

les dossiers
d'**AGROPOLIS**
INTERNATIONAL

Expertise of the scientific community

SPECIAL ISSUE ON
PARTNERSHIP

**A model laboratory
without walls:
the Brazilian Labex**



AGROPOLIS INTERNATIONAL

agriculture • food • biodiversity • environment

Agropolis International is a campus devoted to the green sciences. It groups an exceptional set of scientific and technology competences, with more than 2 200 scientists working for more than 100 research units in Montpellier and elsewhere in Languedoc-Roussillon, including 300 scientists working in 60 countries.

This scientific community is organised in broad thematic fields matching the major scientific, technology and economic issues of development.

A centre for the capitalisation and use of knowledge, a facility for training and technology transfer and a platform for hosting international exchanges, the Agropolis International scientific community is developing actions involving collective expertise and contributes to providing scientific and technology elements that make it possible to develop and implement development policies.

EMBRAPA

Research at the service of Brazilian agricultural development

Embrapa (*Empresa Brasileira de Pesquisa Agropecuária*, Brazilian Agricultural Research Corporation) has the task of providing solutions for sustainable agricultural development in Brazil by means of the creation and transfer of technologies. 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 output while conserving natural resources and the environment.

With more than 2000 research scientists, Embrapa has built up a network of 41 research centres, 3 service centres and 13 central divisions. Present in all the Brazilian states, it coordinates the national agricultural research system. Embrapa is also involved in numerous international cooperation projects, in particular through the Labex—today in the United States, Europe and Asia—and thanks to technological transfer offices in Africa (Ghana), Venezuela and Panama.

The research competences of Montpellier and the Languedoc-Roussillon region within the framework of Labex Europe

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

Embrapa, the Brazilian Agricultural Research Corporation, has implemented this strategy through Labexes—'external laboratories' without walls—in the United States, Europe and more recently in Asia. Senior scientists are posted to 'cutting-edge' teams to work for half of the time on an ambitious project of joint interest. They use the rest of the time for scouting, for seeking new opportunities.

Information flows from these Labexes to Brazilian research institutes. An increase in collaborative projects is observed now that operations have been running for a few years.

This special Agropolis International Dossier devoted to 'Partnership' describes the teachings of seven years of functioning of Labex-Europe. Teachings that Embrapa and Agropolis International wish to share.

A model laboratory without walls: the Brazilian Labex

A Brazilian innovation

Page 4

The three themes addressed at Labex Europe

Management of natural resources

Page 6

Agrifood technologies

Page 8

Genomics and plant biotechnology

Page 10

International Advanced Biology Consortium

Page 12

Labex Europe:

Page 18

what the French teams learned

The challenges of coordination

Page 19

The prospects of Labex Europe

The French point of view

Page 20

The Brazilian point of view

Page 21

Main publications

Page 22

The Labex and training

Page 24

The Euraxess Languedoc-Roussillon Centre

Page 25

Acronyms and abbreviations

Page 26

A Brazilian innovation

The idea was born in Brazil. At its inception, Eliseu Alves and Francisco Reifschneider gave the following explanation: ‘*We want our researchers, and not just our students, to “rub shoulders” with the best teams of the great scientific powers. In programmes that are at the cutting-edge, each in its specific field, as regards new technologies and innovation. We have chosen a formula of the “laboratory without walls” or “external laboratory (Labex)” type in which our researchers choose the team that they wish to join, the one that works best on the subject that is most relevant to the requirements of the theme that they address in Brazil. They do not work on “their own” research subject but on the research subject of the host team, like any other scientist in the team. They must make themselves accepted, recognised as researchers of international quality and establish all the links required to develop a network of new collaboration between European and Brazilian laboratories.*’ Labex Europe has now been running for seven years. It has reached the age of reason. The moment to draw lessons from a magnificent experience and to share them.

International partnerships for both higher education and research can be in various forms. Many students in Southern countries perform their

doctoral studies in universities in the North. Unfortunately, they too often work on research subjects that are only relevant for the host country. In addition, the intensity of doctoral work leaves them little time to explore opportunities and/or learn things outside their research subjects. Senior researchers do not often leave their laboratories, except to attend international congresses; those who do travel are mainly consultants from the North on missions to the South of varying duration, or are seconded for several years, as is common for French researchers at CIRAD (Agricultural Research for Development) and IRD (*Institut de recherche pour le développement*).

Is the Labex a true model that can be reused for other partnerships here and elsewhere?

At the end of the 1990s, *Empresa Brasileira de Pesquisa Agropecuária* (Embrapa) decided to explore a new partnership model, the ‘laboratory without walls’, whose main designers were Francisco Reifschneider and Eliseu Alves, the first Director-President of Embrapa. The new concept consists of sending senior scientists to high-level laboratories in the North for a period of 2 to 4 years. Their mission is twofold: first, to complete and strengthen their experience by joining a high-level team and working on one of its cutting-edge projects, and, second, to devote as much time as allowed by a half-time post to exploratory activities (scientific watch, visits, participation

in conferences, etc.) completed by communication/information activities addressed to their Brazilian colleagues.

The first Labex was set up in 1998 in the United States, hosted by and collaborating with a single organisation, USDA-ARS*. A second one was started four years later in Europe. CIRAD, INRA (*Institut National de la Recherche Agronomique*) and IRD gave a mandate to Agropolis International for the signing of an agreement between Embrapa and the regional multi-institutional consortium—24 research and higher education establishments—housed at Agropolis International in Montpellier, France.

This Agropolis International Dossier on partnership describes Labex Europe, a successful experience in scientific cooperation. It explains the choice of themes made by Embrapa management—genomics, natural resources, agrifood technologies—and highlights the main results achieved. It analyses the lessons learned and future prospects with reference to both the Brazilian institution and its French partners. Is the Labex a true model that can be reused for other partnerships here and elsewhere?

**Yves Savidan (Agropolis International, France)
& Pedro Arcuri (Embrapa, Brazil)**

* United States Department of Agriculture, Agricultural Research Service

A few dates of Labex Europe



© O. Piauí

2 October 2002

Official inauguration of Labex Europe attended by the President-Director, Dr Alberto Duque Portugal, and the Brazilian Minister of Agriculture, Dr Pratinô de Moraes, at Agropolis International, Montpellier



© O. Piauí

April - May 2002

Beginning of the work of the scientists Ana Brasileiro, Regina Lago and José Madeira in the Montpellier laboratories



© O. Piauí

21 January 2002

Launching of the activities of the Labex Europe office with the arrival in Montpellier of Elisio Contini, the first coordinator

October 2001

Locating of Labex Europe at Agropolis International, Montpellier, by decision of the executive management of Embrapa

April 2001

An Embrapa delegation visited various European centres including that in Montpellier, France

January 2001

The executive management of Embrapa decided to set up an external laboratory without walls (Labex) in Europe



© Embrapa

2 November 2005

Beginning of the work of the scientist Heloisa Filgueiras in Avignon, France

January 2005

The second coordinator, Luis F.Vieira, took up his post



© Agropolis International

20 May 2006

Installation of Labex Europe at the University of Wageningen, Netherlands, with the scientist Manoel Souza



© Agropolis International

1 February 2009

The third coordinator, Pedro B. Arcuri, took up his post

September 2008

Creation of the International Advanced Biology Consortium (CIBA)

July 2008

Decision to work with Rothamsted Research Institute in the UK

18 - 24 May 2008

Visit to the United Kingdom by an Embrapa delegation to identify a host institution for a Labex researcher

2001 2002 2003 2004 2005 2006 2007 2008 2009



© O. Piauí

A message from Elisio Contini

the first coordinator of Labex Europe

Labex Europe institutionalises long-term scientific and technical cooperation between Embrapa, the Brazilian Agricultural Research Corporation, and Agropolis International in Montpellier, with the participation of several European centres of excellence in agriculture in France, the Netherlands and England.

The presence of Brazilian researchers in European research centres shows Brazil's interest and its dynamism in terms of partnerships in joint research projects and monitoring new scientific discoveries in this continent.

Scientific links remain when the scientists return to Brazil after their stays in European centres, and new projects or programmes are implemented, as is the case of the International Advanced Biology Consortium (*Consortium International en Biologie Avancée*, CIBA) in genetics and genomics (page 12).

Labex Europe also stands out for its creativeness and the construction of new partnership models; it is evaluated with regard to the results achieved. Without going over and above the laws of the participating countries, it is free of the long bureaucratic procedures required for the approval of projects and of the administrative procedures that are generally essential for awarding permission to civil servants to leave their country.

It has contributed to strengthening the quality of the research conducted by Embrapa by allowing its researchers to work in centres of scientific and technological excellence. In return, European researchers have benefited from confrontation with new research problematics and the issues associated with a country at the developing stage as regards technology and science. They have been involved in the search for new products and responses to problems in tropical agriculture. They have made progress in the knowledge required to help other developing countries, in Africa for example.

The implementation at world level of knowledge that can help agriculture to increase its contribution to reducing poverty in the world has a significant humanitarian impact. It can help people to live in their own countries and thus reduce traumatising, illegal migration.

Contact: Elisio Contini, contini@embrapa.br

Management of *natural resources*

A note by

**José da Silva Madeira Netto,
Geraldo Stachetti Rodrigues**

THE THEMES social responsibility and environmental conservation are gaining increasing importance at various levels in institutional development agendas. In this context, it seems increasingly necessary to create, select, adapt, transfer and evaluate environmental management procedures. This dynamics of innovation in management processes should be focused first of all on farming activities, given their impacts at the spatial level and on all natural and human resources.

With the aim of attaining this sustainable development objective, society must make use of and reward farmers and agricultural production sectors that perform steering adapted to natural resources and the productive environment. This must be considered as an incentive for the promotion of sustainable development, a reward for the environmental services rendered by these growers and production sectors with awareness of environmental protection.

Environmental management systems for farming activities must make it possible to recommend suitable agricultural practices for improving social and environmental performance. In order to encourage producers and representatives of agricultural production sectors to promote technological conversion and the adoption of sustainable steering practices, environmental impact

systems have been developed along two lines of research used by the Labex Europe team for environmental impact assessment:

- The modelling, analysis and understanding of interactions between management practices and environmental quality: models have been developed to calculate the vegetation indices of deciduous crop plants using remote sensing.

- Evaluation of the performance of rural activities as regards environmental management: an environmental management method combined with a sustainability index has been developed for palm oil production. Mention can also be made of the design of a performance indicator system for agroforest management in humid tropical zones and the setting up of a methodological platform for evaluating energy and economic performance of the banana sector in Guadeloupe.

These two lines of research are summarised below through descriptions of the main cooperation initiatives, the results obtained and the scientific and technological prospects of the theme.

**José da Silva Madeira Netto
& Geraldo Stachetti Rodrigues (Embrapa, Brazil)**

The results have
been very positive'



Marc Voltz,
Director of the
Laboratoire
d'étude des
Interactions Sol-
Agrosystème-
Hydrosystème
(LISAH,
Laboratory for
the study of

soil-agrosystem - hydrosystem interaction),
a joint research unit that hosted a Brazilian
researcher for three years, gives us his
opinion of Labex Europe.

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

We had previously hosted Brazilian doctoral students and visitors, including an Embrapa researcher. But this was not organised within a formalised framework like that of the Labex.

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

José Madeira, the Embrapa researcher, spent more than two years with LISAH. He came with a precise idea that he explained to us and that we developed with him. This concerned the spectral reflectance of soils that can be observed by remote sensing to map soil properties, knowledge of which is extremely limited at the world level—Brazil and France included.

Environmental management: the activities of Labex Europe

■ Modelling 'Management practices – Environmental quality' interactions

Models were developed to calculate vegetation indices of deciduous crops (vines) using remote sensing. They can simulate complex systems (micro-basins with intensive agricultural use of land) to describe and characterise water flows, the associated inputs and the impact of management practices.

■ Integrated index of the sustainability of palm oil crops

An environmental management method integrated with a sustainability index was developed for palm oil cropping in the form of collaboration between CIRAD and Labex: APOIA-Dendé (support for palm oil growing). The system incorporates 62 indicators with five sustainability dimensions: i) landscape ecology, ii) environmental quality, iii) sociocultural values, iv) economic values, and v) management and administration. This evaluation tool was tested in the Belém region in Brazil and then in large estates and smallholdings in Indonesia to verify its appropriateness in contrasted production contexts. The system has been presented at various workshops as a decision aid for preparing holdings for certification (*Round Table on Sustainable Palm Oil*). This sustainability index is the subject of international negotiation for the improvement of the palm oil sector. It could be used for similar initiatives and other production sectors (e.g. soybean).

■ Performance indicator system for traditional agroforestry (TAPIS)

Agroforests form complex agro-sylvo-pastoral formations in humid tropical zones. Agri-environmental indicators can help producers to take management practice and technology decisions in order to improve these farming systems. The TAPIS indicator system was developed (CIRAD-Labex collaboration) within the ATP-Caresys project on 'Characterisation and evaluation of the agroecological performance of associated cropping systems in the humid tropics' using data from 38 Cameroonian agroforestry systems. The system incorporates eight agroecological performance indicators and eight agroecological indicators; these are used to classify holdings and to make recommendations designed to improve sustainability (priorities as regards investments, working time, etc.).

The results were very positive and stimulated the continuing of this line of research. While José Madeira was posted in Montpellier, we also organised the first international workshop devoted to digital soil mapping, an event attended by several Brazilian researchers.

3. 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?

After José Madeira's stay, we planned to develop a joint project with Embrapa on the environment assessment of the impacts of growing sugar cane, an activity that is increasing

world-wide and in Brazil as a result of the need for biofuels. Several preparation missions have been conducted and have resulted in the construction of a first version of the project, including an Embrapa and Campinas University (São Paulo state, Brazil) laboratory.

However, the project is currently on hold as it is difficult to find an experimental site that corresponds to all the scientific and operational criteria desired.

Contact: Marc Voltz,
voltz@supagro.inra.fr



© G. Stachetti

▲ Participants at the workshop on the environmental management of palm oil growing (PT Smart Research Institute, Libo, Indonesia, November 2008).

■ Methodological platform for the evaluation of sustainability (SAMEFrame)

H.T. Odum's 'environmental accounting method' provides a systemic approach in which productive inputs (materials, energy, labour, etc.) are evaluated in their respective units and integrated in a common unit (joules of solar energy). The costs and impacts resulting from the deterioration of resources are converted into indices that describe the overall sustainability of the system. The methodological platform *SAMEFrame* was developed as part of the programme *Environmental Accounting, Sustainability Indicators and Environmental Management of Rural Activities* (Labex/INRA collaboration) to study the energy and economic performance of the banana sector in Guadeloupe. The environmental and economic determinants of farming systems in Guadeloupe were found to be excessively dependent on imported industrial inputs. Improving the environmental performance of banana production in Guadeloupe therefore requires the adoption of innovations in environmental management (e.g. the recycling of nutrients).

Contact: Geraldo Stachetti Rodrigues,
stachetti@cnpmembrapa.br

The Brazilian scientist hosted

José Madeira (Embrapa) stayed for nearly three years at the 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

The host laboratory

LISAH joint research unit
Laboratoire d'étude des Interactions Sol,
Agrosystème et Hydrosystème
(INRA, IRD, Montpellier SupAgro)
70 scientific and technical staff
Director: Marc Voltz, voltz@supagro.inra.fr
www.umr-lisah.fr

Scientific correspondent:
Philippe Lagacherie, lagache@supagro.inra.fr

Agrifood technologies

A note by

Régina Lago

‘**THE FIRST GROUP**’ of Brazilian researchers arrived in 2002 as explorers of a new life in Montpellier. Two years later, a guide called ‘*Comment arriver, séjourner et repartir de Montpellier*’ was written and certainly helped other Brazilian scientists. Becoming a member of a Labex team is an important change of life. Indeed, we are senior scientists who already have families and careers. It is no longer a question of spirit of adventure, of being fed up or irreverence or even of a small measure of juvenile irresponsibility. We have much to gain, but we also leave much behind.

Each of us has a different understanding of the role of a Labex researcher. The establishment of the Labex in France has meant scouting activities aiming at a more intense, effective dialogue with other players at Embrapa. The strategy was that of writing notes and technical reports on new knowledge found at conferences, lectures, etc., and circulating it in a network in Brazil. Our correspondents were R&D managers or research scientists. Discussion was set up but reactions were not always up to the standard of the actions. However, the information was always read and analysed.

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 International Relations management and the Scientific management thus have a role to play. Labex scientists must contribute to developing scientific relations with Europe.

As my field was oils and fats technology, Jean Graille (Amis Department, CIRAD) was my French correspondent. He retired a month later. Our strategy resulted in contacts with the IATE joint research unit (Montpellier SupAgro/INRA/CIRAD/Montpellier University 2), of which Stéphane Guilbert is now the director. The laboratories and the pilot plant set up still house the CIRAD Fats Technology Laboratory. We have also provided support for a CAPES-COFECUB* project managed in Brazil by the Embrapa Agricultural Instrumentation Centre.

We worked on the castor-oil plant, *Ricinus communis*, that became a star plant in Brazil a year later thanks to its agro-energy potential. The results led to publications even after my return to Brazil. A student at the Federal University in Rio de Janeiro worked on the project for six months and a patent was applied for. A doctoral student at Universidade Estadual de Campinas received training with the ‘lipids’ team and at the Institut des Membranes in Montpellier.

The centre did not have sufficient weight in oils and fats at the time and the consequences of my stay were not significant. On my return to Brazil, I worked more on international relations and was then appointed as director of the Embrapa Food Technology Centre on 1 April 2008.

I have kept up links with the IATE team. We presented a joint project at the *Conselho Nacional de Desenvolvimento Científico e Tecnológico*. I was invited to Paris by the Association Française pour l’Étude des Corps Gras to give a talk on castor-oil and jatropha as part of the association’s annual ‘Chevreul’ day.

The future recruitment of two more researchers in oils and fats will provide scope for joint projects and stronger relations with CIRAD and other French teams in the sector.

Regina Lago (Embrapa, Brazil)

* CAPES: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Ministry of Education / COFECUB: Comitê Francês de Avaliação da Cooperação Universitária com o Brasil

The Brazilian scientist hosted

Regina Lago (Embrapa) stayed for nearly three years at the IATE joint research unit and, more particularly, at the CIRAD Amis department’s Laboratoire de Lipotechnie (October 2002–October 2005) to identify new plant enzyme sources isolated from Brazilian biomass (development of a process for extracting ricin lipase) and to process ricin for the production of lipid derivatives of strong nutritional interest.

Contact: lago@ctaa.embrapa.br

The host laboratory

**IATE joint research unit
Ingénierie des Agropolymères et
Technologies Émergentes**
(Montpellier SupAgro/INRA/UM2/CIRAD)

70 scientific and technical staff

Director: Stéphane Guilbert,
guilbert@supagro.inra.fr
<http://umr-iate.cirad.fr>

Scientific correspondents: Stéphane Guilbert,
guilbert@supagro.inra.fr & **Pierre Villeneuve,**
pierre.villeneuve@cirad.fr

A note by

Heloisa Filgueiras

MY ARRIVAL in June 2005 to replace Régina Lago and continue the work conducted in agrifood technologies enabled Labex Europe to have its first experience of the posting of a scientist outside Montpellier at the *Sécurité et qualité des produits d'origine végétale* joint research unit (INRA/ Université d'Avignon et des Pays de Vaucluse). The research project was then focused on the interface between foodstuffs *in natura* and processed foodstuffs and, more specifically, on the possible alternatives to chemical methods for the conservation of the quality of lightly processed plants. For this, different types of abiotic stresses were applied in a controlled manner to monitor metabolic processes first to delay enzymatic browning and senescence and second to increase the levels of functional compounds considered as being favourable.

Internal reorganisation of Inra leading to the changing of the priorities of the Avignon centre resulted in the moving of Labex activities in agrifood technologies to the *Laboratoire de physiologie des fruits et légumes* at the University of Avignon (UAPV). The initial line of research was then strengthened, with more rigorous requirements as regards the presence of residues and the running of a study of the use of chlorine in the food industry.

Initially, the UAPV team did not know Embrapa well and had little international experience in spite of its high scientific level. The partnership also coincided with the launching the *Pôle Européen d'Innovation Fruits et Légumes* (European Innovation Cluster for Fruits and Vegetables) and the halting of all of INRA's research on vegetables *in natura* (at least at the Avignon centre).

The Brazilian scientist hosted

Heloisa Filgueiras (Embrapa) spent three years (November 2005 – July 2008) with the 'Fruit Physiology' team *Sécurité et qualité des produits d'origine végétale* joint research unit (INRA/UAPV) and then with the same team at the 'Laboratoire de Physiologie des Fruits et Légumes' (UAPV) to study possible alternatives to chemical methods for conservation of the quality of little-processed plants.

Contact: heloisa@cnpat.embrapa.br

The host laboratories

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

49 scientific and technical staff

Director: **Christophe Nguyen-The**,
christophe.nguyenthe@avignon.inra.fr

Scientific correspondent:
Patrick Varoquaux (retired)

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

6 scientific and technical staff

Director: **Huguette Sallanon**,
huguette.sallanon@univ-avignon.fr

Scientific correspondent: **Huguette Sallanon**



C. Dore © INRA

In spite of this special context, the fact that Embrapa was present enabled UAPV to strengthen its image as a research institution, thus giving it the possibility of closer relations with the agricultural institutions in Montpellier—and more specifically with CIRAD through the Qualisud joint research unit. Its partnership with *Université Blaise Pascal* (Clermont-Ferrand, France) was also strengthened. The project made it possible to develop relations with two Dutch institutions, Radboud University (Nijmegen) and Wageningen University and Research Centre (WUR) and, through the latter, with the European laboratory *LaserLab Europe* (Milan, Italy).

In addition, five Brazilian scientists (from the Embrapa agricultural instrumentation and food industry centres, São Paulo State University, Jaboticabal, and Ceará Federal University) were invited by UAPV to install in its Fruit and Vegetable Physiology Laboratory the methods and technologies developed and/or adapted in Brazil.

Institutional relations have been maintained with several Embrapa centres and Brazilian universities since my departure. The approval of a new project on the use of Brazilian tropical fruits (CAPES/WUR programme) means that the work conducted by researchers at Embrapa and the various Brazilian and European universities can continue until 2010 (Fluminense Federal University, Paraíba Federal University, two laboratories at WUR, the LaserLab European platform).

Within the framework of bilateral cooperation between Embrapa and France, Labex Europe has enabled UAPV to join the Franco-Brazilian doctoral school and draw up the agreements required for the joint supervision of theses. The partnership activities of Embrapa and CIRAD initiated by the first Labex team have been continued by a post-doctoral position and a number of visits by researchers from Embrapa and Brazilian partner institutions.

I also participated in the UAPV master's degree and doctorate in the management of produce quality and several steering committees for doctoral students.

Heloisa Filgueiras (Embrapa, Brazil)

Plant genomics *and biotechnology*

A note by

Ana Cristina Miranda Brasileiro

WORLD POPULATION GROWTH, especially in poor countries, the continuous degradation of arable land, reduced access to potable water and climate change are substantial challenges for agricultural production and food security. Many efforts have been made to date to improve the tolerance of crop plants to various abiotic stresses, including drought, salinity, cold and pollution by heavy metals. However, the improvement of tolerance characters is very difficult in classic breeding programmes.

Better knowledge at the molecular level of the genes involved in resistance/susceptibility to abiotic stresses should aid in the development of new varieties that are better adapted to environmental constraints. The adaptation of plants to various abiotic stresses is a complex phenomenon with the direct or indirect involvement of numerous genes in the signal perception and transduction chains and in the mechanisms regulating other genes.

Functional genomics techniques now make it possible to analyse an entire plant as a system and lead to better understanding of the biological function and interactions of the genes expressed under certain stress conditions, such as shortage of moisture and salinity. Embrapa has a long tradition of research on plant improvement and the conservation of genetic resources and has an avant-garde leadership position in scientific research of plant genomics in Brazil.

A project of joint interest entitled 'Functional genomics of the response to abiotic stresses in rice' was therefore run within the framework of Labex Europe. It was conducted jointly by Embrapa and the DAP ('Plant development and improvement') joint research unit for four years (2002-2006) as part of the BIOTROP programme (Biotechnology and plant genetic resources) in Montpellier. The main aim of the project was to identify and characterise the genes involved in the response to abiotic stresses—drought and salinity—using rice as a model plant for cereals.

Ana Cristina Miranda Brasileiro (Embrapa, Brazil)

'A process has been launched'



Jean-Christophe Glaszmann, is now the Director of the 'Biological Systems' (BIOS) Department at CIRAD. The

Brazilian scientist was hosted by one of his teams for four years. He gives us his view of Labex Europe.

1. Did you work in collaboration with Brazil in general and with Embrapa in particular before a Labex scientist joined your team?

CIRAD has worked with Embrapa for a long time in various fields such as the varietal improvement of rice, the genetics of eucalyptus and natural resource management in Amazonia. But Embrapa, like CIRAD but on an even larger scale, is a complex body with specialised centres—some devoted to certain species and others to themes. Our relations were little coordinated and above all more opportunist than strategic.

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

Making a list of all the interactions and collaborative work undertaken would take too long. It covers the genetics and genomics of more than ten crops; projects have been developed and some—not enough yet—have received international funding. A movement has been got under way. We have organised meetings in Montpellier or Brasilia several times and the two communities have got to know each other. As regards subjects that might result in collaboration, French scientists now know where to go and who to contact at Embrapa and vice versa.

Identification of the genes involved in the response to abiotic stresses in rice

© A. Brasileiro and QH. Le, C. Périn



The project of joint interest 'Functional genomics of the response to abiotic stresses in rice' was conducted for four years within the framework of the BIOTROP programme (CIRAD, Montpellier). The main aim was to identify and characterise the genes involved in the response of rice to drought and salinity. The conclusions of the work are as follows:

■ The project is considered as a pilot operation by the CIRAD plant genomics team as a number

of the methodologies used then enabled the team to launch other functional genomics projects. Without being exhaustive, projects include a hydroponic system for large-scale osmotic and saline treatment, obtaining and validating subtractive banks, marking probes for microarrays, etc.

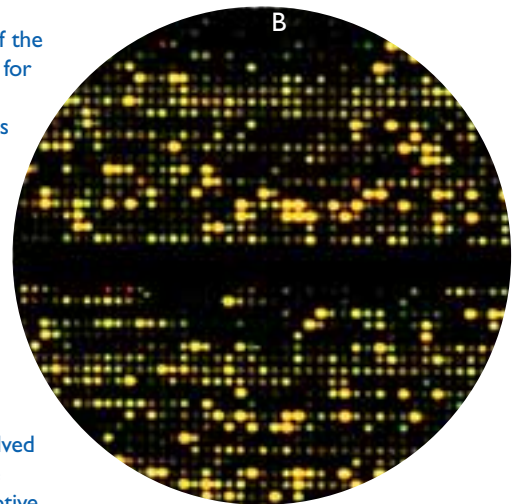
■ A total of 101 rice genome sequences were identified as having differential, early expression in response to moisture stress. These candidate genes code the proteins involved in the response to abiotic stress such as signal transduction, oxidative stress and adaptive processes. Two possible genes were also identified as coding proteins involved in the adaptive response of radicular architecture to osmotic stress. This had not been described previously in rice.

■ Of the 43 candidate genes validated by RT-PCR and by study of the association between radicular architecture (phenotyping), the four most interesting ones were selected for the final stage of validation by transformation.

■ Validation of the biological function of the candidate genes was continued by the construction of RNAi type vectors for the four candidate genes and the use of *Agrobacterium* to introduce them in transgenic rice plants ('Nipponbare' and 'Nona Bokra' varieties). The T1 lines of these plants are currently being subjected to molecular analysis to confirm the suppression of the respective genes.

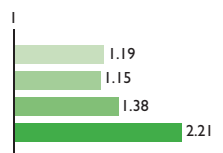
■ In the final stage of this work, the genetically modified rice lines bred will be phenotyped under controlled conditions in greenhouses in Brazil and Vietnam to evaluate the phenotypic effects of the suppression of the expression of the four candidate genes and thus confirm their role in plant response to moisture and saline stresses.

Contact: Ana Brasileiro, brasileiro@cenargen.embrapa.br

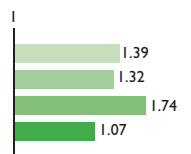


Treated:Control ratio according to duration of osmotic treatment (Primer 1 Na/Ca Exchanger)

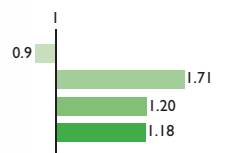
■ 15' ■ 1 h ■ 3 h ■ 5 h



Stem



Leaf



Root

Identification of the genes involved in the response of rice to osmotic shock (100 mM mannitol)

① Photo A - cv. 'Nipponbare' rice plants cultivated under hydroponic conditions 6 days after their transfer to a nutrient solution containing or not 100mM mannitol

② Cloned inserts corresponding to transcripts of the genes expressed differentially between the two treatments (SSH method)

③ Photo B - Display of transcripts over- (red) and under-expressed (green) under osmotic shock by microarray analysis on a glass slide (performed on the IGH transcriptomic platform)

④ Figure C - The regulation of the candidate genes by osmotic stress is confirmed by Q-RT PCR before functional validation by the analysis of mutants and/or overexpressors.

3. 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 have set up the *Consortium International en Biologie Avancée* (CIBA, International Advanced Biology Consortium). This performs regular monitoring and the people who run it are from our unit. In addition, Ana Brasileiro is a member of the programme committee of the CIRAD Biological Systems department. Some projects are running and others are being prepared.

Finally, the initiative will last if it is in the teams' interest, if they can secure funding, if they can find partnerships of a new type—triangular ones with African partners for example—and above all if a flow of students becomes established to strengthen links and to lay the foundation for new networks in the future.

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

The Brazilian scientist hosted

Ana Brasileiro, research scientist (Embrapa Genetic Resources and Biotechnology Department, Cenargen) spent nearly four years (May 2002 – April 2006) with the PIA joint research unit in molecular biology and genomics, working on the functional analysis of the tolerance of rice to drought and salinity.

Contact: brasileiro@cenargen.embrapa.br

The host laboratory

DAP (Développement et Amélioration des Plantes, Plant Development and improvement) joint research unit (formerly PIA, Polymorphismes d'intérêt agronomique, joint research unit) (CIRAD, Montpellier SupAgro, INRA, UM2) 68 scientists

Director: Emmanuel Guiderdoni, emmanuel.guiderdoni@cirad.fr <http://umr-dap.cirad.fr>

Scientific correspondent: Pascal Gantet, pascal.gantet@univ-montp2.fr

The International Advanced *Biology Consortium*

(*Consortium International en Biologie Avancée, CIBA*)

Strategies for high-throughput studies of genomes and their expression combined with functional genomics approaches for the study and validation of the functions of genes of species of agricultural interest will result in the considerable acceleration of the characterisation of plant genetic resources. Using cutting-edge technologies and conventional breeding approaches, this knowledge facilitates the analysis and use of existing genetic variability. It provides new opportunities for the breeding of new varieties aimed at reducing the impacts of various stresses on crop productivity and at improving nutritional safety and quality. They thus contribute to taking up the major challenges of the future resulting from climate change and an increasing world population.

However, no single research institution will be capable of mobilising all the skills required to manage and use these new technologies effectively in varietal breeding programmes and ensure the best possible exploitation of all the diversity of the biological resources available. It is therefore necessary that all the players in plant and agricultural sciences should set up and consolidate joint strategies for the development of collaboration in interdisciplinary, multi-institutional research and training to achieve recognised, high-quality international research. This observation led to the founding of the International Advanced Biology Consortium (*Consortium International en Biologie Avancée, CIBA*) with partners in Brazil (Embrapa and the network of universities and research and teaching institutions) and France (research institutes in Montpellier under the Agropolis International banner—CIRAD, IRD, INRA, Montpellier SupAgro and UM2—

at the service of varietal improvement for southern countries.

CIRAD and Embrapa have collaborated intensely and fruitfully in agricultural research and the formation of excellence at the service of sustainable development of the rural tropical and subtropical world for more than 30 years. The present structure of this collaboration is centred on five priority fields of cooperation—including advanced biology—listed in a joint strategic statement for the period 2003-2009.

This was the framework for Embrapa's posting from the end of 2002 to early 2006 of one of its researchers to Labex Europe, with hosting by CIRAD's *Développement et Adaptation des Plantes* (Plant development and adaptation) joint research unit. These combined operations have made it possible to stimulate and institutionalise research and the training and exchange of scientists and students in advanced biology applied to plant breeding. This work currently takes the form of some thirty collaborative research projects involving research scientists at Embrapa, Agropolis International and its international partners.

This strong and lasting scientific partnership was the foundation used by Embrapa and Agropolis International, with support from CIRAD, for the formalisation of the creation of CIBA in July 2008, with the main objective of strengthening and continuing this Franco-Brazilian collaboration in scientific excellence. CIBA players pool their resources, capacities, knowledge and know-how to develop and use innovative tools in advanced biology to continue their research and work in breeding applied to tropical species of agricultural interest.

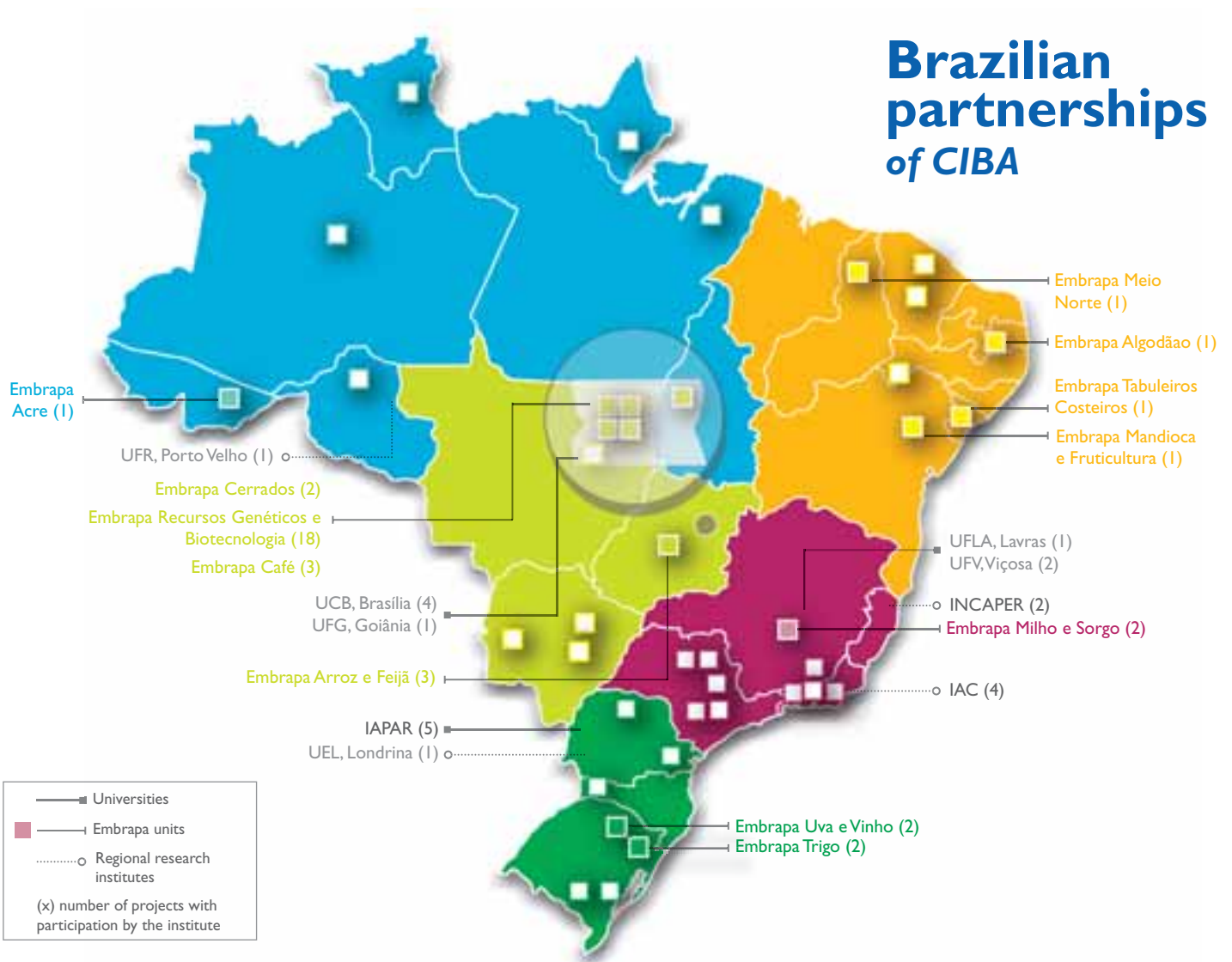
The CIBA must make the following possible:

- the creation of unique scientific synergy that is at the international forefront in plant and agricultural sciences;
- the sharing of infrastructure and facilities;
- the maintaining and organising of the various competences in order to manage, share and disseminate scientific knowledge and technological innovations;
- increasing interaction and scientific and technical collaboration at the national and international levels;
- increasing the international visibility of collaboration;
- facilitating the 'Europe – South America – Africa' triangle in both scientific projects and diploma and non-diploma training programmes;
- creating a model of collaboration and sharing that will be of use in other themes or other countries.

CIBA has organised since December 2007 four Franco-Brazilian workshops focused on the emergence and hinging of ambitious projects. More than twenty proposals for new projects have thus been developed and submitted to various national or international donors. Today, CIBA has a portfolio of some thirty projects. The fourth workshop was held in Montpellier from 5 to 9 October 2009 supported by Agropolis Fondation. It was attended by players in research and training from Brazil, France and Africa and was aimed at stimulating the emergence of triangular projects combining research, training and international mobility for scientists and students.

**Ana Brasileiro (Embrapa, Brazil),
Pascal Gantet (UM2, France)
& Marc Berthouly (CIRAD, France)**

Brazilian partnerships of CIBA



International partnerships of CIBA

201
scientists

Coordination unit:

Pascal Gantet (UM2), pascal.gantet@univ-montp2.fr,
Ana Cristina Miranda Brasileiro (Embrapa), brasileiro@cenargen.embrapa.br,

Steering committee:

Philippe Petithuguenin (CIRAD), petithuguenin@apis.com.br,
Pedro Arcuri (Embrapa), embrapa@agropolis.fr,
Paulo Carneiro (Embrapa), paulo@cenargen.embrapa.br,
Yves Savidan (Agropolis International), yves.savidan@agropolis.fr

Together in the ‘Generation Challenge Programme’



© INRA

In 2001, the Consultative Group on International Agricultural Research (CGIAR) launched the ‘Challenge Programme’ concept consisting of broad transverse programmes that enable 15 CGIAR international research centres to work closer together on the same theme. They are also intended to strengthen partnerships between the CGIAR and research institutes in the North and South.

The ‘Generation Challenge Programme’ (GCP) is focused on genetic resources, the diversity of crop plants and related species. It aims at permitting the use of a larger proportion of the diversity held in *ex situ* collections (gene banks) by means of genomics technologies—comparative genetics in particular—and molecular biology. The GCP has chosen to devote research to abiotic stresses and especially plant tolerance to drought, a major climatic constraint for most southern agricultures.

France has mobilised efforts for the programme, with Agropolis International on the steering committee and involved in the management of two of the five subprogrammes entrusted to French researchers, and it works with its Brazilian partners.

As genomics is one of the themes chosen by Labex Europe, numerous projects (replying to bid invitations) have involved Brazilian and French laboratories together, thus contributing to an increase in Franco-Brazilian collaboration. The joint projects selected are shown in the following table.

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

Head of project*	Project name	Partners*
Agropolis International-IRD Mathias Lorieux	Exploring natural genetic variation: developing genomic resources and introgression lines for four AA genome rice relatives	CIAT, Embrapa, Cornell University, ADRAO, Fedearroz
Agropolis International-Inra Jean-Benoît Morel	Functional genomics of cross species resistance to fungal diseases in rice and wheat (Cereal Immunity)	Agropolis International-CIRAD, Embrapa, IAPAR, UC Davis, CIMMYT, NIAS, JIC
Embrapa José Francisco Valls	Unlocking the genetic diversity in peanut’s wild relatives with genomic and genetic tools	UCB, Catholic University of Goiás, CERAAS, ICRISAT, UAS, Agropolis International –CIRAD, IBONE, Univ. Aarhus, Texas AES
Agropolis International-Cirad Marcel de Raïssac	Whole plant physiology modelling of drought tolerance in cereals	Agropolis International-Inra, IRRI, CSIRO, Univ. Queensland, CIMMYT, ICRISAT, Embrapa, Pioneer Hi-Bred
NIAS	Targeted Musa genome sequencing and frame map construction	Agropolis International-CIRAD, Bioversity International, Embrapa, Univ. Leicester
IRRI	Development of an integrated GCP information platform	Agropolis International-CIRAD, CIMMYT, Embrapa, ICRISAT, NCGR
ISRA	Enhancing groundnut (<i>Arachis hypogaea</i> L.) genetic diversity and speeding its utilization in breeding for improving drought tolerance	PROINPA, USDA, Agropolis International-CIRAD, ICRISAT, Embrapa, UCB
ISRA/CERAAS	Capacity building à la carte 2007 – Application of molecular tools for controlled wild introgression into peanut cultivated germplasm in Senegal	Agropolis International-CIRAD, UCB, Embrapa, ICRISAT

* See list of acronyms on page 26.

Agropolis Fondation: support for the International Advanced Biology Consortium

Agropolis Fondation was founded in 2007 with an initial endowment of 20 million euros to support and promote international level scientific programmes in agriculture and sustainable development with focus on issues in both the North and the South. In particular, Agropolis Fondation —with its four charter members INRA, CIRAD, IRD and Montpellier SupAgro— makes it possible for international scientists to come and work in the Foundation's scientific network. It also helps teams to organise meetings, in particular for developing new collaborative projects. Since 2007, Agropolis Fondation has launched regular Call for Proposals. In 2007, it funded the proposal aimed at providing financial support for the workshops organized under the International Advanced Biology Consortium (CIBA), a Labex spin-off.

The first two CIBA workshops were held at the end of 2007 and early 2008, with the development of new projects submitted to French and European Calls for Proposals. Agropolis Fondation supported Workshops 3 (Brazil, end of 2008) and 4 (Montpellier, October 2009). The fourth workshop was of particular interest as it initiated research and training within a France-Brazil-Africa tripartite framework.

Contact: agropolis-fondation@agropolis.fr

Further information is available at www.agropolis-fondation.fr

Genetic resources, genome analysis and varietal improvement of groundnut

Groundnut is the main legume in sub-Saharan Africa and is grown on 23 million hectares in the tropics, forming an important world source of food, oil and plant protein. The species grown is an allotetraploid resulting from a recent hybridisation between two wild diploid species that led to reproductive isolation of the cultivated species from other species. The genetic base is small, limiting the impact of breeding on responses to the main cultivation constraints (drought and diseases).

In 2004, the GCP funded a three-year project, with collaboration between Embrapa, UCB, CIRAD, ICRISAT, CERAAS, IBONE and Aarhus University. The aim was to remove the main biological blockages to the improvement of groundnut: (i) the breeding of synthetic wild varieties with the same ploidy level as the cultivated species to provide access to the diversity of the wild compartment, (ii) the development of the molecular tools required for study of the genome and the implementation of modern breeding approaches. Synthetic varieties of wild origin developed by Embrapa have been transferred to the groundnut development programme run by ISRA (Senegal). In addition, scientific exchanges between Embrapa and CIRAD have resulted in the development of genome resources (BAC libraries) that are specific to the two wild species.

With support from the GCP, the partnership (Embrapa, UCB, ISRA and CIRAD) was continued by scientific visits, exchanges of plant material and the supervision of a doctoral thesis. The resulting germplasm and molecular tools were used in an approach incorporating marker-assisted selection and genetic analysis: a set of chromosome segment substitution lines for both renewing the genetic base of the cultivated species and identifying the genome zones involved in the expression of characters of agricultural interest was developed. This new germplasm was developed partly from an elite variety grown in Senegal and provides opportunities for the rapid improvement of the species grown in dry zones. Characterisation of this material in a broad range of environments and its use for breeding purposes will be continued in the broadened framework of a GCP – Bill & Melinda Gates Foundation project.



© H.-A. Tossim, D. Foncéka

- ▲ 1: The development of chromosome segment substitution lines in a greenhouse at the CERAAS (Thiès, Sénégal).
- 2: Emasculation of a groundnut flower during manual crossing for backcross purposes.
- 3: Pods harvested from an introgression line.

This partnership used in successive projects has made it possible to prolong South-South and North-South collaborations and to develop lasting training activities concerning the genetic base of cultivated groundnut and the incorporation of molecular tools in selection work.

Contacts: Jean-Francois Rami, jean-francois.rami@cirad.fr
& Daniel Foncéka (CIRAD), daniel.fonceka@cirad.fr
Soraya Bertioli (Embrapa), soraya@cenargen.embrapa.br
David Bertioli (UCB), david@pos.ucb.br
Ousmane Ndoye (ISRA), ousndoye@refer.sn
Jean-Christophe Glaszmann (GCP), gcppl@cirad.fr



© GHJ Kema, Plant Research International, Wageningen, the Netherlands

Labex Europe at Wageningen University, Netherlands: the MusaForever programme

Since 2006, the Labex has enabled Wageningen University and Research Centre (WUR) and Embrapa to establish firm relations through multi-partner research projects responding to major agricultural issues. Manoel Souza, who in 2006 was the first Brazilian scientist posted to Wageningen (Biointeractions and Plant Health research unit, Plant Research International) has coordinated the 'MusaForever' programme of joint interest that involves several European (PRI-WUR, KU Leuven, CIRAD) and Brazilian partners (Embrapa, Lavras Federal University) in the genetics, genomics and biotechnology of pathosystems that are serious for the banana agroindustry: Black Sigatoka (*Mycosphaerella fijiensis*) and Panama disease (*Fusarium oxysporum* f.sp. *cubense*).

The programme is aimed at creating genome libraries and using them for the development of biotechnology tools that optimise the genetic control of the pathosystems in question. The lines of research are (a) the creation of genetic maps and genome libraries of the host and the pathogen, (b) the identification and validation of molecular markers for the diagnosis and study of intra and inter-population variability, (c) the production of genetically modified pathogens (using the gene knockout technique or that of reporter genes) for the early detection of states of biotic stress and for the study of the infection process using Multiple Image Plant Stress technique, (d) the development of *in vitro* and *in vivo* phenotyping systems, (e) molecular characterisation of host-pathogen interactions, (f) the development and/or validation of candidate genes and the technologies required to breed genetically modified bananas.

The Brazilian scientist hosted

Manoel Teixeira Souza Júnior (Embrapa) spent nearly four years at Wageningen University and Research Centre, (May 2006-March 2010) to coordinate and develop the *MusaForever* programme and the strategic alliance between Wageningen University and Research Centre and Embrapa.

Contact: manoel.souza@wur.nl

The host laboratory

**Biointeractions and
Plant Health Department**
(WUR)

80 scientific and technical staff

Director: Dr. Piet Boonekamp,
piet.boonekamp@wur.nl

www.pri.wur.nl/UK/research/Biointeractions

Scientific correspondent: Gert H.J. Kema,
gert.kema@wur.nl

MusaForever has made it possible to launch the initiatives *BioBananas Business Plan** and *SafetyFirst***, that form a platform for capacity strengthening and for multilateral technology transfer. Up to 2009, *MusaForever* had hosted eight Embrapa scientists and also scientists from Ecuador and Colombia. Two doctoral theses and a Diploma of Advanced Studies were completed in 2009.

Contacts: **Manoel Teixeira Souza Junior**, manoel.souza@wur.nl
& **Gert H.J. Kema**, gert.kema@wur.nl

*The *BioBananas Business Plan* wishes to found a biotechnology company whose aim is to use genetic engineering to design elite banana varieties with resistance to biotic stresses (Labex Europe, KUL and Secure Harvests Limited, SHL).

** *Safetyfirst* is the result of a Brazil/Netherlands alliance devoted to the detection and identification of plant pathogens in quarantine using modern molecular methods. The aim is to train Brazilian scientists and students in innovative methods for the detection and identification of crop pathogens that are of strategic importance for agriculture and for bilateral trade between the two countries.





Labex Europe: *what the French teams learned*

C. Melo © Embrapa

The quality and success of partnerships depend on the complementarity and interdependence of the respective contributions of the different partners. The investment required and the inherent difficulties of this type of operation encourage scientists to be conservative: they always work with the same people and only strong incentives (European funding for example) encourage teams to open up to new partners. The Labex has functioned as **a tool for broadening** to new synergies for the French teams. Indeed, the presence of experienced Brazilian researchers with good knowledge of the national research system in Brazil is a source of spontaneous, direct and above all high-quality information, meaning that French researchers do not have to 'look for' a partner. The Brazilian scientists hosted spontaneously suggest new projects, most of which turn out to be excellent contributions because these scientists have good knowledge of the strengths and weaknesses of those involved in both countries.

In the fields in which the teams already worked together on common questions for several years before the Labex was created, the latter has functioned as a tool **for the strengthening and diversification** of partnerships. The presence in Montpellier of a Brazilian scientist specialised in genetics and plant improvement has made it possible to increase the number of projects submitted jointly for external funding, as is the case of the projects selected by CGIAR's Generation Challenge Programme (GCP). The latter has made it possible to go more deeply into a particular area—genomics—and to cover a larger number of research subjects and various training components.

At a time of virtual communication, work in partnership, side by side in the same laboratory, creates links that cannot be forged on the internet. Seven years of experience with Embrapa is noteworthy as it forms a **complement to our usual cooperation tools**. The success of the endeavour is a clear invitation to try

it with others. International research in agriculture in the broadest sense of the term is far from taking place mainly in CGIAR international centres or in centres of excellence in the North such as that of Montpellier. Countries like Brazil, India, China, Mexico and South Africa among others have made substantial investments in research and in training scientists in the last decade or two. We share the same concerns with regard to the future of the planet. We have the same questions concerning the research to be undertaken to face the major challenges of the future. For both them and us, research is becoming increasingly a question of 'good' partnerships. The Brazilians brought us their idea, their model—the Labex—and we are very grateful to them. We have tested the idea and it has worked extremely well. We now hope that others will use it. And this is one of the ambitions of this Agropolis International Dossier: other Labexes with other partner countries!

Yves Savidan (Agropolis International, France)

The challenges of coordination

The role of coordination is fundamental in the development of the relations and synergies that are essential for the good functioning of a small group of scientists specialised in very different fields. They develop thanks to personal and technical relations of course, but also by means of the links formed between the Labex and partner institutions. The challenges are as follows for coordination:

1. Strategic vision: an overall strategy must be proposed for the activities of the Labex to have both impacts of interest to the strategic objectives of research at Embrapa and benefits for its international partners. The coordination must understand the different environments in which the Labex operates and the expectations of the various stakeholders. It must thus share a common vision and objectives with the team in spite of the diversity of the expertise and persons that form it and difficulties resulting from geographic scattering. This forms the real challenge of finding common references for the supervision of individual activities and establishing transdisciplinarity within the team.

2. Credibility: Labex Europe aims at mobilising high-level scientific and technological knowledge from both Brazil and Europe by developing cutting-edge research projects. The coordination must work with the team to maintain a high credibility level for Embrapa and the Labex in terms of scientific competence and the capacity and determination to respect technical, financial and institutional undertakings.

3. Parity: another challenge is that of positioning the Labex and Embrapa as true peers of European institutions, making an intellectual undertaking to identify and develop activities that are of strategic value for both parties, to provide joint funding for these activities and to mobilise the human resources required to complete them.

It is necessary to convince partners that the aim of the Labex is to build and strengthen cooperation and alliances between peers and not to beg for assistance (in the paternalistic sense of the word) or to purchase services.

4. Inspiration: numerous activities and research themes of interest for Embrapa and Brazil can generate benefit for European partners and these benefits are not always perceived as such immediately. A challenge for coordination is therefore that of convincing partners of the shared benefits of these collaboration projects. Conversely, when opportunities for collaborative projects with great impact arise and are not at first perceived as such, the coordinator, aided by the team, must succeed in ensuring that the need for their re-evaluation is recognised.

5. Impacts: the Labex is designed to produce different impacts. Coordination must organise activities to make them visible:

- *for partners*, the hosting of Brazilian scientists must facilitate the organising and funding of cutting-edge strategic research, enable publications in reputed journals and exchanges of scientists and students;
- *for Embrapa*, the expected impacts are the incorporation of advanced, promising themes in its research programme, high quality publications co-authored with international partners and exchanges of scientists, post-docs and students. Coordination must propose a large portfolio of varied projects for international cooperation in research and training. Embrapa also expects coordination to make substantial contributions to developing innovative models of management of research and rendering them operational.

6. Continuity: the presence of a Brazilian scientist in a European institution is a significant investment for Embrapa in financial terms and in researcher-time. The work carried

out leads him/her to cooperation relations that go beyond his/her field of expertise. The person who replaces him or her does not necessarily join the same institution or team and may have a different specialisation. This results in two challenges for coordination: (a) working with the researcher so that his/her work allows the development of the cooperation expected by Embrapa and (b) the proactive development of models of relations that enhance the durability of the partnerships established during the stay so that the return on Embrapa's investment is as good as possible.

7. Integration: Embrapa is developing Labexes in the United States, Europe and Asia (coordinated from South Korea). Embrapa and several of its partners also wish to develop triangular structures to support and cooperate with other regions of interest, such as the countries of Africa, Asia and Latin America. Some work by Labexes in advanced biology and on HLB (Huanglongbing, a serious disease of citrus) shows that this is possible. This is important value-added for the Labex—being a facilitator of partnerships between institutions and research laboratories in countries in different continents. Coordination serves to mobilise, motivate, facilitate and execute, in contact with all the players involved. The materialisation of these ambitions is perhaps the main challenge for the coordination of all those involved and of each Labex.

8. Representation and management: the challenge most expected in the coordination of the Labex is doubtless representation of Embrapa with regard to European institutions and partners and the management of the resources and institutional relations established by preceding coordinators.

Luis F. Vieira, Elisio Contini & Pedro B. Arcuri (Embrapa, Brazil)



The prospects of Labex Europe

The French point of view

© INRA

Labex Europe was inaugurated in 2002 with the seconding of four Embrapa scientists to Montpellier (France). At the end of 2009, although the number of Labex Europe scientists had increased from 4 to 6, Montpellier only hosted the coordinator as the other scientists were in France, the Netherlands and the United Kingdom, matching Embrapa's desire to diversify its partnerships in Europe. However, this is a cause for surprise among the scientific managers of the Montpellier cluster—considered to be the largest and most diversified in international agricultural research.

The first element to be taken into consideration is that the

collaborations set up during the first phase of the Labex are still running and even diversifying, as in genetics with the example of the International Advanced Biology Consortium.

The main point is doubtless that the weakness of Labex presence in

'The overall caliber of research in Montpellier in the genetics of tropical crops is better than anywhere else in the world. These skills serve as a magnet to attract interactions with overseas scientists with complementary skills.'

Jeffrey D. Bennetzen,
a leading figure in plant genomics in the United States,
where he is a member of the National Academy
of Science. Agropolis Foundation Visiting
Senior Fellow in 2008

Montpellier is justified by its success and the fact that Brazil is now the main scientific partner of the Montpellier agro-environment cluster, where one research unit in four has ongoing cooperation with one or more Brazilian research and training institutions.

Embrapa's need to develop new partnerships is thus clearly elsewhere today, with other European countries. And it is time for France to review what it has gained from a successful experience.

Indeed, for Montpellier, after seven years of Labex presence, the future lies in a search for the diversification of 'Labex-type' interactions. One of the aims of this Agropolis International Dossier on the Labex is to explain the merits of this type of interaction to other partner institutions.

Finally, the ideal would be to achieve the coexistence of different countries on a single Labex Europe platform and to enhance exchanges between them. The other idea to be promoted is that although the Labex has functioned very well in one direction, it could operate just as well in the other. In other words, entrusting French senior scientists with functions similar to those of the Brazilian Labex scientists with several major priority partners should enable the same development of bilateral cooperation as the Labex made possible with Montpellier.

Yves Savidan (Agropolis International, France)



The prospects of Labex Europe

The Brazilian point of view

After 11 years in the United States and 7 years in Europe, Labex still has some fine operations to perform. Indeed, large fields of knowledge remain to be explored and several European scientific centres have not yet had the opportunity to set up cooperation and long-term partnership mechanisms with Embrapa.

Embrapa's current strategy, in conformity with its 5th Master Plan, is that of continuing and strengthening the Labex in order to organise its presence in other European countries with recognised technical and scientific competences. Labex Europe is thus still Embrapa's priority after four successive administrations. Thus, when the Brazilian government decided to increase Embrapa's budget in the Growth Acceleration Programme (*Programa de Aceleração do Crescimento*), Labex Europe increased from four to six scientists.

These investments and strategic decisions focused on the Labex are aimed at the progressive internationalisation of Embrapa. One of the expected results is a general improvement of the quality of research through the creation

of research networks for running structuring projects. Indeed, interaction between Embrapa and European centres of excellence encouraged Brazilian scientists to be competitive and as a result they are also encouraged to master cutting-edge research methods. These researchers then become catalysts in the production of new technologies that are useful in the development of crop and livestock farming in the tropics. The setting up of international research networks also creates strong synergy with universities and the other Brazilian research institutions. Another tool consisting of the combining of different kinds of research training at the postdoctoral or other levels with the inclusion of Labex research priorities can be used to strengthen these research networks. Capacity would thus be increased and provide a better response to the expectations of a greater number of Embrapa research centres and other institutions. Thanks to coordination and its scientists, Labex Europe is contributing to bring together the central units and various decentralised parts of Embrapa and also those of all the other Brazilian institutions and European partners too.

Another prospect that can be mentioned is the increasing importance of Labex Europe's contribution on the one hand to triangular capacity-strengthening projects and mobility and on the other to technology transfer involving first of all African countries, Embrapa and European public institutions. With this in view and combined with other Embrapa cooperation tools, other Brazilian research bodies will be involved such as for example farming-livestock research systems and the universities in the various states, but also Latin American research institutes and their partners.

Finally, we hope that the strengthening of Labex Europe using the results achieved as a foundation will inspire other countries to develop similar cooperation models with Europe while creating new synergies with Labex Europe, for the greatest benefit of the countries concerned and the European partners.

**Elisio Contini, Luis F.Vieira
& Pedro B. Arcuri (Embrapa, Brazil)**

Main publications

Ana Brasileiro

Berri, S., Abbruscato, P., Faivre-Rampant, O., Brasileiro, A.C.M., Fumasoni, I., Satoh, K., Kikuchi, S., Mizzi, L., Morandini, P., Pé, M.E., Piffanelli, P. Characterization of WRKY co-regulatory networks in rice and Arabidopsis. **BMC Plant Biology (Online)**. **9**: 120, 2009.

Périn, C., Rebouillat, J., Brasileiro, A.C.M., Dievert, A., Gantet, P., Breitler, J.C., Johnson, A.A.T., Courtois, B., Ahmadi, N., Raissac, M., Luquet, D., Conte, M., This, D., Pati, P., Le, Q.H. 2007. Novel insights into the genomics of rice root adaptive development. In: Brar DS, Mackill DJ, Hardy B. (Orgs.). In **Rice Genetics V**, Manila: World Scientific Publishing and Los Banos, p. 117-141.

Elisio Contini

Contini, E., Caldas, R.de A. 2003. Escola de Competitividade. **Revista Agroanalysis**. Dec-Jan 2003: 72-73.

Contini, E., Reifschneider, F, Savidan, Y. 2003. Os Donos do Conhecimento no Mundo. **Revista Ciencia Hoje** 40(199): 97, Sociedade Brasileira para o Progresso da Ciência, SP.

Contini, E. 2003. Velha Europa, novos Alimentos. **Revista Agroanalysis**. FGV. Rio de Janeiro, Abril de 2003: 41-42.

Contini, E., Sampaio, M.J.A., Avila, A.F.D. 2003. GM Plants & Biosafety Regulations: Potential Impact on Research and Agribusiness in Brazil. **7th ICABR International Conference on Public Goods and Public Policy for Agricultural Biotechnology**. Ravello (Italie), juin 2003.

Contini, E. 2003. Agriculture Brésilienne : état des lieux et grands enjeux. Cafés-débats à Marciac. Cahier N. 29. www.agrobiosciences.org/article.php3?id_article=0778

Contini, E. 2003. O Cobiçado mercado Europeu. **Revista Agroanalysis**. **23(6)**. Setembro de 2003: 28-30.

Contini, E. 2004. Agricultura e Política Agrícola na União Européia. **Revista de Política Agrícola XIII(1, Jan / fev/ Mar)**: 30-46, MAPA. Brasília.

Contini, E. 2004. Os donos do conhecimento no mundo. **Revista Ciência Hoje**. **201(Fév)**: 43, 2004 Sociedade Brasileira para o Progresso da Ciência, SP.

Arraes, P., Vieira, L.F, Contini, E. 2005. Brasil no Coração da Ciência Mundial. **Agroanalysis (Especial: Ciência e Tecnologia)**. **25(4)**: E15-E16; Abril 2005. Fundação Getúlio Vargas, São Paulo.

Hartwich, F, Gonzalez, C., Vieira, L.F 2005. Public-Private Partnerships for Innovation-led growth in Agrichains: A Useful Tool for Development in Latin America? **ISNAR Discussion Paper 1**. IFPRI/ISNAR Division. Washington, DC. (Sept. 2005).

Heloisa Filgueiras

Alves, R.E., Filgueiras, H.A.C, Almeida, A.S., Machado, F.L.C., Bastos, M.S.R., Lima, M.A.C., Terao, D., Silva, E.O., Santos, E.C., Pereira, M.E.C., Miranda, M.R.A. 2005. Postharvest use of 1-MCP to extend storage life of melon in Brazil - current research status. **Acta Horticulturae, Leuven**. **3(682)**: 2233-2237.

Lima, M.A.C., Alves, R.E., Biscegli, C.I., Filgueiras, H.A.C. 2005. Qualidade pós-colheita de melão *Galia* submetido à modificação da atmosfera e ao 1-metilciclopropeno. **Horticultura Brasileira, Brasília**. **23(3)**: 793-798.

Filgueiras, H.A.C., Charles, F. 2007. Amélioration de la conservation des fruits et légumes frais : utilisation des atmosphères modifiées combinées au froid. **Revue Générale du Froid**. **1070 (jan-fev)**: 46-54.

Alves, R.E., Filgueiras, H.A.C., Mosca, J.L., Silva S.M. Menezes, J.B. 2008. Postharvest Physiology and Biochemistry of Some Non-Traditional American Tropical Fruits. **Acta Horticulturae. (ISHS) 768**: www.actahort.org/books/768/768_50.htm

Muniz, C.R., Soares, A.A., Filgueiras, H.A.C., Dussan-Sarria, S., Matias, M.L., Silva, E.O. 2008. Effect of Postharvest Mechanical Injury on Microstructure and Quality of Cantaloupe Melons. **Acta Horticulturae.768**: 323 - 328. www.actahort.org/books/768/768_50.htm

Paiva, W.O., Filgueiras, H.A.C., Mosca, J.L., Lima, C.R.M., Mesquita, J.B.R., Freitas, F.W.A. Caitano, R.F. 2007. Improved quality and nutritional value of melon. **Acta Hort. (ISHS) 760**: 363-366. www.actahort.org/books/760/760_50.htm

Salman, A., Goupil, P, Filgueiras, H., Charles, F, Ledoigt, G., Sallanon, H. 2008. Controlled atmosphere and heat shock affect PAL1 and HSP90 mRNA accumulation in fresh-cut endive (*Cichorium intybus L.*). **European Food Research and Technology**. **227**: 721-726.

Salman, A., Filgueiras, H., Cristescu, S., Lopez-Lauri, F, Harren, E, Sallanon, H. 2009. Inhibition of wound-induced ethylene does not prevent red discoloration in fresh-cut endive (*Cichorium intybus L.*). **European Food Research and Technology**. **228**: 651-657.

Djioua, T., Charles, F, Lopez-Lauri, F, Filgueiras, H.A.C., Coudret, A., Ducamp-Collin, M., Sallanon, H. 2009. Improving the storage of minimally processed mangoes (*Mangifera indica L.*) by hot water treatments. **Postharvest Biology and Technology**. **52**: 221 - 226.

Regina Lago

Barouh, N., Piombo, G., Goli, T. Barea, B., Pina, M., Lago, R., Villeneuve, P. 2008. Enzymatic Production of Conjugated Linoleic Acids (CLA) monoacylglycerols from dehydrated isomerized castor bean oil. **Journal of Food Lipids**. 15: 13-27.

Damaso, Mônica C.T., Passianoto, M.A., Freitas, Sidinéa C., Freire, D.M.G., Lago, R.C.A., Couri, S. 2008. Utilization of agro industrial residues for lipase production by Solid-state fermentation. **Brazilian Journal of Microbiology**. 39: 1-6.

Cavalcanti, E.D.C., Maciel, F.M., Villeneuve, P., Lago, R.C.A., Machado, O.L.T., Freire, D.M.G. 2007. Acetone powder from dormant seeds of *Ricinus communis* L. **Applied Biochemistry and Biotechnology**. 136-140: 57-66.

Villeneuve, P., Barouh, N., Barea, B., Piombo, G., Lago, R., Figueroa-Espinoza, M.C.F Turon, Pina, M. 2007. Chemoenzymatic Synthesis of Structured Triacylglycerols with Conjugated Linoleic Acid (CLA) in Central Position. **Food Chemistry**. 100: 1443-1452.

Cambon, E., Gouzou, E., Pina, M., Barea, B., Barouh, N., Lago, R., Ruales, J., Tsai, S.W., Villeneuve, P. 2006. Comparison of lipase activity in hydrolysis and acyl transfer reactions of two latex plant extracts from Babaco (*Vasconcellea x Heilbornii* cv.) and *Plumeria rubra*: Effect of aqueous microenvironment. **Journal of Agricultural Food Chemistry**. 54(7): 2726-2731.

Pina, M., Severino, L. S., Beltrão, N.E.M., Villeneuve, P., Lago, R. 2005. De nouvelles voies de valorisation pour re-dynamiser la filière ricin au Brésil. **Cahiers de l'Agriculture**. 14(1): 169-171. Edition spéciale France-Brésil.

Villeneuve, P., Turon, F., Caro, Y., Escoffier, R., Barea, B., Barouh, N., Lago, R., Piombo, G.; Pina, 2005. M. Lipase-catalyzed synthesis of canola phytosterols oleate esters as cholesterol lowering agents. **Enz. Microb. Technol.** 37: 150-155.

Villeneuve, P., Lago, R., Barouh, N., Barea, B., Piombo, G., Dupré, J-Y., Le Guillou, A., Pina, M. 2005. Production of Conjugated Linoleic Acids (CLA) Isomers by Dehydration and Isomerisation of Castor Bean Oil. **Journal of the American Oil Chemical Society**. 82(4): 261-269.

Brevet (Dépôt d'un privilège d'Invention)

Aranda, D.A.G., Antunes, O.A.C., Freire, D.M.G., Lago, R.C.A., Cavalcanti, E.A.C., Souza, J.S., Production des acides gras catalysée par lipases non purifiées de semences ou fruits végétaux pour l'estérification ensuite par la catalyse acide. Produção de ácidos graxos catalisada por lipases não purificadas de sementes ou frutos vegetais para subsequente esterificação por catálise ácida. PI 0603824-7, 19/09/2006

José Madeira

Madeira Netto, J da S., Robbez-Masson, J.M., Martins, E. 2006. Visible-NIR hyperspectral imagery for discriminating soil types in the La Payne watershed (France). In: P. Lagacherie, A.B. Mc Bratney & M. Voltz, Eds, **Digital Soil Mapping: an Introductory Perspective**, Elsevier.

Lagacherie, P, Baret F, Feret, J.-B., Madeira Netto, J., Robbez-Masson, J.-M., Estimation of soil clay and calcium carbonate using laboratory, field and airborne hyperspectral measurements. **Remote Sensing of Environment**. 112 (3) (2008): 825-835.

Bainville, S., Affholder, F, Figuié, M., Madeira Netto, J. da S. Les transformations de l'agriculture familiale de la commune de Silvânia : une petite révolution agricole dans les cerrados brésiliens. **Cahiers Agricultures**. 14(1): 103-110. 2005.

Affholder F, Scopel E., Madeira Neto J. Capillon A. 2003. Diagnosis of the productivity gap using a crop model. Methodology and case study of small scale maize production in central Brazil. **Agronomie**. 23: 305-325.

Affholder, F; Assad, E.D.; Bonnal, P, Silva, F.A.M. da, Forest, E, Madeira Netto, J., Scopel, E., Corbeels, M. 2006. Risques de stress hydrique sur les cultures dans les cerrados brésiliens du zonage régional à l'analyse des risques à l'échelle des exploitations familiales. **Cahiers Agricultures**. 15(5): 433-439.

Geraldo Stachetti Rodrigues

Rodrigues, G.S., Rodrigues, I.A., Buschinelli, C.C. De A., Ligo, M.A., Pires, A.M., Frighetto, R.T., Irias, L.J.M. 2007. Socio-environmental impact assessment of oleaginous crops for biodiesel production in Brazil. **Journal of Technology Management and Innovation**. 2(2): 46-66. www.jotmi.org/index.php/GT/article/view/art45/81

Rodrigues, G.S., Buschinelli, C.C. de A., Muniz, L.R. 2008. Ostrich farming and environmental management tools: an overview. **Australian Journal of Experimental Agriculture**. 48: 1308-1313.

Barros, I. de, Blazy, J.M., Rodrigues, G.S., Tournebize, R., Cinna, J.P. 2009. Emergy evaluation and economic performance of banana cropping systems in Guadeloupe (French West Indies). **Agriculture, Ecosystems and Environment**. 129: 437-449.

Rodrigues, G.S., Rodrigues, I.A., Buschinelli, C.C. de A, Ligo, M.A., Pires, A.M. 2009. Local Productive Arrangements for Biodiesel Production in Brazil - Environmental Assessment of Small-holder's Integrated Oleaginous Crops Management. **Journal of Agriculture and Rural Development in the Tropics and Subtropics**. 110(1): 61-73.

Rodrigues, G.S., Barros, I. de, Ehabe, E.E., Sama-Lang, P, Enjalric, F 2009. Integrated indicators for performance assessment of traditional agroforestry systems in South West Cameroon. **Agroforestry Systems**. 77(1): 9-22.

Rodrigues, G.S., Rodrigues, I., Buschinelli, C.C. de A., de Barros, I. 2009. Integrated farm sustainability assessment for the environmental management of rural activities. Environmental Impact Assessment Review, doi:10.1016/j.eiar.2009.10.002.

Rodrigues, G.S., Rodrigues, I.A., Buschinelli, C.C. de A., Ligo, M.A., Pires, A.M., Frighetto, R.T., Irias, L.J.M. 2007. Socio-environmental impact assessment of oleaginous crops for biodiesel production in Brazil. **Journal of Technology Management and Innovation**. 2(2): 46-66.

Rodrigues, G.S., Buschinelli, C.C. de A., Rodrigues, I.A., Medeiros, C.B. 2007. A collaborative research initiative for the environmental management of struthioculture. **Brazilian Journal of Poultry Sciences**. 9(4): 221-228.

Moreira-Viñas, A., Rodrigues, G.S. La Evaluación del Impacto Ambiental de Actividades Rurales (EIAR) en el Proyecto de Producción Responsable. **Anuario OPYPA: 265-277, 2007.**

Santos, M.R.C. dos, Rodrigues, G.S. 2008. Socio-environmental and sustainability assessment for technology innovations in pectens production in Brazil. **Journal of Technology Management and Innovation**. 3(3): 123-128.

Rodrigues, G.S., Buschinelli, C.C. de A., Santana, D.P., da Silva, A.G., Pastrello, B.M.C. 2008. Avaliação ambiental de práticas de manejo sítio específico aplicadas à produção de grãos na região de Rio Verde (GO). **Revista Brasileira de Agrociência**. 14(3).

Rodrigues, G.S. 2009. Indicadores de sustentabilidade, avaliação de impactos e gestão ambiental de atividades rurais. **Informe Agropecuário, Belo Horizonte**. 30(252): 7-16, set./out.

Manoel Souza

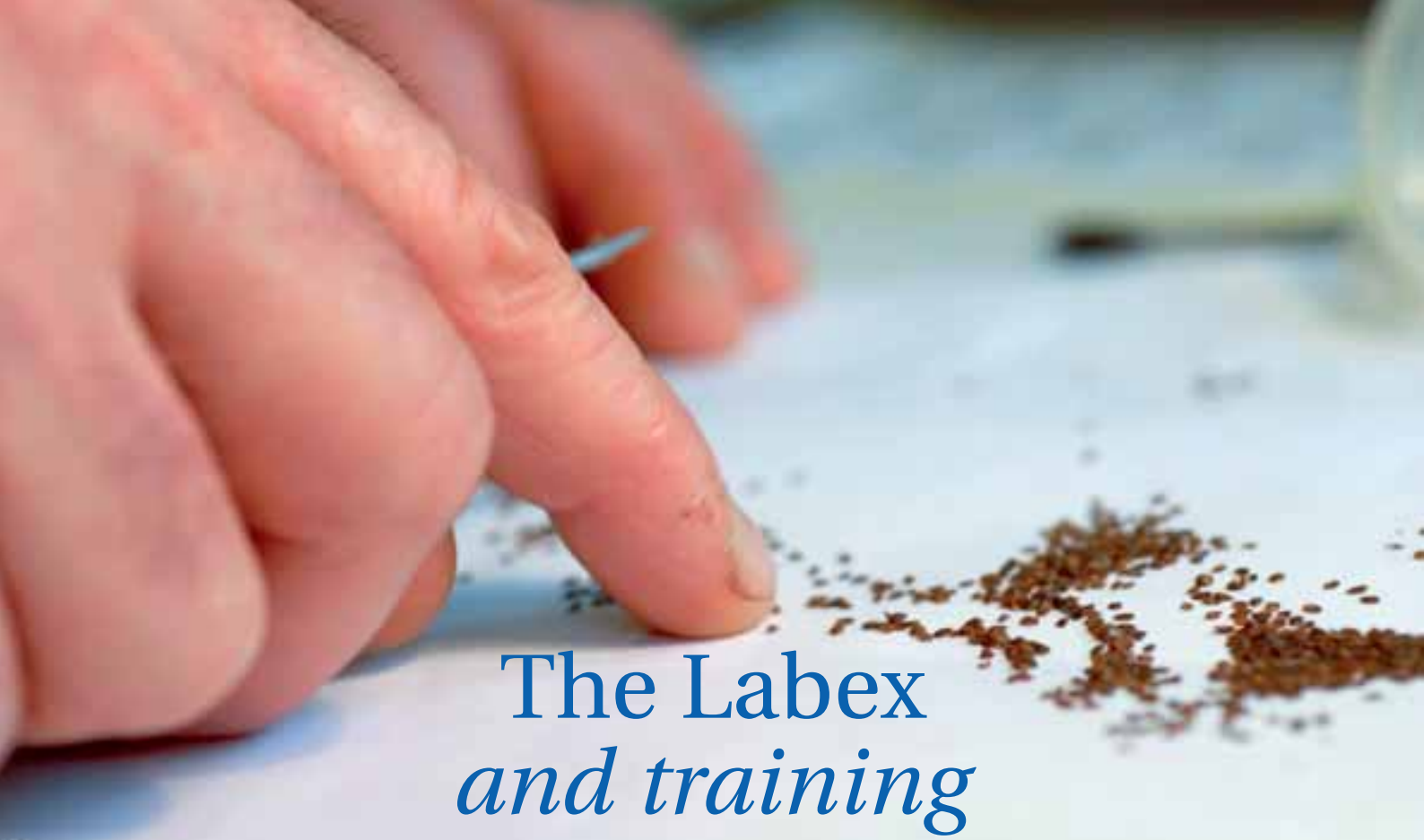
Lescot, M., Piffanelli, P, Ciampi, A.Y., Silva, F.R., Santos, C.R., Dhont, A., Vilarinhos, A., Pappas Junior, G., Souza Junior, M.T., Miller, R.N.G. Insights into the Musa genome: syntenic relationships between rice and Musa species. **BMC Genomics**. 9: 58, 2008.

Miller, R.N.G., Bertioli, D., Baurens, F.C., Santos, C.R., Alves, P.C.M., Martins, N.F, Togawa, R., Souza Junior, M.T., Pappas Junior, G. Analysis of non-TIR NBS-LRR resistance gene analogs in *Musa acuminata* Colla: Isolation, RFLP marker development, and physical mapping. **BMC Plant Biology (Online)**. 30: 15, 2008.

Khroyratty, S.S.S., Souza Junior, M.T., Jaufeerally-Fakim, Y. Structural analysis of catalase from two Musa accessions, FHIA18 and Williams, and from *Ravenala madagascariensis*. **Silico Biology (Online)**. 8: 0032, 2008.

Capdeville, G., Souza Junior, M.T., Szinay, D., Diniz, L.E.C., Wijnker, E., Swennen, R., Kema, G, de Jong, J.H. The potential of high-resolution BAC-FISH in banana breeding. **Euphytica (Wageningen)**. 84: 6, 2008.

Roux, N., Baurens, F.C., Dolezel, J., Hribova, E., Heslop-Harrison, P, Town, C., Sasaki, T., Matsumoto, T., Aert, R., Remy, S., Souza Junior, M.T., Lagoda, P. Genomics of Banana and Plantain (*Musa* spp.), Major Staple Crops in the Tropics. In: P.H. Moore, R. Ming. (Org.). **Genomics of Tropical Crop Plants**. 1 ed.: Springer, 2008, v. 1, p. 83-111.



The Labex *and training*

© Inra

Agropolis International provides a full range of education and training through member institutions consisting of universities, engineering schools and institutions specialised in vocational training. This totals more than 80 diploma and degree courses (2 to 8 years of higher education: technician, graduate engineer, degree, master's degree, doctorate) and about a hundred training modules (pre-existing or *à la carte*).

The Labex scientists have a twofold mission of research and scouting. They do not have the role of participating in teaching provided by the European partner institutions. However, their presence in leading research teams sometimes attracts and facilitates visits to these research teams by numerous young Brazilian researchers. One can therefore talk in terms **a contribution to training via research**. The Labex scientists provide joint supervision for master's or doctoral students and numerous short-stay trainees.

C. Soudais © Agropolis International



C. Soudais © Agropolis International



C. Soudais © Agropolis International

The Euraxess Languedoc- Roussillon Services Centre:

Information and services for guest scientists and their host team

Set up by the European Commission in 2004, mobility centres (that became Euraxess Services Centres in 2008) have Ministry of Research and Higher Education approval.

Mission

The purpose of the Euraxess Languedoc-Roussillon Services Centre is to facilitate preparations for the stay and installation of doctoral students, postdocs, scientists and lecturers hosted by higher education and research establishments.

Services

The Euraxess Services Centre is at the disposal of doctoral students, research scientists and guest lecturers and their host laboratories and departments:

- 'Guest scientists and professors' guide (in French and English) consultable online at: www.agropolis.fr/pratique
- Reception of the public (by appointment)
- Provision of a welcome kit for new arrivals. This consists of tourist literature about the city, the department and the region, cultural facilities, associations, etc.
- Registration as a Guest Researcher (partnership with the Kastler foundation and access to the benefits attached)
- 'Scientific Residence Permit' facility with the *Pôle de recherche et d'Enseignement Supérieur – Université Montpellier Sud de France (PRES-UMSF)*
- Administrative assistance for questions of insurance, banking, family allowances
- Information about accommodation
- Help in enrolling children at schools
- Organisation of French classes
- Cultural activities (cultural programme, organised visits, invitations, etc.)

Contact: Claudine Soudais, soudais@agropolis.fr

Further information available at: www.agropolis.fr/pratique

'The Euraxess reception centre has contributed to hosting 9 Brazilian research scientists and several doctoral students and trainees.'

Pedro Arcuri

Acronyms and *abbreviations*

ADRAO	<i>Centre du riz pour l'Afrique, Benin</i>
BIOS	<i>Département Systèmes Biologiques, France</i>
CAPES	<i>Coordination pour le Perfectionnement du Personnel de l'Enseignement Supérieur, French Ministry of Education</i>
CATIE	<i>Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica</i>
CERAAS	<i>Centre d'Étude Régional pour l'Amélioration de l'Adaptation à la Sécheresse, Senegal</i>
CGIAR	<i>Consultative Group on International Agricultural Research</i>
CIAT	<i>International Center for Tropical Agriculture, Colombia</i>
CIBA	<i>Consortium International en Biologie Avancée (International Advanced Biology Consortium)</i>
CiCy	<i>Centro de Investigación Científica de Yucatán, Mexico</i>
CIMMYT	<i>International Maize and Wheat Improvement Center, Mexico</i>
CIRAD	<i>Agricultural Research for Development, France</i>
CNRS	<i>Centre National de la Recherche Scientifique, France</i>
COFECUB	<i>Comité Français d'Évaluation de la Coopération Universitaire et Scientifique avec le Brésil</i>
CSIRO	<i>Commonwealth Scientific and Industrial Research Organisation, Australia</i>
DAP	<i>UMR Développement et Amélioration des Plantes, France</i>
Embrapa	<i>Empresa Brasileira de Pesquisa Agropecuária, Brazil</i>
Fedearroz	<i>Federación de productores de arroz, Colombia</i>
GCP	<i>Generation Challenge Programme</i>
HLB	<i>Huanglongbing</i>
IGH	<i>Institute of Human Genetics, France</i>
IAPAR	<i>Instituto Agronômico do Paraná</i>
IATE	<i>UMR Ingénierie des Agropolymères et Technologies Émergentes, France</i>
IBONE	<i>Instituto de Botánica del Nordeste, Argentina</i>
ICRISAT	<i>International Crops Research Institute for the Semi-Arid Tropics, India</i>
INRA	<i>Institut National de la Recherche Agronomique, France</i>
INRAN	<i>Institut National de Recherches Agronomiques du Niger</i>
IRD	<i>Institut de recherche pour le développement, France</i>
IRRI	<i>International Rice Research Institute, Philippines</i>
ISRA	<i>Institut sénégalais de recherches agricoles</i>
JIC	<i>John Innes Centre, United Kingdom</i>
KU Leuven	<i>Catholic University of Leuven, Belgium</i>
LISAH	<i>Laboratoire d'étude des Interactions Sol - Agrosystème - Hydrosystème, France</i>
NCGR	<i>National Center for Genome Resources, United States</i>
NIAS	<i>National Institute of Agrobiological Sciences, Japan</i>
PIA	<i>UMR Polymorphismes d'Intérêt Agronomique</i>
PIC	<i>Projet d'intérêt commun</i>
PRES-UMSF	<i>Pôle de recherche et d'Enseignement Supérieur – Université Montpellier Sud de France</i>
PRI	<i>Plant Research International, Wageningen, Netherlands</i>
PROINPA	<i>Fundación, Promoción e Investigación de Productos Andinos, Bolivia</i>
UAPV	<i>Université d'Avignon et des Pays de Vaucluse, France</i>
UC Davis	<i>University of California Davis, United States</i>
UCB	<i>Universidade Católica de Brasília, Brazil</i>
UM2	<i>Université de Montpellier 2, France</i>
UMR	<i>Unité mixte de recherche</i>
UR	<i>Unité de recherche</i>
UR2PI	<i>Unité de Recherche sur la Productivité des Plantations Industrielles, Congo</i>
USDA-ARS	<i>United States Department of Agriculture-Agricultural Research Service</i>
WUR	<i>Wageningen University and Research Centre, Netherlands</i>

Published with support from
Agropolis Foundation and Embrapa.

Agropolis International members and partners
involved in this publication

Members

CIRAD
INRA
IRD
Montpellier SupAgro
UM2

Partners

Université d'Avignon et des Pays de Vaucluse
Wageningen University and Research Centre,
Rothamsted Research Institute

Director of the publication: Bernard Hubert

Execution: Isabelle Amsallem (Agropolis Productions)

Scientific coordinators: Yves Savidan, Pedro B. Arcuri

Iconography: Isabelle Amsallem, Olivier Piau,
Nathalie Villeméjeanne

Contributions by: Pedro B. Arcuri, Marc Berthouly,
David Bertioli, Soraya Bertioli, Ana Cristina Miranda Brasileiro,
Elisio Contini, Heloisa Filgueiras, Daniel Foncéka,
Cécile Fontana, Pascal Gantet, Jean-Christophe Glaszmann,
Emmanuel Guiderdoni, Stéphane Guilbert, Gert H.J. Kema,
Clara Lachgar, Regina Lago, José da Silva Madeira Netto,
Ousmane Ndoye, Christophe Nguyen-Thé, Oliver Oliveros,
Jean-Francois Rami, Michel Salas, Huguette Sallanon,
Yves Savidan, Claudine Soudais, Manoel Teixeira Souza Junior,
Geraldo Stachetti Rodrigues, Luis F Vieira, Pierre Villeneuve,
Marc Voltz, Anne-Lucie Wack.

Translation: Simon Barnard

Photo credits:

INRA, IRD (Indigo)
and all contributors to this Dossier

Design, layout and computer graphics:

Olivier Piau (Agropolis Productions)
agropolisproductions@orange.fr

Printed by: Les Petites Affiches (Montpellier, France)

ISSN: 1628-4240 • Copyright: February 2010



Also available in
Portuguese and French

On the cover: Emasculating a groundnut flower
during manual crossing for backcross purposes
© Hodo-Abalo Tossim, Daniel Foncéka.
Inset: Plantains on the market in Manaus, Brazil.
M. Lourd © IRD

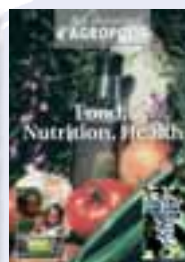
The information presented in this dossier
was valid on 03/02/2010



Already published in the same collection



May 2001
24 pages
French / English



September 2005
60 pages
French / English



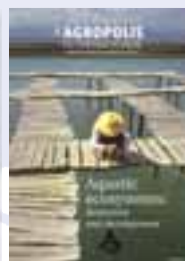
November 2005
56 pages
French / English



March 2007
60 pages
French / English



November 2007
64 pages
French / English



November 2007
68 pages
French / English



December 2008
68 pages
French / English



June 2009
52 pages
French / English



February 2010
68 pages
French / English

— Les dossiers d'Agropolis International —

The Dossiers d'Agropolis International series is a deliverable of Agropolis International that is produced within the scope of its mission to promote expertise of the scientific community.

Each Dossier is devoted to a broad scientific theme, and includes a clear overview that is a ready reference for all laboratories and teams associated with Agropolis International that are conducting research on the target theme.

This series is meant to boost the awareness of our different partners on the expertise and potential available within our scientific community, but also to facilitate contacts for the development of scientific and technical cooperation and exchange.



AGROPOLIS
INTERNATIONAL

Avenue Agropolis
F-34394 Montpellier CEDEX 5
France

Tel.: +33 (0)4 67 04 75 75
Fax: +33 (0)4 67 04 75 99

agropolis@agropolis.fr
www.agropolis.org