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Annual Report  
2001



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**IITA**  
**Annual Report**  
**2001**

**International Institute of Tropical Agriculture**  
Ibadan, Nigeria



### **Mission statement**

IITA aims to enhance the food security, income, and well-being of resource-poor people primarily in the humid and subhumid zones of sub-Saharan Africa by conducting research and related activities to increase agricultural production, improve food systems, and sustainably manage natural resources, in partnership with national and international stakeholders.

### **Mission**

*L'IITA aspire à augmenter la sécurité alimentaire, les revenus et le bien-être des populations pauvres, principalement dans les zones humides et subhumides d'Afrique subsaharienne grâce à la recherche et activités connexes en vue d'accroître la production agricole, d'améliorer les systèmes de production alimentaire et de gérer de manière durable les ressources naturelles, en collaboration avec les parties prenantes au niveau national et international.*

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*From the  
Director  
General*

**D**uring the past thirty-five years of development efforts, much of the world has made astounding progress. We have seen developing economies turned around and the decline of wars in Africa.

Nevertheless, while Africa produces more food every year, it is not keeping pace with the need and the level of poverty is too high. Often the potent combination of civil war and drought has brought hardship to the people of this continent. Despite the difficulties, there is emerging a growing market economy in Africa. Entrepreneurship and innovation are thriving. Many Africans are risk takers and with their enthusiasm and ideas change is coming. At IITA we will continue to be a part of that change, contributing to the creation of wealth and food security. We will work with all in the food chain who are involved in growing and getting food to the consumer's table. This encompasses the subsistence farm families, buyers, transporters, processors, and policymakers. As the continent's cities continue to grow due to population growth and rural to urban migration, this food system is challenged to be more efficient.

IITA has adopted a new slogan, which is designed to tell the world what we are about. It says, we are an African institution for Africa. We are IITA and we do "Research to Nourish Africa." 2002 will be IITA's 35th year in business. Much has changed in that time and much more will change in the years ahead. At IITA we have a lot of work to do. We who live and work in Africa must take the leadership and initiative to find effective ways to improve the lives of the continent's people.

Hartmann  
Director General, IITA

Des progrès stupéfiants ont été enregistrés dans une bonne partie du globe ces trente cinq dernières années grâce aux efforts fournis en faveur du développement. Des économies en développement ont été remises sur les rails et les guerres ont reculé sur le continent africain.

### *Le mot du Directeur général*

Cependant, l'Afrique qui produit davantage d'aliment chaque année, ne parvient pas à satisfaire les besoins alimentaires et le degré de pauvreté demeure trop élevé. Souvent, l'effet conjugué de la guerre civile et de la sécheresse inflige de rudes épreuves aux populations africaines. Malgré ces difficultés, l'économie de marché se développe en Afrique. L'esprit d'entreprise et les initiatives novatrices y sont en plein essor. Beaucoup d'Africains ont le goût du risque, et grâce à leur enthousiasme et leurs idées, un changement s'opère. A l'IITA, nous continuerons de nous inscrire dans cette logique du changement afin de contribuer à la création de la richesse et à la réalisation de la sécurité alimentaire. Nous travaillerons avec tous ceux qui tiennent un rôle dans la chaîne alimentaire, depuis le champ jusqu'à la table du consommateur. Il s'agit, entre autres, des petites familles agricoles, acheteurs, transporteurs, transformateurs et décideurs. Avec le développement des villes africaines occasionné par la poussée démographique et l'exode rural, le système alimentaire se doit d'être plus efficace.

L'IITA a adopté un nouveau slogan qui est sensé renseigner le monde sur ce que nous sommes : une institution africaine pour l'Afrique. Nous



sommes l'IITA, et nous faisons la « Recherche pour nourrir l'Afrique. » l'année 2002 marque le 35<sup>e</sup> anniversaire de la recherche à l'IITA. Beaucoup de choses ont changé pendant ce temps et davantage de choses changeront dans les années à venir. A l'IITA, nous avons beaucoup à faire. Nous qui vivons et travaillons en Afrique devons prendre les devants ainsi que l'initiative afin de trouver des moyens efficaces pour améliorer les conditions de vie des peuples du continent.

Hartmann  
Directeur général, IITA



IITA's work is structured as 14 multidisciplinary research projects. Some projects focus on production systems for specific crops or crop combinations; others are thematically oriented and can involve many crops. Most of the projects cut across the agroecological zones for which IITA's work is targeted. IITA also serves as the convening institute for the Systemwide Program for Integrated Pest Management and for the Ecoregional Program for the Humid and Subhumid Tropics of Sub-Saharan Africa.

This section presents the highlights of each project for 2001. These summaries are not a complete account of the work begun or completed during the year; rather, they describe some key scientific results and are intended to give the reader an insight into the breadth of the research themes and problems being investigated by IITA scientists.

*Les activités de l'IITA sont structurées en 14 projets de recherche pluridisciplinaire. Certains projets mettent l'accent sur les systèmes de production de cultures spécifiques ou de combinaisons de cultures, d'autres ont une orientation thématique et peuvent concerner plusieurs cultures. La plupart de ces projets couvrent les zones agroécologiques ciblées dans le cadre des activités de l'IITA. L'IITA sert également d'institut hôte du Programme de lutte intégrée à l'échelle du système et du Programme écorégional pour les tropiques humides et subhumides d'Afrique subsaharienne.*

*Cette section présente les points saillants de chaque projet en 2001. Ces résumés ne constituent pas un rapport exhaustif des activités qui ont démarré ou qui sont arrivées à terme au cours de l'année, ils mettent plutôt en exergue quelques résultats scientifiques-clés et sont censés fournir aux lecteurs un aperçu de l'ampleur des thèmes de recherche et des problèmes faisant l'objet d'une investigation par les chercheurs de l'IITA.*

## Research highlights

## Points saillants de la recherche

### Project 1

- ▶ A core collection of cowpea comprising 1926 accessions which are representative of morphological diversity and geographical origin was selected from over 12 000 accessions of the world cowpea collection.
- ▶ One hundred and twenty-seven local cultivars of cassava and 44 yam cultivars were collected in Sierra Leone and added to the IITA germplasm collection.
- ▶ Experiments on cryopreservation of cassava shoot-tips, using encapsulation-vitrification and fast freezing method, gave recovery rates of about 60% in certain genotypes.
- ▶ Studies on population growth and stability of in situ wild yam populations in a forest reserve in Ibadan, monitored over a 3-year period, showed a slight increase in population sizes, but no significant change in the gene frequency of selected morphological markers.
- ▶ Studies on segregation patterns of mutants in crosses between cowpea varieties confirmed the existence of transposable elements that inhibit or excise gene expression.
- ▶ *Musa* genetic diversity studies showed amplified fragment length polymorphism (AFLP) as more powerful than random amplified polymorphic DNAs (RAPDs) in the discrimination of genotypes and the identification of genetic relationships. Plantains from Cameroon were genetically distinct from those of West Africa. Genome composition of all breeding lines and African

## Conservation and use of plant biodiversity

landraces of *Musa* has been determined. Sukali Ndizi, considered a diploid, is a triploid with AAB genome composition.

- ▶ Germplasm material from genebanks and breeders were provided to national agricultural research and extension systems (NARES) on request. The West and Central Africa Collaborative Maize Research Network (WECAMAN) dispatched 169 kg of maize seed to NARES based on superior performance of varieties tested in 2000. Fifty-eight sets of maize regional uniform variety trials and 26 sets of the regional *Striga* variety trial in the extra-early maturity groups were also distributed to NARES collaborators in West, Central, eastern, and southern Africa. Forty sets of soybean international trials were supplied to 21 NARES collaborators in Africa, 3 in Asia, and 1 in the US. Over 10 000 disease-free cassava in vitro plantlets were given to NARES in 6 African countries, 2 European countries, and the US. In addition, 1400 disease-free in vitro yam plantlets and 13 211 yam mini-tubers were given to NARES worldwide.
- ▶ Staining techniques for the isolation and identification of the rust fungi and other microorganisms from infected leaf surfaces of soybean were standardized. *Colletotrichum gloeosporioides* strains causing foliar infection of *Dioscorea* species were classified.

### Conservation et utilisation de la biodiversité végétale

#### Projet 1

- ▶ Une collection de base comprenant 1926 obtentions de niébé représentant une diversité morphologique et d'origine géographique différente a été sélectionnée à partir de 12 000 obtentions de la collection mondiale de niébé.
- ▶ 127 cultivars locaux de manioc et 44 cultivars d'igname ont été collectés en Sierra Leone et ajoutés à la collection de matériel génétique de l'IITA.
- ▶ Des expériences de cryoconservation de pousses apicales de manioc, menées en utilisant la méthode de vitrification par encapsulation et de congélation rapide ont permis des taux de reprise d'environ 60% chez certains génotypes.
- ▶ Des études sur la croissance et la stabilité de populations d'ignames sauvages in situ dans une réserve forestière à Ibadan ont indiqué, après une période de suivi de 3 ans, une légère augmentation de la taille des populations mais pas de changement significatif de la fréquence des gènes des marqueurs morphologiques sélectionnés.
- ▶ Des études sur les schémas de ségrégation de mutants parmi des croisements entre des variétés de niébé ont confirmé l'existence d'éléments transposables qui inhibent ou stimulent l'expression des gènes.
- ▶ Des études sur la diversité génétique de *Musa* ont montré que la méthode AFLP est plus puissante que la méthode RAPD en matière de discrimination des génotypes et d'identification des relations génétiques. Des plantains du Cameroun se sont avérés génétiquement distincts des plantains d'Afrique occidentale. La composition du génome de toutes les lignées de sélection et des cultivars locaux de *Musa* a été déterminée. Sukali Ndizi considéré comme un diploïde s'est révélé un triploïde avec une composition de génome AAB.
- ▶ Du matériel génétique en provenance des banques de gènes et des sélectionneurs a été fourni aux Systèmes nationaux de recherche et de vulgarisation agricoles (SNRVA) suite à des requêtes. Le Réseau maïs pour l'Afrique occidentale et centrale (WECAMAN) a distribué 169 kg de semences de maïs aux Systèmes nationaux de recherche agricole (SNRA) sur la base de la supériorité de la performance des variétés testées en 2000. Cinquante huit séries d'essais régionaux variétaux uniformes et 26 séries d'essais régionaux sur les variétés de *Striga* portant sur les groupes de maturité extra-précoce ont été également distribuées aux SNRA partenaires en Afrique occidentale, centrale, orientale et australe. Quarante séries d'essais internationaux sur le soja ont été fournies à différents SNRA partenaires : 21 en Afrique, 3 en Asie et 1 aux Etats-Unis d'Amérique. Plus de 10 000 plantules in vitro de manioc exemptes de maladies ont été distribuées à 6 SNRA d'Afrique, 2 d'Europe et celui des Etats-Unis d'Amérique. En outre, 1400 plantules in vitro d'igname exemptes de maladies ainsi que 13 211 mini-tubercules d'igname ont été distribués aux SNRA à l'échelle mondiale.

- ▶ Des techniques de teinture pour l'isolation et l'identification du champignon de la rouille et d'autres micro-organismes sur les surfaces de feuilles de soja infectées ont été standardisées. Les souches de *Colletotrichum gloeosporioides* responsables de l'infection foliaire des espèces *Dioscorea* ont été classifiées.

### Project 2

- ▶ Tetraploid (4n) x diploid (2n) crosses mostly produce triploid (3n) progeny while 2n x 4n crosses mostly produce 2n progeny, showing that ploidy in offspring is controlled by paternal microsporogenesis.
- ▶ A secondary 3n cooking banana hybrid (TM3x30456 [612-74x8075-7]) with excellent plant and fruit traits was selected in Nigeria. Another 3n selection was obtained from 2n parents (TMB2x9722-1 x TMB2x9128-3) in Uganda, demonstrating that unilateral sexual polyploidization can be used to improve East African highland bananas (EAHB).
- ▶ Total DNA analysis revealed 3 genetic subspecies in *Musa acuminata* and 2 forms in *M. balbisiana*, suggesting that there are at least 3 A genomes and 2 B genomes. A quantitative assay based on AFLP analysis of ribosomal RNA genes for discrimination of A and B genomes was developed.
- ▶ Transmission of *Beauveria bassiana* from infected to uninfected banana weevils was demonstrated while resistance to the pest was identified in Calcutta 4, TMB2x7197-2, and TMB2x8075-7.
- ▶ Long-lasting reduction in nematode infestation by hot-water treatment (HWT) of planting materials was demonstrated. Fertilizer application also suppressed nematodes, particularly without HWT. Resistant progenies (TMHx660K-1 and TMHx917K-2) from crosses between Enzirabahima (susceptible) and Calcutta 4 (resistant) were identified, increasing prospects for breeding resistance in EAHB.
- ▶ Stable integration of reporter genes was achieved for the control of banana viruses in prelude to genetic transformation against banana streak virus (BSV) and putative nematode vectors of banana die-back virus (BDBV) were identified.
- ▶ Significant progress was made in establishing *Musa* breeding operations in the Cameroon benchmark and in the duplication of hybrid propagation for distribution at Ibadan, marking a major shift in the operational mode of plantain research in West and Central Africa. *Musa* breeding and nematology research capacity in Uganda for eastern and southern Africa was restored.
- ▶ Three workshops were held to facilitate the delivery of improved hybrids to farmers and large-scale, on-farm variety demonstration plots were established in 11 states across the Nigerian plantain belt.

### Projet 2

- ▶ Les croisements entre tétraploïdes (4n) x diploïdes (2n) ont essentiellement produit des descendants triploïdes (3n), tandis que les croisements 2n x 4n ont eu des descendants 2n, ce qui indique que la ploïdie des descendants est contrôlée par la microsporogénèse paternelle.
- ▶ Un hybride secondaire de banane à cuire 3n (TM3x30456 [612-74x8075-7]) doté d'excellentes caractéristiques de la plante et du fruit a été sélectionné au Nigéria. Une autre sélection 3n a été obtenue avec deux parents 2n (TMB2x9722-1 x TMB2x9128-3) en Ouganda, démontrant ainsi que la polyploïdisation sexuelle unilatérale peut être utilisée pour améliorer la banane d'altitude d'Afrique orientale (EAHB).
- ▶ L'analyse de l'ADN total a révélé l'existence de 3 sous-espèces génétiques chez *Musa acuminata* et 2 formes chez *M. balbisiana*, ce qui suggère qu'il existe au moins 3 génomes A et 2 génomes B. Un essai quantitatif basé sur l'analyse AFLP des gènes ARN de ribosomes pour la discrimination des génomes A et B, a été mis au point.
- ▶ La transmission de *Beauveria bassiana*, des charançons du bananier infectés aux charançons non infectés, a été démontrée, tandis que la résistance au ravageur a été identifiée chez Calcutta 4, TMB2x7197-2, et TMB2x8075-7.

### Improving plantain- and banana-based systems

### Amélioration des systèmes à dominante banane et plantain



**Musa leaf with signs of banana streak virus – Symptômes du virus de la striure du bananier sur feuille de Musa**

- ▶ La réduction de longue durée de l'infestation des nématodes grâce à la méthode de traitement à l'eau chaude (HWT) du matériel de plantation, a été démontrée. L'application d'engrais a également supprimé les nématodes, en particulier sans HWT. Des descendants résistants (TMHX660K-1 et TMHX917K-2) des croisements entre Enzirabahima (sensible) et Calcutta 4 (résistant) ont été identifiés, ce qui augmente les perspectives de sélection pour la résistance chez EAHB.
- ▶ Une intégration stable des gènes reporters a été réalisée pour la lutte contre les virus de la banane, en prélude à la transformation génétique pour lutter contre le virus de la striure du bananier (BSV) et les nématodes putatifs vecteurs du virus de la verse du bananier (BDBV) ont été identifiés.

- ▶ Des progrès significatifs ont été réalisés dans la mise en oeuvre d'opérations de sélection de Musa dans le site de référence du Cameroun et en matière de duplication de la propagation d'hybrides en vue de leur distribution à Ibadan, ce qui marquerait un changement majeur dans le mode de fonctionnement de la recherche sur la banane et le plantain en Afrique occidentale et centrale. Les activités de sélection de Musa ainsi que la capacité de recherche en nématologie ont été restaurées en Ouganda pour l'Afrique orientale et australe.
- ▶ Trois ateliers ont été organisés en vue de faciliter la distribution d'hybrides améliorés aux agriculteurs et des parcelles de démonstration variétale à grande échelle ont été installées dans 11 états dans la « ceinture du plantain » au Nigéria.

### Improving cowpea–cereal systems in the dry savannas

#### Project 3

- ▶ A total of 595 new cowpea breeding lines were developed and tested in the moist savanna, dry savanna, and the Sahel. Over 60 promising lines combining high yield potential and resistance to diseases, insect pests, and *Striga* were selected. Of these, IT97K-568-11, IT97K-568-18, IT568-19, IT98K-491-4, IT98K-128-3, IT98K-131-1, IT98K-506-1, IT98K-589-2, IT98K-598-4, IT99K-381-6, IT99K-453-1, IT99K-718-6, IT99K-856-19, IT99K-1152-28, and IT99K-1258 were most promising.
- ▶ Improved *Striga*-resistant cowpea variety IT97K-499-38 yielded 50% to 300% higher than the local varieties in *Striga* infested fields in Benin Republic. It also caused high percentage of suicidal germination of *Striga hermonthica* seeds.
- ▶ Bruchid-resistant cowpea varieties showed 3–5 eggs/g seed and 12–18% adult emergence compared to 10–20 eggs/g seed and 55%–68% adult emergence in the susceptible varieties. Seed size, color, and texture had no effect on oviposition and adult emergence.
- ▶ Drought-tolerant cowpea varieties such as IT97K-499-39, IT97K-1075-7, IT97K-634, and IT97K-819-118, and heat tolerant varieties such as IT99K-1058, IT99K-1059, IT99K-1060, IT88D-643-1, IT88D-867-11, and TVu 4552 were developed.
- ▶ Some cowpea varieties were screened for shade tolerance. A 60% reduction in light caused a 56% reduction in grain yield. IT90K-277-2, IT93K-452-1, and IT89KD-391 were more shade tolerant than other varieties.
- ▶ A multiple cropping system involving a wheat crop from November to March, heat-tolerant cowpea from March to June, and rice from July to October was developed and tested at the Kadawa (Nigeria) irrigation scheme for 2 years with an annual food production of 8 to 9 t/ha.
- ▶ The IITA/ICRISAT/ILRI improved crop–livestock system was adopted by a large number of farmers. Supplementary feeding of only 200 g cowpea haulms per

day along with sorghum stover to young rams doubled their weight gain compared to feeding them sorghum stover alone.

- ▶ Significant genetic differences were observed among cowpea varieties for seed quality. The Aloka local cowpea had the hardest seed (9 kg crushing weight) and took longest to cook (57.5 minutes).
- ▶ A total of 294 sets of cowpea international trials comprising over 100 improved breeding lines were sent, on request, to national collaborators.

### Projet 3

- ▶ *Au total, 595 nouvelles lignées de sélection de niébé ont été mises au point et testées en zones de savane humide et aride ainsi que dans le Sahel. Plus de 60 lignées prometteuses combinant un potentiel de rendement élevé et une résistance aux maladies, aux ravageurs et au Striga ont été sélectionnées. Parmi ces lignées, IT97K-568-11, IT97K-568-18, IT568-19, IT98K-491-4, IT98K-128-3, IT98K-131-1, IT98K-506-1, IT98K-589-2, IT98K-598-4, IT99K-381-6, IT99K-453-1, IT99K-718-6, IT99K-856-19, IT99K-1152-28, et IT99K-1258 se sont avérées les plus prometteuses.*
- ▶ *La variété améliorée de niébé et résistante au Striga, IT97K-499-38, a donné des rendements de l'ordre de 50 à 300% supérieurs à ceux des variétés locales dans des champs infestés de Striga en République du Bénin. Elle a également causé un pourcentage élevé de germination suicidaire des graines de Striga hermonthica.*
- ▶ *Des variétés de niébé résistantes aux bruches ont indiqué une présence de 3–5 oeufs/g de graines et un taux d'émergence des adultes de 12 à 18% par rapport aux 10–20 oeufs/g de graines et 55% à 68% de taux d'émergence des adultes chez les variétés sensibles. La taille, la couleur et la texture des graines n'ont eu aucun effet sur l'oviposition et l'émergence des adultes.*
- ▶ *Des variétés tolérantes à la sécheresse telles IT97K-499-39, IT97K-1075-7, IT97K-634 et IT97K-819-118, ainsi que les variétés tolérantes à la chaleur, IT99K-1058, IT99K-1059, IT99K-1060, IT88D-643-1, IT88D-867-11 et TVu 4552 ont été mises au point.*
- ▶ *Des variétés de niébé ont été criblées pour la tolérance à l'ombrage. Une réduction de lumière de 60% a entraîné une baisse du rendement en grains de 56%. IT90K-277-2, IT93K-452-1, et IT89KD-391 se sont avérées plus tolérantes à l'ombrage que les autres variétés.*
- ▶ *Un système de cultures multiples comprenant une culture de blé, de novembre à mars, du niébé tolérant à la chaleur, de mars à juin et une culture de riz, de juillet à octobre, a été mis au point et testé en condition d'irrigation à Kadawa (Nigéria) pendant 2 ans avec une production alimentaire de 8 à 9 t/ha.*
- ▶ *Le système amélioré agriculture-élevage IITA/ICRISAT/ILRI a été adopté par un grand nombre d'agriculteurs. Une supplémentation des aliments de seulement 200 g de paille de niébé par jour avec de la paille de sorgho reçue par de jeunes bœufs a doublé leur gain en poids comparé à un régime alimentaire uniquement à base de paille de sorgho.*
- ▶ *Des différences génétiques significatives ont été observées chez les variétés de niébé en ce qui concerne la qualité de leurs grains. La variété locale Aloka a présenté le grain le plus dur (9 kg de poids de concassage) et à mis plus de temps pour cuire (57,5 minutes).*
- ▶ *Au total, 294 séries d'essais internationaux sur le niébé dont plus de 100 lignées améliorées de sélection ont été fournies aux collaborateurs nationaux suite à leur requête.*

### Project 4

- ▶ To identify varieties with a high micronutrient content, 20 early-maturing maize varieties grown in 3 diverse locations were evaluated for iron, zinc, and  $\beta$ -carotene content. One of these varieties grown at Ikenne showed 45% more iron bioavailability than a control variety widely grown in Nigeria. The results indicate that the potential exists to breed early-maturing maize varieties for high and stable mineral content across diverse growing conditions.
- ▶ In collaboration with the United States Department of Agriculture (USDA) and various universities and institutions in Nigeria, IITA conducted a national food consumption and nutrition survey. Data were collected on household composition, socioeconomic characteristics, food security, household food

*Amélioration des systèmes à dominante niébé-céréales en zone de savane aride*

*Improving maize–grain legume production systems in West and Central Africa*

consumption expenditure, and health care issues. Nutrition status was assessed and biological samples collected. Data entry and laboratory analysis of biological samples are in progress.

- ▶ An experiment was conducted at Ikenne to compare the performance of 24 early-maturing improved maize varieties developed at IITA and CIMMYT with 25 early-maturing farmers' ecotypes from Senegal under controlled drought stress and sufficient moisture supply. As a group, the improved open-pollinated (OP) varieties out-yielded the local ecotypes by 112% under drought stress and by 94% under sufficient moisture supply.
- ▶ A trial consisting of 15 maize varieties was evaluated at 3 levels of nitrogen (N) application in Mokwa and Zaria, Nigeria. The four top-ranking varieties, DTSR-W, LNPC3, ACR8328C7, and LNTP produced higher yields than a widely grown OP variety, TZB-SR, at 30 kg/ha N application. They did not differ from other varieties at 90 kg/ha N.
- ▶ Three soybean breeding lines (TGX 1909-7F, TGX 1910-10F, and TGX 1910-11F) which fix about 10% more nitrogen than the current best variety (TGX 1448-2E) were developed. Also, 15 dual-purpose soybean lines with 2–2.5 t/ha grain and 2.5–3.5 t/ha stover yields were identified for distribution to NARES.
- ▶ Extra-early (2000 Syn EE-W) and early (EV DT 97 STR C1) maturing *Striga*-resistant varieties evaluated at Férkessedougou outyielded the respective best non-*Striga*-resistant varieties by as much as 46% under artificial *Striga* infestation.

### Amélioration des systèmes de production à dominante maïs – légumineuses à graines en Afrique occidentale et centrale

#### Projet 4

- ▶ Afin d'identifier les variétés à forte teneur en micro nutriments, 20 variétés précoces de maïs cultivées dans 3 localités différentes, ont été évaluées pour leur teneur en fer, zinc et en carotène  $\beta$ . Une de ces variétés cultivées à Ikenne a présenté une bio-disponibilité en fer de 45% supérieure à celle du témoin largement cultivé au Nigéria. Les résultats indiquent l'existence d'un potentiel de sélection de variétés précoces de maïs pour une teneur minérale élevée et stable dans des conditions de culture différentes.
- ▶ En collaboration avec le Département américain de l'agriculture (USDA) et différentes universités et institutions au Nigéria, l'IITA a mené une enquête nationale sur la consommation alimentaire et la nutrition. Des données ont été collectées sur la composition des ménages, les caractéristiques socio-économiques, la sécurité alimentaire, les dépenses liées à la consommation alimentaire et les soins de santé des ménages. Le statut nutritionnel a été évalué et des échantillons biologiques collectés. La saisie de ces données et l'analyse des échantillons biologiques au laboratoire sont en cours de réalisation.



Striga-resistant maize – Du maïs résistant au Striga

- ▶ Une expérience a été menée à Ikenne afin de comparer la performance de 24 variétés précoces de maïs, mises au point à l'IITA et au CIMMYT, à celle de 25 écotypes précoces des agriculteurs du Sénégal en condition de stress de sécheresse contrôlé et d'humidité suffisante. En tant que groupe, les variétés à pollinisation libre (OP) ont eu un rendement plus élevé de 112% en condition de stress de sécheresse et de 94% en condition d'humidité suffisante.
- ▶ Un essai composé de 15 variétés de maïs a été évalué selon 3 taux d'application d'azote (N) à Mokwa et à Zaria (Nigeria). Les quatre meilleures variétés, DTSR-W, LNPC3, ACR8328C7, et LNTP ont eu des rendements plus élevés que la variété

à pollinisation libre largement cultivée, TZB-SR, à un taux d'application d'azote de 30 kg/ha. Elles n'ont pas présété de différence par rapport aux variétés à un taux d'application de 90 kg/ha.

- ▶ Trois lignées de sélection de soja (TGX1909-7F, TGX 1910-10F et TGX 1910-11F) avec un taux de fixation d'azote supérieur de 10% à celui de la meilleure variété du moment, ont été mises au point. Par ailleurs, 15 lignées de soja à usage double présentant des rendements en graines de 2 à 2,5 t/ha et de 2,5 à 3,5 t/ha de paille, ont été identifiées en vue d'une distribution auprès des SNRA.
- ▶ Des variétés extra-précoces (2000 Syn EE-W) et précoces (EV DT 97 STR C1) de variétés résistantes au Striga évaluées à Férkessedougou ont eu des rendements plus élevés que celui des variétés respectives non résistantes au Striga de l'ordre de 46% en condition d'infestation artificielle de Striga.

### Project 5

- ▶ Farmers in Oyo and Kwara states of Nigeria were satisfied with the hot-water (53 °C) therapy of seed yams for reducing nematode symptoms and improving germination, tuber quality, and market value. Under high infestation the therapy more than doubled net profit. Users' constraints were evaluated.
- ▶ *Dioscorea rotundata* Poir. (white yam) accession TDr 1640 as well as *D. alata* L. (water yam) accessions TDa 291 and TDa 289 are resistant to *D. alata* virus (DAV), *D. alata* bacilliform virus (DaBV), and cucumber mosaic virus (CMV).
- ▶ Two gibberellin inhibitors, uniconazole-P (UP) and prohexadione-calcium (PC), coupled with tuber storage at 30 °C, shortened tuber dormancy in *D. alata* accessions TDa 99/00049 and TDa 95/00328.
- ▶ Three IITA-derived clones of *D. rotundata* (TDr 89/02461, TDr 89/02565, and TDr 89/02677) were formally released as new varieties in Nigeria.
- ▶ About 30 000 seed tubers of new *D. rotundata* varieties were delivered to over 300 farmers in 10 districts of Uganda for farmer-participatory testing.
- ▶ Two cultivars of *D. rotundata* planted in December 1999 were harvested in September or December 2000 and stored at ambient conditions until March 2001. Both groups sprouted about the same time but tuber weight loss, spoilage, and edible food losses were greater in the September batch. Better quality foods were made from the December batch. Peeling loss increased, tuber moisture content decreased, and oil absorption of fried yam chips reduced with storage.
- ▶ Twelve graduate students conducted research on yams and the entries in a yam R & D personnel directory now exceed 200.
- ▶ The IFAD/WECARD/IITA Yam Project organized a work-planning workshop, a workshop on analytical skills for yam economists, and toured yam research activities in Côte d'Ivoire.

### Projet 5

- ▶ Les agriculteurs dans les états d'Oyo et de Kwara au Nigéria ont été satisfaits du traitement des semenceaux d'igname à l'eau chaude (53 °C) en vue de réduire les symptômes de nématodes et d'améliorer la germination, la qualité des tubercules et la valeur marchande. En condition de forte infestation le traitement a plus que doublé les bénéfices nets. Les contraintes au niveau des utilisateurs ont été évaluées.
- ▶ Les obtentions de *Dioscorea rotundata* (igname blanche), TDr 1640 et de *D. alata* (igname à eau), TDa 291 et TDa 289 se sont révélées résistantes au virus de *D. alata* (DAV), au virus bacilliforme de *D. alata* (DaBV) ainsi qu'au virus de la mosaïque du concombre (CMV).
- ▶ Deux inhibiteurs du gibbérelline, uniconazole-P (UP) et le calcium prohexadione (PC), doublés d'un stockage des tubercules à 30 °C, ont permis de raccourcir la dormance chez les obtentions de *D. alata*, TDa 99/00049 et TDa 95/00328.
- ▶ Trois clones IITA dérivés de *D. rotundata* (TDr 89/02461, TDr 89/02565 et TDr 89/02677) ont été officiellement homologués en tant que nouvelles variétés au Nigéria.

### Improving yam-based systems

### Amélioration des systèmes à dominante igname

- ▶ Environ 30 000 semenceaux des nouvelles variétés de *D. rotundata* ont été distribuées à plus de 300 agriculteurs dans 10 districts en Ouganda en vue d'un test participatif.
- ▶ Deux cultivars de *D. rotundata* plantés en décembre 1999 ont été récoltés en septembre ou décembre 2000 et stockés en condition ambiante jusqu'en mars 2001. Les deux groupes ont germés à peu près en même temps, mais les pertes en poids des tubercules, les avaries et les pertes en aliments comestibles, étaient plus élevées dans le lot de septembre. Des aliments de meilleure qualité ont été obtenus avec le lot de décembre. Les pertes à l'épluchage ont augmenté, la teneur en humidité des tubercules a baissé et l'absorption d'huile par les chips d'igname a baissé suite au stockage.
- ▶ Douze étudiants en formation diplômante ont mené des recherches sur les ignames et le nombre des entrées dans un annuaire du personnel R&D appliquée à l'igname dépasse à présent 200.
- ▶ Le Projet igname FIDA/CORAF/IITA a organisé : un atelier de planification des activités, un atelier sur les compétences analytiques des économistes spécialistes des ignames et des visites des activités de recherche sur l'igname en Côte d'Ivoire.

### Improving cassava-based systems

#### Project 6

- ▶ Over 10 000 tissue culture plantlets of elite cassava germplasm were distributed to collaborators in 5 African and 3 non-African countries, while over 284 000 seeds from 1100 families were distributed to 9 national programs in Africa. In addition, large-scale seedling nurseries with over 100 000 botanical seeds were established at high disease pressure sites in Kenya, Malawi, Mozambique, and Tanzania to intensify the screening effort and accelerate the deployment of improved varieties resistant to cassava brown streak disease in East and southern Africa.
- ▶ Benefits from the Uganda cassava multiplication project to combat the cassava mosaic disease pandemic, calculated using the Dynamic Research Evaluation for Management (DREAM) impact model of IFPRI, were approximately US\$36 million over 4 years (1998–2001) for an investment of US\$0.8 million.
- ▶ Cassava plant regeneration efficiency through organogenesis was doubled with the addition of 8 mg/l silver nitrate and an increase (0.8%) of agar concentration in the culture medium. Results from flow cytometry and chromosome counts of field-established cassava regenerants showed few abnormalities.
- ▶ The assessment of pasting profiles and granular characteristics of starch of 11 cassava clones indicate considerable differences in starch functionality, peak viscosity (181.9–456.3 RVU), setback viscosity (53.6–111.4 RVU), final viscosity (193.3 and 255.1 RVU), pasting temperature (73.6–75.3 °C), and starch granule sizes (9–20 µm, oval, rounded, and truncated). These results provide directions for cassava selection and improvement for cassava starch-based products, and processing variables.
- ▶ Cumulative cassava leaf litter dry matter production in southern Benin over two 12-month periods ranged from 2.4 t/ha (in a low rainfall year without fertilizer) to 4.1 t/ha (in an adequate rainfall year with fertilizer), indicating the potential of cassava to contribute to maintaining soil properties.
- ▶ IITA has expanded its collaboration with CIAT, Colombia, to enhance the Southern Africa Root Crops Research Network (SARRNET's) potential to promote expanded utilization, commercialization, and national and regional trade of cassava and sweetpotato. A public–private sector consortium has been formed to provide linkages between research and private sector partners.
- ▶ A training course on agro-enterprise development was held for 27 participants in Uganda. Over 100 researchers, technicians, and extension personnel in the region were trained in report and proposal writing, rapid multiplication techniques, and postharvest technology of cassava and sweetpotato. SARRNET has provided 16 items of cassava processing equipment to its member countries for demonstrations to farmers and the private industry.



### Projet 6

- ▶ Plus de 10 000 plantules sous forme de culture de tissus de germoplasme de manioc élite ont été distribuées aux collaborateurs dans 5 pays africains et dans 3 pays non africains, tandis que plus de 284 000 semences provenant de 1100 familles ont été distribuées à 9 programmes nationaux en Afrique. En outre, des pépinières de plantules à grande échelle avec plus de 100 000 semences botaniques, ont été installées dans des sites à forte pression de maladies dans les pays suivants: Kenya, Malawi, Mozambique et Tanzanie, en vue d'intensifier les efforts de criblage et d'accélérer le déploiement de variétés améliorées résistantes à la maladie de la marbrure du manioc en Afrique orientale et australe.
- ▶ Les bénéfices du projet de multiplication de manioc pour combattre la pandémie de la mosaïque du manioc en Ouganda basé sur le modèle impact DREAM de l'IFPRI ont été estimés à environ 36 millions de dollars américains (\$US) pendant une période de 4 ans (1998–2001), suite à un investissement de 0,8 millions de \$US.
- ▶ L'efficacité de la régénération du plant de manioc grâce à l'organogenèse a doublé suite à l'addition de 8mg/l de nitrate d'argent et à l'augmentation (0,8%) de la concentration de l'agar du milieu de culture. Les résultats de la cytométrie en flot et le compte de chromosomes du manioc régénéré qui s'est établi au champ, ont présenté peu d'anomalies.
- ▶ L'évaluation des profils de coagulation et des caractéristiques granulaires de l'amidon de 11 clones, indique des différences considérables concernant la fonctionnalité de l'amidon, la viscosité maximum (181,9–456,3 RVU), la viscosité au repos (53,6–111,4 RVU), la viscosité finale (193,3 et 255,1 RVU), la température de coagulation (73,6–75,3°C), et la taille des granules d'amidon (9–20 mm, ovale, arrondie et tronquée). Ces résultats révèlent des directions à suivre en matière de sélection et d'amélioration des produits à base d'amidon de manioc et de variables de transformation.
- ▶ Pendant une période de 12 mois dans le sud du Bénin, la production cumulative de matière sèche des débris de feuilles de manioc a été estimée entre 2,4 t/ha (en condition de faible pluviométrie et sans application d'engrais) et 4,1 t/ha (en condition de pluviométrie appropriée et avec application d'engrais), indiquant ainsi le potentiel de contribution du manioc au maintien des propriétés du sol.
- ▶ L'IITA a étendu sa collaboration avec le CIAT (Colombie) en vue de renforcer la capacité du SARRNET à promouvoir l'extension de l'utilisation, la commercialisation et le commerce national et régional du manioc et de la patate douce. Un consortium regroupant les secteurs privés et publics a été mis en place afin de servir de lien entre la recherche et les partenaires du secteur privé.
- ▶ Un stage de formation sur le développement des agro-entreprises a été organisé à l'intention de 27 participants en Ouganda. Plus de 100 chercheurs, techniciens et agents de vulgarisation de la région ont reçu une formation dans les domaines suivants: rédaction des rapports et des propositions de projet, techniques de multiplication rapide et technologies post-récolte du manioc et de la patate douce. Le SARRNET a fourni 16 équipements de transformation du manioc à ses pays membres en vue des démonstrations pour les agriculteurs et le secteur industriel privé.

### Amélioration des systèmes à dominante manioc

### Project 7

- ▶ A major international workshop on biopesticide regulatory frameworks for African countries, jointly organized by IITA and Virginia Polytechnic Institute (VPI) with financial support from the US Agency for International Development (USAID), was held at the IITA Benin station from 29 January to 2 February. Consequently, Comité inter-Etat de lutte contre la sécheresse dans le Sahel (CILSS) established a framework for the registration of biopesticides and Green Muscle® obtained the temporary sales permission of Comité Sahélien des Pesticides, the last step before full registration in nine CILSS countries.
- ▶ Biological Control Products (BCP), the South African commercial partner of Lutte Biologique contre les Locustes et Sauteriaux (LUBILOS), has shipped the first large Green Muscle® order to Niger.

### Biological control and functional biodiversity

- ▶ In Mali, several NGOs have committed themselves to the regular use of Green Muscle® for grasshopper control. Green Muscle® will be ordered on a regular basis with the support of donors.
- ▶ *Plutella xylostella* granulovirus has been imported from Kenya to Benin, an important step towards improved control of *P. xylostella* in West Africa.
- ▶ Scientists and government representatives improved their understanding on aspects of biodiversity, biotechnology, and law of the convention of biological diversity and its implementation during a West African Network for Taxonomy (WAFRINET) workshop, coorganized with the Global Biodiversity Institute (GBDI).
- ▶ More than 250 isolates of fungal pathogens of water hyacinth were collected across 3 major river systems in West Africa in different ecological zones.
- ▶ The impact of classical biological control of water hyacinth and mango mealybug has been studied, demonstrated, and published.
- ▶ Results of a survey on the distribution of African root and tuber scale *Stictococcus vayssierei* across a range of different vegetation types and non-crop host plant species indicate that this pest can be controlled through appropriate fallow management.
- ▶ The acquisition and preservation of 19 000 new specimens from faunistic surveys in Benin, Cameroon, Ghana, Nigeria, and Togo collected by IITA's insect museum strengthens its leading position in the provision of taxonomic support to NARES within West Africa.

### Lutte biologique et biodiversité fonctionnelle

#### Projet 7

- ▶ Grâce à un financement de l'USAID, un atelier international majeur sur les cadres de réglementation des bio pesticides en Afrique a été conjointement organisé par l'IITA et l'Institut Polytechnique de Virginie (VPI) à la station de l'IITA au Bénin, du 29 janvier au 2 février. Par conséquent, le Comité inter-Etat de lutte contre la sécheresse dans le Sahel (CILSS) a mis en place un cadre pour l'enregistrement des biopesticides et Green Muscle® a obtenu une autorisation temporaire de vente du Comité sahélien des pesticides, ce qui constitue la dernière étape avant son enregistrement total dans neuf pays membres du CILSS.
- ▶ Biological Control Products (BCP), le partenaire sud africain du Projet Lutte Biologique contre les Locustes et Sauteriaux (LUBILOS), a expédié au Niger la première grande commande de Green Muscle®.
- ▶ Au Mali, plusieurs ONG se sont engagés à utiliser régulièrement Green Muscle® pour lutter contre les sauteriaux. Green Muscle® fera l'objet de commandes régulières avec l'appui des bailleurs de fonds.



**The water hyacinth menace is now under control in sub-Saharan Africa –  
La maîtrise de la jacinthe d'eau est une réalité en Afrique subsaharienne**

## Research highlights

- ▶ *Le granulovirus Plutella xylostella a été importé du Kenya au Bénin : un pas important vers l'amélioration de la lutte contre P. xylostella en Afrique occidentale.*
- ▶ *Des chercheurs et représentants du gouvernement ont pu améliorer leur compréhension des aspects de la biodiversité, de la biotechnologie et de la loi relative à la convention sur la diversité biologique et son application au cours d'un atelier du WAFRINET, conjointement organisé avec l'Institut de la biodiversité mondiale (GBDI).*
- ▶ *Plus de 250 isolats de pathogènes fongiques de la jacinthe d'eau ont été collectés dans trois systèmes fluviaux majeurs dans différentes zones écologiques d'Afrique occidentale.*
- ▶ *L'impact de la lutte biologique classique contre la jacinthe d'eau et la cochenille du mangouier a fait l'objet d'études, de démonstrations et de publications.*
- ▶ *Les résultats d'une enquête sur la distribution de la cochenille africaine des racines et tubercules Stictococcus vayssierei à travers une gamme de types de végétation et sur différentes espèces de cultures non-hôtes ont indiqué que ce ravageur peut être combattu par une gestion appropriée des jachères.*
- ▶ *L'acquisition et la conservation de 19 000 nouvelles spécimens, suite à des enquêtes sur la faune au Bénin, Cameroun, Ghana, Nigéria, et Togo, collectées par le musée d'insectes de l'IITA renforcent la position de leader de ce dernier en matière de fourniture d'un appui taxonomique aux SNRVA en Afrique occidentale.*

### Project 8

- ▶ Synthetic sex pheromones of *Maruca vitrata* were used to monitor field populations at 3 locations. In central Benin, a good correlation was found between adult catches in the traps and larval populations in the field, indicating the possibility of using the traps as a tool to time pest control interventions. However, adult catches from both Tamale and Kano were low in spite of substantial field infestations, indicating possible behavioral/physiological differences in migrating *M. vitrata* populations.
- ▶ The investigation of natural enemies of the cowpea aphid (*Aphis craccivora*) in southern and central Benin revealed spectacular epizootics of the entomopathogenic fungus *Neozygites* sp. in the Ouémé valley which wiped out aphid colonies. The total absence of hymenopterous parasitoids was confirmed, indicating a potential "off the shelf" bicocontrol project.
- ▶ During 2 consecutive years, the early-maturing soybean line TGX 1835-10E was confirmed as moderately resistant to soybean rust (*Phakopsora pachyrhizi*). Some early varieties with relatively shorter pod filling duration had less yield loss in spite of high disease incidence.
- ▶ A regional adoption survey (120 farm households per country) showed that neem extracts are being used by 7, 32, and 38% of farmers in Niger, Nigeria, and Ghana, respectively, and papaya extracts by 47% of farmers in Benin. The constraint is mainly labor-intensive processing of leaves. Key factors affecting adoption of cowpea integrated pest management (IPM) are access to extension, profitability, off-farm incomes, farm labor supply, and level of education.
- ▶ A study of cowpea IPM technologies in Benin revealed that botanical insecticides are more profitable when applied on improved cowpea varieties (high yielding or pest/disease resistant). The net benefits ranged from US\$10/ha (local varieties), to US\$110/ha (improved varieties), and up to US\$200/ha with improved market access.
- ▶ Farmer field schools (FFS) trained 1112 farmers and 60 NGO and extension agents in cowpea IPM in the 9 PRONAF countries. In northern Ghana farmer-to-farmer diffusion of knowledge following FFS is increasing.

### Projet 8

- ▶ *Des phéromones sexuelles synthétiques de Maruca vitrata ont été utilisées pour assurer le suivi des populations au champ dans 3 localités. Dans la partie centrale du Bénin, une bonne corrélation a été observée entre les prises d'adultes dans les pièges et la population de larves*

### Integrated management of legume pests and diseases

### Lutte intégrée contre les ravageurs et les maladies des légumineuses

au champ, d'où la possibilité d'utiliser les pièges comme instrument de mesure des interventions de lutte contre les ravageurs. Cependant, les prises d'adultes à Tamale et à Kano ont été faibles en dépit des infestations substantielles des champs, d'où la possibilité de différences de comportements/physiologiques chez les populations migrantes de *M. vitrata*.

- ▶ Des investigations sur les ennemis naturels du puceron du niébé (*Aphis craccivora*) dans le sud et le centre du Bénin, ont révélé des épizooties spectaculaires concernant le champignon entomopathogène *Neozygites sp.* dans la vallée de l'Ouémé où il a décimé des colonies de pucerons. L'absence de parasitoïdes hyménoptères a été confirmée, indiquant ainsi l'existence d'un projet de lutte biologique potentiel presque prêt.
- ▶ Au cours de 2 années consécutives, la lignée de soja précoce TGX 1835-10E a été confirmée comme étant modérément résistante à la rouille du soja (*Phakopsora pachyrhizi*). Certaines variétés précoces dotées d'une période de remplissage des gousses relativement plus courte, ont subi moins de perte de rendement en dépit de la forte incidence de la maladie.
- ▶ Une enquête d'adoption régionale (120 ménages agricoles par pays) a révélé que les extraits de neem étaient utilisés par 7, 32 et 38% d'agriculteurs au Niger, au Nigéria et au Ghana, respectivement, et les extraits de papaye l'étaient par 47% des agriculteurs au Bénin. La contrainte s'avère être essentiellement la transformation des feuilles à haute intensité de main-d'œuvre. Les facteurs clés affectant l'adoption de la lutte intégrée (IPM) contre les ravageurs du niébé sont: l'accès aux services de vulgarisation, la rentabilité, les revenus hors champs, l'offre de main d'oeuvre agricole et le niveau d'éducation.
- ▶ Une étude sur les technologies IPM du niébé menée au Bénin, a révélé que les insecticides botaniques sont plus rentables lorsqu'ils sont appliqués sur les variétés améliorées de niébé (rendement élevé ou résistance aux ravageurs/maladies). Les bénéfices nets ont été estimés entre 10 \$US/ha (variétés locales) et 110 \$US/ha (variétés améliorées), jusqu'à 200 \$US/ha en condition d'accès amélioré au marché.
- ▶ Les Ecoles paysannes (FFS) ont permis à 1112 agriculteurs et 60 agents d'ONG et de vulgarisation de bénéficier d'une formation en IPM dans 9 pays membres du PRONAF. Dans le nord du Ghana, la diffusion des connaissances d'agriculteurs à agriculteurs est à la hausse, suite au fonctionnement des FFS.

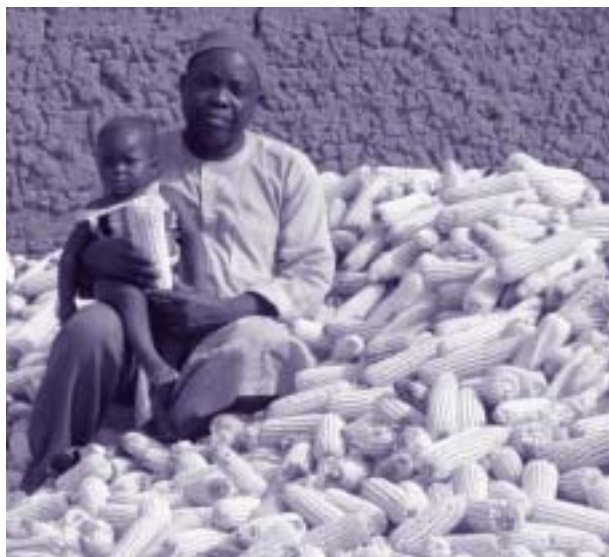
### Integrated management of maize pests and diseases

#### Project 9

- ▶ A medical epidemiology survey in the southern Guinea savanna of Benin and Togo revealed that 99% of 479 children were aflatoxin-positive, 33% showed stunted growth, and 29% were underweight. Exposure to aflatoxin was correlated with aflatoxin content of maize, maternal education and socioeconomic status, consumption of maize-based weaning food, and number of L-strain *Aspergillus flavus* colonies in the maize.
- ▶ Aflatoxin accumulation in selected IITA maize inbred lines was tested using a kernel screening assay in collaboration with the laboratory of the US Department of Agriculture (USDA) in New Orleans, and was found to be much lower (< 50 ng/g) than the best US resistant line (> 200 ng/g).
- ▶ Public awareness campaigns on aflatoxin were launched in Benin, Ghana, and Togo in collaboration with senior national policymakers, ministers of agriculture and of health, representatives of the diplomatic corps, the FAO Regional Office on Post-harvest, and Rotary International.
- ▶ Larvae of the maize stem borer *Sesamia calamistis* had a much lower survival rate (1.6%) on new advanced inbred lines 10 days after artificial infestation with 60 eggs/plant.
- ▶ Three strains of *Trichoderma* species—*T. harzianum*, *T. pseudokoningii*, and *T. hermatum*—persisted in maize stalks co-inoculated with the causal agent of maize stalk rot, *Fusarium verticillioides*, in greenhouse tests. These 3 strains reduced stalk rot and were also effective against the pathogen in *in vitro* tests. The mechanism appears to be hyperparasitism.
- ▶ Treating maize plants with neem oil at different concentrations in the greenhouse has reduced oviposition by *S. calamistis* by three-quarters even at the lowest concentration tested.

### Projet 9

- ▶ Une enquête épidémiologique médicale dans la zone de savane sud guinéenne du Bénin et du Togo a révélé que sur 479 enfants, 99% ont été testés positifs à l'aflatoxine, 33% ont présenté une croissance réduite et 29% avaient un poids inférieur à la normale. Une corrélation a été établie entre l'exposition à l'aflatoxine et la teneur en aflatoxine du maïs, à l'éducation maternelle et aux conditions socio économiques, à la consommation d'aliments de sevrage à base de maïs et au nombre de colonies d'*Aspergillus flavus* souche-L dans le maïs.
- ▶ L'accumulation de l'aflatoxine chez une sélection de lignées endogames de maïs de l'IITA a été testée en utilisant un essai de criblage des grains en collaboration avec le laboratoire de l'USDA en Nouvelle Orleans et s'est révélée beaucoup moins élevée (< 50 ng/g) que celle de la meilleure lignée résistante des Etats-Unis d'Amérique (> 200 ng/g).
- ▶ Des campagnes de sensibilisation sur l'aflatoxine ont été lancées au Bénin, au Ghana et au Togo en collaboration avec les décideurs principaux au niveau national, les ministères de l'agriculture et de la santé, les représentants du corps diplomatique, le Bureau régional de la FAO chargé des aspects post-récolte et le Rotary International.
- ▶ Des larves de foreurs de tiges de maïs *Sesamia calamistis* ont présenté un taux de survie plus faible (1.6%) sur les nouvelles lignées endogames avancées, 10 jours après l'infestation artificielle avec 60 oeufs/plant.
- ▶ Trois souches d'espèces *Trichoderma*—*T. harzianum*, *T. pseudokoningii*, et *T. hermatum*—ont persisté dans la tige de maïs co-inoculée avec le vecteur de la pourriture du maïs, *Fusarium verticillioides*, au cours de test en abri grillagé. Ces 3 souches ont réduit la pourriture des tiges et se sont également révélées efficaces contre le pathogène au cours de tests *in vitro*.
- ▶ Le traitement des pieds de maïs avec de l'huile de neem selon différentes concentrations en condition de serre, a indiqué que l'oviposition de *S. calamistis* était réduite de 3/4, même avec les plus faibles concentrations testées.



Maize has become a cash crop in sub-Saharan Africa – Le maïs est devenu une culture de rente en Afrique subsaharienne

### Lutte intégrée contre les ravageurs et les maladies du maïs

### Project 10

- ▶ The exotic phytoseiid predator *Typhlodromalus aripo* continues to persist and further expand its range in 20 countries in sub-Saharan Africa, and is providing effective management of the cassava green mite.
- ▶ The preference of *T. aripo* for hairy cassava tips was shown to be widespread and food web surveys in Malawi and Mozambique confirmed that *T. aripo* is restricted to cassava and only affects CGM populations.
- ▶ Two Brazilian isolates of *Neozygites tanajoae* introduced in 1999 into cassava fields in southeastern and northern Benin to complement CGM biocontrol by phytoseiid predators continued to persist and produce an average of 25% infection levels in CGM populations in several locations.
- ▶ In collaboration with the University of Arizona, USA, molecular techniques were used to demonstrate the association of a distinct cassava-colonizing genotype of *Bemisia tabaci* with the epidemic of severe CMD in Uganda.
- ▶ Through an emergency CMD management program in East and Central Africa, IITA, with NARES and NGOs, deployed more than 2000 ha of CMD resistant germplasm, introduced 960 elite CMD-resistant clones into open quarantine sites in Kenya and Tanzania and 158 clones in tissue culture to Congo Republic, transferred 7 newly released varieties from Uganda to Tanzania, and evaluated the performance of more than 50 clones with farmers in technology transfer centers in Kenya, Tanzania, and Uganda.

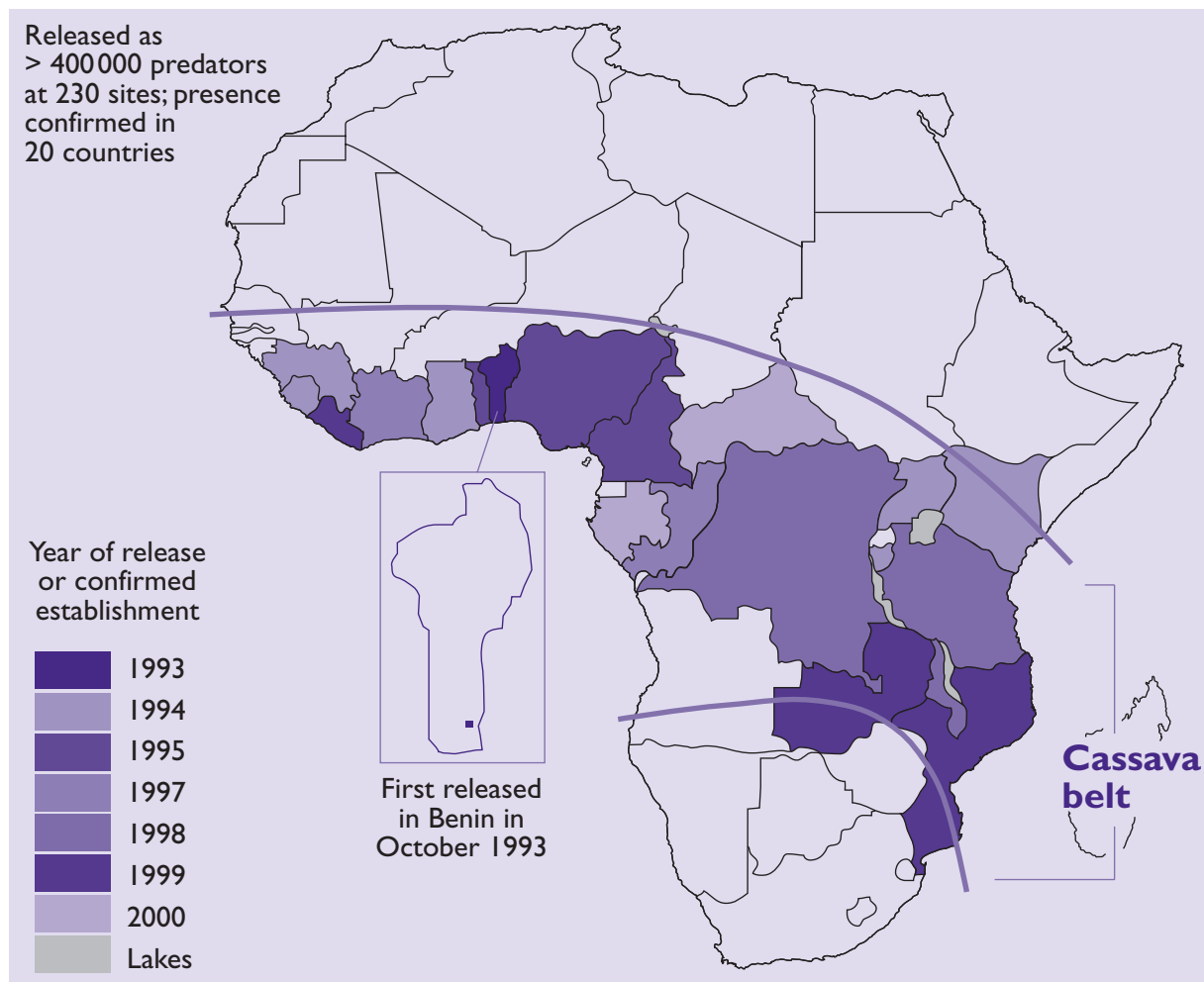
### Integrated management of cassava pests and diseases

- ▶ A preliminary impact assessment study of CMD management work in 6 districts of Uganda estimated a net present value benefit of US\$36 million shared roughly equally between producers and consumers.
- ▶ Surveys of the impact of the released predator, *Teretrius nigrescens*, on beetle pests in cassava chip stores in northern Benin, demonstrated reductions in losses from 45–91% in untreated to 15–70% in treated stores.
- ▶ In addition to cassava, the noncultivated plants *Aframomun danielli* and *Costus afer*, and several wild yam species were identified as common hosts of the African root and tuber scale, *Stictococcus vayssierei*, in fallow and young forest vegetation in western and southern Cameroon.
- ▶ Project training activities included the completion of 3 MSc and 1 PhD study programs; cassava IPM training of extension workers (and farmers) as follows: 15 (20) in Guinea, 10 (2100) in Kenya, 20 (95) in Malawi, 1000 in Tanzania, 10 (50) in Togo, and 29 (250) in Uganda; the distribution of 300 sets of cassava IPM manuals in Kenya, Tanzania, and Uganda; and the development of an educational leaflet for *T. aripo* conservation.

### Lutte intégrée contre les ravageurs et les maladies du manioc

#### Projet 10

- ▶ *Le prédateur phytoseïde exotique Typhlodromalus aripo continue de persister et étend sa propagation dans 20 pays d'Afrique subsaharienne tout en assurant une lutte efficace contre l'acarien vert du manioc.*
- ▶ *La préférence de T. aripo pour les pousses apicales pileuses du manioc a été confirmée à grande échelle et des enquêtes sur la toile alimentaire au Malawi et au Mozambique ont confirmé que T. aripo se limite au manioc et n'affecte que les populations d'acariens verts du manioc.*
- ▶ *Deux isolats brésiliens de Neozygites tanajoae introduits en 1999 dans des champs de manioc dans le sud-est et le nord du Bénin en vue de renforcer la lutte biologique contre les acariens verts au moyen des prédateurs phytoseïdes, persistent et produisent en moyenne 25% de niveau d'infection dans les populations d'acariens verts dans plusieurs localités.*
- ▶ *En collaboration avec l'Université d'Arizona (Etats-Unis d'Amérique) des techniques moléculaires ont été utilisées pour démontrer l'association entre un génotype de Bemisia tabaci distinct et colonisateur du manioc et l'épidémie sévère de la mosaïque du manioc en Ouganda.*
- ▶ *Dans le cadre d'un programme d'urgence de lutte contre la mosaïque du manioc mené en Afrique orientale et centrale, l'IITA, en collaboration avec les SNRVA et les ONG, a déployé plus de 2000 ha de germoplasme résistant à la mosaïque, introduit 960 clones élites résistant à la mosaïque dans les sites de quarantaine ouverts au Kenya et en Tanzanie ainsi que 158 clones sous forme de culture de tissus en République du Congo, transféré, de l'Ouganda en Tanzanie, 7 variétés nouvellement homologuées et évalué la performance de plus de 50 clones avec les agriculteurs dans les centres de transfert de technologies au Kenya, en Tanzanie et en Ouganda.*
- ▶ *Une étude sur l'évaluation préliminaire de l'impact portant sur les activités de lutte contre la mosaïque du manioc au niveau de 6 districts de l'Ouganda a estimé le bénéfice actuel net à 36 millions de \$US pratiquement partagé entre les producteurs et les consommateurs.*
- ▶ *Des enquêtes sur l'impact du prédateur, Teretrius nigrescens, lâché sur les coléoptères ravageurs des cossettes de manioc stockées, dans le nord du Bénin, ont révélé des réductions de pertes de l'ordre de 45 à 91% dans les stocks non traités et de 15 à 70% dans les stocks traités.*
- ▶ *En plus du manioc, les plants non cultivés de Aframomun danielli et Costus afer, ainsi que plusieurs espèces sauvages d'ignames, ont été identifiés comme hôte communs de la cochenille africaine des racines et des tubercules, Stictococcus vayssierei, dans les jachères et la végétation des jeunes forêts dans les parties occidentales et du sud du Cameroun.*
- ▶ *Les activités de formation des projets ont permis les réalisations suivantes : l'achèvement de 3 programmes de Maîtrise et d'1 programme de troisième cycle ainsi qu'une formation des agents de vulgarisation (et des agriculteurs) en lutte intégrée contre les ravageurs du manioc: 15 (20) en Guinée, 10 (2100) au Kenya, 20 (95) au Malawi, 1000 en Tanzanie, 10 (50) au Togo et 29 (250) en Ouganda; la distribution de 300 séries de manuels de lutte intégrée contre les ravageurs du manioc au Kenya, en Tanzanie et en Ouganda et l'élaboration d'un dépliant didactique sur la conservation de T. aripo.*



Countries in sub-Saharan Africa with established *T. aripo* populations –  
Pays d'Afrique subsaharienne où les populations de *T. aripo* se sont établies

### Project 11

- ▶ In the forest margins benchmark area (FMB), annual maize production in a *Mucuna*/*Pueraria* cover crop/relay system was sustained for 5 years at 2.5 t/ha. Maize grain yields after *Mucuna* var. *jaspæda* were the highest over 3 consecutive years over other *Mucuna* varieties.
- ▶ Three soybean varieties were identified for various farmer circumstances in the FMB. High nodulation was observed in shorter fallow areas, with consequent higher yields. Farmers in the northern benchmark, where yields exceed 1 t/ha without inputs, are now adopting soybean.
- ▶ In a study in the northern Guinea savanna and derived savanna benchmark areas to identify target options for herbaceous legumes, farmer participation doubled over the previous year. Four field days involving some 130 farmers were held, and new methodologies tested during farmer workshops.
- ▶ Some 280 kg of herbaceous legume seed consisting of 117 seedlots were distributed to IARCs, NARES, and NGOs.
- ▶ Successful stakeholders' workshops on weed management strategies were conducted in Zaria and Makurdi. Steering committees on *Striga* and *Imperata* were formed to coordinate research. Two seed companies and the Nigerian Participatory Rural Appraisal Network agreed to assist with workshops and scaling-up activities.
- ▶ *Mucuna* was shown to suppress speargrass by reducing available solar radiation and other mechanisms.

### Protection and enhancement of vulnerable cropping systems

- ▶ The Rockefeller Foundation provided a grant to research the effect of genotype and environment on the concentration of L-Dopa in *Mucuna* seed and other plant parts.
- ▶ For the 2001 growing season, research and development projects in Benin have purchased more than 2000 kg of *Mucuna* from Centre d'information et d'échanges sur les plantes de couverture en Afrique (CIEPCA). The CIEPCA newsletter was produced and posted on the Web, and 4 issues of *Mucuna News* have been produced.
- ▶ A standpoint survey found *Acacia auriculiformis* woodlots to be the most popular soil fertility enhancing technology coming out of 10 to 15 years of work on improved fallows in southern Benin.

### Protection et renforcement des systèmes de production vulnérables

#### Projet 11

- ▶ Dans la zone de référence de lisière forestière (FMB), la production annuelle de maïs dans un système de relais de culture de couverture *Mucuna/Pueraria*, a été maintenue pendant 5 ans avec un rendement de l'ordre de 2,5 t/ha. Les rendements en grains du maïs après *Mucuna* var. *jaspaeda* étaient les plus élevés après 3 années consécutives par rapport aux autres variétés de *Mucuna*.
- ▶ Trois variétés de soja ont été identifiées pour différentes circonstances agricoles dans la FMB. Une nodulation élevée a été observée dans les zones de jachère de courte durée avec des rendements élevés consécutifs. Les agriculteurs dans la zone de référence du nord où les rendements ont dépassé 1 t/ha sans intrants, adoptent à présent le soja.
- ▶ Dans le cadre d'une étude dans les zones de référence de la savane nord guinéenne et de savane dérivée visant à identifier les options cibles pour les légumineuses herbacées, la participation des agriculteurs a doublé par rapport à l'année précédente. Quatre journées agricoles ont été organisées avec la participation d'environ 130 agriculteurs et de nouvelles méthodologies ont été testées au cours des ateliers paysans.
- ▶ Environ 280 kg de semences de légumineuses dont 117 lots de semences ont été distribués aux CIRA, SNRA et ONG.
- ▶ Des ateliers à l'intention des parties prenantes portant sur les stratégies de lutte contre les adventices ont été organisés et couronnés de succès à Zaria et Makurdi. Des Comités directeurs relatifs au *Striga* et *Imperata* ont été mis en place en vue de coordonner les activités de recherche. Deux sociétés de production de semences et le Nigerian Participatory Rural Appraisal Network ont accepté d'appuyer les ateliers et les activités de renforcement.
- ▶ *Mucuna* a prouvé sa capacité de suppression d'*Imperata* à travers la réduction de la radiation solaire et d'autres mécanismes.



**Farmer participation is vital in the spread of new technologies – La participation des paysans est essentielle pour la diffusion des nouvelles technologies**



- ▶ La Fondation Rockefeller a alloué une subvention pour la recherche sur l'effet du génotype et de l'environnement sur la concentration de L-Dopa dans les semences de *Mucuna* et dans d'autres parties de la plante.
- ▶ Pour la campagne de culture de 2001, les projets de recherche et développement au Bénin, ont acheté plus de 2000 kg de *Mucuna* auprès du Centre d'information et d'échanges sur les plantes de couverture en Afrique (CIEPCA). Le bulletin du CIEPCA a été produit et rendu accessible sur Internet et 4 numéros de *Mucuna News* ont été produits.
- ▶ Une enquête d'opinion a révélé que les lots d'*Acacia auriculiformis* constituent la technologie d'amélioration de la fertilité du sol la plus populaire, suite à leur production au cours d'une période de 10 à 15 ans, dans des jachères améliorées dans le sud du Bénin.

### Project 12

- ▶ On-farm trials conducted from 1999 to 2000 in 19 *Striga hermonthica*-infested fields in the dry savanna agroecozone of Nigeria showed that integrated *S. hermonthica* control was highly effective, in comparison to traditional practices, both in reducing *S. hermonthica* incidence by more than 70% and in increasing maize grain yields by more than 60%.
- ▶ Maize herbicide evaluation trials conducted in Ibadan and Ilorin showed that postemergence application of nicosulfuron at 50 to 400 g a.i./ha resulted in lower *Imperata cylindrica* biomass (4 to 19 g/m<sup>2</sup>) than in the unweeded control plots (63 g/m<sup>2</sup>) at crop harvest. The effect of weeding 5 times on *I. cylindrica* biomass was equivalent to that of nicosulfuron at rates of 200 to 400 g a.i./ha.
- ▶ Comparative economic evaluation and appropriate technology targeting of 10 legume rotation treatments showed that the grain legume and dual-purpose varieties gave cumulative net benefits ranging between US\$914 and US\$1233, an increase of over 150% above the least profitable system at Ibadan fertile derived savanna (DS) site. The same trends were observed in the northern Guinea savanna where the most profitable system outperformed the green manure system economically by over 500%.
- ▶ The monitoring of N and P in Zouzouvou, DS site in Benin, indicates that the N balance was negative. N exports through harvest products and removal/burning of crop residues constituted the largest loss term. The annual P balance ranged between a surplus of 42 kg P/ha and a deficit of 30 kg P/ha.
- ▶ Preliminary maize yield data for the on-farm, farmer-managed demonstration trials confirmed earlier findings that maize grain yields in the sole fertilizer treatment were similar to yields in the mixture treatment in which about 40% of the fertilizer N was substituted by manure. Farmers' practices led to about 30% lower yields than in either of the other treatments.
- ▶ Growing maize after soybean resulted in significantly higher grain yield (1.2- to 2.3-fold increase compared to maize control) except for the maize cultivar Oba Super 2 (8644-27) an N-efficient hybrid.

### Projet 12

- ▶ Des essais en milieu réel menés de 1999 à 2000 dans 19 champs infestés de *Striga hermonthica* dans l'agroécosystème de savane aride du Nigeria ont indiqué que la lutte intégrée contre *S. hermonthica* était plus effective que les pratiques traditionnelles aussi bien en ce qui concerne la réduction, de plus de 70%, de l'incidence de *S. hermonthica* que l'augmentation des rendements en grains du maïs supérieure à 60%.
- ▶ Des essais d'évaluation des herbicides du maïs menés à Ibadan et à Ilorin, ont indiqué que l'application post-émergence d'un herbicide du maïs, le nicosulfuron selon des doses de 50 à 400 g p.a./ha a entraîné la réduction de la biomasse d'*Imperata cylindrica* (4 à 19 g/m<sup>2</sup>) par rapport aux parcelles témoins non défrichées (63 g/m<sup>2</sup>) à la récolte. L'effet de 5 défrichages sur la biomasse de *I. cylindrica* a été équivalent à celui du nicosulfuron à des doses de 200 à 400 g p.a./ha.
- ▶ L'évaluation économique comparative et un ciblage technologique approprié de 10 traitements de rotation de légumineuses ont révélé que la légumineuse à graines et les variétés à usage double

Improvement of high-intensity food and forage crop systems

Amélioration des systèmes intensifs de production vivrière et fourragère



**Striga: beautiful to behold, but deadly to maize –  
Striga: belle plante maïs ennemi mortel du maïs**

### Integrated perennial and annual cropping systems

### Project 13

- ▶ Efforts to establish tree-based assets on deforested land in southern Cameroon continued. The cocoa hybrids from Côte d'Ivoire have demonstrated significantly superior establishment vigor and growth and 3 of the 4 hybrids had a significantly greater number of flowers relative to the landraces and local hybrid. The survival of all cocoa seedlings through the second dry season was significantly greater when integrated with shade providing plantain (*Musa* spp.).
- ▶ In a remote area of the southern Cameroon Atlantic rainforest, the Sustainable Tree Crops Program (STCP) and its partners assisted about 200 small cocoa producers to create a farmers' union of village-based organizations. Cocoa marketed through the union in its initial year yielded a 33% higher price than cocoa marketed individually and inputs purchased by the union were bought at a 7% discount. The lessons learned from this are being used by STCP and its partners to reinforce farmer organizations throughout southern Cameroon and West Africa.
- ▶ An on-farm experiment evaluated the productive capacity of a mature cocoa agroforest after a 2-year abandonment with particular focus on the management of the fungal blackpod disease, the most important constraint to production. Two levels of fungicide treatment were applied and compared to a no fungicide control. A yield of over 300 kg/ha was obtained which is in excess of the average yield for this part of southern Cameroon. Yield at the no fungicide control was less than 50 kg/ha indicating the importance of the constraint.
- ▶ An on-farm experiment in southern Cameroon compared the decomposition rates in 4 types of land use—the complex cocoa agroforest, forest, *Chromolaena odorata* fallow land, and *Imperata cylindrica* fallow land. The conclusion is that the cocoa agroforest retains more ecosystem functionality when compared to short fallow cropping land-use systems.

ont produit un bénéfice cumulatif net de 914 à 1233 \$US, une augmentation de plus de 150% supérieure à celle du système le moins rentable dans le site fertile de savane dérivée d'Ibadan. Les mêmes tendances ont été observées dans la savane nord guinéenne où la plupart des systèmes rentables ont eu une performance économique supérieure, de plus de 500%, à celle du système d'engrais vert.

- ▶ Le suivi de la teneur en N et en P à Zouzouvou, le site de savane dérivée au Bénin, indique que le bilan de N était négatif. Les exportations de N à travers les produits de la récolte et l'enlèvement/brûlis des résidus de culture ont représenté les plus grandes pertes. Le bilan annuel de P s'est situé entre un surplus de 42 kg P/ha et un déficit de 30 kg P/ha.
- ▶ Des données préliminaires de rendement de maïs provenant des essais de démonstration en milieu réel et gérés par les agriculteurs ont confirmé des résultats précédents selon lesquels les rendements en grains de maïs d'un seul traitement étaient supérieurs à ceux du traitement mixte dans lequel presque 40% de l'engrais azoté étaient remplacés par la fumure. Les pratiques paysannes ont entraîné environ 40% de réduction de rendement que dans les deux autres traitements.
- ▶ La culture du maïs après le soja a produit des rendements en grains significativement plus élevés (une augmentation de 1,2 à 2,3 fois plus élevée que le maïs témoin), à l'exception du cultivar de maïs Oba Super 2 (8644-27) un hybride à utilisation efficace de N.

### Projet 13

- ▶ Les efforts visant l'établissement de produits arboricoles sur des terres ayant subi une déforestation se poursuivent dans le sud du Cameroun. Les variétés hybrides de cacao en provenance de la Côte d'Ivoire ont présenté une vigueur et une croissance significativement supérieures après leur établissement et 3 des 4 hybrides ont donné un nombre de fleurs significativement plus élevé que celui des cultivars et des hybrides locaux. La survie de tous les jeunes plants de cacao pendant la seconde saison sèche a été substantiellement plus élevée en condition d'intégration du plantain (*Musa spp.*) qui a fourni un ombrage.
- ▶ Dans une zone éloignée de la forêt ombrophile de l'Atlantique, dans le sud du Cameroun, le Programme pour le développement durable des cultures pérennes (STCP), en collaboration avec ses partenaires, a apporté une assistance à environ 200 petits exploitants de cacao en vue de la création d'une union des organisations communautaires de base. Le cacao vendu par le canal de l'union a permis, au cours de la première année, une augmentation des prix de 33% par rapport au cacao vendu individuellement; en outre, les intrants achetés par l'union ont fait l'objet d'une réduction de 7%. Les leçons tirées de cette expérience seront utilisées par le STCP et ses partenaires en vue de renforcer les organisations paysannes à la fois dans le sud du Cameroun et en Afrique occidentale.
- ▶ Une expérience en milieu réel a permis d'évaluer la capacité de production d'une agroforêt de cacao mature après un abandon de 2 ans en mettant un accent particulier sur la lutte contre la maladie cryptogamique de la gousse noire, la principale contrainte à la production. Deux doses de traitement au fongicide ont été appliquées et comparées à un traitement sans fongicide. Un rendement de plus de 300 kg/ha a été obtenu, ce qui représente un surplus par rapport aux rendements moyens dans cette partie du sud Cameroun. Dans la parcelle témoin sans fongicide, le rendement a été inférieur à 50 kg/ha, ce qui est une indication de l'importance de la contrainte.
- ▶ Une expérience en milieu réel dans le sud du Cameroun a permis la comparaison des taux de décomposition de 4 types d'utilisation des terres – le complexe agroforestier cacao, la forêt, une jachère de *Chromolaena odorata* et une jachère d'*Imperata cylindrica*. La conclusion est que l'agroforêt cacao conserve plus de fonctionnalité de l'écosystème par rapport aux systèmes de production en condition de jachère courte.

### Systemes de production intégrée cultures pérennes et cultures annuelles

### Project 14

- ▶ A household expenditure survey in 4 cities of the forest zone of Cameroon confirmed that demand prospects for domestic products (yam, plantain, cassava, maize, and sorghum) are high because they are more desired by urban dwellers than imported products such as rice.
- ▶ A new micro "Market Information Systems" model developed by FOODNET, with support from the Technical Center for Agricultural and Rural Cooperation (CTA), disseminates the information to about 5 million people in 8 districts of eastern Uganda.
- ▶ An efficiency analysis of about 560 mixed crop–livestock farms in the northern Guinea savanna of Nigeria showed that the 10% most efficient farms were smaller in size, experienced high pressure on land, were managed by younger farmers, and had higher integration between crops and livestock.
- ▶ A new, easy, and quick "GPS transect walk" method was successfully tested to quantify the spread and intensity of the adoption and adaptation processes of "best bet" cowpea technologies in the savanna zone of Nigeria.
- ▶ Positive effects of technological change and policy on the profitability of cowpea systems were found in Couffo département, southern Benin. Financial returns for systems with an improved cowpea variety and botanical insecticide (Neem) to control pests in storage generated an advantage of CFA92250/ha over systems without an improved variety. An additional gain of CFA59305/ha was recorded for systems with improved variety and Neem and located in areas with good road infrastructure.
- ▶ A landscape model of human and land resources for the forest margins was developed in Cameroon. The model links the "human" side and the "land" side

### Impact, policy, and systems analysis

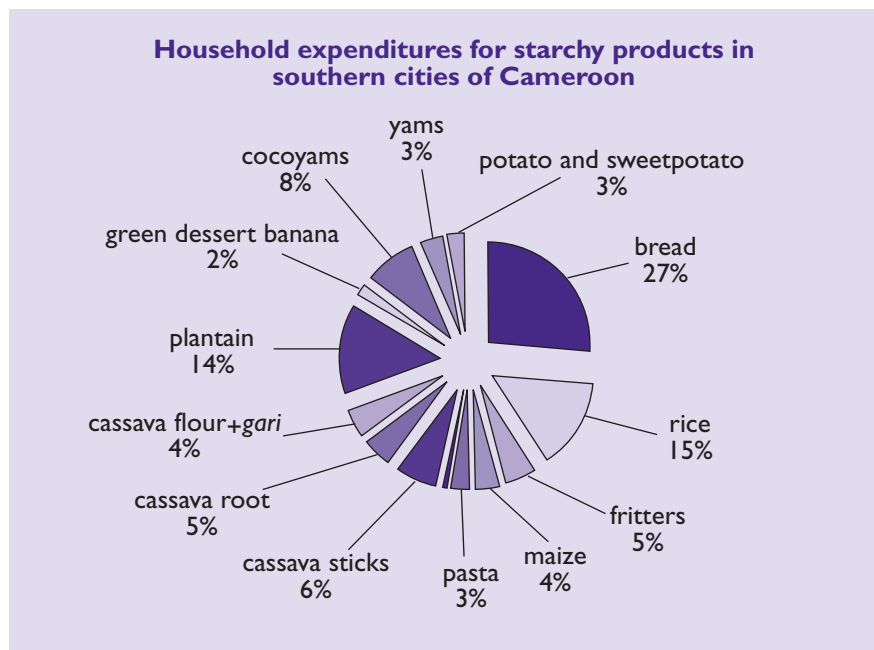
through land tenure systems and combines geo-positioning system (GPS), socioeconomic, and biophysical data in a geographic information system (GIS).

- ▶ The capability for the application of GIS techniques by IITA and NARES has greatly improved through special training of 61 scientists in eastern and West Africa. Refresher courses were held for 20 NARES scientists in West Africa on advanced methods for impact and economic analyses while 8 local manufacturers in Tanzania were trained in the maintenance and repair of processing equipment.

### Analyse de l'impact, des politiques et des systèmes

#### Projet 14

- ▶ Une enquête menée sur les dépenses des ménages dans 4 villes de la zone de forêt du Cameroun a confirmé que les perspectives de demande en produits domestiques (igname, plantain, manioc, maïs et sorgho) étaient élevées parce qu'ils sont plus prisés par les citoyens que les produits importés, le riz par exemple.
- ▶ Un nouveau micro modèle, le Système d'information sur le marché, mis au point par FOODNET, en collaboration avec le Centre technique de coopération rurale et agricole (CTA) permet la diffusion d'informations à environ 5 millions de personnes dans 8 districts dans l'est de l'Ouganda.
- ▶ Une analyse d'efficacité d'environ 560 exploitations mixtes agriculture-élevage dans la savane nord guinéenne du Nigéria a indiqué que 10% des exploitations les plus efficaces étaient de taille plus réduite, subissaient une forte pression sur les terres, étaient gérés par des agriculteurs plus jeunes et présentaient une plus grande intégration entre l'agriculture et l'élevage.
- ▶ Une nouvelle méthode de découpage en section par le Système de positionnement géographique (SPG), facile et rapide, a été testée avec succès dans la quantification de la progression et l'intensité des processus d'adoption et d'adaptation des meilleures technologies du niébé dans la zone de savane du Nigéria.
- ▶ Les effets positifs des changements technologiques et politiques sur la rentabilité des systèmes de production de niébé ont été confirmés dans le département de Couffo, dans le sud du Bénin. Les revenus financiers des systèmes à base de variétés améliorées de niébé et d'insecticide botanique (Neem) pour lutter contre les ravageurs du niébé stocké, a généré un bénéfice de 92250 CFA/ha par rapport aux systèmes sans variété améliorée. Un gain supplémentaire de 59305 CFA/ha a été enregistré avec les systèmes à base de variétés améliorées et de Neem et situés dans des zones dotées de bonnes infrastructures routières.



Diversity of the starchy diet – Une gamme riche de féculents

- ▶ Un modèle sur l'aménagement des ressources humaines et des terres pour les zones de lisière forestière a été mis au point au Cameroun. Ce modèle permet d'établir un lien entre l'aspect humain et le volet terre à travers les systèmes fonciers et combine le système de positionnement géographique (SPG), les données socioéconomiques et biophysiques dans un système SIG.
- ▶ La capacité d'application des techniques du SIG par l'IITA et les SNRA a été considérablement augmentée grâce à une formation spéciale dont ont bénéficié 61 chercheurs de l'Afrique orientale et occidentale. Des stages de recyclage ont été organisés pour 20 chercheurs des SNRA d'Afrique occidentale et ils ont porté sur les méthodes avancées d'analyse de l'impact et d'étude économique, tandis que 8 fabricants locaux ont été formés en entretien et en réparation des équipements de transformation en Tanzanie.

### SP-IPM

- ▶ Characterized the agronomic, socioeconomic, and epidemiological features of whiteflies and whitefly-transmitted viruses in cassava, legumes, and sweetpotato in Latin America, Africa, the Caribbean, and Mexico, and initiated strategic research to develop appropriate IPM options.
- ▶ Developed vision of farmer participatory research (FPR) and participatory learning (PL) to advise on what would need to be done differently at the level of farmers, community organizations, extension workers, researchers, and policymakers if FPR/PL were to be successful in IPM.
- ▶ Recorded significant yield gains by farmers at 6 pilot sites in Africa where intercropping, habitat management, crop rotation schemes, and pest-tolerant crop varieties were introduced as "best-bet" IPM options to control the parasitic weeds *Striga* and *Orobanche* in maize–legume cropping systems. The participatory approach and processes at the sites assisted organizations to develop effective partnerships to increase the understanding and adoption of IPM options.
- ▶ Increased public and donor awareness of the benefits of IPM through information materials including news stories, a brochure, and a CD-ROM of information resources.
- ▶ Caractérisation des traits agronomiques, socioéconomiques et épidémiologiques des mouches blanches et des virus transmis par les mouches blanches au manioc, aux légumineuses et à la patate douce en Amérique latine, en Afrique, aux Caraïbes au Mexique et lancement d'une stratégie de recherche en vue d'élaborer des options de lutte intégrée appropriées.
- ▶ Elaboration de méthodes de recherche participative (MARP) et de formation participative (FP) en vue de déterminer les besoins d'action à la fois au niveau des agriculteurs, des organisations communautaires, des vulgarisateurs, des chercheurs et des décideurs afin d'assurer la réussite de la MARP/FP dans la lutte intégrée contre les ravageurs.
- ▶ Enregistrement de gains de rendement significatifs par les agriculteurs dans 6 sites pilotes en Afrique, suite à l'introduction de l'association culturale, de la gestion de l'habitat, de la rotation culturale et des variétés tolérantes aux ravageurs en tant que meilleure technologie de lutte intégrée contre les phanérogames parasites *Striga* et *Orobanche* dans des systèmes de production maïs-légumineuses. L'approche et les méthodes participatives adoptées au niveau des sites ont aidé les organisations à développer des partenariats effectifs en vue d'accroître la compréhension et l'adoption des options de lutte intégrée.
- ▶ Renforcement de la prise de conscience du public et des bailleurs de fonds des bénéfices de la lutte intégrée grâce au matériel d'information comprenant des articles de presse, une brochure et un CD ROM contenant des données d'information.

### Systemwide program on integrated pest management

### Programme de lutte intégrée contre les ravageurs à l'échelle du système

## Graduate research completed in 2001

Degree	Country	University	Sponsor	Name	M/F	Research topic
<b>Crop Improvement Division</b>						
MSc	Cameroon	University of Ibadan	Self	Acha, A.	M	Variation in suitability to rapid multiplication in yams ( <i>Dioscorea</i> spp.)
MSc	Nigeria	University of Ibadan	Self	Oso, R.	F	In vitro regeneration and propagation of African cultivars of banana and plantain
PhD	Cameroon	University of Göttingen	IITA	Abang, M.	M	Population and pathotype structure of <i>Colletotrichum gloeosporioides</i> from yam ( <i>Dioscorea</i> spp.) in Nigeria
PhD	Nigeria	University of Port Harcourt	Self	Adeleke, M.	F	Meiotic studies in the genus <i>Musa</i>
PhD	Nigeria	University of Ibadan	Self	Adesoye, A.O.	M	In vivo and in vitro approaches to cowpea transformation
PhD	Nigeria	University of Port Harcourt	Self	Aziagba, P.C.	M	Cytogenetic studies in diploid and polyploid <i>Musa</i> species
PhD	Nigeria	Ahmadu Bello University, Zaria	Self	Baba, I.	M	Productivity of sorghum/cowpea and millet/cowpea intercrops as affected by cowpea genotype and row arrangement
PhD	Nigeria	University of Ibadan	Self	Egesi, C.	M	Influence of planting date, location, tuber milking, and ploidy level on flowering in <i>Dioscorea alata</i> (L.)
PhD	Nigeria	University of Port Harcourt	SMRP	Nwakanma, D.C.	M	DNA fingerprinting in the genus <i>Musa</i> L.
PhD	Nigeria	University of Ibadan	GCF	Odu, B.	M	Identification of resistance to yam viruses in <i>Dioscorea</i> species and genetic analysis of resistance to yam mosaic virus in <i>D. rotundata</i> Poir.
PhD	Nigeria	University of Ibadan	It.	Ogbe, F.O.	M	Survey of cassava begomoviruses in Nigeria and the response of resistant cassava genotypes to African cassava mosaic begomovirus infection
PhD	Nigeria	University of Ibadan	Self	Onyeka, J.T.	M	Genetic variability for resistance to root rot pathogens in cassava germplasm
PhD	Nigeria	University of Ibadan	Self	Salami, A.	M	Response to selection for yield and other agronomic traits in two tropically adapted complementary maize populations
PhD	Nigeria	University of Ibadan	Self	Udoh, E.	M	Population dynamics and genetic diversity of in situ wild yam germplasm
PhD	Nigeria	Rivers State University of Science and Technology	SMRP	Wilson, V.	F	Improving pollination efficiency and propagation for decentralization of <i>Musa</i> breeding
<b>Plant Health Management Division</b>						
MSc	Benin	Université Nationale du Bénin	IITA	Fagbemissi, R.	F	Importance of the role of rural women in the biological control against green mites in Benin
MSc	Benin	Université Nationale du Bénin	IITA	Soukossi-Hessou, A.	F	Studies on the impact of aphid, <i>Aphis craccivora</i> Koch (Homoptera: Aphididae) on cowpea, <i>Vigna unguiculata</i> (Walp.) and assessment of natural enemies associated with the pest in Benin Republic
PhD	Nigeria	University of Ibadan	Self	Babalola, O.	F	Physiological and microbiological interactions of <i>Striga hermonthica</i> and rhizosphere bacteria in maize and sorghum
PhD	Benin	University of Hannover	EC	Banito, A.	M	Development and ecozonal adaptation of integrated control measures of cassava bacterial blight in Togo
PhD	Nigeria	University of Ibadan	Self	Dongo, E.	F	Identification and characterization of cucumber mosaic virus infecting <i>Musa</i> sp. in Nigeria
PhD	Nigeria	University of Ibadan	Self	Ittah, M.A.	M	Inheritance studies and mapping of resistance genes to some seed-borne viruses of cowpea ( <i>Vigna unguiculata</i> [L.] Walp.)

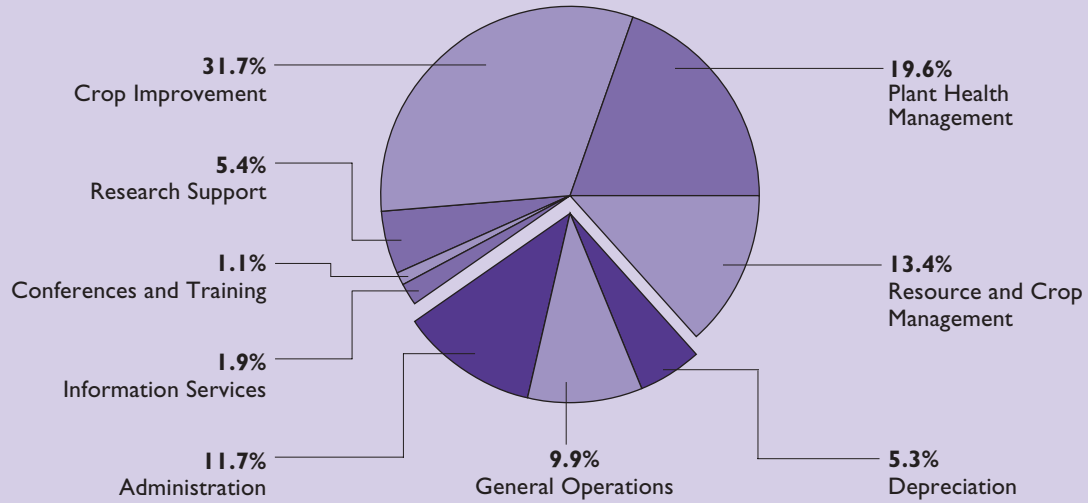
## Graduate research completed in 2001

Degree	Country	University	Sponsor	Name	M/F	Research topic
PhD	Cameroon	University of Yaoundé	IITA	Ngakou, A.	M	Potential of beneficial microorganisms on cowpea pest management in three agroecological zones of Cameroon
PhD	Nigeria	University of Ibadan	IITA	Sobowale, A.	M	Biological control of <i>Fusarium moniliforme</i> Sheld. on maize stems by some fungal isolates from maize phyllosphere and rhizosphere
PhD	Benin	University of Hannover	EC	Zinsou, V.	M	Integrated control of cassava bacterial blight adapted to ecozones of Benin with special emphasis on host plant resistance and resistance markers and mechanisms
<b>Resource and Crop Management Division</b>						
MSc	Nigeria	University of Ibadan	Self	Emerole, C.	F	Statistical investigation of some nutritional characteristics of boarding students in King's College, Lagos
MSc	Portugal	University of Reading	Self	Maridalho, P.A.	F	Soil degradation in maize
MSc	Eritrea	Georg-August University, Germany	Self	Tsegai, D.	M	Determinants of urban household demand for cassava and cassava products in northern Nigeria
PhD	Benin	University of Hohenheim	GTZ-BMZ	Akouegnon, G.E.	M	Development of strategies for the promotion of herbaceous legumes in West Africa

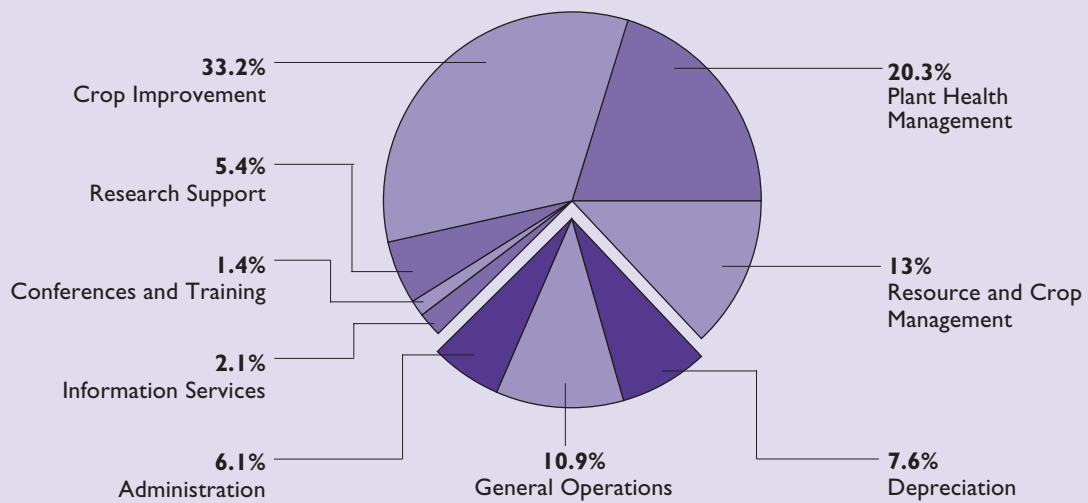
### Sponsors:

- EC: European Community  
GCF: Gatsby Charitable Foundation  
GTZ/BMZ: Gesellschaft für Technische Zusammenarbeit/  
Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (Germany)  
It.: Government of Italy  
SMRP: Strategic *Musa* Research Project (Government of Belgium)

**Core costs by operating segment, 2001**

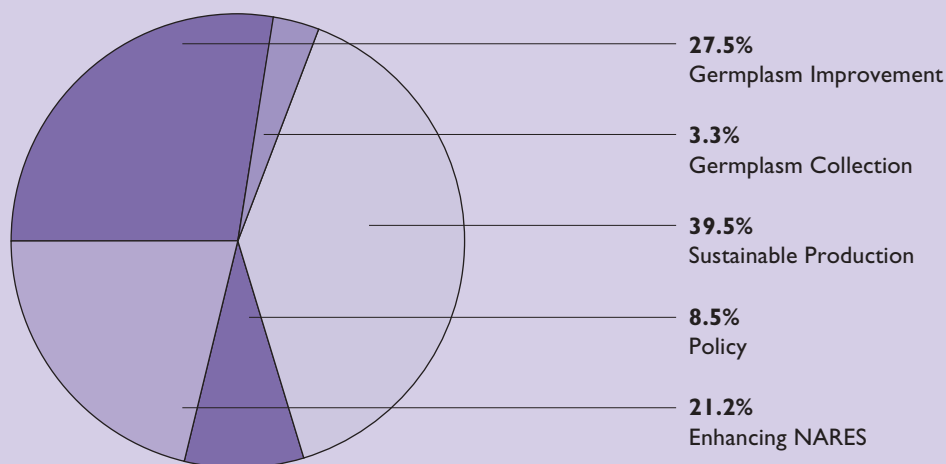


**Core costs by operating segment, 2000**

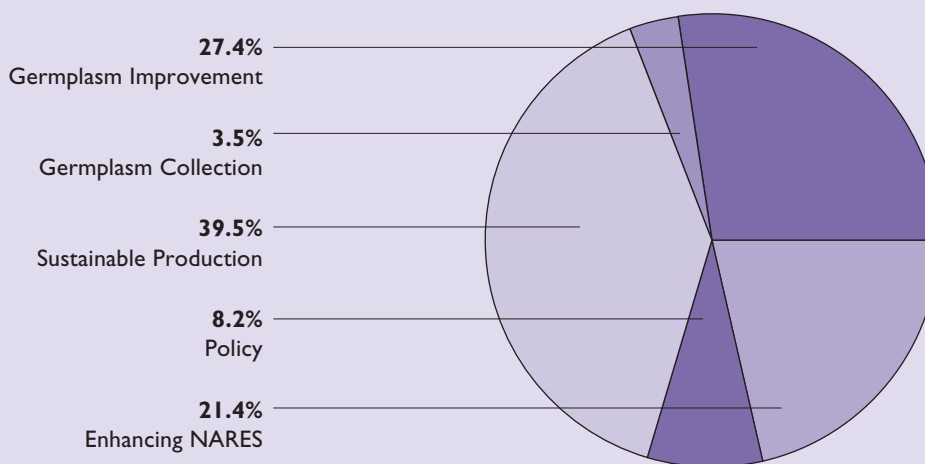




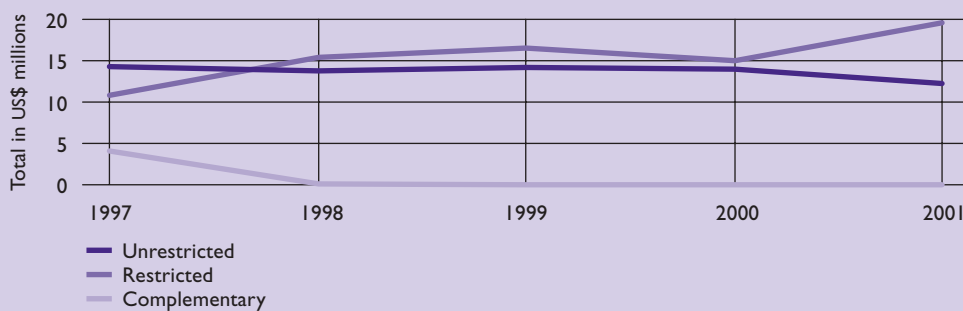
### Core research expenditure by CGIAR output, 2001



### Core research expenditure by CGIAR output, 2000



### Core (unrestricted and restricted) with complementary funding, 1997–2001



Note: The core budget is used to fund those research-related activities essential in meeting CGIAR objectives for developing countries.

**Statement of Financial Position**
*For the year ended 31 December—in US\$ thousands*

	2001	2000
<b>Assets</b>		
<b>Current assets</b>		
Cash and cash equivalents	18,869	17,258
Accounts receivable: Donors	2,238	6,361
Others	1,012	470
Inventories	918	966
Prepaid expenses	199	106
Other assets	81	173
<b>Total current assets</b>	<b>23,317</b>	<b>25,334</b>
<b>Fixed assets</b>		
Property, plant and equipment	28,283	37,929
Less: accumulated depreciation	(21,482)	(30,783)
<b>Total fixed assets – net</b>	<b>6,801</b>	<b>7,146</b>
<b>Total assets</b>	<b>30,118</b>	<b>32,480</b>
<b>Liabilities and net assets</b>		
<b>Current liabilities</b>		
Bank indebtedness and overdrafts	942	–
Accounts payable: Donors	3,118	5,688
Employees	6,552	5,282
Others	730	721
Accruals and provisions	1,723	1,546
<b>Total current liabilities</b>	<b>13,065</b>	<b>13,237</b>
<b>Net assets</b>		
Unrestricted: Unappropriated	11,492	13,323
Appropriated	5,561	5,920
Restricted (temporary)	–	–
<b>Total net assets</b>	<b>17,053</b>	<b>19,243</b>
<b>Total liabilities and net assets</b>	<b>30,118</b>	<b>32,480</b>

**Statement of Activity**
*For the year ended 31 December—in US\$ thousands*

	2001			2000
	Unrestricted	Temporarily restricted	Total	Total
<b>Revenue</b>				
Grants	12,282	19,547	31,829	28,962
Other revenues	1,965	–	1,965	1,267
<b>Total revenue</b>	<b>14,247</b>	<b>19,547</b>	<b>33,794</b>	<b>30,229</b>
<b>Expenses</b>				
Program related expenses	9,210	19,547	28,757	24,966
Management and general expenses	8,595	–	8,595	6,729
Total expenses	17,805	19,547	37,352	31,695
Indirect cost recovery	(2,072)	–	(2,072)	(1,637)
<b>Net expenses</b>	<b>15,733</b>	<b>19,547</b>	<b>35,280</b>	<b>30,058</b>
<b>Change in net assets</b>	<b>(1,486)</b>	<b>–</b>	<b>(1,486)</b>	<b>171</b>
Net assets at 1 January, 2001	19,243	–	19,243	41,748
Write-off of net book value of fixed assets	(704)	–	(704)	(22,728)
	18,539	–	18,539	19,020
Gain on disposal of fixed assets	–	–	–	52
Change in net assets during the year (deficit)/surplus	(1,486)	–	(1,486)	171
Net assets at 31 December, 2001	17,053	–	17,053	19,243

## Financial information

### Statement of Cash Flows

For the year ended 31 December—in US\$ thousands

	2001	2000
<b>Cash flows from operating activities</b>		
(Shortfall)/excess of revenue over expenses	(1,486)	171
<b>Adjustments to reconcile net cash</b>		
<b>Provided by operating activities:</b>		
Depreciation	2,015	2,418
Write-off of disposed assets	25	135
<b>Decrease (Increase) in assets:</b>		
Accounts receivable: Donors	4,123	(557)
Others	(542)	131
Inventories	48	239
Prepaid expenses	(93)	92
Other assets	92	19
<b>Increase (Decrease) in liabilities:</b>		
Bank indebtedness and overdrafts	942	–
Accounts payable: Donors	(2,570)	(942)
Employees	1,270	10
Others	9	(89)
Accruals and provisions	177	(791)
Total adjustments	5,496	665
<b>Net cash provided by operating activities</b>	<b>4,010</b>	<b>836</b>
<b>Cash flow used in investment activities:</b>		
Acquisition of fixed assets	(2,399)	(1,801)
<b>Net increase/(decrease) in cash and cash equivalents</b>	<b>1,611</b>	<b>(965)</b>
<b>Cash and cash equivalents:</b>		
Beginning of year	17,258	18,223
End of year	<b>18,869</b>	<b>17,258</b>

### Donor Funding

For the year ended 31 December—in US\$ thousands

	2001	2000
Austria	532	456
Belgium	535	1,206
BMZ, Germany	984	873
Brazil	–	20
Canada	694	733
Commission of the European Communities	1,170	53
Denmark	1,790	1,356
Department for International Development (DFID) – UK	972	667
Food and Agriculture Organization	(1)	–
Ford Foundation	–	15
France	461	453
Gatsby Charitable Foundation	289	417
International Centre for Research in Agroforestry	–	(16)
International Development Research Centre	12	(11)
International Fund for Agricultural Development	1,166	893
International Institute of Biological Control	277	258
Italy	384	234
Japan	3,073	3,831
Korea, Republic of	50	50
Netherlands	707	749
Nigeria	–	1,004
Norway	775	581
NRI	123	95
Rockefeller Foundation	955	628
Sasakawa Africa Association	139	85
South Africa	50	50
Sweden	419	392
Switzerland	758	831
United Nations Development Programme	315	237
United States Agency for International Development	10,568	8,451
United States Department of Agriculture	120	13
World Bank	3,715	3,362
Miscellaneous/Multiple Projects	797	996
Closed Projects	–	–
<b>Total</b>	<b>31,829</b>	<b>28,962</b>

## Publications by IITA staff

Contributions by IITA staff to scientific literature that became available during 2001, including journal articles, books and book chapters, papers in monographs or conference proceedings, published abstracts, research notes, and disease reports. Also included are publications based on work done by IITA staff prior to their joining IITA, especially where the work reported is of interest to IITA, and publications by staff who have left IITA, which are based on work done while they were at the Institute.

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M. Tamò, PhD, Integrated management of maize and legume pests, *Benin*  
A. Tenkouano, PhD, Improving plantain- and banana-based systems, *Onne*  
J. Wendt, PhD, Protection and enhancement of vulnerable cropping systems, *Cameroon*

### Crop Improvement Division

K.E. Dashiell, PhD, breeder/geneticist, director, *Ibadan*\*\*  
R. Ortiz, PhD, geneticist, director, *Ibadan*

### Scientists

S.O. Ajala, PhD, maize breeder/geneticist, *Ibadan*  
M.I. Andrade, PhD, agronomist, *Mozambique*  
B. Asafo-Adjei, PhD, soybean breeder/geneticist, *Ibadan*  
R. Asiedu, PhD, yam breeder/geneticist, *Ibadan*  
B. Badu-Apraku, PhD, breeder, coordinator WECAMAN, *Côte d'Ivoire*  
W. Bertenbreiter, PhD, project coordinator, IITA/GTZ/CSIR seed project, *Ghana*  
M. Bokanga, PhD, biochemist and food technologist, *Ibadan*\*\*  
A.G.O. Dixon, PhD, cassava breeder/geneticist, *Ibadan*  
C.A. Fatokun, PhD, legume biotechnologist and PRONAF coordinator, *Ibadan*  
A.J.G. van Gastel, PhD, project coordinator, IITA/GTZ/CSIR seed project, *Ghana*\*\*  
I. Ingelbrecht, PhD, head, biotechnology laboratory, *Ibadan*  
I.N. Kasele, PhD, multiplication expert, *Zimbabwe*\*\*  
B.W. Khizzah, PhD, agronomist, *Uganda*  
J.S. Machuka, PhD, molecular biologist, *Ibadan*\*\*  
N. Mahungu, PhD, agronomist, coordinator SARRNET, *Malawi*  
B. Maziya-Dixon, PhD, maize food technologist, *Ibadan*  
A. Menkir, PhD, maize breeder/geneticist, *Ibadan*  
H.D. Mignouna, PhD, molecular biologist, *Ibadan*\*\*  
N.Q. Ng, PhD, germplasm scientist, *Ibadan*  
S.Y.C. Ng, MSc, tissue culture specialist, *Ibadan*  
M. Pillay, PhD, *Musa* breeder, *Uganda*  
B.B. Singh, PhD, cowpea breeder/geneticist, *Kano*  
A. Tenkouano, PhD, *Musa* breeder/geneticist, *Cameroon*  
P. Vernier, PhD, yam specialist, CIRAD, *Benin*\*\*  
J.B.A. Whyte, PhD, breeder, coordinator EARRNET, *Uganda*

### Associate Scientist

A. Melake Berhan, PhD, maize biotechnologist, *Ibadan*

### Postdoctoral Fellows

K. Amegbeto, PhD, yam economist, *Ibadan*  
M. Gedil, PhD, molecular geneticist, *Ibadan*\*\*  
A. Kamara, PhD, maize physiologist, *Ibadan*  
H. Matsui, PhD, physiologist, *Kano*\*\*  
H. Shiwachi, PhD, yam physiologist, *Ibadan*  
G. Ude, PhD, molecular geneticist, *Onne*\*\*

### Associate Expert

S. Gilis, Ir, *Musa* agronomist (VVOB), *Onne*

### Visiting Scientists

P.K. Keese, PhD, molecular biologist/virologist, *Ibadan*  
J. Lemchi, PhD, economist, *Musa* germplasm delivery specialist, *Onne*  
P.O. Oyekan, PhD, breeder/geneticist, *Ibadan*\*\*  
N. Wanyera, PhD, yam agronomist, *Uganda*\*\*

### Consultant

A. Okoruwa, MSc, soybean food technologist, *Ibadan*

### Research Farms Unit

F.O. Adunoye, BSc, farm superintendent, *Abuja*  
P. Austin, BSc, unit head, *Onne*  
J. Olobasola, BSc, assistant unit head, *Ibadan*

**Administration and Support Services**

S.J. Udoh, AMNIM, station administrator, *Uganda*  
 R.A. Adeleke, international trials manager, *Ibadan*  
 J.N. Agba, BSc, station administrative manager, *Onne*  
 M. Umaru, BSc, station administrative manager, *Kano*

**Plant Health Management Division**

P. Neuenschwander, PhD, entomologist, director, *Benin*

**Scientists**

R. Bandyopadhyay, PhD, pathologist, *Ibadan*  
 K.F. Cardwell, PhD, pathologist, *Benin/Ibadan\*\**  
 A. Cherry, PhD, entomologist (joint appointment with NRI), *Benin*  
 D. Coyne, PhD, nematologist, *Ibadan*  
 A. Emechebe, PhD, pathologist, *Kano*  
 G. Goergen, PhD, entomologist, *Benin*  
 C. Gold, PhD, entomologist, *Uganda*  
 W.N.O. Hammond, PhD, entomologist and PRONAF coordinator, *Benin*  
 R. Hanna, PhD, acarologist, *Benin*  
 J.d'A. Hughes, PhD, virologist, *Ibadan*  
 B.D. James, PhD, entomologist, *Benin*  
 J. Langewald, PhD, insect pathologist, *Benin*  
 P. Le Gall, PhD, entomologist (IRD), *Benin*  
 J. Legg, PhD, virologist (joint appointment with NRI), *Uganda*  
 R.H. Markham, PhD, entomologist, *Ibadan\*\**  
 W. Meikle, PhD, entomologist, *Benin\*\**  
 F. Schulthess, PhD, ecologist, *Benin\*\**  
 M. Tamò, PhD, insect ecologist, *Benin*

**Postdoctoral Fellows**

T. Adati, PhD, entomologist, *Kano*  
 F. Beed, PhD, weed pathologist, *Benin*  
 K. Hell, PhD, pathologist, *Benin*  
 B. Niere, PhD, mycologist, *Uganda*  
 L. Tripathi, PhD, molecular virologist, *Ibadan*

**Associate Experts**

A. Auwerkerken, Ir, nematologist (VVOB), *Onne*  
 C. Dochez, MSc, biologist, *Uganda*  
 S. Egal, MSc, geographer, *Benin*  
 T. Hoffstadt, MSc, fungal ecologist, *Benin*  
 K. Jacobsen, MSc, nematologist, *Cameroon*  
 J.C. Meerman, MSc, nematologist, *Ibadan\*\**

**Visiting Scientists**

O. Coulibaly, PhD, agricultural economist, *Benin*  
 A. Hounsa, MD, medical epidemiologist, *Benin\*\**  
 C. Nankinga, PhD, insect pathologist, *Uganda*  
 S.H.O. Okech, PhD, entomologist, *Uganda*  
 P. Ragama, PhD, statistician, *Uganda*  
 S. Shoyinka, PhD, virologist, *Ibadan\*\**  
 M. Tindo, PhD, entomologist, *Cameroon*  
 M. Toko, PhD, entomologist, *Benin*

**Germplasm Health Unit**

M. Ayodele, PhD, plant pathologist, *Ibadan*  
 J.d'A. Hughes, PhD, unit head, *Ibadan*

**Administration and Support Services**

C.A. Soboyejo, MPhil, station administrator, *Benin*  
 J.B. Akinwumi, MSc, engineer, *Benin*  
 S. Korie, MSc, statistician, *Benin*  
 S. Nyampong, executive assistant to the director, *Benin*  
 B. Ronellenfitch, BSc, training documentation specialist (on secondment from COL, Canada), *Ibadan*  
 F. Tossé, DECF, chief accountant, *Benin*  
 R.W. Yussuf, MA, multimedia specialist, *Benin*

**Resource and Crop Management Division**

J.D.H. Keatinge, PhD, agronomist, director, *Ibadan*

**Scientists**

V. Aggarwal, PhD, breeder, coordinator ISAR/IITA/USAID project, *Rwanda\*\**  
 R.J. Carsky, PhD, agronomist, *Benin*  
 D. Chikoye, PhD, weed scientist, *Ibadan*  
 J. Diels, PhD, modeler, *Ibadan*  
 S. Ferris, PhD, enterprise development specialist, *Uganda*  
 J. Gockowski, PhD, agricultural economist, *Cameroon*  
 L.S. Halos-Kim, MSc, food and agricultural engineer, *Ibadan*  
 S. Hauser, PhD, soil physicist, *Cameroon*  
 F. Ishida, PhD, soil scientist, *Ibadan\**  
 C. Legg, MSc, landscape ecologist, *Cameroon*  
 V.M. Manyong, PhD, agricultural economist, *Ibadan*  
 C. Nolte, PhD, soil fertility specialist, *Cameroon*  
 J.L. Rueda, PhD, agronomist and STCP coordinator, *Cameroon*  
 N. Sanginga, PhD, soil microbiologist, *Ibadan*  
 S.A. Tarawali, PhD, agronomist (joint appointment with ILRI), *Ibadan*  
 G. Tian, PhD, soil fertility specialist, *Ibadan\*\**  
 S. Weise, PhD, weed scientist and officer-in-charge HFC, *Cameroon*  
 J. Wendt, PhD, soil chemist, *Cameroon*

**Associate Scientists**

B. Douthwaite, PhD, impact assessor, *Ibadan*  
 S. Kolijn, MSc, postharvest specialist, SARRNET, *Tanzania*  
 S. Schulz, PhD, agronomist, *Ibadan*  
 B.P. Vanlauwe, PhD, soil microbiologist, *Ibadan\*\**

**Postdoctoral Fellows**

P. Kormawa, PhD, agricultural economist, *Ibadan*  
 F-B. van der Meer, PhD, GIS specialist, *Ibadan*

**Associate Experts**

N. de Haan, PhD, rural sociologist, *Ibadan*  
 A. Ghebreyesus, MSc, agronomist, *Ibadan*  
 O. Lyasse, Ir, agronomist (VVOB), *Ibadan*  
 O.K. Nielsen, MSc, weed scientist, *Ibadan*  
 V. Robiglio, MSc, GIS specialist, *Cameroon*  
 K. Roing, MSc, agronomist, *Ibadan*

**Visiting Scientists**

S. Dury, PhD, agricultural economist (CIRAD), *Cameroon*  
 L. Norgrove, PhD, STCP/MARS scientist, *Cameroon*

**Consultants**

W. Adekunle, PhD, technology transfer specialist, RUSEP project, *Ibadan*  
 C. Ezedinma, PhD, agricultural economist, RUSEP project, *Ibadan*  
 O. Makinde, PhD, marketing economist, (Winrock International), *Ibadan*  
 G. Tarawali, PhD, agronomist, NARS collaboration, *Ibadan*

**Analytical Services Unit**

J. Uponi, MSc, laboratory manager, *Ibadan*

**Biometrics Unit**

S. Nokoe, PhD, biometrician, unit head, *Ibadan*  
 N.A. Akintunde, MSc, research database manager, *Ibadan*  
 S. Korie, MSc, statistician, *Benin*

**Administration and Support Services**

Y. Aoubakar, MA, station administration supervisor, *Cameroon*  
 E. Ndindjock, MBPA, finance officer, *Cameroon*  
 E.O. Oyewole, research administration manager, *Ibadan*  
 C. Yumga, station assistant, *Cameroon*

## Professional staff

### Communications and Information Services

R.P. Eaglesfield, BSc, head, communications and information, *Ibadan\*\**  
D. Mowbray, MSc, head, communications and information, *Ibadan*  
A. Moorhead, MSc, chief science editor, *Ibadan\*\**  
O. Ogunyinka, PhD, coordinator, ICS-Nigeria, *Ibadan*  
P. Philpot, BA, multimedia unit manager, *Ibadan*  
Y. Adedigba, MA, head, library and documentation, *Ibadan*  
J.I. Adeyomoye, MLS, principal librarian, *Ibadan\*\**  
T. Babaleye, MCA, public information manager, *Ibadan*  
E.O. Ezomo, MLS, principal librarian, *Ibadan*  
Y. Olatunbosun, BSc, editor, *Ibadan*  
T.T. Owoeye, MLS, coordinating editor, *Ibadan*  
A. Oyetunde, MA, editor, *Ibadan*  
R. Umelo, BA, consultant editor, *Ibadan*

### External Liaison Office

#### Project Liaison

A.P. Uriyo, PhD, head, *Ibadan\*\**

#### NARS Liaison

E.A. Atayi, PhD, agricultural economist, coordinator, EPHTA, *Ibadan*

#### Training

M. Ajayi, MSc, research training specialist, *Ibadan*  
R. Obubo, MSc, research training specialist, *Ibadan*  
C. Okafor, MBA, manager, individual training, *Ibadan*

#### Interpretation and Translation Unit

C.H. Dia, MA, head, *Ibadan\*\**

### Scientists of Other IARCs/AROs Resident at IITA

J.J. Adu-Gyamfi, PhD, agronomist, ICRISAT, *Ibadan*  
R. Brummett, PhD, ICLARM scientist, *Cameroon*  
A. Cherry, PhD, entomologist, (joint appointment with NRI), *Benin*  
S. Dury, PhD, agricultural economist, CIRAD, *Cameroon*  
R. Fashola, PhD, postdoctoral fellow, Hirose project, *Ibadan*  
F. Idachaba, PhD, principal research fellow, ISNAR, *Ibadan*  
A. Larbi, PhD, agronomist, ILRI, *Ibadan*  
P. Le Gall, PhD, entomologist, IRD, *Benin*  
J. Legg, PhD, entomologist, NRI (joint appointment with IITA), *Uganda*  
O. Munyemana, PhD, project scientist, WARDA, *Ibadan*  
J. Niezen, PhD, ruminant nutritionist, ILRI, *Ibadan*  
O. Ndoye, PhD, forest economist, CIFOR, *Cameroon*  
O. Osiname, PhD, soil scientist, WARDA, *Ibadan*  
S.A. Tarawali, PhD, agronomist (joint appointment with ILRI), *Ibadan*  
P. Vernier, PhD, yam specialist, CIRAD, *Benin\*\**  
T.O. Williams, PhD, agricultural economist, team leader, ILRI, *Ibadan*

### Corporate Services Division

S.A. Adetunji, PhD, soil scientist, a/director, *Ibadan*  
P. Watts, BSc, director, *Ibadan\*\**

#### Budget and Finance

E. Estoque, CA, chief financial officer, *Ibadan*  
B.A. Adeola, FCIS, accountant, *Ibadan*  
J.E. Bolarinwa, MBA, payroll accountant, *Ibadan*  
S. Ogunade, treasury manager, *Ibadan*  
K.O. Olatifede, ACA, special projects accountant, *Ibadan*  
O. Sholola, ACA, corporate accounting manager, *Ibadan*

#### Computer Services

J. Scott, MSc, manager, computer services, *Ibadan*

#### Human Resources/Personnel

C.F. McDonald, MSc, manager, human resources (irs), *Ibadan*

O.I. Osotimehin, BSc, DDA, personnel manager (nrs), *Ibadan*

J.B. Adenuga, AMIPM, employee services manager, *Ibadan*  
A. Ohanwusi, MBA, planning/training manager, *Ibadan*

#### Management Information Systems

R. Lafond, CA, oracle implementation manager, *Ibadan\*\**  
I. Neish, HCIMA, head, *Ibadan*  
N.N. Eguzozie, BSc, financial information systems (FIS) manager, *Ibadan*  
L.O. Afemikhe, MSc, senior technical analyst (FIS), *Ibadan*

J. Ukpong, ACA, FIS senior analyst, *Ibadan*

#### Materials Logistics

B. Draper, materials logistics manager, *Ibadan*

#### Medical Unit

F.O.A. Ajose, MD, head, IITA clinic, *Ibadan*  
E.O. Lawani, MD, physician, *Ibadan*  
F. O'Dwyer, BSc, nurse/practitioner, *Ibadan\*\**  
P.O. Ojo, MSc, medical laboratory services officer, *Ibadan*

#### Physical Plant Services

A. Bhatnagar, BSc, head, physical plant services, *Ibadan*  
R. Bishop, site maintenance services officer, *Ibadan*  
S.W. Quader, BSc, electronic services officer, *Ibadan*  
E.O. Akintokun, research vehicle services officer, *Ibadan*  
F.K. Alude, HND, heavy equipment and fabrication services manager, *Ibadan*  
P.T. Lamuren, BSc, telecommunication services officer, *Ibadan*

M.A. Oyedeji, C&G (FTC), electrical services officer, *Ibadan*  
O.O. Taiwo, HND, assistant services officer, *Ibadan*

#### Auxiliary Services

H. Cameron, manager, hotel and catering services, *Ibadan*  
D. Errington, MSc, specialist science teacher, *Ibadan*  
D. Hurst, BEd, head, international school of IITA, *Ibadan*  
K. Hurst, Dipl. Ed, teacher, international school of IITA, *Ibadan*  
C. Inniss-Palmer, MA, specialist english teacher and deputy head, international school of IITA, *Ibadan*  
D.J. Sewell, manager, aircraft operations, *Ibadan*  
W. Ekpo, ACIS, security manager, *Ibadan*  
C.A. Enahoro, HND, head, travel services, *Lagos\*\**  
A. Ndakotsu, MBA, assistant head, travel services, *Lagos\*\**  
M.O. Olanrewaju, HND, assistant manager, hotel and catering services, *Ibadan*

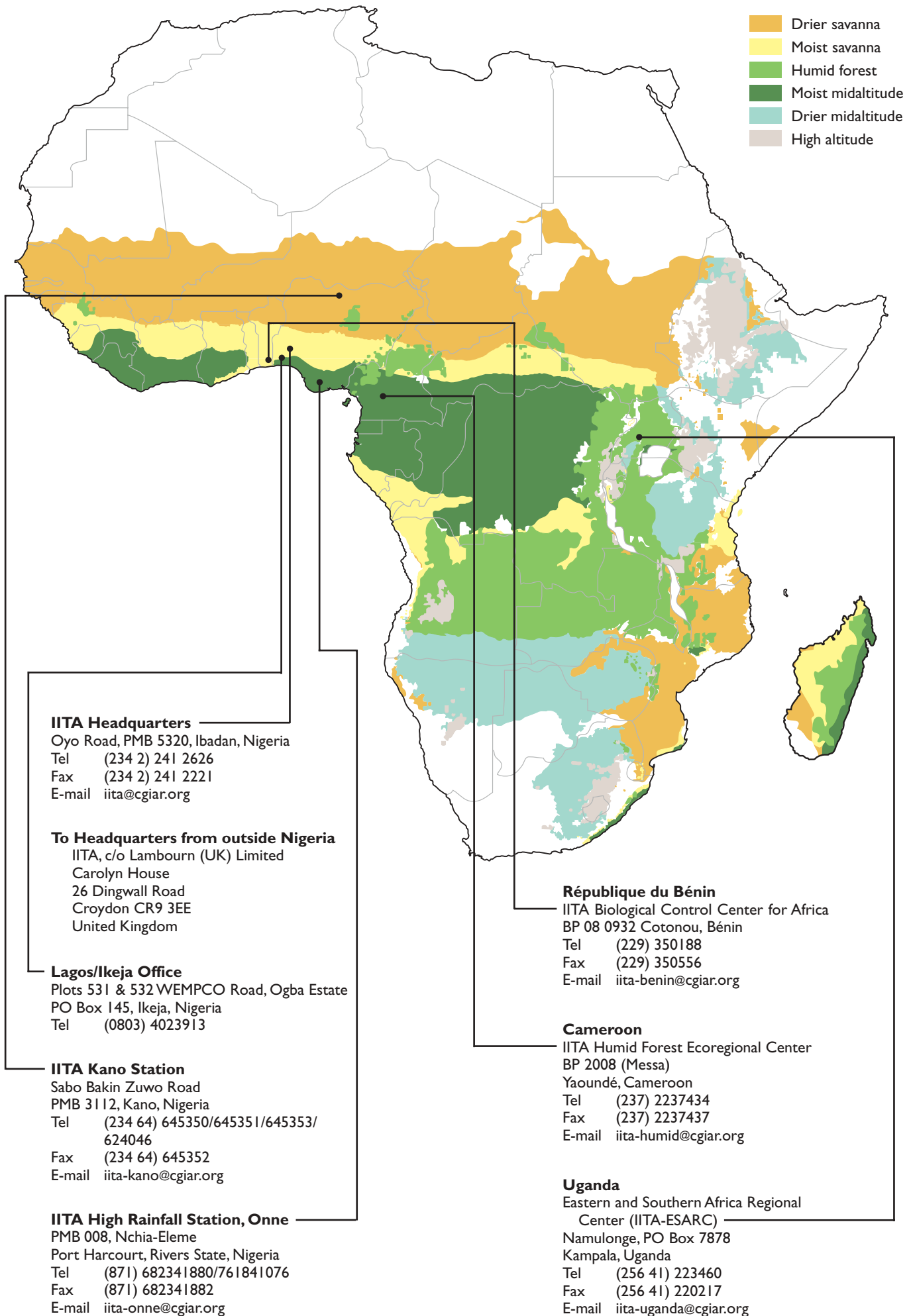
Italics are used for *country* of work location other than for Nigeria when *location* within Nigeria is given.

\* Passed away in 2001

\*\* Left in 2001

### Abbreviations used in this report

<b>AFLP</b>	amplified fragment length polymorphism
<b>BDBV</b>	banana die-back virus
<b>BSV</b>	banana streak virus
<b>BCP</b>	Biological Control Products (South Africa)
<b>BMZ</b>	<i>Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (Germany)</i>
<b>CGM</b>	cassava green mite
<b>CIAT</b>	<i>Centro Internacional de Agricultura Tropical</i>
<b>CIEPCA</b>	<i>Centre d'information et d'échanges sur les plantes de conversion en Afrique</i>
<b>CIFOR</b>	Center for International Forestry Research
<b>CILSS</b>	<i>Comité inter-Etats de lutte contre la sécheresse dans le Sahel</i>
<b>CIMMYT</b>	<i>Centro Internacional de Mejoramiento de Maíz y Trigo</i>
<b>CIRAD</b>	<i>Centre de coopération internationale en recherche agronomique pour le développement (France)</i>
<b>CGM</b>	cassava green mite
<b>CMD</b>	cassava mosaic disease
<b>CSIR</b>	Council for Scientific and Industrial Research
<b>CTA</b>	Technical Center for Agricultural and Rural Cooperation (EEC)
<b>DFID</b>	Department for International Development (UK)
<b>DNA</b>	deoxyribonucleic acid
<b>DREAM</b>	Dynamic Research Evaluation for Management (an impact model)
<b>DS</b>	derived savanna
<b>EACMV</b>	East African cassava mosaic virus
<b>EAHB</b>	East African highland banana
<b>EARRNET</b>	East Africa Root Crops Research Network
<b>EPHTA</b>	Ecoregional Program for the Humid and Subhumid Tropics of Sub-Saharan Africa
<b>ESARC</b>	Eastern and Southern Africa Regional Center
<b>ESA</b>	East and Southern Africa
<b>FIS</b>	Financial Information System
<b>FFS</b>	farmer field schools
<b>FMB</b>	forest margins benchmark area
<b>FOODNET</b>	Postharvest and Marketing Research Network for Eastern and Central Africa
<b>FPR</b>	farmer participatory research
<b>GBDI</b>	Global Biodiversity Institute
<b>GCF</b>	Gatsby Charitable Foundation
<b>GIS</b>	geographic information system
<b>GPS</b>	geo-positioning system
<b>GTZ</b>	<i>Gesellschaft für Technische Zusammenarbeit (Germany)</i>
<b>HFC</b>	Humid Forest Ecoregional Center
<b>IARC</b>	international agricultural research center
<b>ICLARM</b>	International Center for Living Aquatic Resources Management
<b>ICRISAT</b>	International Crops Research Institute for the Semi-Arid Tropics
<b>IFAD</b>	International Fund for Agricultural Development
<b>IFPRI</b>	International Food Policy Research Institute
<b>ILRI</b>	International Livestock Research Institute
<b>IPM</b>	integrated pest management
<b>ISNAR</b>	International Service for National Agricultural Research
<b>LUBILOSA</b>	<i>Lutte biologique contre les locustes et sauteriaux</i>
<b>NARES</b>	national agricultural research and extension system(s)
<b>NGO</b>	nongovernmental organization
<b>NGS</b>	northern Guinea savanna
<b>NRI</b>	Natural Resources Institute (UK)
<b>PEDUNE</b>	<i>Project écologiquement durable du niébé</i>
<b>PL</b>	participatory learning
<b>PRONAF</b>	<i>Projet niébé pour l'Afrique</i>
<b>RAPD</b>	random amplified polymorphic DNA
<b>RNA</b>	ribonucleic acid
<b>RUSEP</b>	Rural Sector Enhancement Project
<b>SARRNET</b>	Southern Africa Root Crops Research Network
<b>SP-IPM</b>	Systemwide Program on Integrated Pest Management
<b>STCP</b>	Sustainable Tree Crops Program
<b>USAID</b>	United States Agency for International Development
<b>USDA</b>	United States Department of Agriculture
<b>VPI</b>	Virginia Polytechnic Institute
<b>WAFRINET</b>	West African Network for Taxonomy
<b>WCA</b>	West and Central Africa
<b>WECAMAN</b>	West and Central Africa Maize Network (SAFGRAD)
<b>WECARD</b>	West and Central African Council for Research and Development



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