

Following consultations with partners and stakeholders, the International Plant Genetic Resources Institute (IPGRI), of which INIBAP is a part, implemented in 2005 a new organizational structure in which the institute's work on crops of great significance for the livelihoods of small-scale farmers, namely banana, coconut and cacao, are grouped under the 'Commodities for Livelihoods' programme. The new structure reflects a shift of emphasis from the conservation of crop genetic resources to improving the well-being of people through the deployment of agricultural biodiversity. Helping people benefit from biodiversity is expected to result in genetic resources being conserved for future use.

INIBAP's agenda now falls within two thematic areas:

- Conserving, understanding and improving *Musa* biodiversity
- Using *Musa* biodiversity to improve rural livelihoods

## CONSERVING, UNDERSTANDING AND IMPROVING *MUSA* BIODIVERSITY

Activities focus on the effective conservation and characterization of *Musa* genetic diversity in order to increase its use and address problems posed by the plant's biology. As a parthenocarpic, vegetatively propagated polyploid crop, *Musa* is hard to improve by conventional means. Its cultivated varieties have a very narrow genetic base and even current breeding efforts are using only a small proportion of the existing diversity. Meanwhile, research on *Musa* is chronically under-funded despite its importance as a food crop. Genebanks are also poorly-resourced and not adequately linked to global efforts that could facilitate the more effective use of *Musa* diversity.

### Conservation of *Musa* genetic resources

Representative materials from banana-growing regions are maintained in a state-of-the-art germplasm collection managed by INIBAP at the ITC<sup>1</sup> in KULeuven with the support of the DGDC of Belgium. Most of the collection is held 'in trust', under the auspices of the FAO for the benefit of the international community and is made publicly available through material transfer agreements. Research is carried out to eliminate pathogens and accessions are indexed to ensure that only disease-free material is distributed to users world-wide. Accessions are currently being rejuvenated, checked for trueness-to-type and replaced in tissue culture while a duplicate set is cryopreserved for secure, long-term storage. Some 30% of the *Musa* genebank is currently cryopreserved and half of the collection has been rejuvenated. About 70% of the

rejuvenated accessions have been sent for verification in the field of their trueness-to-type.

In the Democratic Republic of Congo (DR-Congo), 20 plantain cultivars were collected and planted in the field collection of the University of Kisangani. A collecting mission in Tanzania identified 16 potentially new East African highland banana cultivars.

To place the conservation of banana diversity on a secure, long-term footing, a Global Conservation Strategy for *Musa* is being developed in the framework of the Global Crop Diversity Trust, the FAO-CGIAR-initiated endowment fund set up to support crops on Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture. Information has been gathered from 45 collections while experts and regional banana research networks have been consulted to establish a 'road map' for improving and rationalizing conservation of *Musa* on a global scale.

### Understanding of *Musa* genetic resources

INIBAP's *Musa* Germplasm Information System (MGIS) provides access to information on accessions in various collections, including phenotypic and molecular characterization data. A major upgrade of MGIS, to include more illustrations and a wider range of information, as well as increasing its ease-of-use, is nearing completion under a CGIAR-wide genebank upgrade project, funded by the World Bank.

The Global *Musa* Genomics Consortium brings together expertise from 27 publicly funded institutions in 20 countries. As well as encouraging close collaboration, the Consortium enables research resources to be shared, including sequence data and enabling technologies. Members of the Consortium are active participants in the Generation Challenge Programme (GCP), which is supporting the development of a common set of markers for better characterization of banana genetic resources, as well as comparative genomics studies between banana and rice. In 2005, 304 accessions representing the range of *Musa* diversity were characterized using molecular markers (24 SSRs). Four types of markers/methods (SSR, IRAP, CpDNA, DArT) were used and compared in characterizing 48 accessions considered as the 'mini-core' collection. (For more information, consult the website at [www.musagenomics.org](http://www.musagenomics.org))

The *Musa* Genome Resource Centre, hosted by the IEB, in the Czech Republic, provides DNA libraries, individual DNA clones, markers for molecular cytogenetics and high-density colony filters to the members of the Consortium. (For more information, consult the website at [www.musagenomics.org/index.php?page=resources](http://www.musagenomics.org/index.php?page=resources))

The International *Mycosphaerella* Genomics Consortium brings together seven partners from seven countries who have a shared research interest in *Mycosphaerella* species. In 2005, the Joint

<sup>1</sup> See page 32 for acronyms and abbreviations in full.

Genome Initiative of the US Department of Energy announced the sequencing of the *Mycosphaerella fijiensis* genome.

### Genetic improvement of *Musa*

Support to *Musa* breeding is provided by the Pro*Musa* network and its specialist working groups. The Pro*Musa* working group coordinators proposed a new structure and strategy for the network, focusing on developing global public goods based on using *Musa* diversity more effectively in the areas of crop improvement, protection and production. Trials for the third phase of the International *Musa* Testing Programme (IMTP) are being carried out

in 25 countries. Complete datasets have been received from two test sites and progress reports from several other sites. An IMTP working group has been initiated to coordinate data collection and analysis.

Protocols for evaluating carotenes (Vitamin A precursors) and micronutrients (especially iron and zinc) in banana and plantain were developed under a grant from the HarvestPlus Challenge Programme. These will be used initially to identify higher-nutrient plantains and cooking bananas among those available in West Africa, with a view to promoting their wider use by sectors of the population vulnerable to malnutrition.

Projects	Donors	Partners
Rehabilitation of CGIAR global public goods assets	World Bank	BPI, ESPOL, FHIA, KULeuven, University of Gembloux
Improving the management of banana and plantain genetic resources for Africa	Gatsby Charitable Foundation	CARBAP, Infruitec-Nietvoorbij, KULeuven, Maruku Agricultural Station, NARO, University of Kisangani
Conservation and improvement of <i>Musa</i> germplasm	DGDC	KULeuven
<i>Musa</i> microarray platform	Austria	ARC, IAEA, IEB
Support distribution of reference germplasm	GCP (sub-programme 1: Genetic diversity)	CIRAD, IEB
Genotyping of composite germplasm set, <i>Musa</i>	GCP (sub-programme 1: Genetic diversity)	ARC, CARBAP, CIRAD, IITA, University of Leicester, IAEA
Validation of DArT as a platform for whole genome profiling in orphan crops	GCP (sub-programme 1: Genetic diversity)	DArT, CIRAD
Population structure, phenotypic information and association studies in long-generation crops	GCP (sub-programme 1: Genetic diversity)	CARBAP, CIRAD
<i>Musa</i> genome frame-map construction and connection with the rice sequence	GCP (sub-programme 2: Comparative genomics)	CIRAD, EMBRAPA, IEB, NIAS, University of Leicester
Validation of conserved orthologous markers	GCP (sub-programme 2: Comparative genomics)	University of Leicester
Exploring the structure of the <i>Musa</i> genome	USAID linkage funds	TIGR
Evaluating the potential of banana and plantain diversity to contribute to improved human nutrition	HarvestPlus Challenge Programme	CARBAP, IITA, KULeuven
Novel approaches to the improvement of East African highland banana varieties	Uganda with Belgium, Rockefeller Foundation, USAID	CIRAD, FABI, IITA, JIC, KULeuven, NARO, University of Pretoria, Makerere University

## USING *MUSA* BIODIVERSITY TO IMPROVE LIVELIHOODS

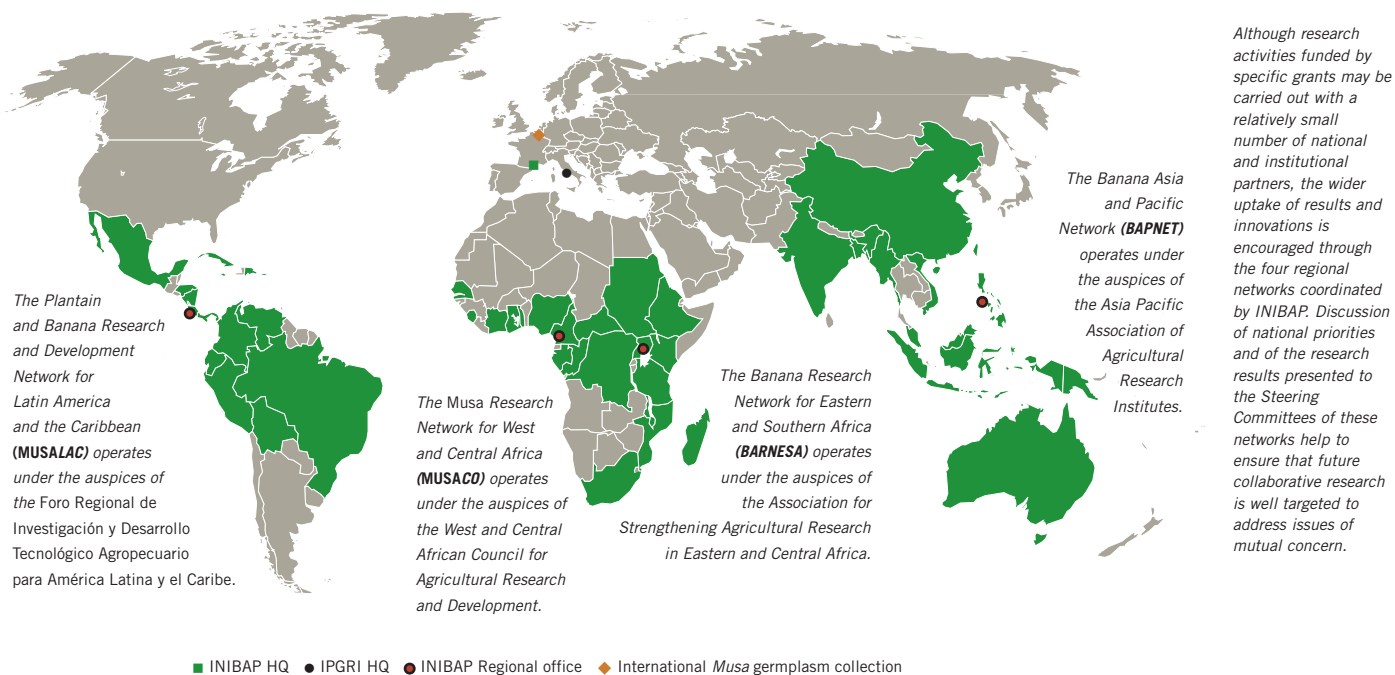
Rural communities in tropical and subtropical regions, including those dependent on banana-based systems, face challenges of resource degradation, poverty, climatic change, globalizing markets, changing consumer preferences and costly external inputs. The ability of people to better manage the diversity in such systems, so as to improve their food security and increase their income depends on being able to enhance their skills in agro-ecological and business management as well as having access to useful genetic materials and new production and post-harvest technologies. In order to succeed, they need ready access to sources of such new information and skills – which are usually provided by field organizations, private sector services, educational institutes and mass media. This thematic area of INIBAP's work is directed mainly towards the groups, organizations and institutions that are involved in improving rural well-being through the use of banana and plantain diversity.

Targeted research topics include diagnosing soil, root and plant health, managing pests and diseases (such as fusarium, bacterial wilts, banana

bunchy top virus and leaf spot diseases), and managing crop and crop-associated diversity to improve the productivity and sustainability of high- and low-input systems. In Central America, partners in a FONTAGRO-funded project have intensively sampled 40 fields in four countries and are analysing the data with a view to developing indicators of soil and root health. In the same region, botanical extracts are being evaluated on a semi-commercial scale as an option for black Sigatoka management.

The over-riding concern in East and Central Africa is the spreading epidemic of banana *Xanthomonas* wilt. As well as carrying out a study, funded by DFID, to evaluate the effects of the wilt epidemic on rural livelihoods, and another study, funded by IDRC, to see how farmers are coping with this challenge, INIBAP's team in Uganda helped to mobilise expertise from Latin America and Asia, where similar bacterial diseases are already well established; the experts, convened with the support of FAO and other international organizations, proposed strategies to mitigate the impact of the new disease outbreak.

Deploying improved varieties and improving systems for multiplying planting material are



regarded as key elements in addressing several disease problems, as well as other challenges faced by farming communities. Experiences in this area are most developed in Asia where a project funded by the Philippines government has mobilised private- and public-sector partners, with the technical support of INIBAP, to respond to an epidemic of BBTv. Such strategies will also be amongst those deployed in a new project being launched to revitalise the banana sector in Central Africa (specifically Rwanda, Burundi and eastern provinces of the Democratic Republic of Congo), with the support of DGDC and in collaboration with IITA and CIAT-TSBF.

If banana farmers and their communities are to derive maximum benefit from more productive new varieties and the diversity of traditional ones,

they will need to link up with various stakeholders who are involved in adding value to *Musa* post-harvest, through diverse processing and marketing opportunities. Case studies on banana-based post-harvest enterprise development were conducted by partners in 9 countries and discussed at a workshop in the Philippines, with a view to distilling common lessons that can be applied elsewhere.

A continuing concern of INIBAP is to ensure that the products of research and development experiences are made available, in the appropriate form, to as wide a range of stakeholders as possible in the banana sector. Relevant information is disseminated through regional newsletters, question-and-answer services and increasingly as web-based products that can be downloaded and printed locally by would-be users.

Projects	Donors	Partners
Technological innovations to improve soil health and quality in banana plantations of Latin America and the Caribbean	FONTAGRO, IDB, CGIAR	CATIE, CEDAF, CORBANA, IDIAF, IDIAP, INIA, University of Bonn
Development of biological pest control products	FONTAGRO	IDIAF, INIA
Rehabilitation of banana industry devastated by BBTv in northern Philippines	DA-BAR	CAVSU, DA-BAR, DMMSU, ISPSC, MMSU, PCARRD
Developing a coherent regional response to BXW	FAO, IDRC	MAAIF, NARO
Assessing the impact of BXW on household livelihoods	DFID	EG Consulting, IFPRI, MAAIF, Makerere University, NARO, NIDA,
Community coping mechanisms in response to BXW	IDRC	Ssemwanga Group Ltd.
Development of BSV and CMV management strategies	STC-Peru	INIEA
Nematode studies	VVOB	CARBAP, IITA, IPB, NARO, Makerere University
Enset and banana project in Ethiopia	VVOB	SARI
Farmer-participatory evaluation and dissemination of improved <i>Musa</i> germplasm	CFC	CIRAD, FHIA, FUNDAGRO, IICA, INERA, IRAG, NARO, UNAN-Leon
Increasing productivity and market opportunities for banana and plantain	USAID TARGET	ADRA, AFRICARE, ARDI, Cameroon Gatsby Trust, CARBAP, CARE, Casa do Gaiatus, CSIR, FAIDA, INIA, Mozambique Ministry of Works, UEM, WV Ghana
Building impact pathways for improving livelihoods in <i>Musa</i> -based systems in Central Africa	DGDC	AgroBiotec, CIAT-TSBF, INERA, IRAZ, ISABU, ISAR, KULEuven, Université Catholique du Graben, WV Rwanda
Utilisation of <i>Musa</i> biodiversity to improve livelihoods in East Africa	IDRC	ARDI, FADECO, Farmer Associations from Bisheshe, Chanika, Ibwera, Bushenyi and Masaka, Makerere University, NARO, Ssemwanga Group Ltd, Uganda Biodiversity Network
Cultivar evaluation and deployment in Asia-Pacific region through the NMRDCs	EU, National Programmes	BAPNET member countries
Diversifying market opportunities (case studies and workshop)	Rockefeller and CFC	ARDI, MARDI, MoA, NRCB, NIHORT, PCARRD, UNAN-Leon

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