IITA

Annual Report 2008/09

www.iita.org

International mailing address:
IITA
Carolyn House, 26 Dingwall Road
Croydon, CR9 3EE, UK

ISSN 0331 4340

Cover design, typesetting and layout by IITA

Cover picture: Farmers harvesting soybean using a mechanized thresher in Ruace, Mozambique.
Photo by Sicco Kolijn, IITA

IITA
Annual Report 2008/09

Vision

To be Africa's leading research partner in finding solutions for hunger and poverty.

Photo by Sicco Kolijn, IITA

Who we are

Africa has complex problems that plague agriculture and people's lives. We develop agricultural solutions with our partners to tackle hunger and poverty. Our award winning research for development (R4D) is based on focused, authoritative thinking anchored on the development needs of sub-Saharan Africa. We work with partners in Africa and beyond to reduce producer and consumer risks, enhance crop quality and productivity, and generate wealth from agriculture. IITA is an international non-profit R4D organization established in 1967, governed by a Board of Trustees, and supported primarily by the CGIAR.

Contents

Photo by Sicco Kuijn, IITA

Introduction

Mechanically grinding cassava roots and leaves to make silage at Umbeluze Research Station, Mozambique.

Delivering solutions, meeting Africa's challenges

The year 2008 had been challenging for us, as with most other organizations, in light of the global financial meltdown and the food price crisis. However, through our research-for-development (R4D) approach and with the help of partners, we delivered appropriate solutions to the food and agricultural challenges of Africa.

Our achievements in sub-Saharan Africa this year are summarized below. For detailed descriptions of these highlights, please refer to the "Research Highlights" section of this report:

We helped safeguard African crop genetic resources by sending and depositing more than 7000 unique seed samples of domesticated and wild cowpea, maize, soybean, and Bambara groundnut from 36 African nations in the Svalbard Global Seed Vault -- as a repository of last resort for humanity's agricultural heritage.

In northern Nigeria, we helped women by linking the use of our improved dual-purpose cowpea with the generation and distribution of household resources. Surplus income generated by this improved cowpea gives women more decision-making influence in allocating resources for food and other household needs. The improved cowpea also enhances the health and nutrition of the children.

We developed and distributed improved soybean and cowpea varieties that resist important pests and diseases such as rust and *Striga*, helping farmers save more than US$200 million in production and seed losses annually.

Using new tools, we produced cassava and yam varieties with higher yields, contain more nutrients, and with stronger resistance to pests and diseases such as scales and brown streak disease, thereby enhancing the food security, nutrition and incomes of more than 250 million farmers who depend on these major staples.

By introducing resistance genes derived from sweet pepper into local banana varieties to make them withstand banana wilt better, we are slowing the spread of the disease and mitigating its threat to the livelihoods of smallholder farmers in East and Central Africa.

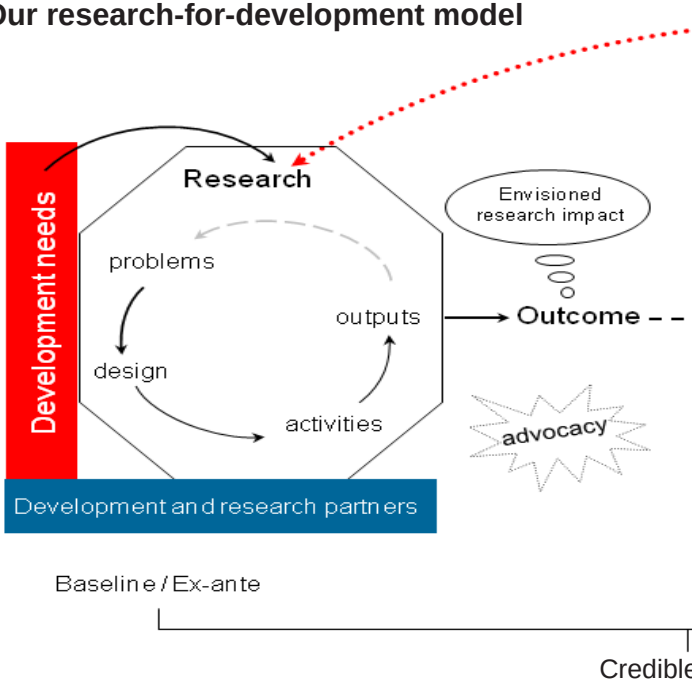
We organized the first Pan-African banana conference, the product of which is a 10-year strategy that would harmonize efforts

to promote the marketing and trade of banana on the continent and to shift commercial production into more sustainable systems with greater private sector participation.

The CGIAR conferred us two awards in 2008 -- the Regional Award for Outstanding Agricultural Technology in sub-Saharan Africa and the Science Award for Outstanding Communications. The former cited our work on cassava drying technologies that contributed to considerable income and employment gains for numerous small- and medium-scale enterprises, while the latter recognized our innovation in training farmers by using digital video cameras to share knowledge on sustainable cocoa production.

Producing more food is one side of the equation; keeping what Africa grows is another. On this front, we worked closely and effectively with organs of the African Union (AU), in particular the AU/IAPSC, to arrive at a comprehensive phytosanitary policy for the continent. This AU policy would help protect Africa from devastating pests and diseases that come from imported plant material. Four entities were also identified by the AU to provide technical backup: South Africa, Egypt, Kenya, and IITA.

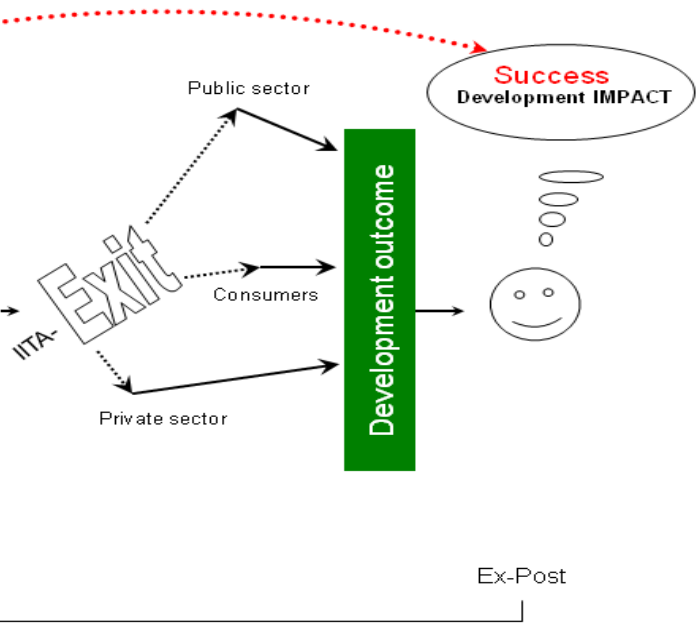
Our research-for-development model



1. **Development needs:** Identifies societal, producer and consumer needs that require addressing. Guarantees research relevance.
2. **Research design:** Specifies research problems that can be addressed by IITA with advanced research institutes and national partners. The design demands envisioning the potential impact.
3. **Outcome:** Defines scalable research outcomes and any advocacy activities required. A successful outcome entices partners to adoption.

We introduced important changes in the way we operate to make us more efficient and cost-effective in our work. These included implementing measures to optimize our energy use and putting in place systems to effectively monitor and recover costs. These efforts freed up much needed unrestricted funds to support more science-based research work.

Our scientists produced or contributed to the development of more than 200 publications. We also trained 160 individuals through hands-on research training in our headquarters and stations. We delivered over 200 group training courses in 20 countries across sub-Saharan Africa, benefitting more than 10,500 individuals.



4. **Exit:** Once the outcome is embraced by national/ regional partners IITA exits implementation and changes role to monitoring the research outcomes.

5. **Success/Development impact:** Ex-post evaluations are carried and compared to baseline information to measure the impact on the ultimate beneficiaries.

6. **Further work:** Development impact creates new challenges which are referred back to development needs.

As in previous years, our 2008 financial statement reflects the Institute's sustained financial health and stability, and the prudent management of resources. Our liquidity and reserve levels are above the recommended benchmarks of the CGIAR, indicating our continued ability to meet long- and short-term obligations. The financial report is presented in the "Financial Information" section of this report.

Research highlights

Photo by Sicco Kolijn, IITA

Preparing land for planting soybean using a mechanized tractor.

Agro-biodiversity

Africa's biodiversity is rich but very vulnerable. Our genebank conserves this diversity for sustainable use now and in the future. We use biotechnology and new diagnostic tools for the efficient, long-term conservation and use of genetic resources of staple and under-utilized crops and non-plant organisms.

African seeds locked in "Doomsday Vault"

On 30 January 2008, we shipped 21 boxes filled with 7000 unique seed samples from more than 36 African nations to the Svalbard Global Seed Vault, a facility built in a mountain deep inside the permafrost on a remote island in the Arctic Circle. Commonly referred to as the "Doomsday Vault", it serves as the repository of last resort for humanity's agricultural heritage. Our shipment, the first to arrive in Norway, consists of thousands of duplicates of unique varieties of domesticated and wild cowpea, maize, soybean, and Bambara groundnut. The vault, which opened on 26 February 2008, was built by the Norwegian government as a service to the global community. The Global Crop Diversity Trust funds its operation.

Collectively, CGIAR-supported centers maintain 600,000 plant varieties in crop genebanks, which are widely viewed as the foundation of global efforts to conserve agricultural biodiversity. Our genebank houses the world's largest collection of cowpea, with over 15,000 unique varieties from 88 countries around the world. We hold in-trust about 70 per cent of cowpea landraces from Africa. Storage of these and all the other seeds at Svalbard is intended to ensure that they will be available for bolstering food security should a man-made or natural disaster threaten agricultural systems, or even the genebanks themselves, at any point in the future.

(Left) Genebank staff checking accession number as they are packed in shipment box. (Right) Svalbard boxes ready for shipment. Each shipment/ storage box contains the list of accessions with minimum germplasm data.

New biotechnology tools to improve cassava

Cassava appeals to both small-scale and commercial farmers because it can be cultivated under conditions considered marginal for most other staple crops and it can be utilized in industries to produce starch and derived products. However, breeding to improve the crop is difficult due to high levels of heterozygosity and low flowering. Biotechnology could complement conventional breeding programs, but related tools are currently limited.

To enhance available genomics tools for cassava, we generated and characterized an 18,166 Expressed Sequence Tag (EST) dataset enriched for drought responsive genes. This dataset contains 8577 unigenes comprised of 3194 clusters and 5383 singletons. About 63% of these ESTs could be annotated, 11% were homologous to hypothetical genes with unknown function while the remaining 26% were not significantly homologous to sequences in public databases. To increase the repertoire of markers for molecular genetic applications, we identified and validated Simple Sequence Repeats using a diverse cassava panel. We also utilized the EST dataset, as well as publicly-available sequences, to develop a 60-mer oligo DNA microarray comprised of 35,785 ESTs assembled into 5230 contigs and 8838 singletons, which we used to design an array with ~11,000 probes for transcriptome analysis.

Biotechnology could effectively enhance the productivity of cassava.

Photo by IITA

Opportunities and threats

Food security and livelihoods in Africa face many risks. We examine and analyze the environmental, social and economic dynamics that impact food security and livelihoods. Our work serves as an early warning system, strategic guide, and assessor of all our research-for-development activities.

Staying in the game: cooperating for improved livelihoods and rural development

To determine the influence of social institutions and structures on technology uptake, we studied the dynamics of cooperation among farmers with the aim of developing interventions that are better targeted at specific social groups. We conducted the research in partnership with the University of Tilburg, The Netherlands.

It was assumed that smallholders could increase their production by pooling and collectively using their resources and making joint decisions. The gains of the joint production are then subdivided, such that each farmer remained independent. This type of cooperation is modeled using linear programming and the cooperative game theory. While linear programming establishes insights in optimal farm plans for farmers who cooperate, the game theory is used to generate fair divisions of the extra gains that are established by cooperation.

We applied the model on a village in northern Nigeria, clustering the households based on pre-defined socioeconomic parameters and then exploring cooperation. The optimal farm plan of the farmers' cooperative contains more crops with high market and nutritional value, such as cowpea and sugarcane. It was shown that the gross margin of the cooperative is 12 per cent higher than the sum of the individual gross margins. To divide these gains, we applied four established solution concepts from game theory: the Owen value, Shapley value, compromise value and nucleolus. Results showed that all farmers gained from cooperation and, interestingly, the four solution concepts gave similar results. The study also illustrated how the provision of microcredit can be used to stimulate cooperation, benefiting even the poorest farmers.

Findings of this research will be especially useful in helping policy makers make informed decisions on fostering institutional frameworks, such as farmers' cooperatives, to enhance technology uptake and increase agricultural productivity in the rural areas.

Africa presents a ‘‘fantastic opportunity’’

Africa presented a “fantastic opportunity” to complement and stabilize the global food system with small-farmer production in ways not foreseen at present, Hartmann said during a press conference. He was at the United Nations’ Headquarters in New York in line with the 16th Session of the UN’s Commission on Sustainable Development from 5 to 16 May 2008.

Floating ideas and hopes for realizing the continent’s agricultural potential, Hartmann said good news was spreading everywhere in Africa, that would prove to be a rich stage for developing a solution to the unstable food system of today. Small producers could complement the major commercial systems that had been carrying the burden of feeding the world. Africa had the necessary land mass, but did not need to raise productivity in the short term, given the present food crisis. However, it had the requisite arable lands and ability to grow different crops in different seasons.

He said world leaders needed to decide to make use of Africa’s assets in feeding the new demands arising from increasing populations and economic growth in the mega-economies of China, India, Brazil, and elsewhere around the globe. The World Bank was projecting population growth of 50 per cent by 2030, which would be catastrophic without major changes in how people were fed. Africa had a very big new role to play in such a scenario. Everyone had seen what had been done in Ghana and in Malawi. Among the lessons learned was the fact that technology or aid on its own was not enough. Progress must be based on a holistic approach, supported by technology.

Testing of mobile grater at Inharrime Vocational Training Centre, Mozambique.

Photo by Sicco Kolijn, IITA

Roots and tubers systems

Roots and tubers such as cassava and yam are Africa's main staple-food, but they face many threats. We reduce pre- and postharvest losses, increase productivity, and improve processing technologies, marketing, and profitability.

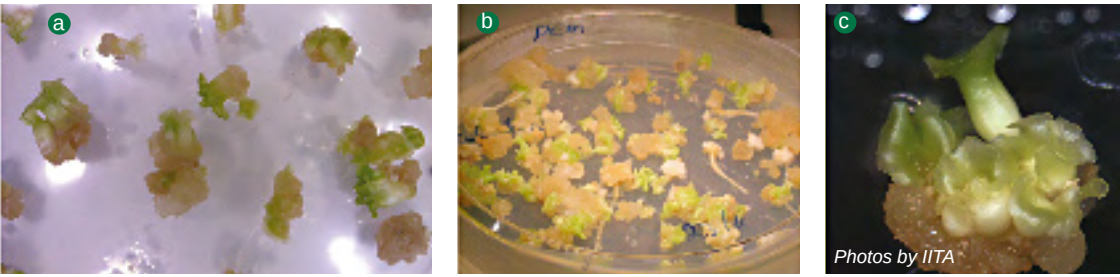
A tribute to postharvest innovation

Dr Lateef Sanni Oladimeji of the University of Agriculture in Abeokuta, Nigeria and IITA Postharvest Specialist received the 2008 CGIAR Regional Award for Outstanding Agricultural Technology in sub-Saharan Africa. His expertise on drying technologies has contributed to considerable income and employment gains for numerous small- and medium-scale enterprises in Nigeria and several other West African countries.

For example, Sanni initially designed a rotary dryer that increased production of cassava flour to 300 kg every 8 hours. It was then disseminated to cassava processing facilities in southwest and southeast Nigeria. More recently, within IITA's Integrated Cassava Project, he assembled a team of engineers that has designed a "flash" dryer capable of drying 250 kg of cassava flour per hour. His work has helped to increase the use of locally-manufactured flash dryers in Nigeria from two units before 2003, to over 60 units today.

Building a genetic defense against the Streak

Most farmer-preferred landraces of cassava in sub-Saharan Africa are susceptible to the Cassava Brown Streak Disease (CBSD). Genetic transformation could complement conventional breeding programs to make the crop more resistant to the disease. However, current protocols are limited to model genotypes not used by farmers or breeders in the region. Since transformation protocols are genotype-dependent, procedures suited to modify landraces need to be developed.



Mature somatic embryo of cultivar Albert (A) and Kibaha (B) with close-up of cv Albert (C) (light incubation).

Photos by IITA

We established somatic embryogenesis and organogenesis for three farmer/breeder-preferred varieties–two from East Africa (cv *Kibaha* and cv *Albert*) and one from West Africa (TME12) – all susceptible to CBSD. We established primary and cyclical somatic embryogenesis for the three varieties, with cotyledon tissues from somatic embryos used as source explants for *Agrobacterium*-mediated genetic transformation. Through an intron-interrupted β–glucuronidase reporter gene construct under the control of the *Cassava vein mosaic virus* promoter, we were able to obtain stable transformed cassava tissues and plants with increased resistance to CBSD.

ARTS on a cassava stem cutting.

Scaling down ARTS

Over the last three years we have been screening Cameroon local cassava germplasm collection maintained in Nkolbisson and those introduced from our collection in Ibadan, Nigeria for resistance to African Root and Tuber Scale (ARTS). Results of our trials showed that two farmers' cultivars supported very low scale density. These have been multiplied and are being further tested along with other landraces and improved varieties in two locations in southern Cameroon and would be included in a breeding program targeted at ARTS-prone zones across sub-Saharan Africa if they continue to show potential.

Screening of improved germplasm showed large variations in suitability to ARTS. In Cameroon, three varieties TMS 96/0023, TMS 96/1762 and TMS 92/0057 (all with excellent CMD resistance) have been identified and are currently being disseminated in scale-infested areas. In southeastern DR Congo, we conducted ARTS-related studies in collaboration with our USAID-funded Cassava Project. Through the project, we developed Disanka, or TMS 96/0102, that has considerable tolerance to ARTS. We are currently promoting the variety in an integrated scale- management package, along with several other scale-tolerant varieties that we have previously developed and released.

Aside from developing ARTS-resistant varieties, we are also promoting farm practices to manage the pest. In two villages in southern Cameroon, we tested pre-planting removal and destruction of host plants, particularly left-over cassava in fallow fields, within a 20-m perimeter and inside the fields cleared for planting to reduce scale infestation. We found that this approach reduced ARTS populations by up to 41% with an associated 31% increase in cassava yield. This approach is being scaled-out in three villages in southern Cameroon and in three villages in DR Congo using a farmer participatory approach and in combination with the use of tolerant cassava varieties.

Photo by Rachid Hanna, IITA

Cereals and legumes systems

Cereals and legumes such as maize and cowpea are important food crops for most households in Africa, but production is very unstable. We develop and disseminate improved varieties, natural resource management approaches, and new production technologies to enhance and sustain productivity.

Rust-proof soybean

All soybean cultivars grown in Nigeria are highly susceptible to rust (*Phakopsora pachyrhizi*), which can cause 60-80% seed losses. We are currently undertaking research to develop resistant or tolerant varieties to manage this serious disease and prevent it from spreading across Africa.

In 2007–2008, we evaluated three sets of 65 F_7 lines derived from the cross TGx 1805-31F (susceptible elite line) and UG5 (resistant line) under rust-endemic conditions at our experimental farms in Ibadan, Nigeria. All F_7 lines showed no infection or had negligible disease severity. The susceptible parent (TGx 1805-31F) and a released cultivar (TGx 1485-1D) used as check had 20-78% and 78-92% disease damage.

In terms of yields, four resistant lines tested in the first set of trials had 70–81% more yield than the susceptible parent. In the second set, 11 lines significantly out-yielded the susceptible parent by as much as 112–149%. In the third set, 10 rust-resistant lines yielded 101–179%

more than the susceptible elite parent. The best-yielding resistant lines were TGx 1987-43F, TGx 1987-49F, and TGx 1987-57F. These rust-resistant lines could either replace susceptible varieties following adaptation tests, or could be used in breeding programs to transfer their favorable alleles to any desired cultivar.

Killing the cowpea witch

From 2005 to 2007, we conducted multi-location and multi-year field trials in *Striga,* or witchweed, hot-spots in Nigeria, Niger, Bénin, Mali, Burkina Faso, Senegal, Cameroon, and Ghana to identify and select *Striga*-resistant cowpea genotypes with high adaptability to the pest. During the period, we distributed a total of 37 cowpea lines to national partners for screening against *Striga* races prevalent in each location.

Our field trials confirmed that IT98K-205-8, B301 and TVu14676 have multiple resistances to different *Striga* races in Burkina Faso, Mali, Nigeria, Niger, Benin, and Senegal. Additionally, our cowpea breeding lines – IT81D-994, IT98K-503-1, IT98K-205-10, and IT98K-216-44 -- exhibited good resistance to *Striga* races in Zakpota, Benin Republic. These genotypes can be used as candidate genetic resources in national breeding programs to develop *Striga* resistant cowpea varieties to mitigate yield losses estimated at US$200 million annually across Africa.

Less Striga means more cowpea to sell.

Photo by IITA

Banana and plantain systems

Banana and plantain are basic food crops for over 70 million people in Africa, but yields have been declining. We use greater knowledge on the crops' agroecology to develop new varieties and better production practices. Our solutions improve production and productivity and increases profit from better quality and variety of banana-based food products.

Paving the way for African bananas

Increasingly, bananas are being targeted for commercialization not only within Africa but also for the lucrative and emerging markets in the Middle East and Europe, where dessert bananas are hugely popular as fruits. Recently, large international banana producers have announced plans for long-term strategic investments in sub-Saharan Africa, shifting banana production for European markets from Latin America to Africa.

To capitalize on this wave of change, we organized the Banana Conference 2008, the first-ever Pan-African banana conference that linked research to markets within the African context. Themed "Harnessing international partnerships to increase banana and plantain research in Africa", the conference brought together major banana research and industry players to develop a 10-year strategy that would harmonize efforts to promote the marketing and trade of banana on the continent and to shift commercial production into more sustainable systems with greater private sector participation. The conference was held in Mombasa, Kenya from October 5 to 9.

Partners in the conference included Bioversity International, Forum for Agricultural Research in Africa, Kenya Agricultural Research Institute, and the International Society of Horticultural Science. The conference was supported by the Bill & Melinda Gates Foundation, Technical Centre for Agriculture and Rural Cooperation, Belgium Directorate General for Development and Cooperation, National Agricultural Research Organization of Uganda, Du Roi and other public and private organizations.

Fighting the wilt: sweet pepper to the rescue

Banana *Xanthomonas* wilt (BXW) is a disease that has been spreading rapidly in East and Central Africa since 2001, starting with an outbreak in Uganda. Since then, it has crossed into five other countries in the region, severely affecting the livelihoods of millions of smallholder growers and

threatening to wipe-out local banana genetic resources. One such cultivar in danger of disappearing due to the wilt is the East African Highland Banana (EAHB), a type of cooking banana from Uganda that is highly preferred by farmers. These local cultivars are difficult to improve through conventional breeding due to sterility and long generation times. Genetic transformation offers an effective alternative in developing varieties resistant to the disease.

In collaboration with national partners in Uganda, we are currently developing transgenic EAHBs resistant to wilt by introducing a gene from sweet pepper. Hundreds of transformed lines of various cultivars have been generated, which are being screened for resistance against the disease under laboratory conditions. The most promising lines will be further evaluated in field trials. The transgenic lines will also be tested for environmental and food safety in compliance with the regulations of target countries.

The sweet pepper-derived wilt resistance genes are patented by the Academia Sinica, Taiwan. We have negotiated royalty-free license from them through the African Agricultural Technology Foundation to use the technology in our research.

A farmer inspecting one of his banana plants heavily infected by BXW.

Photo by SP-IPM

Horticulture and tree systems

Vegetables and tree crops such as cocoa support the income of Africa's rural poor. We develop and promote responsible production and postharvest technologies, and influence enabling policy and marketing environments that sustain productivity and increase income.

A YouTube moment for sustainable cocoa production

Dr Soniia David, IITA Technology Transfer Specialist, and her team at the Sustainable Tree Crops Program were conferred the 2008 CGIAR Science Awards - Outstanding Communications Category for training farmers in West African countries to use digital video cameras as a way to share knowledge of sustainable cocoa production. By setting up Video Viewing Clubs (VVC), the team got together groups of farmers to watch and learn from the videos. To date, 450 farmers in Ghana have participated in VVCs. Farmers who adopted the crop and pest management practices promoted by the YouTube videos are likely to increase yields by 20-40 per cent and decrease pesticide use by 10-20 per cent. Dr Paula Bramel, DDG R4D, received the award on behalf of David during the CGIAR AGM held in Mozambique in December 2008.

Women cocoa farmers in Ghana watching a video on crop and pest management courtesy of the VVC.

Photo by IITA-STCP

Preying on the predators

As part of our efforts to find an effective biological control solution to manage aphid damage in horticultural crops, we identified 11 species of natural enemies of aphids. We are rearing four of the most common to test their potentials in aphid management. These include: a) primary parasitoid - *Lysiphlebus testaceipes* (Cresson) (Hymenoptera: Braconidae); and b) predators- *Ischiodon aegyptius* W. (Diptera: Syrphidae), *Cheilomenes propinqua* M. (Coleoptera: Coccinellidae), and *Cheilomenes sulphurea* O. (Coleoptera: Coccinellidae). In addition, the entomopathogen *Neozygites* sp. was also commonly found feeding on aphids.

Additionally, we conducted intensive pest-host diagnostic tests in 31 vegetable sites across Benin where we identified 22 vegetable and 15 weed species that were preferred hosts of aphids. These include: a) *Aphis gossipii* G. (Hemiptera: Aphididae) on okra, hot pepper/sweet pepper, African garden eggplant and cucumber; b) *Lipaphis erysimi* K. (Hemiptera: Aphididae) on cabbage and turnip; c) *Hyadaphis coriandri* D. (Hemiptera: Aphididae) on coriander and Vernonia sp; and d) other unidentified aphids on amaranth, basil, lettuce, bush okra/West African sorrel, white charlock, zucchini, red sorrel, carrot, green beans, tomato, watermelon, mints, *Celosia*, and aubergine.

The most common alternate host plants (weeds) were *Chromoleana odorata*, *Euphorbia hirta*, *Catharantus roseus* and *Palisota hirsuta*.

Photos by Arnstein Staverløkk, Bioforsk

Three out of four important aphid pests in vegetables in Benin: Lipaphis erysimi, Aphis gossypii *and* Aphis crassivora.

Towards safer dried vegetables

In pursuit of making food crops safer for human consumption, we conducted assessment studies of fungal, aflatoxin and fumonisin contamination in dried vegetables by analyzing samples of dried okra, hot chili, tomato, onion leaves, baobab leaves, and melon seeds marketed in Benin, Togo and Mali.

Through these surveys, we identified and recorded 561 fungal isolates, with levels as low as 18 in tomato and as high as 218 in baobab leaves. Baobab leaves, hot chili and okra showed the highest levels of fungal count, while shelled melon seeds, onion leaves and tomato had the lowest contamination levels.

Selling dried hot chili in Benin.

Species of *Aspergillus* were found to be dominant on all marketed dried vegetables in the countries surveyed. Mycotoxin assessment through Reversed-Phase High Performance Liquid Chromatography showed that among the dried vegetables sampled, only okra and hot chili were naturally contaminated with aflatoxin B_1 (concentrations 6.0 µg/kg) and aflatoxin B_2, (concentrations 3.2 µg/kg).

Agriculture and health

Poor food quality risks health, restricts trade, and reduces labor productivity of millions in Africa. We improve diets, health, and productivity through research on micronutrient content, food toxins, and nutrient patterns.

Empowered women, healthier children: dual benefits from dual purpose cowpea

We explored the intra-household impact of the use of our improved dual-purpose cowpea on food, fodder and income availability from a gender perspective. Our study showed that surplus income derived from using our improved cowpea gives women more decision-making influence in allocating resources for food and other household needs especially during periods of risk. Additionally, children who regularly consume the cowpea variety as part of their daily diets are healthier.

To validate our findings, we tested income invested in food security and the nutritional values attributed to cowpea against anthropometric data. Results were calculated based on three groups of households categorized by length of adoption of the dual-purpose cowpea: two years, three years, and four years.

No significant differences were observed between children of adopters and those of non-adopters for all the anthropometric scores after two years of adoption. However, a significant difference in the weight-to-height ratio between the two groups was observed after three years of adoption; while significant differences were observed in the weight-to-height and weight-to-age ratios for four or more years of adoption of the improved cowpea.

Analysis of our findings indicates that those who adopt and use the dual-purpose cowpea over the longer term tend to become more food secure due to the added income generated by the improved crop, which translates to more resources allocated to food and other related household needs. Children of adopters are also healthier because of the added nutrients in the dual-purpose cowpea.

Fighting micronutrient malnutrition through biofortification: An *ex-ante* assessment

Biofortification is increasingly being seen as an important tool to combat micronutrient malnutrition. In this study, we estimated the costs and potential benefits of biofortification of major staple crops with provitamin A, iron, and zinc, for a large number of countries in Africa, Asia, and Latin America. We used a modified Disability-Adjusted Life Years framework to see if the intervention can make a significant and cost-effective impact on micronutrient deficiencies in the developing world.

Methodological differences prevent a direct comparison of these figures with those for biofortification. Nevertheless, biofortification appears relatively more cost-effective than other interventions in most regions under the optimistic scenario where coverage rates are comparable to those of other interventions at 40–60%. The significant exceptions are in northeast Brazil for vitamin A, and in Latin America for zinc. In both cases, nutrient fortification is definitely more cost-effective.

Beta carotene-fortified cassava.

Systemwide Program on Integrated Pest Management

Pests cause high crop losses and reduce quality of agricultural produce. We coordinate and participate in the CGIAR Systemwide Program on Integrated Pest Management (SP-IPM), which develops knowledge and technologies that responsibly tackle crop pests.

A revitalized SP-IPM

In 2008, SP-IPM underwent a programmatic and strategic re-orientation to better respond to the new challenges of agricultural production such as increasing demand for affordable food, climate change, scarcity of productive land, and declining agricultural biodiversity.

The program kick-started the year with a Strategic Planning Workshop and Steering Committee meeting held at ICARDA in Aleppo, Syria in February to discuss and agree on an operational and management framework. The workshop built upon issues discussed during the 2007 Steering Committee meeting and the CCER recommendations. The meetings provided an excellent opportunity for

Preparing for the future: SP-IPM Strategic Planning workshop at ICARDA, Aleppo, Syria, February 2008.

Photo by SP-IPM

SP-IPM's new logo reflects its programmatic and strategic re-orientation.

the new Chair to be acquainted with the members of the Steering Committee and some of the partners.

The workshop developed a framework for SP-IPM to make important contributions to the achievement of the CGIAR's Science Council Priorities and related Millennium Development Goals. To better respond to the current and future global challenges, three research themes were prioritized: (1) climate change impact on cropping systems and adaptation of IPM strategies; (2) food, feed and environmental safety; and (3) agro-ecosystem resilience.

In July 2008, the newly appointed chair and coordinator of the program officially joined the SP-IPM Secretariat. Unlike in previous years, the Chair was recruited from outside the CGIAR, particularly from the University of Bonn, Germany. The Secretariat was also moved from IITA-Benin to the IITA's Headquarters in Ibadan, Nigeria. To reflect the changes within SP-IPM, a new logo has been designed and adopted. The program website (www.spipm.cgiar.org) will take a different structure and new content and will be re-launched in early 2009.

To further strengthen the program, the chairman and the coordinator visited member-centers' CIP, CIMMYT, CIAT, and Bioversity to foster commitments as well as several donor agencies to explore new funding opportunities. An SP-IPM exhibit was also put up during the CGIAR AGM in Maputo, Mozambique in December 2008 to raise awareness among participants, particularly donors and investors.

The SP-IPM coordinator was invited by the European Network for the Durable Exploitation of Crop Protection Strategies (ENDURE), a network of excellence funded by the European Union under the Framework 6 Programme, to give a plenary presentation at the network's first international conference on "Diversifying Crop Protection" held in October 2008. SP-IPM was also represented at the global IPM forum in June 2008 organized by the Michigan State University.

SP-IPM is grateful to the Italian Government for resuming funding to the Secretariat, to CropLife International for funding the production of two IPM Briefs and the redesign of the website, and to IITA for bearing all other operational costs of the Secretariat, including staff costs.

Financial Information

Funding overview

Total funding for 2008 was US$51.090 million, of which 94.2% came from CGIAR investors and 5.8% from other sources. Expenditure was US$50.747 million (net of indirect costs recovery of US$4.965 million), of which 83.3% was used for program expenses and 16.7% for management and general expenses.

The governments and agencies that provided the largest share of our funding in 2007 and 2008 are shown in Figure 1 (top 10 donors).

Our 2007 and 2008 expenditures by CGIAR system priorities and our program portfolio are shown in Figures 2 and 3, respectively; while the performance indicators, as prescribed by CGIAR, are reflected in Figure 4.

Figure 1. Funding: top 10 donors, 2007 and 2008

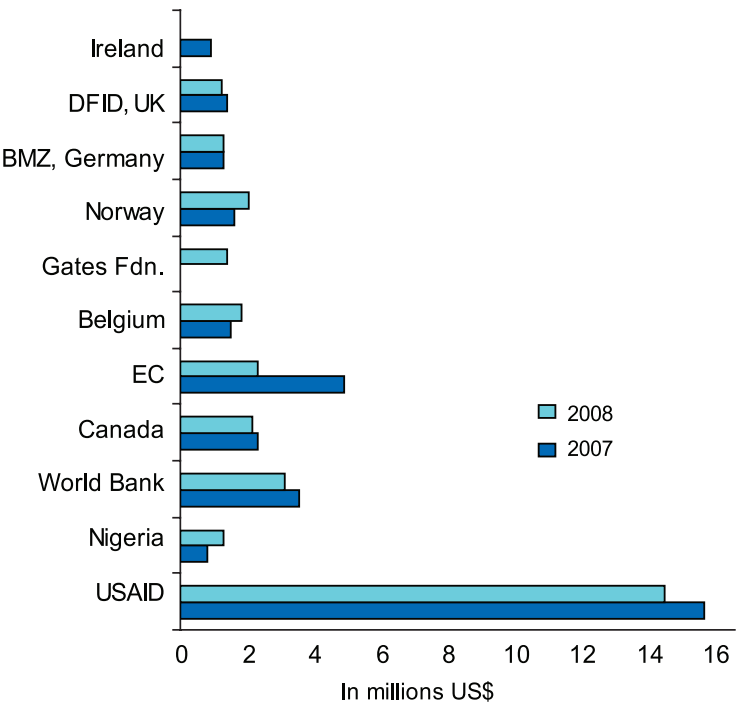
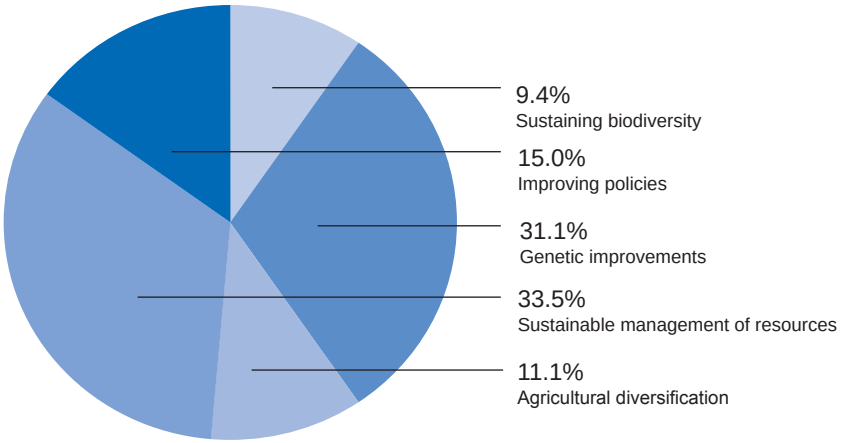
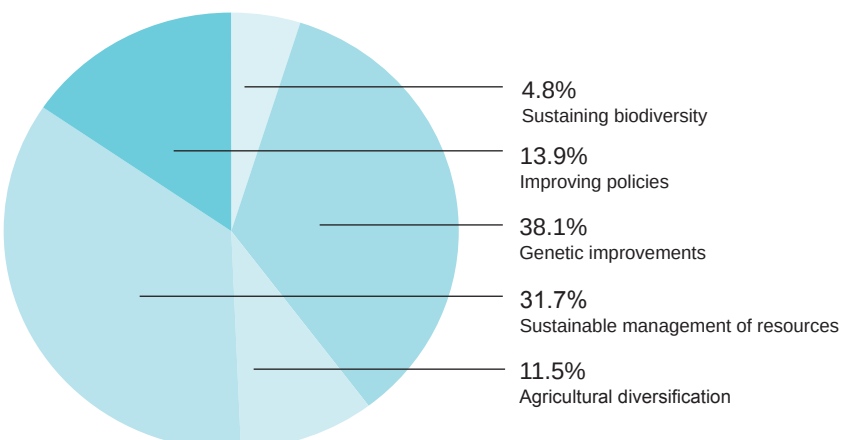


Figure 2. Expenditure by CGIAR System Priorities, 2007



Expenditure by CGIAR System Priorities, 2008



IITA investors	(expressed in US$ Thousands)
African Agricultural Technology Foundation	223
Austria	259
Belgium	1,767
BMZ, Germany	1,267
Cadbury Schweppes	374
Canada	2,092
Catholic Relief Service	944
Chemonics International	114
Commission of the European Communities	2,251
Common Fund for Commodities	350
Denmark	777
Department for International Development, UK	1,174
Food and Agriculture Organization	519
France	175
Gates Foundation	1,325
Gatsby Charitable Foundation	283
Global Crop Diversity Trust	165
International Fund for Agricultural Development	827
Ireland	765
Italy	379
Japan	411
Korea, Republic of	50
Netherlands	833
Nigeria	1,255
Norway	1,984
PLAN International	145
Rockefeller Foundation	392
Shell Petroleum Development Company of Nigeria Ltd.	274
South Africa	40
Sweden	486
Switzerland	393
United Nations Development Program	152
United States Agency for International Development	13,981
W. K. Kellogg Foundation	266
World Bank	3,000
Miscellaneous Projects	4,233
Challenge Program	4,225
Grand Total	48,150

Figure 3. Expenditure by IITA Program Portfolio: 2007 and 2008

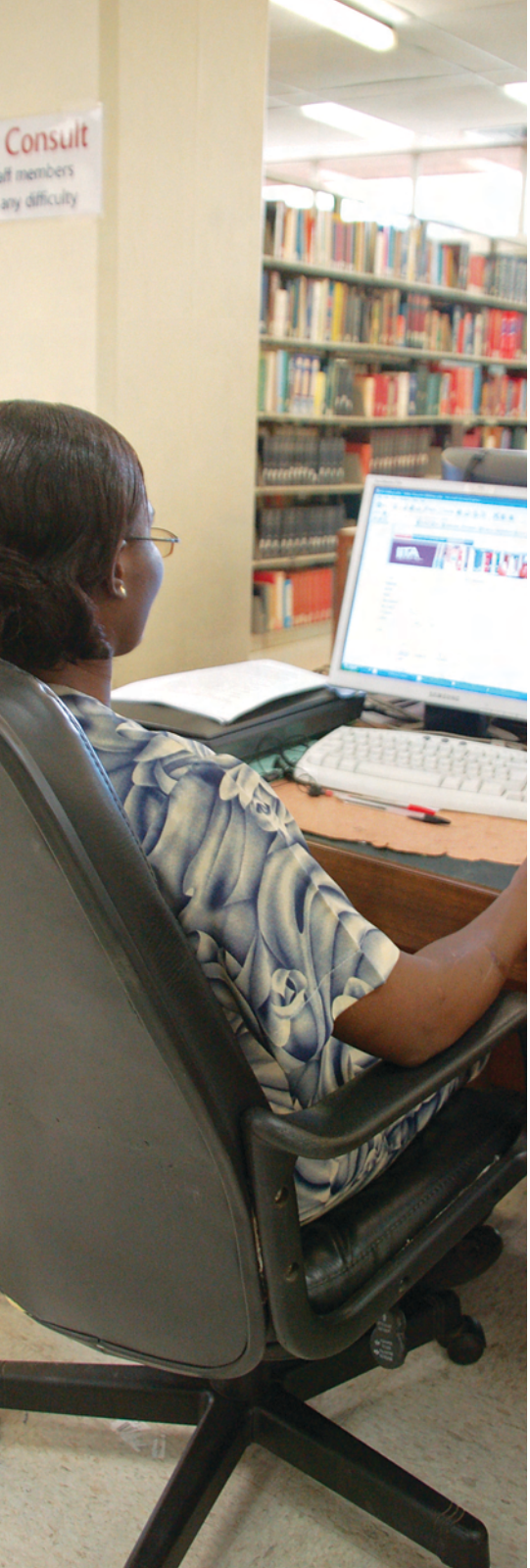
	2007		2008	
Project	Cost ($`000)	%	Cost ($`000)	%
Agriculture and Health	2,056	4.5	2,299	4.5
Agrobiodiversity	4,339	9.6	2,765	5.4
Banana and Plantain Systems	4,638	10.2	5,054	10.0
Cereal and Legume Systems	9,218	20.3	13,673	26.9
Opportunities and Threats	2,366	5.2	2,834	5.6
Horticulture and Tree Systems	7,701	17.0	8,512	16.8
Root and Tuber Systems	14,176	31.2	14,644	28.9
Systemwide Program on Integrated Pest Management	873	1.9	966	1.9
Total	45,367	100	50,747	100

Figure 4. Performance Indicators: Financial Health

	2007	2008
Short-term Solvency (or Liquidity)	175 days	158 days
Long-term Financial Stability (Adequacy of Reserves)	175 days	158 days
Indirect Cost Rates	21.2%	20.4%
Cash Management on Restricted Operations	0.07	0.24
Audit Opinion	Unqualified / Clean Bill of Financial Health	

Heeding the sign: we need to renew our approach, attitude and outlook if African agriculture is to move forward.

Photo by IITA



Publications and Graduate Research

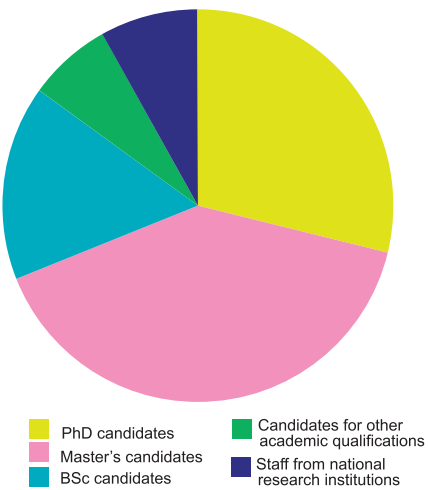
A trainee doing a literature search using IITA's online bibliography.

Publications

In 2008, we produced 238 publications, comprised of 159 journal articles, 9 books, 18 in-books, 22 conference proceedings, 13 technical reports, and 17 other publications. A total of 115 of the journal articles appeared in peer-reviewed journals that are listed in Thomson Scientific/ISI. The complete listing and details of these publications could be found in our online bibliography at http://biblio.iita.org/.

Graduate research

Individual training



During the year, 160 trainees completed individual research training with us. Of these, 29% were conducting research for their PhDs, 40% were working towards their MSc degrees (or equivalent), 16% were working towards their BSc degrees, and 7% were working towards other academic certificates and diplomas. The remaining 8% came for short-term, hands-on training in field or laboratory techniques, or to work alongside our scientists. A total of 141 trainees came from 18 different countries in sub-Saharan Africa. The other 19 trainees came from various countries in Europe, Central and North America, and Asia.

Group training

In 2008, we delivered over 200 group training courses in 20 countries across sub-Saharan Africa. More than 10,500 individuals received training through these courses, comprising of scientists, technicians and extension workers from national partners and NGOs, cooperative groups, farmer field school facilitators, farmers, university lecturers, and private sector representatives. Training topics included: extension, field/lab research skills, pest risk assessments, pest/pathogen diagnostics, collective marketing, agronomic practices, processing and utilization, statistical computing, vegetative propagation, lab safety, agribusiness, managing cooperatives, participatory variety selection.

Governing board

Selling maize in a farmer's market in Nigeria.

Bryan Harvey (Chair)
Special Advisor to the Vice President
Research
University of Saskatchewan
Canada

Barbara Becker
Managing Director
North-South Center
Swiss Federal Institute of Technology
Switzerland

Hartmann
Director General
IITA
Nigeria

A. Afolabi
Permanent Secretary
Federal Ministry of Agriculture and
Rural Development
Garki, Abuja
Nigeria

Gunnvor Berge
First Secretary
Royal Norwegian Embassy
China

Cees Karssen
General Foulkesweg 69
The Netherlands

Dean Lewis
Chief Financial Officer
University City Science Center
Philadelphia
United States

Paul Mbe-Mpie Mafuka
Professor
Department of Natural Resource
Management
University of Kinshasa
Democratic Republic of Congo

Henri Maraite
Professor
Faculty of Agricultural Sciences
Université Catholique de Louvain
Louvain-la-Neuve
Belgium

Birger Møller
Head
Center for Molecular Plant Physiology
Danish National Research Institute
Denmark

Emmy Bartz Simmons
USAID (*retired*)
United States

Nthoana Tau-Mzamane
Registrar
Walter Sisulu University
South Africa

Yo Tiémoko
Director General
National Agronomic Research
Centre
Côte d'Ivoire

IITA scientists and project managers

Juggling time and priorities are some of the things our scientists do best, aside from their science, of course.

Abass, Adebayo Busura
Coordinator, Cassava Value Chain
Abdoulaye, Tahirou
Outcome/Impact Socio-Economist
Abele, Steffen
Director
Ajala, Oyewole S.
Maize Breeder
Ajeigbe, Hakeem A.
Crop Livestock Specialist
Alene, Arega D.
Impact Economist
Amaza, Paul Sambo
Agricultural Economist
Asare, Richard
Cocoa Agroforester
Asiedu, Robert
Director
Ayodele, Maria Awo
Plant Pathologist
Badu-Apraku, Baffour
Maize Breed, DTMA Project
Bandyopadhyay, Ranajit
Pathologist
Beed, Fen Douglas
Plant Pathologist
Biemond, Pieter Chris
Seed System Specialist
Boahen, Stephen
Legume Specialist
Boukar, Ousmane
Cowpea Breeder
Bouwmeester, Hein
GIS Specialist
Chikoye, David
Director
Cornet, Denis D.
Agronomist
Coulibaly, Ousmane
Agricultural Economist
Coyne, Daniel Leigh
Nematologist
David, Soniia
STCP Technology Transfer Specialist
Davis-Mussagy, Melba
Agro-enterprise Development Specialist
Dubois, Thomas L.M.
Biocontrol Specialist
Duindam, Jelle Wille
Starchy Crops Agronomist
Dumet, Dominique Juliette
Head, Genebank
Ekeleme, Friday F.
Agronomist
Fatokun, Christian A.
Coordinator, Legumes for Livelihoods Project
Ferguson, Morag
Plant Molecular Geneticist
Fiaboe, Komi M.
Banana Entomologist
Franco, Jorge
Biometrician/Statistician
Gedil, Melaku A.
Cassava Molecular Geneticist
Gockowski, Jim J.
Agricultural Economist
Godonou, Ignace
Entomologist
Gyamfi, Isaac Kwadwo
STCP Country Manager, Ghana
Hanna, Rachid
Entomologist/Biocontrol Specialist

Hauser, Stefan
Agronomist/Soil Physicist
Hearne, Sarah Jane
Plant Molecular Geneticist
Hell, Kerstin
Postharvest Biologist
Herron, Caroline Mary
Virologist, Cassava BSD
Hoeschle-Zeledon, Irmgard
Coordinator, SP-IPM
Ihedioha, Onyema Damia
Agri-Processing Specialist
Ingelbrecht, Ivan Luc
Head, Biotechnology Lab
James, Braima D.
Entomologist/Project Manager, USAID-UPoCA
Jonas, Mva Mva
STCP Country Manager, Cameroon
Kamara, Alpha Yaya
Savannah Systems Agronomist
Kanju, Edward Eneah
Cassava Breeder/Pathologist
Kikuno, Hidehiko
Yam Physiologist
Kim, Dong-Jin D
Biotechnologist
Kolijn, Sicco S.
Postharvest & Agro-Enterprise Specialist
Kumar, Lava
Virologist, West & Central Africa
Legg, James
Virologist
Lorenzen, James H.
Banana Breeder
Mahungu, Nzola-Meso
Coordinator, NPACI & IITA Cassava Project in DR Congo
Manyong, Victor A.W.
Agricultural Economist
May-Guri, Seathre S.
Senior Researcher
Maziya-Dixon, Busie
Crop Utilization Specialist
Menkir, Abebe
Maize Breeder
Muoki, Penina Ngusye
Food Technologist
Muranaka, Satoru
Crop Physiologist
Neuenschwander, Peter
Scientist Emeritus
Ntawuruhunga, Pheneas
Coordinator, SARRNET
Okafor, Christopher
STCP Country Manager, Nigeria
Okechukwu, Richardson Uchenna
Database/Statistics Manager
Ouma, Emily Awuor
Socio-Economist
Pay-Bayee, Macarthur M.M.M.
STCP Country Manager, Liberia
Raji, Adebola A.
Biotechnologist
Rusike, Joseph J.
Outcome/Impact Socio-Economist
Sanni, Lateef Oladimeji
Cassava Postharvest Specialist
Sartie, Alieu Mortuwah
Yam Molecular Geneticist
Sharma, Kamal
Researcher in Plant Pathogen Diagnostics
Sonder, Kai
GIS/Data Management Specialist
Tamo, Manuele
Legume Entomologist

Tarawali, Gbassay
Project Manager, CEDP
Tefera, Hailu
Soybean Breeder
Tegbaru, Amare
PROSAB Manager
Tripathi, Leena
Biotechnologist
Van Asten, Petrus J.A.
Systems Agronomist
Van Melle, Cathelijne Cornelia H.
Commodity Supply Management Specialist
van Vugt, Daniel
Legume Agronomist
Vayssieres, Jean-Francois J.
Entomologist
Vroh, Bi Irie B.I.
Breeder
Weise, Stephan F.
STCP Manager
Yade, Mbaye
Regional Coordinator, SAKSS
Yapo, Robert Assamoi
STCP Country Manager, Cote d'Ivoire
zum Felde, Alexandra
Banana/Plantain Agronomist

Some of our scientists in a simulated live-TV interview during R4D Week 2008.

Photo by IITA

Locations

IITA-Nigeria

IITA Headquarters
PMB 5320
Oyo Road, Idi-Oshe
Oyo State, Ibadan
Tel: +234 2 2412626; +234 2 7517472; 1 201 6336094
Mobile: +234 2 8034035281-3
Fax: +234 2 2412221
Email: iita@cgiar.org

Abuja
Experimental and Outreach Station
Phase 4, Kubwa
Near Old Water Board (behind Government Secondary School)
PMB 82
Garki GPO, Abuja

Akure
STCP Office
c/o Federal University of Technology
PO Box 1803, Akure
Ondo State

Kano
Sabo Bakin Zuwo Road
PMB 3112
Kano
Email: iita-kano@cgiar.org

Lagos
IITA International Guest House
Plots 531 and 532 WEMPCO Road
Ogba Estate
PO Box 145, Ikeja, Lagos
Mobile: +234 803 4023913

Maiduguri
PROSAB Office
Kwajaffa Road, Old GRA, Off Giwa Barracks Road,
PO Box 935, Maiduguri
Nigeria
Tel: +234 076231732
Mobile: +234 8034475430; +234 8024092270
Email: iitaprosab@cgiar.org

Onne
Onne High Rainfall Station
PMB 008 Nachia Eleme
Onne, near Port Harcourt
Rivers State
Mobile: +234 8037001497; +234 8039784016

IITA-Bénin
08 BP 0932 Tri Postal
Cotonou
Republic of Benin
E-mail**:** iita-benin@cgiar.org

IITA-Cameroon
IITA Humid Forest Ecoregional Center
BP 2008 (Messa), Yaounde
Cameroon
Tel: +237 2 2237434; 22237522;
Fax: +237 2 2237437
Mobile: +237 99880832
E-mail: iita-cameroon@cgiar.org

IITA-Cote d'Ivoire
2pltx, 7ème Tranche,
Rue L54-27
BP 696 Abidjan 27
Cote d'Ivoire
Tel/Fax: +225 22 523732
Mobile: +225 05000441

IITA-Democratic Republic of Congo
INERA Headquarters
Avenue des Cliniques 13,
Gombe, Kinshasa
Democratic Republic of Congo
Tel: +243 815 216368; 995 386236
Email: iita_dr_congo@airpost.net

IITA-Ghana
HH/No.Z-75, Volta Street
Airport Residential
PO Box GP 135, Accra
Ghana
Tel: +233 21 773873/75
Fax: +233 21 772789
Email: iita-ghana@cgiar.org

IITA-Kenya
Plant Biodiversity and Genomics Facility
c/o International Livestock Research Institute (ILRI)
PO Box 30709, Nairobi
Kenya
Tel: +254 20 4223000
Fax: + 254 20 4223001
Mobile: +254 724 201918
E-mail: iita-kenya@cgiar.org

IITA-Malawi
Chitedze Research Station
Box 30258, Lilongwe 3
Malawi
Tel: +265 1 707014
Fax: +265 1 707026
Email: iita@iitamw.org

IITA-Mozambique
PO Box 709, Nampula
Mozambique
Tel: +258 2 6216381
Fax: +258 2 6216272
Mobile: +258 825678730
Email: iita-mozambique@cgiar.org

Maputo
PO Box 2100, Maputo
Mozambique
Tel: +258 21 462613
Fax: +258 21 462454

IITA-Tanzania
Plot 331, Kambarage Road
Mikocheni A
PO Box 34441, Dar-es-Salaam
Tanzania
Tel: +255 22 2700092
Fax: +255 22 2775021
Mobile: +255 764 580 866
Email: iita-tanzania@cgiar.org

Kibaha Office
Sugarcane Research Institute (SRI) Complex
Kibaha, Tanzania
Tel: +255 23 2402370/1
Fax: +255 23 2402372

IITA-Uganda
Plot 15 East Naguru Road
Upper Naguru, Kampala
PO Box 7878, Kampala
Uganda
Tel: +256 041 4285060/4
Fax: +256 041 4285079
Mobile: +256 075 2787802; 075 2787801
Email: iita-uganda@iita-uganda.org

International Mailing Address
IITA
Carolyn House, 26 Dingwall Road
Croydon, CR9 3EE, UK
Tel: +44 020 86869031
Fax: +44 020 86818

ISSN 0331 4340