CASSAVA BIOTECHNOLOGY RESEARCH PROJECTS

Supplement to CBN Newsletter October 1994, supersedes previous versions

CBN thanks many readers for corrections and information received and incorporated in this list of projects that use plant biotechnologies (tissue- and gene-based) or microbial-based biotechnologies for cassava research. Additional information on these and related cassava research projects is available from the CBN Coordinator and through many of the listed projects.

The CBN Coordinator will be pleased to receive information for future updates.

How this list is organized:

I. Projects using or developing biotechnological tools

A. For genetic improvement of cassava

- Molecular and cytological characterization of *Manihot* genomes
- Molecular map of cassava
- Useful genes and gene promoters
- Regeneration and genetic transformation
- Regulation of reproductive biology

B. For conservation, exchange, propagation of *Manihot* genetic diversity

- Diagnostic and phytosanitary methods
- Cryopreservation for long term conservation
- Tissue culture for germplasm conservation and micropropagation

II. Projects working on biotechnology applications

A. For realizing new opportunities for cassava

- Starch quantity and quality
- Post harvest keeping quality
- Microbial biotechnologies for new or improved products & processes
- Improved nutritional quality
- Cassava performance in stress environments

B. For solving problems of cassava

- Integrated pest management
- Resistance to viral diseases
- Biochemistry, physiology, genetics of cassava cyanogenesis
- Fermentation systems for cyanogen reduction
- Fermentation for processing waste management

Some projects are listed more than once. Example: a project on cloning genes for starch quality would be listed under the tool being developed (useful genes) and again under the application (starch quality).

I. Biotechnological tools: For genetic improvement of cassava

MOLECULAR AND CYTOLOGICAL CHARACTERISATION OF *MANIHOT* GENOMES			
Brazil	Univ. de Brasilia, Cx.P. 04477 CEP 70919, Brasilia	N. Nassar	Chromosome engineering; polyploidy
Brazil	CENARGEN/EMBRAPA, Cx. P. 02372, 70700 Brasilia, DF	G.S.C. Buso, L.J.C.B. Carvalho	Brazilian *Manihot* spp.: diversity and relationships
France	INRA, Stat. Amelioration Arbres Forestiers, 45160 Ardon	F. Lefevre, A. Charrier	Diversity and heredity of isozymes, African cassava

MOLECULAR AND CYTOLOGICAL CHARACTERIZATION OF *MANIHOT* GENOMES			
France/ United Kingdom	ORSTOM, 2051 ave du Val de Montferrand; BP 5045; 34032 Montpellier, France/ Univ. of Bath, School of Biological Sciences, Claverton Down, Bath BA2 7AY, UK	P. Marmey (ORSTOM) J. Beeching (U. Bath)	Genetic diversity among African cultivars
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	J. Jos; K. Vasudevan	Polyploidy; cytogenetics
International	CIAT, Biotechnology Research Unit and Cassava Program, A.A. 6713, Cali, Colombia	J. Tohme, M. Fregene, F. Angel, M. Bonierbale, C. Iglesias, C. Ocampo	Molecular markers for management of world *Manihot* collection
International	IITA, Oyo Rd., PMB 5320, Ibadan, Nigeria	c/o R. Asiedu	RAPD & isozyme finger-printing: germplasm mgt., phylogeny res; cytogenetics
Singapore	National University of Singapore, Dept. Botany, Kent Ridge, Singapore 0511	Yeoh, H.H., S. Joseph	Cassava chloroplast DNA variation
United Kingdom	Univ. Newcastle upon Tyne, Dept. Biochem & Genetics, Medical School, Newcastle upon Tyne, NE2 4HH	H.R. Haysom	Phylogeny of *Manihot*
United States	Washington Univ., Biology Dept., One Brooking Drive, Campus Box 1137, St. Louis, MO 63137	B. Schaal	Phylogeny of *Manihot*

MOLECULAR MAP OF CASSAVA			
International	CIAT, Biotechnology Research Unit and Cassava Program, A.A. 6713, Cali, Colombia	J. Tohme, F. Angel, M. Fregene, M. Bonierbale	RFLPs and RAPDs mapping, genome analysis
United States	Univ. of Georgia, Botany Dept., Athens Georgia 30602	G. Kochert P. Chavarriaga	Microsatellite mapping of cassava

USEFUL GENES AND GENE PROMOTERS CHARACTERIZED AND/OR CLONED			
Brazil	CENARGEN/EMBRAPA, Cx. P. 02372; 70700 Brasilia, DF	L. Carvalho	Molec. biology of starch biosynthesis and deposition
International	CIAT, Biotechnology Research Unit, A.A. 6713, Cali, Colombia	J. Mayer L. Destefano	Molecular taxonomy of lactic acid bacteria; in-situ hybridization of cassava PEP-carboxylase
Netherlands	Agric. Univ. Wageningen, Dept. Plant Breeding, PO Box 386; 6700 Wageningen	E. Jacobsen, R. Visser	Starch quality and quantity
Trinidad	Univ. of the West Indies, St. Augustine	G. Sirju-Charran	Molecular biology of cassava starch deposition
United Kingdom	Univ. Newcastle upon Tyne, Dept. Biochem & Genetics, Medical School, Newcastle upon Tyne, NE2 4HH	M. Hughes	Key enzymes in cyanogen metabolism

IMPROVEMENT OF CASSAVA PLANT REGENERATION AND GENETIC TRANSFORMATION			
Argentina	Inst. de Botanica del Nordeste, Sargento Cabral 2131, C.C. 209, Corrientes	L. Mroginski	Somatic embryogenesis
Australia	CAMBIA, c/o CSIRO Dev. Plant Industry, GPO Box 1600, Canberra ACT 2601	R. Jefferson	Non-destructive transformation marker
Brazil	CENARGEN/EMBRAPA, Cx.P.02372, 70700 Brasilia, DF	C.B. Cabral; F.J.L. Aragao; D. Monte-Neshich	Somatic embryogenesis; transformation of protoplasts
Canada /Switzerland	Univ. of Guelph, Dept. Crop Sci., Guelph, Ontario, N1G 2W1, Canada /ETH-Zentrum, Inst. Agrarwirtschaft, Zurich, CH 8092, Switz.	L. Erickson (Guelph) C. Sautter (ETH) I. Potrykus (ETH)	Microprojectile bombardment of meristems/ non-genotype-specific
China	South China Academy of Tropical Crops, National Key Biotech. Lab. for Tropical Crops, P. No. 571737, Danxian, Hainan, China	Zheng, X.; Zhou Peng	Regeneration from callus; transf. using *Agrobacterium*, microprojectiles
China	South China Institute of Botany (Academia Sinica); Wu Shen, 510650, Guangzhou, PRC	Li, Geng Guang; Zhang, L.Y.; Huang, W.-Y.	Regeneration, transf. of Chinese varieties
France	LPRGAPT-ORSTOM, 2051 ave du Val de Montferrand; BP 5045; 34032 Montpellier	J. Sequier A. Charrier	Somatic embryogenesis
France	Univ. de Paris Sud 11; Morphogenesea Vegetale Experimentale, Bat. 360; 91405 Orsay Cedex	G. Ducreux	Regeneration and organogenesis
France	Univ. de Picardie Jules Vernes, Fac. de Sciencea/Androgenese et Biotech.; Ilot des Poulies; 33 rue Saint-Leu; 80039 Amiens Cedex	K. Koffi N'Da B. Sangwan	Regeneration
India	Tamil Nadu Agricultural University, Coimbatore 641 003, India	T.C. Narayanaswamy, N.M. Ramaswamy	Somatic embryogenesis
Indonesia	Indonesian Inst. of Sciences, R&D Centre for Biotechnology,. Jl.Raya Cibinong Km 46, Cibinong 16911 (Bogor PO Box 422)	E. Sudarmonowati	Somatic embryogenesis in Indonesian cultivars
International	CIAT, Biotechnology Research Unit, A.A. 6713, Cali, Colombia	W. Roca J. Mayer L. Destafano	Agrobacterium- and microprojectile bombardment transformation
International	IITA, Oyo Road, PMB 5320, Ibadan, Nigeria	S. Y. C. Ng	Somatic embryogenesis in African cassava accessions
Netherlands	Agric. Univ. Wageningen, Dept. Plant Breeding, PO Box 386; 6700 AJ Wageningen	E. Jacobsen R. Visser C.J.J.M. Raemakers	Somatic embryogenesis systems; agrobacterium-mediated tranaformation
Singapore	National Univ. of Singapore; 10 Kent Ridge Crescent, Singapore 0511	Chia, Tet-Fatt	Transformation (particle bombardment) (project ended)
South Africa	Univ. of the Witwatersrand, Dept. Botany, PO Wits, Johannesburg, South Africa 2050	V.M. Gray	Somatic embryogenesis, Agrobacterium-med. transf., protoplast transf., protoplast culture and regeneration
United Kingdom	Univ. Bath, School of Biological Sciences, Claverton Down, Bath BA2 7AY	G. Henshaw N. Taylor	Regeneration systems incl. somatic embryogenesis

IMPROVEMENT OF CASSAVA PLANT REGENERATION AND GENETIC TRANSFORMATION			
United Kingdom	Rothamstead Exp't. Station, Harpenden, Hertfordshire, AL5 2JQ	P. Lazzari P. Shewry	Genetic transformation via electroporation
United States	International Lab. for Tropical Agricultural Biotechnology (ILTAB) /(ORSTOM), The Scripps Res. Inst., 10666 N. Torrey Pines Rd., La Jolla, CA 92037	C. Fauquet C. Schopke R. Beachy	Agrobacterium, microprojectile bombardment, and combined methods
United States	Purdue Univ., Dept. of Biology, West Lafayette, Indiana 47907; Ohio State Univ., Dept. Plant Biology, Columbus OH 43210-1293 USA	S. Gelvin (Purdue); R. Sayre (Ohio)	Agrobacterium-mediated transformation

REGULATION OF REPRODUCTIVE BIOLOGY *(flowering, pollen conservation, haploid production, apomixis, true seed)*			
Brazil	Univ. de Brasilia, Px. P 04477, CEP 70919, Brasilia	N. Nassar	Selection of apomictic clones; cytology
India	CTCRI, Sreekariyam, Trivandrum, 695 017 Kerala	N.G.Nair; A. Mukerjee; M. Unnikrishnana	Anther and embryo culture
Japan	Miyazaki Univ., Applied Genetic & Biotechnology Div., Fac. of Agric., Miyazaki 889-21	T. Adachi M. Ogburia	Cytological search for apomixis

Biotechnological tools: For conserving, exchanging, and propagating Manihot genetic diversity

DIAGNOSTIC AND PHYTOSANITARY METHODS FOR SAFE CASSAVA GERMPLASM TRANSFER			
France	ORSTOM, Lab. de Phytopathologie, 2051 ave du Val de Montferrand; BP 5045; 34032 Montpellier	V. Verdier	Diagnostics: cassava bacterial blight (prop.proj.)
India	CTCRI, Sreekariyam, Trivandrum, 695 017 Kerala	M. Thankappan	Thermotherapy for ICMV
International	CIAT, Biotechnology Research Unit and Genetic Resources Unit, A. A. 6713, Cali, Colombia	W. Roca, R. Hildago	Thermotherapy for virus cleanup
Nigeria/ International	Inst. for Agric. Res. & Training, Obafemi Awolowo Univ., Moor Plantation, PMB 5029, Ibadan; IITA Biotech Unit and TRIP, Oyo Rd. PMB 5320, Ibadan	S.A. Shoyinka (IAR&T); G.Thottappilly, R. Asiedu (IITA)	ACVM diagnostics for African NARS (proposed project)
United Kingdom	Scottish Crops Research Institute, Invergowrie, Dundee, DD2 5DT	B.D. Harrison, M.M. Swanson, D.J. Robinson	Diagnostic methods for ACMV, other viri

CRYOPRESERVATION FOR LONG-TERM CONSERVATION OF CASSAVA GENETIC RESOURCES			
France	ORSTOM/LRGAPT, 2051 ave du Val de Montferrand; BP 5045; 34032 Montpellier	F. Engelmann; E. Benson; N. Chabrillange	Alginate bead encapsulation of meristem apices
International	CIAT, Biotechnology Research Unit, A.A. 6713, Cali, Colombia	W. Roca, R. Escobar, G. Mafla	Long-term effects; genotype range; shoot tips, zygotic embryos
United Kingdom	Univ. of Bath, School of Biological Sci., Claverton Down, Bath BA2 7AY	G. Henshaw	Cryopreservation of somatic embryos

TISSUE CULTURE FOR CASSAVA GERMPLASM CONSERVATION AND MICROPROPAGATION			
Brazil	CNPMF/EMBRAPA, Cx.P. 007; 44.380 Cruz das Almas, BA, Brazil	A. da Silva-Souza	In vitro germplasm conservation & exchange
Bangladesh	Jahangirnagar Univ., Dept. Botany, Savar, Dhaka	S.K.Roy, N. Alam	Micropropagation
Cameroon	Inst. of Agronomic Res., I.P.J. Biotechnology Lab, Ira Ekona, PMB 25, Buea	S. Zok	Micropropagation in breeding program
China	South China Institute of Botany, (Academia Sinica) Wu Shen, Guangzhou, 510650, PRC	Guo, Jan-Yen Liu, Yin Qin	Micropropagation for variety dissemination
Congo	DGRST, contact c/o ORSTOM, BP 181, Brazzaville	J. Mabanza	In vitro virus elimination, germplasm cons. & exch.
Costa Rica	Univ. de Costa Rica, Centro de Investigaciones Agronomicas, San Jose	H. Garita, R. Valverde	In vitro germplasm conservation & exchange
Cuba	INIVIT, Santo Domingo, Villa Clara	M. Garcia V. Vega S. Morales	Meristem culture: yield recovery of traditional varieties and propagation
Dutch Antilles	Dienst Landbouw, Veeteelt en Visserij, PO Box 43, Kralendijk, Bonaire	E. Berben	In vitro germplasm conservation, exchange
Guyana	National Agric. Research Institute, Biotech. Section, Mon Repos, East Coast Demerara	V. Broomes	In vitro germplasm conservation & exchange
India	CTCRI, Sreekariyam, Trivandrum, 695 017 Kerala	N.G.Nair; M. Unni-krishnana; A. Mukherjee	Virus elimination, in vitro germplasm conserv.
International	CIAT Biotechnology Research Unit & Genetic Resources Unit, A.A. 6713, Cali, Colombia	W. Roca; G. Mafla R. Hidalgo	In vitro germplasm conservation & exchange
International	IITA Genetic Resources, Oyo Road, PMB 5320, Ibadan, Nigeria	S.Y.C. Ng	In vitro germplasm conservation & exchange
Nigeria	National Root Crops Res. Inst. (NRCRI), Umudike, PMB 7006, Umuahia, Abia State	E. Mbanaso	In vitro plants for mutation breeding (collab. IAEA Vienna)
Panama	IDIAP, Apto. 6-7909 El Dorado, Ciudad Panama	F. Lara M.	In vitro germplasm conservation & exchange
Paraguay	Instituto Agronomico Nacional, Presidente Franco No. 479, Asuncion	M. Zacher de Martinez	In vitro germplasm conservation & exchange

TISSUE CULTURE FOR CASSAVA GERMPLASM CONSERVATION AND MICROPROPAGATION			
Peru	Univ. Nac. Pedro Ruiz Gallo, Lab. de Cultivo de Tejidos Vegetales, Recursos Geneticos, Apdo. 48, Lambayeque	G. Delgado C. Rojas	Meristem culture for high quality planting material
Philippines	Philippine Root Crops Research & Training Center, Visayas State College of Agriculture, Leyte 6521-A, Philippines	V.Z.Acedo	In vitro germplasm conservation & exchange
Thailand	Rayong Field Crops Research Center, Rayong, 21150, Thailand	S. Sarakarn	In vitro germplasm conservation & exchange
United Kingdom	Univ. of Bath, School of Biological Sciences, Claverton Down, Bath, BA2 7AY	G. Henshaw, N. Taylor	Enhanced in vitro systems for cassava
Venezuela	Asesora Bioplanta, Apto. 67372, Caracas 1061	M. Bravato C. Zapata	Microprop. for high quality planting material
Venezuela	Instituto Internacional de Estudios Avanzados (IDEA), Secc. Biologica, Apto. 17606, Parque Central, Caracas, 1015-A	L. Cherubini L. Villegas	In vitro germplasm conservation & exchange; micropropagation for planting material
Western Samoa	Univ. of the South Pacific, Pacific Regional Agric. Programme, IRETA Tissue Culture Unit, Alafua Campus, Apia	A. Palupe C. Smith M. Taylor	In vitro germplasm conservation and exchange
Zaire	PRONAM-M'Vuazi, BP 11635, Kinshasa 1, Zaire	N. Delo, K. Muimba, M. N. Bidiaka	Micropropagation in breeding program

II. Biotechnology applications: *For realizing cassava opportunities*

STARCH QUANTITY AND QUALITY FOR DIVERSE END USES OF CASSAVA			
Brazil	CENARGEN/EMBRAPA, Cx.P. 02372, 70700, Brasilia, DF	M.C. Ribeiro, L.F.A. Figueiredo, M.E. Loureiro, G.B. Cabral, L.J.C.B. Carvalho	Starch deposition in roots grown in vitro
Colombia/ France/ International	UNIVALLE/CIRAD/CIAT/ORSTOM: Univ. del Valle, Proyecto Amidon Agrio, A.A. 25360, Cali, Colombia; CIRAD/CIAT, c/o CIAT Cassava Program, A.A. 6713, Cali, Colombia; ORSTOM, c/o UNIVALLE, A.A. 32417, Cali, Colombia; CIRAD/SAR, 2477 Ave. du Val de Montferrand, BP5035, 34032 Montpellier, cedex 1	A.-L. Jaime (UNIVALLE), D. Dufour (CIRAD/SAR/ CIAT); M. Raimbault, D. Alazard (ORSTOM); J. Mayer (CIAT); N. Zakhia (CIRAD/SAR, France)	Enhanced lactic acid bacterial fermentation for breadmaking capacity in cassava sour starch
Colombia/ United Kingdom	NRI, Chatham Maritime, Chatham, Kent, ME4 4TB/Univ. of Nottingham, Dept. Applied Biochem. & Food Sci., School of Agric., Sutton Bonington, Loughborough, LE12 5RD/Univ. del Valle, AA 25360, Cali, Colombia	A.Fernandez (UNIVALLE) J. Wenham (NRI) J. Blanshard (Nottingham)	Starch macromolecule properties in food processing
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	S. Moorthy	Starch characterization

International	CIAT, Biotechnology Research Unit, A.A. 6713, Cali, Colombia	L. Destafano W. Roca	Gene cloning and genetic transformation
Netherlands	Univ. of Wageningen, Dept. Plant Breeding; PO Box 386; 6700 AJ Wageningen	E. Jacobsen R. Visser	Gene cloning and genetic transf., starch biosynth.
United Kingdom	Long Ashton Research Station, Long Ashton, Bristol, BS18 9AF	P. Shewry	Cassava starch synthesis biochemistry
United Kingdom	NRI, Chatham Maritime, Chatham, Kent ME4 4TB	J. Wenham	Starch characterization

ENHANCED POST-HARVEST KEEPING QUALITY OF CASSAVA			
International	CIAT, Biotechnology Research Unit and Cassava Program, A.A. 6713, Cali, Colombia	J. Mayer G. O'Brien	Biochemistry of post-harvest deterioration
United Kingdom	NRI, Chatham Maritime, Chatham, Kent, ME4 4TB	J. Wenham	Biochemistry of post-harvest deterioration

MICROBIAL BIOTECHNOLOGIES FOR NEW OR IMPROVED CASSAVA PRODUCTS & PROCESSES			
Argentina	Univ. Buenos Aires, Dpto. Quimica Organica, FCEyN-UBA, Lab. Microbiologia Alimentos, Pab.II, Piso 3, Ciudad Universitaria(1428), Buenos Aires	S. de Fabrizio	Genetic transformation of starter bacteria for phage resistance
Australia	Australian National Univ., GPO Box 1600, Canberra ACT 2601	H. Bradbury	Cassava products analysis; food science
Brazil	CNPMA/EMBRAPA, CP69, Jaguariuna, SP,; Univ. Estadual Paulista (UNESP)/EBILCE, CP 136, S.J.R. Preto, SP	L. Lima, D. Capalbo, I. Melo (CNPMA); O. Moraes (UNESP)	Biofungicide production on cassava starch extraction wastes
Brazil	ESAL, Dpto. De Ciencia dos Alimentos, CP 37, Lavras, MG, Brazil	E. Ribeiro Vilela; D. Ramirez Ascheri	Modification of cassava starch fermentation
Brazil	Univ. Fed. de Santa Catarina, Centro de Ciencias Agrarias, Dpto. de Ciencias e Tecnologia de Alimentos, Florianopolis, SC, 8803 –001	E. Amante	Fermentation for protein enhancement of cassava roots, protein from waste
Brazil	Ponta Grossa State Univ., Dept. Zoo. & Food Tech., PO Box 992, Ponta Grossa, 84010-330 PR	G. Wosiacki	Single-cell protein from high-cyanogen cassava processing waste
Brazil/France	Univ. Estatual Paulista (UNESP), Botucatu, SP, Brazil (CERAT); CIRAD/SAR, France	M.P. Cereda, I. Takitane, O.L.G.S.Nuñez (UNESP) O. Vilpoux, G. Chuzel (CIRAD)	Enhancement of cassava starch via lactic acid bacteria hydrolysis
Brazil/France	Univ. Fed. dó Parana, Lab. de Processos Biotecnologicos, Dpto.Ingenharia Quimica, 81531-970 Curitiba, PR, Brazil; ORSTOM/Colombia	C. Soccol (U. Fed. Parana) M. Raimbault (ORSTOM)	Fermentation for protein enhancement and amylase production

MICROBIAL BIOTECHNOLOGIES FOR NEW OR IMPROVED CASSAVA PRODUCTS & PROCESSES			
Colombia/France	ORSTOM, Ave.5A Nte. 20-08 (501), AA 32417, Cali, Colombia/Univ. del Valle, Process. Biol., AA 25360, Ciudad Univ. Melendez, Cali, Colombia	M. Raimbault (ORSTOM) D. Alazard (ORTOM/UNIVALLE)	Lactic acid bacterial ferm., reactor design for protein enrichment, ethanol production, other
Congo/France	DGRST (contact c/o ORSTOM, BP181, Brazzaville, RepCongo/LPMC) Centre ORSTOM, Montpellier BP 5045, 34032 France	S. Keléké, E. Miambi (DGRST); S. Treche, A. Brauman, E. Giraud (ORSTOM)	Microbial & biochemical studies on cassava lactic fermentation; new products
Colombia/France/ International	UNIVALLE/CIRAD/CIAT/ORSTOM: Univ. del Valle, Proyecto Amidon Agrio, A.A. 25360, Cali, Colombia; CIRAD/CIAT, c/o CIAT Cassava Program, A.A. 6713, Cali, Colombia; ORSTOM, c/o UNIVALLE, A.A. 32417, Cali, Colombia	A.-L. Jaime (UNIVALLE), D. Dufour (CIRAD/CIAT) M. Raimbault, D. Alazard (ORSTOM) J. Mayer (CIAT)	Enhanced lactic acid bacterial fermentation for breadmaking capacity in cassava sour starch
France	CIRAD/SAR, 2477 ave. du Val de Montferrand, BP 5035, 34032 Montpellier, Cedex 1	D. Griffon N. Zakhia	Fermentation and other processes; sour starch; gari; other
France	Inst. National de Agronomie, Paris-Grignon; 16 rue Claude Bernard, Paris-5	C. Figeros J. Pourquié	Physiology of lactic acid bacteria (fermentation of cassava sour starch)
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	C. Balagopalan; M. George; S.N. Moorthy C. Ray; G. Padmaja	Food, feed, & industrial products from fermentation (single-cell protein, starchy flour, commercial enzymes, quick foods, other
India	Indian Institute of Technology, Dept. Chemica. Engineering, Madras, 600-036	S. Rakshit	Bioprocessing of cassava
Indonesia	Bogor Research Institute for Food Crops, Jl. Tentara Pelajar 3A, Bogor	S. Widowati D. S. Damardjati	Enhanced traditional fermented cassava foods
Indonesia	Bogor Agricultural Univ., Dept. Food Technology & Human Nutrition, PO Box 220, Bogor	B. Satiawihardja, B. Nurtama, Suharna	Pectinase prod. from solid cassava waste
Indonesia	Bogor Agricultural Univ., Dept. Animal Sciences, Jl. Raya Pajajaran, Bogor	Suryahadi, Y. Retnani	Fermentation for protein-enhanced animal feed
Indonesia	Sukamandi Res. Inst. for Food Crops, Jl. Raya 9, Sukamandi, Subang, West Java	S.D. Suismono, Indrasari, B.A.S. Santosa	Enhanced traditional fermented cassava foods
International	IITA, Root and Tuber Improvement Prog., Oyo Rd, PMB 5320, Ibadan, Nigeria	M. Bokanga	Food products from fermentation (taste, nutrition, texture, safety)
Mexico	Univ. Autonoma, Mexico City		Fermentation (protein enhancement)
Mexico	Inst. Technologica de Veracruz; Centro de Graduados; Apdo. Postal 1420 Veracruz, CP; 91860 Mexico	M. G. Aguilar Uscanga	Fermentation (protein enhancement)
Nigeria	Univ. of Ibadan, Dept. Food Technology, Ibadan	G.B.Oguntimein, J.O. Akingbala, M.K. Bolade	Gari processing enhancement

MICROBIAL BIOTECHNOLOGIES FOR NEW OR IMPROVED CASSAVA PRODUCTS & PROCESSES			
Nigeria	Lakoke Akintola Univ. of Technology, Dept. Food Sci. & Engineering, Ogbomoso	O.L.Oke, I.A. Adeyemi	Starter cultures in gari fermentation
Philippines	Univ. of the Philippines, Nat'l. Inst. of Biotech. and Applied Microbiology (BIOTECH), Los Baños, College, Laguna 4031 Philippines	C.B. Pham, M. J. Quinlat	Fermentation for protein enrichment
Philippines	Philippine Root Crop Res. & Training Center, 8 Lourdes St., Pasay City	J. Tan	Microbial isolates for root crop-based soy sauce
South Africa	Univ. of Pretoria, Dept. Microbiology/Physiology, PO Box 757, Pretoria 2000	J.P. Schumann M. Du Plessis	Protein-enriched feed; ethanol
Thailand	Kasetsart University, Dept. of Biotechnology, Bangkok, 10903; Dept. of Microbiology, Bangkok 10900	K. Sriroth (Biotech) B. Yongsmith (Microbio)	Fermentation for food coloring, protein enrichment; bioconv. for L-lysine; glutamic and citric acids
United Kingdom	Long Ashton Research Station, Long Ashton, Bristol, BS18 9AF	P. Shewry	Molecular biology of protein quality, quantity
Vietnam	Centre for Biotechnology, Hanoi National University of Technology, Hanoi	Dang, Thi Thu	Fermentation for protein-enriched animal feed
Vietnam	Centre of Applied Microbiology, Hanoi University, 90 Nguyen Trai St., Hanoi	Nguyen, Lan Dung	Fermentation for protein-enhanced animal feed

IMPROVED CASSAVA NUTRITIONAL QUALITY			
International	IITA, Root & Tuber Improvement Program, Oyo Rd., PMB 5320, Ibadan, Nigeria	A. Dixon	Plant breeding for increased cassava root protein content
United Kingdom	Long Ashton Research Station, Long Ashton, Bristol, BS18 9AF	P. Shewry	Molecular biology of cassava protein quantity and quality

CASSAVA PERFORMANCE IN STRESS ENVIRONMENTS: *Plant-soil relationships, nutrient cycling efficiency, photosynthesis, biofertilizers including mycorrhizal interactions*			
Australia	Univ. of Queensland, Dept. of Agriculture, Brisbane, Qld 4072	S. Fukai	Crop physiology research: photosynthesis; N/P/K utilization
Australia	Div. of Plant Industry, CSIRO, Canberra, ACT 2601	G. Farquhar	Comparative physiology of photosynthesis
France	ORSTOM, Lab. des insectes nuisibles, Parc scientifique Agropolis Bats B5-B6, 34397 Montpellier cedex 5	T. Lamaze, P.A. Calatayud	Physiology of cassava in drought stress

CASSAVA PERFORMANCE IN STRESS ENVIRONMENTS: *Plant-soil relationships, nutrient cycling efficiency, photosynthesis, biofertilizers including mycorrhizal interactions*			
International	CIAT, Cassava Program, A.A. 6713, Cali, Colombia	M. El-Sharkawy	Crop and plant physiology: photosynthesis; P/K utilization
International	CIAT, Biotechnology Research Unit, A.A. 6713, Cali, Colombia	J. Mayer	Mechanisms of CO_2 assimilation in cassava
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	V. Potty	Mycorrhiza
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	S. Sundaresan; P. Indira, V. Ravi	Drought stress: amino acid & protein metabol.; respiration & photosynth.
Italy	Inst. Propagazione delle Specie Legnose; Consiglio Naz. Richerche; Via Ponte di Formicola, 76; 50018 Scandicci; Firenze	M. Lambardi	In vitro selection for drought tolerance
Singapore	National Univ. of Singapore; Dept. of Botany, Kent Ridge, Singapore, 0511	H.-H. Yeoh	Photosynthesis;amino acid biochem; growth & devel
Spain	Consejo Sup. de Invest. Cinetificas; Inst. de Recursos Naturales y Agrobiologia de Sevilla; Avda Reine Mercedes s/n; 41080 Sevilla; Apartado 1052	A. Troncoso de Arce	In vitro selection for salt tolerance
United States	Univ. of Georgia, Biochemistry Dept., Athens Georgia 30605	C. Black	Photosynthesis (project completed)

INTEGRATED PEST MANAGEMENT FOR CASSAVA, *Including host/pathogen and host/pest interactions*			
China	South China Acad. Tropical Crops, National Key Biotechnology Lab., Baodao Xincun, Danxian, Hainan, PRC	Zheng Xueqin; Huang Chai Cheng	Genetic transformation for CBB resistance
Brazil	Fed. Univ. of Ceara, Dept. Biochem. & Molec. Biol., PO Box 1065, Fortaleza	F. Campos	Defense proteins in cassava roots
France	ORSTOM, Lab. des insectes nuisibles, Parc scientifique Agropolis Bats. B5-B6, 34397 Montpellier cedex 5	B. Le Ru, P.A. Calatayud	Biochemical physiology of plant defense against cassava mealybug
France	ORSTOM, Lab. de Phytopathologie; 2051 ave du Val de Montferrand; BP 5045; 34032 Montpellier	V. Verdier B. Boher	Molecular analysis of the genetics of CBB
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	K.S. Pillai, P. Rajamma, M.S. Palaniswami	Pre-& postharv. cassava integrated pest mgt.
International	CIAT, Cassava Program, A.A. 6713, Cali, Colombia	Cassava Pathology Section	Antagonistic fungi for control of root rot
International/ Benin/Brazil/ Cameroon/Ghana/ Nigeria	South America c/o CIAT, Cassava Prog., A.A.6713, Cali, Colombia; PROFISMA, CNPMF/EMBRAPA, CP007, 44.380 Cruz das Almas, Bahia, Brazil. Africa c/o ESCaPP, IITA Benin, BP08-0932, Cotonou, Rep. Benin	L. Smith, A. Bellotti (CIAT); A. Pires de Matos (CNPMF), S. Yaninek (IITA)	Molecular markers for monitoring release of biocontrol organisms

United Kingdom	Univ. of Bath, School of Biological Sciences, Claverton Down, Bath BA2 7AY	R. Cooper G. Henshaw	Biochemical physiology of plant defense (CBB)

RESISTANCE TO IMPORTANT VIRAL DISEASES OF CASSAVA			
International	CIAT, Virology Research Unit, AA 6713, Cali, Colombia	L. Calvert	Resistance & diagnostics, CCMV, CVMV, Frogskin viral diseases
Kenya	Biotechnology Section, National Potato Research Center, KARI, PO Box 338, Limuru	E. Kanguha	Mutation breeding - ACMV resistance (collab. IAEA)
South Africa	Univ. of the Witwatersand, Microbiology Dept., P O Wits, 2050, Johannesburg	C. Rey	Study of a new cassava geminivirus
Uganda	Namulonge Agric. Res. Inst., P O Box 7084, Kampala	G. Otim-Nape	Biology, epidemiology of ACMV; vector biology
United Kingdom	John Innes Institute, Inst. of Plant Science Research, Colney Lane, Norwich NR4 7UH	J. Stanley	Molecular charact .of ACMV, virus infection and replication
United Kingdom	Scottish Crops Research Inst., Invergowrie, Dundee DD2 5DT	B. Harrison	Molecular char.& diagnostics, ACMV and related viri
United States/ France	International Lab. for Tropical Agricultural Biotechnology (ILTAB) /(ORSTOM), The Scripps Res. Inst., 10666 N. Torrey Pines Rd., La Jolla, CA 92037	C. Fauquet R. Beachy	Genetic transformation for ACMV resistance using viral coat protein
Zimbabwe	Univ. of Zimbabwe, Crop Sci. Dept., PO Box MP 167, Mount Pleasant, Harare	I. Robertson	Genetic transformation for ACMV resistance via viral coat protein

CASSAVA CYANOGENESIS: GENETICS, BIOCHEMISTRY, PHYSIOLOGY			
Denmark	Royal Vet. & Agric. Univ., Plant Biochem. Lab, 40 Thorvaldsenvej, DK-1871 Frederiksberg, Copenhagen	B. Moller	Biosythetic pathway and enzyme system
Germany	Univ. of Braunschweig; Botanisches Inst., Mendelssohnstr. 4; Postfach 3329; D-38092 Braunschweig	D. Selmar	Translocation of cyanogens
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	B. Nambisan	Physiology of cyanogenesis
International	IITA, Root & Tuber Improvement Prog., Oyo Rd, PMB 5320, Ibadan, Nigeria	M. Bokanga	Biosynthetic pathway
Thailand	Mahidol Univ. Dept Biochem., Rama 6 Rd, Bangkok	M. Chulavatnatol	Biochemistry (enzymes in cyanogenesis)

United Kingdom	Univ. of Newcastle upon Tyne, Dept. Biochem & Genetics, The Medical School, Newcastle upon Tyne, NE2 4HH	M. Hughes J. Hughes	Biochemistry and gene cloning
United States	Ohio State Univ., Dept. Plant Biol. and Biochem., 2021 Coffey Rd, Columbus, Ohio 43210-1293	R. Sayre	Biochemistry and gene cloning

ENHANCED FERMENTATION SYSTEMS FOR CYANOGEN REDUCTION IN CASSAVA PROCESSING			
Central African Repub.	Univ. de Bangui, Faculté des Sciences et de Technologie, BP 908, Bangui	C. Kamayen J. M'Boliguipa	Enhanced (faster) safe fermentation systems
India	CTCRI, Sreekariyam, Trivandrum 695 017 Kerala	G. Padmaja, M. George	Enhanced fermentation for detoxification
International	IITA/TRIP, Oyo Rd., PMB 5320, Ibadan, Nigeria	M. Bokanga	Microbiology of cassava fermentation
Netherlands	Agric. Univ. Wageningen, Dept. of Food Science, 6703 HD Wageningen	A. Essers	Enhanced village-level fermentation
Nigeria	Fed. Inst. of Industrial Research Oshodi, P.M.B. 21023, Ikeja, Lagos, Nigeria	T. Anibaba; O. Olantunji O. Odunsi	Fermentation for cyanogen reduction in cassava starch
Nigeria	Lakoke Akintola Univ. of Tech., Depts. of Pure & Ap. Chem. and Food Sci. & Eng., PMB 4000, Ogbomoso, Oyo State	O. Oke I. Adeyemi	Improved starter cultures for gari processing
Nigeria	Ndamdi Azikiwe Univ., Awka, P.O. Box 1457, Enugu, Nigeria	N. Okafor	Enhanced fermentation for safe gari production
Nigeria	Rivers State Univ. of Science and Tech, Dept. Food Sci & Tech., Nkpolu, Port Harcourt, Rivers State	O. Kemdirim O. Chukwu S. Achinewhu	Processing effect on cyanogens in gari and cassava flour
Tanzania	Tanz. Food & Nutr. Centre, PO Box 977, Dar es Salaam, Tanzania	N. Mlingi	Enhanced village-level fermentation
Thailand	Chulalongkorn Univ., Dept. Microbiology, Bangkok 10330	Ch. Puttikhunt, S. Pichyangkura	Linamarase activity of yeasts in cassava ferm.
United Kingdom/Tanzania	NRI, Chatham Maritime, Chatham, Kent, ME4 4TB; Tanzania Food & Nutrition Centre, PO Box 977, Dar es Salaam, Tanzania	A. Westby Z. Bainbridge (NRI); N. Mlingi (TFNC)	Enhanced village-level fermentation

ENHANCED FERMENTATION SYSTEMS FOR WASTE MANAGEMENT IN CASSAVA PROCESSING			
Brazil	CNPMA/EMBRAPA, CP69 Jaguariuna, SP; Univ. Estadual Paulista (UNESP)/EBILCE, CP 136 S.J.R. Preto, SP	L. Lima, D. Capalho, I. Melo (CNPMA); O. Moraes (UNESP)	Use of cassava starch extraction waste for biofungicide production
Brazil	Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF)/EMBRAPA, Cx.P. 007; 44.380 Cruz das Almas, BA, Brazil	P. Alves de Almeida	Uses of waste products

Brazil	Univ. Fed. Santa Catarina, Centro de Ciencias Agrarias, Dpto. de Ciencias e Tecnologia de Alimentos, Florianopolis, SC, Brazil 88034-001	E. Amante	Single-cell protein from cassava industrial wastes
Brazil	Ponta Grossa State Univ., Dept. Zootechny & Food Technology, PO Box 992, Ponta Grossa 84010-330, PR, Brazil	G. Wosiacki	Single-cell protein from fermentation of high-cyanogen processing wastes
Brazil	Univ. Estatual Paulista (UNESP), Fac. Ciencias Agronomicas, Dpto. Tecnol. dos Productos Agropecuarios, Cx.P. 237, CEP 18603-970, Botucatu, SP; Inst. Agronomico do Parana, Est. Exp. de Paranavai, PR, Brazil	M.P. Cereda (UNESP) M. Takashashi (Paranavai)	Characterization and treatment of cassava processing wastes
Colombia	Corp. Autonoma Regional del Cauca (CVC), Water Div., Dept. Pollution Control, Cali, Colombia	L. M. Baena A. D. Vargas	Treatment of waste water from small-scale starch extraction
India	CTCRI, Sreekariyam, Trivandrum 695 017, Kerala	C. Balagopalan R. Ray	Value-added processing for waste water and residues
Indonesia	Bogor Agricultural Univ., Dept. Food Technology & Human Nutrition, PO Box 220, Bogor	B. Satiawihardja, B. Nurtama, Subarna	Pectinase prod. from solid cassava waste

LIST of ABBREVIATIONS

Organizations:

CENARGEN:	Centro Nacional de Pesquisa de Recursos Geneticos e Biotechnologia, Brazil
CIAT:	Centro Internacional de Agricultura Tropical, Colombia
CIRAD:	Centre de Coopération International en Recherche Agronomique pour le Développement, France
CTCRI:	Central Tuber Crops Research Institute, India
DGRST:	Direction General de Recherche Scientifique et Technique, Congo
EMBRAPA:	Empresa Brasiliera de Pesquisa, Brazil
IITA/TRIP:	International Institute of Tropical Agriculture, Nigeria; Root and Tuber Improvement Program
NRI:	Natural Resources Institute, UK
ORSTOM:	Institut Francais de Recherch Scientifique pour le Développement en Coopération, France
ORSTOM/LRGAPT	ORSTOM/Laboratoire de Ressources Génétiques et Amélioration des Plantes Tropicales

Diseases and Organisms:

ACMV:	African Cassava Mosaic Virus
CBB:	Cassava bacterial blight
CCMV:	Common cassava mosaic virus
CVMV:	Cassava vein mosaic virus
ICMV:	Indian cassava mosaic virus