetic analysis. A population of chromosome segment substitution lines was developed which renewed the genetic base of the cropped species and led to the identification of genome zones involved in the expression of characters of agricultural interest. This new germplasm provides opportunities for rapid improvement of the species cropped in dryland areas. Characterization of this material in a broad range of environments and its use for breeding purposes is ongoing in a broader CPG-Bill & Melinda Gates project framework.

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Daniel Foncéka, daniel.fonceka@cirad.fr
Soraya Bertioli, soraya@cenargen.embrapa.br
David Bertioli, david@pos.ucb.br
Ousmane Ndoye, ousdoye@refer.sn & Jean-Christophe Glaszmann, gcpsp1@cirad.fr

Together in the Challenge Program Generation

'Challenge Programs' are large-scale transversal programs that enable 15 international research centers of the CGIAR Consortium to work together on the same theme. They are also intended to strengthen partnerships between CGIAR and research institutes in industrialized and developing countries.

The 'Challenge Program Generation' (CPG) is focused on genetic resources, the diversity of crop plants and related species. It aims to facilitate the use of a larger proportion of the diversity available in ex situ collections (genebanks) via genomics (especially comparative genomics) and molecular biology technologies. CPG devotes research to abiotic stresses, especially plant drought tolerance.

As genomics is one of the themes selected by Labex-Europe, many projects have involved Brazilian and French laboratories, thus contributing to the increased development of Franco-Brazilian collaboration.

Contact: Jean-Christophe Glaszmann, jean-christophe.glaszmann@cirad.fr
Main publications

> Natural resource management


Agrifood technologies


Agrifood technologies


Agrifood technologies


Main publications


Arango, Rafael E., Togawa, Roberto C., Carpentier, Sebastien C., Roux, Nicolas, Hekkert, Bas L., Kema, Gert H. J., Souza, Manoel T., Genome-wide Candidate gene-end sequencing of Musa acuminata DH Pahan reveals further insights into the genome organization of banana. Tree Genetics & Genomes (Print), p. 1, 2011.


Other publications


Full curriculum of researchers and coordinators of the Labex-Europe Program

The 'Lattes' platform of the National Council of Scientific and Technological Development (Brazil) is a freely-available database of curriculum vitae and institutions which is a reference for all fields of knowledge (www.cnpq.br).

Amaral, Alexandre M. do
http://lattes.cnpq.br/4398504738216684

Arcuri, Pedro B.
http://lattes.cnpq.br/0075797281676195

Brasileiro, Ana C. M.
http://lattes.cnpq.br/208564505663481

Contini, Elisio
http://lattes.cnpq.br/5452189819541174

Deliza, Rosires
http://lattes.cnpq.br/5127472125418977

Lago, Regina C. A.
http://lattes.cnpq.br/858234625127987

Netto, José Madeira da S.
http://lattes.cnpq.br/3953731166035813

Rodrigues, Geraldo S.
http://lattes.cnpq.br/943011933773535

Rosenthal, Amauri
http://lattes.cnpq.br/132932290735502

Simões, Margareth S.
http://lattes.cnpq.br/85965948534447

Vieira, Luis E.
http://lattes.cnpq.br/510613073427800
Agropolis International
World centre for agriculture, food and environmental sciences
agriculture • food • biodiversity • environment

At the heart of the scientific community of Montpellier and Languedoc-Roussillon region

- the world's greatest concentration of skills and expertise in fields related to agriculture, food, biodiversity and the environment, oriented towards the development of Mediterranean and tropical regions;

- a strong international dimension, with the CGIAR Consortium office, setting up of international institutions and foreign laboratories (Argentina, Australia, Brazil, USA, etc.), network support: European Society for Agronomy, French Scientific Committee on Desertification... Each year, about 500 research scientists and lecturers from 40 countries.

- a foundation for agricultural research and sustainable development: Agropolis Fondation (p.44).

Contact: agropolis@agropolis.fr
www.agropolis.org

A broad range of expertise...

- Agronomy, crop plants and cropping systems, agroecosystems
- Animal production and health
- Biodiversity and aquatic ecosystems
- Biodiversity and terrestrial ecosystems
- Economy, society and sustainable development
- Ecotechnologies
- Food, nutrition, health
- Genetic resources and integrative biology of plants
- Host-parasite interactions and infectious diseases
- Modelling, geographic information, biostatistics
- Vines and wine
- Water resources and management

...focusing on the main research themes related to major social issues

- Agricultural production, processing and marketing subsectors
- Innovation, uses, technology transfer
- Nutrition, health
- Resource management, environment and sustainable development
- Sustainable food and food security
- Territorial risks and vulnerability

A comprehensive and diversified training package

- Basic professional or research degree training for all levels and expertise fields
- Professional continuing degree or non-degree training
- Training system engineering
**Key figures**

- 28 research and higher education institutions
- 2,300 research scientists and lecturers, including 400 posted in some 60 partner countries
- 80 mainly interinstitutional and interdisciplinary research units
- 8 campuses, including three devoted to agricultural sciences with joint infrastructures: Ecotron, research and training hubs with specialized high performance facilities (Technology, Remote Sensing, Humanities, Water), experimental greenhouses, pilot plants, business innovation centres, etc.
- 3 competitive clusters: Water, Risk, Qualiméditerranée
- A network of 43 libraries
- 5 universities and 9 engineering schools offering:
  - 156 training programmes (2-8 years of higher education: technician, engineering, BSc, MSc, PhD, etc.) hosting over 5,000 students, including 300 PhD candidates a year (1/3 foreign students)
  - 100 continuing professional training modules, and a training engineering capacity

**An Association at the service of the scientific community**

**A gateway that provides**

- Easy access to expertise and resources of the scientific community
- Access to information media: newsletters, websites, thematic portals, summaries of scientific knowledge on current topics and issues
- Support for national and international collective interinstitutional projects (promotion, coordination, management)
- A delegation hosting service
- Assistance for international researchers (EURAXESS Centre in Languedoc-Roussillon)
- A meeting and conference service
- An interface with development stakeholders
- A platform for the development and coordination of new partnerships

**EURAXESS Services Centre of Montpellier Languedoc-Roussillon**

**a tool to facilitate the stay of visiting international researchers**

At the service of the regional scientific community, the EURAXESS Services Centre of Languedoc-Roussillon, managed by Agropolis International and labelled by the European Commission, assists mobile scientists in every step of their move; it is dedicated to PhD students, visiting researchers and professors hosted in higher education and research institutions:

- Entry conditions and residence permits
- Assistance with administrative formalities related to 'scientist' visa, social security, insurances, taxes, banking
- French courses and cultural activities
- Practical information, accommodation, family issues

Since 2002, over 150 Brazilian researchers and PhD students have benefited from the EURAXESS Services Centre of Montpellier Languedoc-Roussillon.

Contact: mobilite.euraxess-lr@agropolis.fr
www.agropolis.fr/mobilite-euraxess-lr
www.agropolis.org/mobility-euraxess-lr
www.agropolis.org/es/movilidad-euraxess-lr
Key figures
- 28 research and higher education institutions
- 2,300 research scientists and lecturers, including 400 posted in some 60 partner countries
- 80 mainly interinstitutional and interdisciplinary research units
- 8 campuses, including three devoted to agricultural sciences with joint infrastructures: Ecotron, research and training hubs with specialized high performance facilities (Technology, Remote Sensing, Humanities, Water), experimental greenhouses, pilot plants, business innovation centres, etc.
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EURAXESS Services Centre of Montpellier Languedoc-Roussillon
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Contact: mobilite.euraxess-fr@agropolis.fr
www.agropolis.fr/mobilite-euraxess-fr
www.agropolis.org/mobility-euraxess-fr
www.agropolis.org/es/movilidad-euraxess-fr
Agropolis Fondation

Scientific collaboration between Agropolis Fondation and Brazil

Agropolis Fondation was established in February 2007. As a grant-making foundation, it supports and promotes research and higher education in agriculture and sustainable development. It seeks to establish and reinforce international collaboration between its scientific network (see box) and key international partners in the North and the South and the Mediterranean.

France and Brazil has very strong scientific links, particularly between Montpellier talent pool and Brazilian scientists in the field of agriculture and food. EMBRAPA is among the top 3 international partners of the foundation’s scientific network.

In this context, Agropolis Fondation has signed a multi-year agreement with the Brazilian Agency for Research and Higher Education (CAPES) on research and training in agriculture and sustainable development, providing a unique opportunity to enhance France-Brazil scientific cooperation. The two institutions launched in 2010 and 2011 Joint Calls for Proposals which led to the funding of 10 projects involving scientists from France, Brazil and African countries. A third Joint Call in 2013 is under preparation.

Also, the Foundation has supported a series of workshops (2007 to 2009) of the International Consortium on Advanced Biology (International Advanced Biology Consortium, CIAB) aimed to develop proposals submitted to French and European Calls for Proposals as well as to define research priorities and partnerships involving France, Brazil and the African region. The Foundation (co-) funds 22 projects involving Brazilian scientists from various research institutions (e.g., EMBRAPA, IAPAR, IAC, CENARGEN, CEPLAC, EPAMIG, etc.) and universities (e.g., Brasilia, Campinas, Londrina, Parana, Rio de Janeiro, Sao Paulo etc.) thereby contributing to knowledge sharing and scientific capacity building.

Agropolis Fondation and its scientific network in brief...

From its base in Montpellier, at the heart of Agropolis International, the Foundation is able to draw on an extraordinary pool of international expertise and talent. The foundation’s scientific network includes 37 research units (involving 2700 staff, including more than 1300 permanent scientists, 600 doctors and 200 post-docs) specializing in plant research at various levels covering a wide range of disciplines including:

- Genetics and genomics, plant breeding, eco-physiology
- Integrated crop protection, plant pests and diseases, symbiotes, population ecology
- Agro-ecosystems, agri-environmental innovations and resource management
- Agri-food systems, processing and quality of food and non-food materials
- Innovation processes and social management of innovation
- From genes to products: integrated approaches for assessing, controlling and improving the quality of plant products
- Intercountry and interdisciplinary approach (biological, engineering, human and social sciences, as well as other disciplines) towards agroecological innovation

As a grant-making foundation, Agropolis Fondation provides different types of funding support designed to encourage break-through research and to create a leverage effect on international attractiveness and visibility. It funds scientific and capacity building programmes in the following interdisciplinary axes:

- Development of plant phenotypes
- Diversity of interactions between plants and bio-aggressors
- Agro-ecosystems, territories, services and innovation
- From genes to products: integrated approaches for assessing, controlling and improving the quality of plant products
- Intercountry and interdisciplinary approach (biological, engineering, human and social sciences, as well as other disciplines) towards agroecological innovation

Since its inception, Agropolis Fondation has privileged integrative (from genes to systems, up to the final use of products) and interdisciplinary approach (biological engineering, human and social sciences, as well as other disciplines) to plants of agronomic interest. It encourages interdisciplinary efforts on key issues facing today's bioeconomy, particularly those that are at the interface of temperate, tropical and Mediterranean regions: increasing demand for plants and plant by-products for both food and non-food applications; interaction between climate change and crops; and prevention and management of risks related to crop and food systems.

Contacts: Anne-Lucie Wack, Director, wack@agropolis.fr
Oliver Oliveros, International relations and partnerships Relations, oliveros@agropolis.fr
www.agropolis-fondation.fr
Prospects of the EMBRAPA Labex Program

As the 40th anniversary of its founding approaches—which will be celebrated in April 2013—EMBRAPA has reaffirmed its commitment to sustainable agricultural development. Its Secretariat for International Affairs is also strengthening the Labex Programme in order to enhance its effectiveness as an instrument for promoting international research networks.

EMBRAPA proposes to partially integrate international bilateral mechanisms for funding research projects into the Labex Program. These will be linked to scientific training programmes organized by EMBRAPA or other Brazilian agencies. One example is the strengthened partnership between EMBRAPA, Agropolis International and Agropolis Foundation on the plant improvement theme via the International Advanced Biology Consortium (CiBA).

Through partnerships managed by Labex in Europe and the United States concerning the priority topics of this program, professionals from EMBRAPA or other Brazilian research institutions who have been selected for postdoctoral scholarships or sabbaticals could collaborate in activities proposed by Labex researchers. The so-called ‘researcher clusters’ created in this way will enhance synergy between Brazilian research networks and their correspondents within Europe by benefiting from institutional anchorage and infrastructures.

Concerning the selection of thematic areas developed under the Labex Program, EMBRAPA has created conditions to streamline them with the priorities of the EMBRAPA Management System (EMS). The creation of research project portfolios and other mechanisms in the EMS will contribute to this streamlining process, thus strengthening partnerships between Brazilian networks and excellence research teams from other parts of the world.

Finally, in the coming years, the EMBRAPA Executive Directorate is encouraging interactions between Labex teams via researchers working on the same research theme. Such interactions, associated with the above-described mechanisms, will ensure a seamless dialogue between Labex teams.

In the climate change scenario projected for the near future, agriculture must be sustainable and ensure the preservation of natural resources while feeding the global population with healthy nutritional foods. The Labex Program will thus act as a strategic tool to complement the international activities of EMBRAPA, which has a growing responsibility to demonstrate the usefulness of agriculture as a solution to those global challenges, by generating knowledge and by developing innovative agricultural technologies.

Francisco Basílio de Souza,
Head, Secretariat for International Affairs

Luciano Nass,
Knowledge-Exchange Coordinator

Pedro Arcuri,
Labex-Europe Coordinator, 2009 to 2013

An Argentinian LabIntex set up at Agropolis International

Agropolis International signed a technical partnership agreement with the Instituto Nacional de Tecnología Agropecuaria (INTA) in late March 2012 at Buenos Aires (Argentina) to set up its first LabIntex (Virtual Laboratories of INTA Abroad) in Montpellier (France)—it is modeled on EMBRAPA’s Brazilian Labex and is supported by the Inter-American Development Bank (IDB). For the purposes of this Dossier d’Argropolis devoted to EMBRAPA’s Labex-Europe, we asked the President of INTA the three following questions:

> How is INTA currently structured and what are its priorities?

INTA is a government organization associated with the Argentinian Ministry of Agriculture, Livestock Production and Fisheries and has agencies throughout the country. It includes 15 regional centers, 6 research centers, 50 research stations, 20 institutes and 350 technical support units. Its priorities include research (organized in 13 national programs) and technological innovation in industries, regions and territories, with the aim of improving competitiveness, preserving environmental quality and ensuring social equity. Its subsidiary INTEA S.A. deals with marketing the technologies, seeds, seeders, registered trademarks, patent licenses and other derivative products of research. It also has a foundation (Fundación ArgenINTA) that finances the development of its research and technical support activities and collaborations with private companies.

> What are the main objectives of LabIntex?

LabIntex intends to carry out advanced research with the aim of developing innovations, and also to identify and develop scientific cooperations by forming innovation networks between organizations in Argentina, France and other European countries. By being positioned on research fronts, LabIntex will thus be able to contribute to boosting the competitiveness and sustainability of Argentinian agricultural production.

> How do you view the interaction between LabIntex, Labex-Europe and Agropolis International?

The strategic presence of EMBRAPA’s Labex-Europe and INTA’s LabIntex in France will enable Brazil and Argentina to be involved in top-notch research by cooperating with their European partners. Agropolis International, as a cooperation platform, facilitates interactions between these two laboratories with stakeholders of the European scientific community.

Contact: Ana Cipolla,
INTA Foreign Affairs Secretariat,
drl@correo.inta.gov.ar

Agreement signed by Carlos Casaniquela, President of INTA (left) and Bernard Hubert, President of Agropolis International (right), in the presence of Lorenzo Baso, Secretary of Agriculture, Government of the Province of Buenos Aires (center), and Damien Bergel, Export Advisor at the Mission Economique et Cultural Embassy in Argentina (not in the photo).
## Acronyms and abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>AGAP</td>
<td>Amélioration génétique et adaptation des plantes méditerranéennes et tropicales joint research unit, France</td>
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<tr>
<td>AgroParisTech</td>
<td>Institut des sciences et industries du vivant et de l'environnement, France</td>
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<tr>
<td>ARS</td>
<td>Agricultural Research Service, USA</td>
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<tr>
<td>BBSRC</td>
<td>Biotechnology and Biological Sciences Research Council, UK</td>
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<tr>
<td>BRAFAGRI</td>
<td>Programa Brasil, France, Agriculture - CAPES, Brazil</td>
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<tr>
<td>BRAFITEC</td>
<td>Programa de Cooperação Franco-Brasileira na Área de Formação de Engenheiros</td>
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<tr>
<td>CAPES</td>
<td>Coordination de Aperfeiçoamento de Pessoal de Nível Superior, Brazil</td>
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<tr>
<td>CATIE</td>
<td>Centro Agronómico Tropical de Investigación y Ensenanza, Costa Rica</td>
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<tr>
<td>CENARGEN</td>
<td>Embrapa Recursos Genéticos e Biotecnologia, Brazil</td>
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<tr>
<td>CEPEC</td>
<td>Centro de Pesquisas do Cacau, Brazil</td>
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<td>CEPLAC</td>
<td>Comissão Executiva do Plano de Lavoura Caatingueira, Brazil</td>
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<td>CERAAS</td>
<td>Centre d'étude régional pour l'amélioration de l'adaptation à la sécheresse, Senegal</td>
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<td>CGIAR</td>
<td>International Agronomical Research Centers</td>
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<td>CIBA</td>
<td>International Advanced Biology Consortium, France-Brazil</td>
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<tr>
<td>CICy</td>
<td>Centro de Investigación Científica y Tecnológica, Mexico</td>
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<tr>
<td>CIMMYT</td>
<td>International Maize and Wheat Improvement Center, Mexico</td>
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<td>CIRAD</td>
<td>La recherche agronomique pour le développement - Agricultural Research for Development, France</td>
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<td>CNES</td>
<td>Centre National d'Etudes Spatiales, France</td>
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<td>CNPq</td>
<td>Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brazil</td>
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<tr>
<td>CNRS</td>
<td>Centre National de la Recherche Scientifique, France</td>
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<td>COFECUB</td>
<td>Comité Français d'Évaluation de la Coopération Universitaire et Scientifique avec le Brésil</td>
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<tr>
<td>CPG</td>
<td>Challenge Program Generation</td>
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<td>CSGA</td>
<td>Centre des Sciences du Goût et de l'Alimentation, France</td>
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<tr>
<td>Cyted</td>
<td>Ibero-american programme for science, technology and development</td>
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<tr>
<td>DEFFRA</td>
<td>Department of Environment and Rural Affairs, UK</td>
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<tr>
<td>EMBRAPA</td>
<td>Empresa Brasileira de Pesquisa Agropecuária, Brazil</td>
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<td>EPAMIG</td>
<td>Empresa de Pesquisa Agropecuária de Minas Gerais, Brazil</td>
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<td>EPAGRI</td>
<td>Empresa de Pesquisa Agropecuária de Extensão Rural de Santa Catarina, Brazil</td>
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<tr>
<td>FP7</td>
<td>European Union 7th Framework Programme</td>
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<td>FunBUC</td>
<td>UK-Brazil Consortium on Functional and Comparative Genomics for Fungi</td>
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<td>FWO</td>
<td>Fonds Wetenschappelijk Onderzoek - Vlaanderen</td>
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<tr>
<td>IAPAR</td>
<td>Instituto Agronômico do Paraná, Brazil</td>
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<td>IATE</td>
<td>Ingénierie des Agropolymères et Technologies Émergentes joint research unit, France</td>
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<tr>
<td>IBONE</td>
<td>Instituto de Botánica del Nordeste, Argentina</td>
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<tr>
<td>ICRISAT</td>
<td>International Crops Research Institute for the Semi-Arid Tropics, India</td>
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<tr>
<td>INCAP</td>
<td>Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural, Brazil</td>
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<td>INRA</td>
<td>Institut National de la Recherche Agronomique, France</td>
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<tr>
<td>INTA</td>
<td>Instituto Nacional de Tecnología Agropecuaria, Argentina</td>
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<tr>
<td>IRD</td>
<td>Institut de recherche pour le développement, France</td>
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<tr>
<td>IRSTE A</td>
<td>Institut national de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture (former CEMAGREF), France</td>
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<tr>
<td>ISRA</td>
<td>Institut sénégalais de recherches agricoles, Senegal</td>
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<tr>
<td>JKI</td>
<td>Julius Kühn Institute, Germany</td>
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<tr>
<td>KU Leuven</td>
<td>Katholieke Universiteit Leuven, Belgium</td>
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<tr>
<td>LabEx</td>
<td>EMBRAPA's laboratory without walls or external laboratory, Brazil</td>
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<tr>
<td>LabIntex</td>
<td>Virtual Laboratories of INTA Abroad, Argentina</td>
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<tr>
<td>LISAH</td>
<td>Laboratoire d'étude des Interactions Sol, Agrosystème et Hydrodyssystème, France</td>
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<tr>
<td>LOMIA</td>
<td>Laboratoire lorrain de recherche en informatique et ses applications, France</td>
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<tr>
<td>PIC</td>
<td>Projet d'intérêt commun - project of common interest</td>
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<tr>
<td>PROCISUR</td>
<td>Programme de coopération pour le développement technologique agroalimentaire et agroindustriel du C ô ne Sud</td>
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<tr>
<td>R&amp;D</td>
<td>Research and development</td>
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<tr>
<td>RDA</td>
<td>Rural Development Administration – Suwon, South Korea</td>
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<tr>
<td>REDD+</td>
<td>The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries</td>
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<tr>
<td>SRI</td>
<td>Secrétariat aux affaires internationales de l'Embrapa, Brazil</td>
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<tr>
<td>TAPIS</td>
<td>Système d'indicateurs de performance pour les agroforesteries traditionnelles</td>
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<tr>
<td>TETIS</td>
<td>Territoires, Environnement, Télédétection et Information Spatiale joint research unit, France</td>
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<tr>
<td>UAPV</td>
<td>Universidade de Aveiro, Brazil</td>
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<td>UC B</td>
<td>Universidade Católica de Brasília, Brazil</td>
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<tr>
<td>UEL</td>
<td>Universidade Estadual de Londrina, Brazil</td>
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<td>UESC</td>
<td>Universidade Estadual de Santa Cruz, Brazil</td>
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<tr>
<td>UFG</td>
<td>Universidade Federal de Goiás, Brazil</td>
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<td>UFLA</td>
<td>Universidade Federal de Lavras, Brazil</td>
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<td>UFV</td>
<td>Universidade Federal de Viçosa, Brazil</td>
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<tr>
<td>UMZ</td>
<td>Université de Montpellier 2, France</td>
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<tr>
<td>UNR</td>
<td>Unité mixte de recherche - joint research unit</td>
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<td>UPR</td>
<td>Unité propre de recherche</td>
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<td>UR</td>
<td>Unité de recherche</td>
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<tr>
<td>USDA ARS</td>
<td>United States Department of Agriculture, Agricultural Research Service, USA</td>
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<tr>
<td>WUR</td>
<td>Wageningen UR (University and Research Centre), Netherlands</td>
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