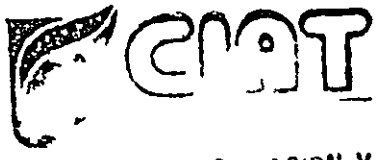
Annual Report Project SB-2
2004



Summary

Conservation and Use of Tropical Genetic Resources

November, 2004

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Project SB-2 Conservation and Use of Tropical Genetic Resources

A PROJECT OVERVIEW

Project Description

Objective To conserve the FAO Designated Collections and employ modern biotechnology tools to identify and use genetic diversity for broadening the genetic base and increasing the productivity of bean cassava rice and *Brachiaria*

Outputs

1 Improved characterization of the genetic diversity of wild and cultivated species and associated organisms
2 Genes and gene combinations used to broaden the genetic base
3 Increased efficiency of NARS breeding programs using biotechnological tools
4 *Phaseolus Manihot* and forage species conserved multiplied and distributed as per international standards
5 Germplasm available restored and safely duplicated
6 Designated Collections made socially relevant
7 NARS strengthened for conservation and use of Neotropical plant genetic resources
8 Conservation of Designated Collections linked with on farm conservation efforts and protected areas

Milestones

2005 Efficient transformation system developed for cassava
Characterization of the bean core collections with 50 genomics and gene based microsatellite markers
Characterization of a basic collection of tepary bean germplasm with AFLP
1500 accession from the cassava collection genotypes with 36 SSRs markers
Bean with high iron and zinc tested and transferred to CIAT Africa program for bioavailability testing
Survey of cassava germplasm for beta carotene
SNP markers developed for bean and rice
Targeted sequencing of cassava genome
Molecular markers developed for dry matter content and resistance to cassava green mites
Isogenic of QTL in rice developed and tested
Gene expression studies for insect resistance in *Brachiaria*
Differentially expressed genes for adaptation of *Brachiaria* to acid soils isolated by microarray
Bean cDNA libraries for drought generated
Comparison of gene flow in bean and rice under controlled and field conditions
Technology for rapid propagation system transferred to NARS

Testing of rice T DNA populations for gene identification

2006 Scaling up of marker assisted selection and genetic transformation established for rice bean and cassava
Marker assisted selected for multiple traits implemented in beans rice and cassava Target genes for drought identified and tested in beans
High iron and zinc bean lines developed through markers assisted selection released for field testing
Beta carotene cassava tested in Colombia Brazil and selected countries in Africa
High protein cassava lines developed and tested in Colombia and selected African countries
Field testing for transformed cassava with Bt gene and transformed rice with sheath blight resistance
High through put propagation for selected tropical fruits initiated

2007 Allele mining of *ex situ/in situ* collections of wild relatives of beans cassava for genes of economic importance
Gene flow studies diffused to NARS
Candidate genes for drought tolerance identified for bean and rice
Germplasm Upgrading Plan completed
Safety duplicates at CIMMYT and CIP for bean and cassava germplasm
Biofortified bean and cassava varieties in field testing
Methods for rapid multiplication of tropical fruit germplasm diffused to NARS
Field testing for cassava transgenic lines expressing inducible flowering genes for control of flowering in cassava breeding

Users CIAT and NARS partners (public and private) involved in germplasm conservation and crop genetic improvement and agrobiodiversity conservation ARIs from DCs and LDCs using CIAT technologies

B Principal Collaborators

Africa NARS

DRC Mvuazi Research Center (INERA) **Ghana** Crop Research Institute (CRI) Kumasi **Kenya** University of Nairobi **Malawi** Chitedze Research Station Malawi **Nigeria** National Root Crops Research Institute (NRCRI) Institute for Agricultural Research and Training (IAR&T) Ibadan **Rwanda** ISAR **Tanzania** Agricultural Research Institute (ARI) **Uganda** Namunlonge Agricultural and Animal Research Institute Kampala Medical Biotech Laboratories Kampala

Latin American NARS and Universities

Bolivia CFP Centro Fitogenetico Pairumani **Brazil** Embrapa Cenargen Embrapa CTA Embrapa CNPAF Embrapa CNPMF University of Campinas **Colombia** Cenicana Cenicafe Universidad Javeriana CIB COLCIENCIAS Colombian Ministry Agriculture and Rural Development Corpoica Corporacion Biotech Colombian National Biosafety Council FEDARROZ ICA Instituto Humboldt UniAndes UniValle Universidad Nacional at Palmira and Bogota, Universidad del Tolima **Chile** INIA REDBIO **Costa Rica** University of Costa Rica **Cuba** INIVIT **Dominican Republic** IDIAF National Bean Programs of the (INIAF) **Ecuador** INIAP Universidad Catolica **Honduras** Zamorano **Mexico** Universidad Autonoma de Mexico INIFAP **Nicaragua** Ministerio de Agricultura **Peru** INIA **Venezuela** Centro Tecnologico Polar Simon Bolivar University

Colombia NGOs

CEGA FIDAR PBA REDBIO Colombia Latin America Small Farmers from Pescador and Tierradentro Cauca Cauca farmers association Parque del Software Cali

Colombia private sector

Corn product Barranquilla Agrobios Bogota LIMSYS Cali DATABIO Cali Syngenta, Cali

Asia NARS

China Academy of Agricultural Sciences (CAAS) SCIB **India** Central Tuber Crops Research Institute (CTCRI) Thiruvananthapuram Kerala **Thailand** Rayong Field Research Center

Biodiversity Institutes

Colombia Instituto Humboldt **Costa Rica** Inbio **Mexico** Conabio **US** Smithsonian Museum of Natural History

Advanced Research Institutes

Australia Center for Applied Molecular Biology in International Agriculture (CAMBIA)

Europe **Belgium** University of Ghent **Denmark** University of Aarhus **France** CIRAD Genoplants IRD INRA Universite de Perpignan **Germany** University of Freiburg University of Hanover University of Hohenheim Federal Biological Research Centre for Agriculture and Forestry (BBA) **Netherlands** PRI Wageningen **Sweden** USLU Uppsala **Switzerland** Universite de Geneve ETH **UK** University of Bath **Japan** JIRCA Tsukuba **United States** Clemson University Cornell University Danforth Center Kansas Sate University Louisiana State University Michigan State University National Center for

Genome Research (NCGR) Ohio State University Penn State University Rutgers University Smithsonian Molecular Systematic Lab University of Nebraska University of Puerto Rico University of Chicago USDA Plant Soils and Nutrition Lab at Cornell University USDA at Children Hospital Baylor University USDA Soybean Genomics at Beltsville Yale University

Regional networks

ASARECA SACCAR AfNet ECABREN and SABRN (Africa) SIGTTA (Central America) REDBIO (Latin America) CATIE and EAP Zamorano (Central America) Cassava Biotechnology Network (CBN LAC) FLAR CLAYUCA

CGIAR and International organizations

CIP CIMMYT FAO IAEA ICARDA ICRISAT IFPRI IITA IPGRI IRRI TSBF WARDA

CGIAR Challenge Programs

HarvestPlus Generation

CGIAR system linkages Saving Biodiversity (40%) Enhancement & Breeding (55%) Training (4%) Information (1%)

CIAT project linkages *Inputs to SB 2* Germplasm accessions from the gene bank project Segregating populations from crop productivity projects Characterized insect and pathogen strains and populations from crop protection projects GIS services from the Land Use Project *Outputs from SB 2* Management of Designated Collections (gene banks) genetic and molecular techniques for the gene bank crop productivity and soils (microbial) projects Identified genes and gene combinations for crop productivity and protection projects Propagation and conservation methods and techniques for gene banks and crop productivity projects Interspecific hybrids and transgenic stocks for crop productivity and IPM projects

C Budget

BUDGET 2004

PROJECT SB2 Conservation and Use of Tropical Genetic Resources

SOURCE	AMOUNT US$	PROPORTION (/)
Unrestricted Core	599 902	14 /
Restricted Core	0	0 /
Carry over from 2003	493 689	12 /
Sub total	**1 093,591**	**26 /**
Special Projects	3 061 200	72 /
Generation Challenge Program	125 000	3 %
Total Project	**4 279 791**	**100 /**

*The largest part of the carry over funds is related to USAID Projects with CIAT partners in process of definition

HARVESTPLUS BUDGET

BUDGET 2004

SOURCE	AMOUNT US$	PROPORTION (/)
Unrestricted Core	0	0 /
Restricted Core	0	0 /
Carry over from 2003	0	0 /
Sub total	**0**	**0 /**
Restricted Projects 1	1 550 000	100 /
Total Project	**1 550 000**	**100 /**

1 Includes only funds implemented by CIAT

D CIAT SB-2 Project Log Frame (2005 2007)

PROJECT CONSERVATION AND USE OF TROPICAL GENETIC RESOURCES
PROJECT MANAGER JOE TOHME

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal To contribute to the sustainable increase of productivity and quality of mandated and other priority crops and to the conservation of agrobiodiversity in tropical countries	# of CIAT scientists and partners using biotechnology information and tools in crop research Germplasm and Genetic stocks available to key CIAT partners	CIAT and NARS publications Statistics on germplasm exchange	
Purpose To conserve the genetic diversity and ensure that characterized agrobiodiversity improved crop genetic stocks and modern molecular and cellular methods and tools are used by CIAT and NARS scientists for improving using and conserving crop genetic resources	A database on diversity of wild and cultivated species Mapped economic genes and gene complexes Improved genetic stocks lines and populations	Publications reports and project proposals	Pro active participation of CIAT and NARS agricultural scientists and biologists
Output 1 Genomes characterized of wild and cultivated species of bean cassava rice and Brachiaria and of associated organisms Development of genome	*Molecular Genetic Techniques and molecular information on diversity* *2005* SNP markers for bean and rice developed	Method available Publication of SNP primers and protocols Reports on marker analysis and	Availability of up to date genomics equipment Collaboration with NARS

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
wide anchored PCR based markers for marker assisted selection germplasm characterization and fine mapping and gene flow analysis Identification and mapping of useful genes and gene combinations for agronomical and nutritional traits Markers assisted selection for multiple traits for bean cassava and rice Bioinformatics tools for data mining	Characterization of core collection and national collections of bean with fifty genomic and gene based microsatellite markers Characterization of a basic collection of tepary bean germplasm with AFLP and microsatellite markers 1500 cassava accessions genotyped with 36 SSR markers Cassava core collection screened for carotenes and true retention of carotenes after processing determined LIMS developed and implemented 2006 07 Cross legume and single nucleotide polymorphism markers in CIAT mapping population integration of legumes cross collection diversity data	articles describing the genetic structure of the bean and cassava core collection of the world germplasm collection vis a vis other accessions of the collection Availability of a laboratory information management system (LIMS) Reports and primers made available in databases Genes suitable for the development of COS markers in cassava databases Articles describing molecular markers associated with agronomical traits Populations markers and BAC library available for distribution and further analysis by partners	maintained and expanded

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
	Selection of a set of genes for the development of cassava COS markers *Identification and mapping useful genes and QTLs for agronomical traits in bean cassava rice and Brachiaria* 2005 QTL analysis completed in two bean populations for nutritional traits including iron zinc and tannin content Molecular markers tightly linked to CMD resistance identified and BAC library of TME3 constructed Two advanced backcross with wild AA Oryza genomes genotyped and QTLs for yield component in rice identified Generation of rice mapping populations for nutritional traits including iron and zinc 2006 07 QTL analysis completed on	Publications reports and data on population posted on web Databases shared Map position sof target genes indicated	

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
	two populations of common bean for drought traits and nutritional traits One advanced backcross populations (BC2F5) from wild beans is genotyped to determine if nutritionally superior genotypes can be obtained Integration of drought and nutrition QTLs across multiple populations Populations segregating for dry matter cyanogenic glucosides content leaf retention resistance to hornworm developed characterized and evaluated with molecular markers QTL analysis completed on one population for Al tolerance in *Brachiaria*		
Output 2 Genomes modified genes and gene combinations used to broaden the genetic base of crops (bean rice and cassava) and forage species	*Candidate genes identified for agronomical traits* 2005 Cloning of candidate genes	Publications reports and	Phenotypic biochemical analysis conducted prior to molecular analysis

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
(*Brachiaria*) Identification of points of genetic intervention and mechanism of plant stress interaction Improved methods for genetic transformation for bean rice and cassava Develop and obtain gene constructs for traits related to plant disease insect resistance plant stress and nutritional traits Acquisition of rice T DNA and Ac/Ds mutants populations for testing and gene discovery Implement biosafety regulation for greenhouse and field condition	involved in tolerance to acid soils full length cDNA libraries developed Differentially expressed genes isolated by microarray Molecular characterization of spittlebug insect resistance in Brachiaria using cDNA subtractive differential expressed libraries Comparative genomics and gene discovery drought in bean by gene expression profiling cDNA libraries produced under drought conditions Cassava bacterial blight interaction characterized using cassava cDNA plant defense microarray chip of 6000 cassava unigene sets T DNA rice 10000 mutants collections characterized under field condition 2006 07 Consolidated genes sequence data for drought and acid soils stress response pathways gene	project proposals Germplasm Libraries and candidate genes available Libraries and candidate genes available Libraries and candidate genes available Microarray chips available for distribution Characterization data made available on web Databases Libraries and sequence made available Databases Technical reports on sites and distribution of wild/weedy/ landraces and cases of gene flow	Continued access to biosafety field testing and collaboration with CIRAD IRD and genoplantes Phenotypic biochemical analysis conducted prior to molecular analysis Funding from Rockefeller Foundation access to genes IPR management to access genes and gene promoters Biosafety regulations in place

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
	chips for candidate genes developed over 5000 genes arrayed and 25 candidate genes putatively related to drought tolerance identified	Number of advanced lines and crosses with RHBV resistant transgenic source	
	Modification of flowering to increase the efficiency of breeding in cassava by using constructs for *LFY AP1* and *FLC* flowering genes under the control of an ethanol inducible promoter		IPR management to access genes and gene promoters Biosafety regulations in place Request extension of field permit to other field locations in Colombia approved
	Cloning of the cassava mosaic disease (CMD) resistance gene CMD2 by positional cloning		IPR management to access genes and gene promoters Biosafety regulations in place
	Transformation	Publications reports and protocols made available and published	
	2005 Degree of gene flow from rice and bean into wild/weedy relatives measured in tropical centers of diversity		Already received approval for field testing Field Biosafety inspected and approved
	Identification evaluation and diffusion of molecular markers for assessing rate and direction of gene flow		

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
	Field performance biosafety evaluation for agronomic traits of advanced generations of crosses between RHBV N resistant transgenic rice and selected rice commercial varieties Transgenic *Agrobacterium* strains generated with constructs from JIRCAS containing different versions of *DREB* gene encoding for drought tolerance Transgenic lines of cassava with Bt constructs and or rice with resistance to sheath blight tested under biosafety field conditions and evaluated for agronomical traits 2006 07 Protocol developed for generating transgenic plants based on mannose selection system in place for rice and cassava Scaling up of rice and cassava transformation efficiencies incorporating new genes cultivars and regeneration		

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
	methods and testing plants in the field Field testing for rice and cassava transformed genotypes Optimization of bean transformation protocols Optimization of low cost alternative system using temporary immersion system principle in place for rice anther culture callus induction and plant regeneration for a scaling up system Adaptation and optimization of protocols for rice isolated microspore culture as an alternative for high efficiency generation of doubled haploids		
Output 3 Increased efficiency of NARS breeding programs using biotechnological tools	2005 Marker assisted selection for Cassava Mosaic Disease (CMD) transferred to NARS in Tanzania CIAT partners in LDCs using information and genetic stocks LAC NARS involved in	Publications Training courses and workshops Project proposals Regional workshop	Government and industry support national biotech initiatives

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
	biofortification effort for iron zinc and beta carotene Improved capacity of Colombian NARS to deal with biosafety 2006 07 New partnerships with private sector Agreement on technology and gene constructs access	MTA established and joint publication	Freedom to operate obtained

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Output 4 Bean Cassava and forage species conserved and multiplied as per international standards	2005 Germination rates for long stored materials Cost per accession/year compared with other gene banks 2006 07 Safety duplicates at CIMMYT and CIP for bean and cassava germplasm	Visits to GRU substations and conservation facilities	Absence of uncontrolled diseases Quarantine greenhouse space available at different altitudes
Narrative Summary	**Measurable Indicators**	**Means of Verification**	**Important Assumptions**
Output 5 Germplasm available restored and safely duplicated	2005 Number of germplasm requests received and fulfilled annually Low cost rapid propagation system for cassava implemented with farmer association Users received germplasm and data 2006 07 Cryo conservation technology developed tested and implemented for cassava Users asked for novel	Visits to multiplication plots Reports on requests and delivery Number of core collections multiplied and shipped	Agreement with CIAT holds CIAT becomes partner to the Treaty

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
	germplasm and data		
Output 6 Designated Collections made socially relevant	2006 07 Landrace diversity restored to farmers Farmers use new varieties Breeders use novel genes	Germplasm catalogs Plant variety registration logs National catalogs	International collecting possible Quarantine matters cleared
Output 7 Strengthen NARS for conservation and use of Neotropical plant genetic resources	2005 NARS germplasm collections conserved Number of trainees trained at CIAT 2006 07 Methods for rapid multiplication of selected tropical fruit germplasm diffused to NARS Number of universities and NARS using training materials	Country questionnaires Courses registered Distribution and sales of training materials Protocols published	NARS and networks willing to cooperate
Output 8 Conservation of Designated Collections linked with on farm conservation efforts and protected areas	Number of case studies and pilot *in situ* conservation projects	Project documentation Databases	NARS interested in conservation efforts Farmers interested in conservation efforts

E Current SB-2 Investigators Discipline, position and time fraction

Name	Discipline	Time dedication %
Alves Alfredo	CBN Regional Coordinator	100
Beebe Steve	Bean Breeding	30
Bellotti Anthony	Cassava Entomology	20
Blair Mathew	Bean Genetics and breeding	70
Ceballos Hernan	Cassava Breeding	40
Chavarriaga, Paul	Transgenesis Cassava	100
Debouck Daniel	Botany	20
Fregene Martin	Cassava Genetics and breeding	60
Ishitani Manabu	Molecular Biologist	100
Lentini Zaida	Biology/Genetics	80
Lorieux Mathias	Rice Genetics	50
Martinez Cesar	Breeding	49
Mejia Alvaro	Cell Biology	100
Sperling Louise	Seed Systems	20
Tohme Joe	Genomics Project Manager	100

F Highlights of outputs

Staff changes

Dr Valerie Verdier IRD will be spending 3 months at CIAT to work on joint projects related to rice –pathogen interaction Dr Verdier s stay with the project to reinforce the collaboration between CIAT and IRD and will allow the team to prepare joint projects for the Generation Challenge Program Dr Verdier will work closely with Fernando Correa Mathias Lorieux Cesar Martinez and Joe Tohme

Team member received the following awards

- Gallego Gerardo PhD 2004 Estudios preliminares para el aislamiento y clonacion de genes de resistencia a *pyricularia grisea* en arroz usando la estrategia de clonacion posicional Universidad Nacional de Colombia Sede Palmira. **Meritoria**
- Gaitan – Solis Gaitan PhD 2004 Obtencion y uso de secuencias microsatelitales GA/CA en estudios de diversidad genetica en las especies de palmas colombianas *Attalea amygdalina Ceroxylon alpinum* y *Ceroxylon sasaimae* realizada en la Universidad Nacional de Colombia, Palmira **Meritoria**

- Arango Adriana MSc 2004 Identification of candidate genes for aluminium resistance in *Brachiaria* Universidad Nacional Bogota **Meritoria**

- Gonzalez Torres R I MSc 2004 Stimation of gene flow on *Phaseolus vulgaris* using molecular markers microsatellites and polymorphims of chloroplast Thesis awarded with **Merit recognition by Universidad Nacional de Colombia**

- Beltran Jesus Premio Nacional Hernando Patino Asociacion Colombiana de Ciencias Biologicas **Mejor Trabajo** de Pre grado Trigesimo cuarto Congreso Nacional de la Asociacion de Ciencias Biologicas Ibague Tolima Oct 12 15 04

- Soto Suarez Mauricio Lopez Camilo Restrepo Silvia Piegu Benoit Cooke Richard Delseny Michel Tohme Joe and Verdier Valerie Analisis de expresion global durante la interaccion yuca *Xanthomonas axonopodis* pv *manihotis* usando microarreglos de ADN **Best work selected during the II Congreso Nacional de Biotecnologia Bogota**

- Gonzalez Torres R I E Gaitan M C Duque O Toro J Tohme & D G Debouck 2004 Measure of gene flow on Common bean using molecular markers **First Award for best poster Memorias II Congreso Colombiano de Biotecnologia Bogota Colombia 210 211**

- Gonzalez Eliana Fory Luisa Fernanda Pineda Rosana Ruiz Paola Vasquez Juan Jose Corredor Edgar Duque Myriam Cristina Silva James y Lentini Zaida Caracterizacion de la Diversidad Genetica Morfologica y Fenologica de Cuatro Poblaciones de Arroz Maleza (Arroz Rojo) Colectadas en las Regiones de Huila y Tolima **Second best poster at II Congreso Nacional de Biotecnologia – Bogotá**

Overall view of the SB2 project

The team members lead successfully the use and integration within CIAT of biotechnology with breeding activities and the conservation characterization of genetic diversity to 1) Improve the nutritional quality of crops achieve and sustain a continuous yield increase to meet the food needs of a rapidly growing population 2) Conserve the natural resources base needed for future development 3) Improve the livelihood of the rural poor who have not benefited so far from the technological advances To achieve its goals the team members have interacted with researchers from Advanced Research Institute National Programs NGO and the private sector They also pursued successfully all three outputs related to

Output 1 Improved characterization of the genetic diversity of wild and cultivated species and associated organisms

Output 2 Genes and gene combinations used to broaden the genetic base

Output 3 Increased efficiency of NARS breeding programs using biotechnological tools

Only the following achievements are summarized

Measuring Genetic Diversity in Common Bean

The microsatellite markers we have developed at CIAT have given us the opportunity to dissect genetic diversity in common bean on a larger scale and to a finer degree than has ever been possible before Diversity was analyzed in a two collection of common bean accessions from Colombia and the Caribbean as well as in tepary bean accessions Both Colombia and the Caribbean sit at cross roads of gene flow between the centers of origin for common bean Therefore many Andean genotypes from these regions show possible introgression of Mesoamerican alleles We wanted to document this phenomenon as a basis for further genotyping of the Andean and Mesoamerican core collections as well as national collections from Bolivia Brazil China Colombia and Mexico which we are doing as part of the Generation Challenge Program This has involved the development of new tools for evaluating genotypic diversity Given that microsatellites are the most reliable polymorphic marker system we are concentrating on developing panels of fluorescent common bean microsatellites useful for genotyping We have now determined the discrimination power and allelic diversity values for all microsatellite markers developed at CIAT and plan to use this information in further genotyping and association mapping studies

Study of bean gene flow

Phase 1 of the Gene Flow Project supported by BMZ of Germany has shown that in the bean model in Costa Rica gene flow between the crop and its wild relative occurs though preferentially from the wild form into the cultivated Intermediate forms hypotesized to result from gene flow events were proven to be so Flow from the cultivated into the wild is low but significant and occurs repeatedly in space and time The results were obtained through molecular markers based on both nuclear and cpDNA genes Gene flow on station in Costa Rica using commercial lines was demonstrated to be low usually below 1% Ways of computing the data seem significant however with higher percentages when one computes the number of hybrid plants instead of hybrid seeds This could explain many discrepancies in outcrossing rates found in the literature In farmers plots in Costa Rica a higher outcrossing of 6 8% was found when using landraces as compared to commercial lines An image analysis of stigma areas between wild forms traditional landraces and modern cultivars has shown a larger terminal area in the wild while cultivated forms have a bigger internal area This could explain many figures in population genetics of the crop model

Expanding the Scope of Marker Assisted Selection in Common Bean at CIAT

Marker assisted selection is a priority in the bean breeding program because of the large number of segregants screened and the diverse array of biotic and abiotic limitations being tackled Until recently all marker assisted selection in common beans was done with SCAR marker In the past year we have begun to implement several gene specific microsatellite markers for the selection of linked traits We have tested microsatellites for selection of a nitrogen fixation QTL in populations derived from BAT477 (also and important drought tolerance source) and for selection of bruchid resistance based on the Arcelin resistance gene

In addition we continue to validate additional SCAR markers in practical real life plant breeding situations We have now made over 4000 plant selections for the SCAR markers for the *bc* 3 and dominant *I* BCMV resistance genes and for the *Co 4*^{2} and *Co 5* anthracnose resistance genes The *bc* 3 marker was found to work well in Andean breeding lines especially for screening of climbing beans where it resulted in substantial savings in planting area and agronomic effort Meanwhile the anthracnose markers were improved for screening with alkaline lysis extracted DNA All of this work builds on last year s successes in using SCAR markers for *bgm 1* and for QTLs for resistance to bean golden yellow mosaic virus (BGYMV) and common bacterial blight (CBB) Next year we plan to implement additional microsatellite and SCAR markers for additional resistance genes and abiotic stress QTLs

QTL mapping of nutritional quality in common bean

QTL mapping of nutritional traits has become an important way to increase our understanding of how to breed common bean for better mineral content as part of the Harvest Plus Challenge Program We are using a mix of traditional biochemistry genetics and genomics to dissect nutritional quality traits Collaborations with USDA Houston is centering on a basic mechanism for mineral uptake in legumes using common bean as a model for the tropical legumes As part of the overall genomics approach information from other well studied species such *Medicago truncatula* peas and soybeans as well as other model species such as *Arabidopsis thaliana* which have extensive genetic and molecular resources are being used for gene discovery and functional analysis A collaboration with the Grusak lab at USDA Houston is producing very interesting results on the analysis of iron reductase as a mechanism for enhanced iron uptake in common beans So far there is evidence that there are differences between parents of several mapping populations for their ability to reduce iron and that these differences are evident more at low Fe concentration than at high iron concentration QTLs for iron reductase activity are located in the same genomic regions as some for iron accumulation More information on this trait will be reported next year when several sets of recombinant inbred lines have been fully tested and the QTLs for this trait definitively localized In addition to increasing iron content per se we are studying the inheritance of soluble and insoluble tannins which are implicated as anti nutrients in mineral absorption through a QTL analysis of parents and segregating populations of common bean We also refined the genetic map for the mineral accumulation mapping populations and added phenotypic data showing patterns of genotype x environment interaction This builds on our research reported last year on the QTL analysis of mineral content (especially of iron and zinc accumulation) All of this research forms part of the Harvest Plus challenge program

Molecular marker assisted farmer partipatory breeding project to improve local cassava varieties in Tanzania with resistance to pest and diseases

The Tanzanian MAS project funded by the Rockefeller foundation seeks to transfer useful variability from the crop s center of diversity of cassava to Africa This year a total of 335 BC_2 progenies (AR lines) that combine resistance to CMD and to the cassava green mites (CGM) derived from a wild relative and 207 genotypes (CR lines) obtained from crossing CIAT elite parents and CMD resistant lines were introduced from Colombia to Tanzania in three shipments The plants were hardened in the screen house evaluated for frog skin disease (FSD) and then transferred to the field They will be evaluated later this season and

no less than 60 genotypes selected based on evaluation of highly heritable agronomic traits for crosses to 90 local varieties selected from all over the country Molecular markers associated with CMD and CGM will be used to discard much of the resulting segregating populations so that the breeder and farmers can concentrate on a small number of progeny having resistance to the principal pest and disease and farmer/end user preferred traits The concept of the Tanzanian MAS project is already being extended to additional NARs in Africa, the AR and CR lines have been shipped to Uganda and Nigeria already in preparation for crosses to local varieties

Identification of sources delayed post harvest physiological deterioration (PPD), resistance to whiteflies and hornworms in wild Manihot species and development of populations to study genetic inheritance and for introgression of the traits into cassava

Post harvest physiological deterioration (PPD) and anthropod pests are severe marketing and production constraints respectively in cassava It has been estimated that cassava farmers typically resource poor farmers lose 48 million tons of fresh root valued at US$1 4billion every year to pests diseases and PPD some 30% of total world production Dramatically delayed PPD has been identified in inter specific hybrids from *Manihot walkerae* The delayed PPD trait originally from the wild *Manihot* parent was successfully transferred to an F_1 inter specific hybrid suggesting a dominant or additive gene action of gene(s) involved The only source of resistance to the cassava hornworm was also identified in 4th backcross derivatives of *M glaziovii* Moderate to high levels of resistance to white flies have also been found in inter specific hybrids of *M esculenta sub spp flabellifolia* Again resistance was recovered easily in F_1 inter specific hybrids suggesting a simple inheritance of the trait Eight mapping populations have been developed for marker assisted study of the inheritance of these traits

Functional Genomic Tools to Study Starch Content and Cassava Bacterial Blight Resistance

Two economically important characters starch content and bacterial blight resistance were targeted to generate a large collection of ESTs and Microarray analysis For ESTs collection two libraries were constructed from cassava root tissues of varieties with high and low starch contents Other libraries were constructed from plant tissues challenged by the pathogen *Xanthomonas axonopodis* pv *manihotis (Xam)* We obtained 11 954 cDNA sequences from the 5 ends including 111 from the 3 ends Cluster analysis permitted the identification of a unigene set of 5 700 sequences Sequence analyses permitted the assignment of a putative functional category for 37% of sequences whereas ~16% sequences did not show any significant similarity with other proteins present in the database and therefore can be considered as cassava specific genes

A cassava cDNA microarray containing the unigene set was constructed and used to study the incompatible interaction between cassava and *Xam* A total of 199 genes were found as differentially expressed (126 up regulated and 73 down regulated) A greater proportion of genes differentially expressed was observed at 7 days after inoculation Expression profiling and cluster analyses indicate that in response to inoculation with *Xam* cassava induces several genes including principally those involved in oxidative burst protein degradation and

pathogenesis related (PR) genes In contrast genes encoding proteins that are involved in photosynthesis and metabolism were down regulated In addition several other genes encoding proteins with unknown function or showing no similarity to other proteins were also induced The QRT PCR experiments allowed to confirm the reliability of our microarray data In addition we showed that some genes are induced more rapidly in the resistant than in the susceptible cultivar This is the first large cassava EST resource and unigene microarray developed today and publicly available thus making a significant contribution to genomic knowledge of cassava

Cassava genetic modification – Biosafety Field testing

The first transgenic cassava plants produced in a CG center have been planted in an open field of CIAT The government of Colombia gave permission on August 2004 to plant about 100 plants of three clones that carry a gene for insect resistance These plants will initially be grown to multiply the seed (cuttings) to perform trials for agronomic evaluation As a precaution to avoid gene flow within CIAT campus plants will not be allowed to flower Besides the cassava germplasm collection at CIAT is not planted in the field in 2004 2005 so there are very little chances of transgenes moving to the cassava collection in the field The transformation efficiency of cassava can double by modifying the temperature at which *Agrobacterium* insert their genes into plant cells A project financed by the USAID which is part of collaboration with Ohio State University aimed at increasing the transformation efficiency of cassava The results obtained so far indicate that with lower co culture temperatures twice as many plants can be produced in a single transformation experiment

Molecular phenotyping for crop improvement under abiotic stresses

The strategy we have been taking to improve crop performance under abiotic stress conditions is to 1) integrate physiological aspects on traits of interest using diverse genetic materials that come out from breeding activity prior to application of molecular tools 2) link obtained molecular components to breeding (e g marker development) 3) expand genomic tools such as full length cDNA clones to facilitate molecular tool development for breeding We focused on identifying key molecular components in common bean to increase plant performance under water limited conditions This activity was in part supported by Generation Challenge Program This involves 1) isolation of the genes involved in response to water stress 2) evaluation of gene expression in relation to phenotypic traits (e g deeper root) and 3) development of useful molecular markers to select genotypes with better performance under water stress conditions We selected 100 to 200 genes from species such as Arabidopsis representing twelve functional categories based on prior evidence suggesting these genes are involved in stress response or metabolic pathways In collaboration with JIRCAS Japan Drought Responsive Element Binding (DREB) gene was cloned from the bean and the gene expression analysis is under way using breeding materials (e g BAT477 and G21212) that was shown distinct phenotypes (deeper rooting and high mobilization of photosynthates) under drought stress

Gene Flow

The first phase of a 4 year BMZ funded project on the assessment of gene flow from crop to wild/weedy relatives in tropical America using bean and rice as models was accomplished The goal of this project is to generate baseline genetic information for the development of guidelines on the safe introduction and use of novel agriculture traits (biotechnology derived or not native from the place of introduction) while reducing potential environmental impact on native biodiversity in the Neotropics The model crops selected are important for food security throughout Latin America Africa and Asia being basic for the rural and urban poor people Results showed (detailed information are found in SB2 Reports from 2001 to 2004) that on both crop models (beans and rice) gene flow occurred i) between the crop and its wild/weedy relatives ii) the direction from the crop to the wild/weedy relative cannot be ignored (from 0 003% to 0 06%) and iii) introgression because of gene flow is repetitive in space and time (on the bean model in rice repeated introgression over time needs to be evaluated) The scoring of phenotypic traits alone (i e herbicide resistance anthocyanin color in flower/stem/leaves) to assess gene flow overestimates the level of hybridization rate Because of these potential errors methodologies were optimized to use molecular markers to detect rate and direction of gene flow in bulk DNA allowing the analysis of large field samples These tools and methodologies generated will give a better understanding of the gene flow/introgression dynamics in crop/wild/weedy complexes and potential impact on biodiversity The potential impact of gene flow on the genetic structure of the recipient population still needs to be assessed To that end we are planning in future studies to use genes that confer a positive advantage against selection also allowed establishing a methodology to detect cases of introgression at small scale in crop/weedy/wild contact zones and to quantify it with the aid of molecular markers

Biosafety Capacity Building

The heavy involvement of university departments and biosafety authorities is key to the institutional strengthening and the development of science based policies on biosafety in developing countries Towards that end CIAT is playing an active role on environmental biosafety research conducted in the Neotropics and on capacity building As part of a 4 year project financed by BMZ (Germany) CIAT conducted a workshop on gene flow analysis and its implications being for the conservation of landraces *in situ* or the introduction and management of modern improved cultivars A total of 41 participants of Universities and public Institutions responsible for implementing biosafety regulations from Mesoamerica Central America, Andean region and Brazil attende The participants included the areas with highest biodiversity of this region and with different level of development and expertise on biosafety Because of CIAT involvement on environmental biosafety research it was invited to give support to a GEF World Bank project approved for Colombia to implement the Cartagena Protocol and as part of this initiative CIAT was requested to offer a series of courses to build technical capacity for the analysis of GMOs and of potential environmental impact The first Biosafety Workshop for the Colombian Inter Institutional Group responsible for implementing the Cartagena Protocol was offered on October 4 6 2004 and included a total of 31 participants from the Miniseries of Agriculture Health Environment Commerce Foreign Affairs Invima ICA Institute Von Humboldt CVC National Department of Planning Colombian National Department of Science Agriculture and Animal National Technical Biosafety Committees

CBN s Activities for 2004

The Cassava Biotechnology Network for Latin America and the Caribbean (CBN LAC) is a network of cassava researchers and end users aiming to enable small scale cassava farmers processors and consumers to benefit from advances in cassava biotechnology enhancing the value of cassava for food security and economic development in the poorest rural areas of the LAC In this fouth year (2004) of operation the CBN LAC devoted to the following main activities a) Implementing monitoring and guidance of 11 projects (pilot sites and small grants programs) in Colombia Brazil Cuba and Ecuador b) Scholarships for postgraduate studies in biodiversity under the Gines Mera Memorial Fellowship Fund c) Realization of the Sixth International CBN meeting (CBN VI)

The main achievements of the CBN s projects were 1) The establishment of propagation systems at farm level for both low cost *in vitro* micropropagation and rapid propagation systems which have allowed farmers to clean local and improved varieties of diseases and pests ensuring their food security and preventing the loss of diversity and 2) building capacity for national cassava R&D programs stimulating collaborative research projects between less developed countries and advanced laboratories through CBN small grants program

The CBN VI held at CIAT from 8 to 14 March 2004 hosted 148 participants from 28 countries from all continents The theme of the meeting was *Adding value to a small farmer crop* to discuss how biotechnology tools can assist small farmers by developing a range of technologies to add value and income to cassava farmers Several topics were discussed in the 40 plenary tematic lectures and 125 posters presentations from which can be mention the following scientific highlights 1) *Transgenics* are a reality and are moving rapidly from the lab to the field 2) *Genome mapping* with greater saturation of markers nearing identification of CMV (cassava mosaic virus) resistance gene and extensive EST libraries 3) *Biodiversity and population genetics* with variations in pigments architecture germination cyanogens photosynthesis drought tolerance etc 4) *ACMV* (African cassava mosaic virus) with new variants and satellite genome 5) *Post harvest deterioration* functional genomics moving forward 6) *Double haploids* identification of recessive traits to avoid genetic load 7) *Expression profiles of pathogens in cassava* bacterial blight 8) *IPM* and biological control of insect pests 9) *Improved industrial varieties* in SE Asia and 10) *In vitro plants* successful propagation of disease free plants for small farmer s groups in Colombia The plenary presentations posters and others CBN VI s documents can be found at CBN website http //www ciat cgiar org/biotechnology/cbn/sixth_international_meeting/index htm

Participation in regional events to strengthen NARS capacity

The CIAT Agrobiodiversity and Biotechnology Project had a significant participation at the meeting of RedBio held in Dominican Republic on June 21 25 2004 A broad diversity of thematic areas were covered which ranged from studies on DNA sequence and gene expression to applications with small farmers in the field and included the following topics structural and functional genomics positional gene cloning marker assisted selection (MAS)

molecular plant/ pathogen interactions molecular breeding for tolerance to abiotic/ resistance to biotic stresses plant genetic transformation in vitro propagation biotechnology for classroom and small farmers biofortification and biosafety Project staff had 16 presentations in symposium or workshop and presented 16 posters Several project staff were part of the organizing committee or chairs of sessions

The II Colombian Congress on Biotechnology was held in The Camara de Comercio and Universidad Nacional Bogota from 1 to 3 September 2004 CIAT s Agrobiodiversity and Biotechnology Project participated in the agricultural session of the Congress giving 4 oral presentations and presenting 14 posters CIAT also participated in the Pre Congress event giving 13 lectures on issues related to genomics and transgenic organisms The Pre Congress was open to the general public and more than 200 students attended

G Problems encountered and their solutions

Some of the major problems facing the project are similar to the encountered in previous years (space access to gene) while others surfaced during the year

Salary of national recruited staff On the major strength of the project is the quality of the research assistants and associates involved However the level of salaries for several categories is well below the average CIAT researchers As an example based on analysis made by human resources 7 out of the 9 research assistants I are below the CIAT average Discussions have been initiated between the staff of SB 2 and Human Resources to analyze the situation and identify possible solutions to be proposed to management

Maintenance of major equipment The maintenance of the major equipments is becoming substandard due to lack of funds and lack of qualified personal on station CIAT maintenance budget while well managed is too small considering the number of requests The lack of preventive maintenance is causing delays for several projects To ensure proper uses of the major equipment training sessions was implemented for the newcomers Discussions with some of the manor providers are on going to tap into their expertise for maintenance

Access to genes and freedom to operate Discussions with the private sector have progressed to obtain access to either information or constructs However no major progress was made to obtain Bt constructs A consortium with Colombia was formed with the support of CIAT to explore the possibilities of identifying useful Bt strains More time and efforts need to be dedicated for the negotiation of possible agreements with the private sector

Space availability Lab and offices spaces continue to be a major constraint facing the different sections of the project The availability of lab and desk space for assistants students and visiting scientists is becoming hard to manage The purchase of new equipment funding of new special projects and the incorporation of a new staff are the major causes of such constraint The restructuring made in 2002 has proven to be insufficient The project will continue to seek efficient use of the lab space and as stated last year no obvious solution seems in sight

Solutions to constraints raised in 2002 2003

Space with the help of a special emergency funds approved by the director of research a the cassava genetics lab was remodeled providing a better quality of the facilities and improved use of the space However the team needs more space

Cassava Frog Skin disease SB 2 has continued to provide to the other sections of CIAT clean materials from in vitro cultures as the problem is restricting the ability of the team to conduct field trials without the concerns of delays and infections Some progress was made in the area of diagnostics by the relevant project at CIAT working on the problem

Bioinformatics The issue was raised in 2002 Advances in the LIMS implementation additional resources from the Generation Challenge program and training of local staff have improved the capacity of the group to tap into the various databases In addition the team benefited from a visit from IRD staff Benoit Piegu who set up for the team an efficient pipeline for sequence analysis In addition the project initiated within Colombia a collaborative consortium on bioinformatics with key institutions such as Cenicana Cenicafe Cenipalma Parque del Software and the Univ Nacional aiming to share expertise

H Plans for next year

Teams members will lead the implementation of the CIDA newly funded regional project on Combating Hidden Hunger in Latin America Biofortified Crops with Improved Vitamin A Essential Minerals and Quality Protein The collaborative is a partnership between CIAT CIP Cimmyt Embrapa and Clayuca and will involve NARS from Central America and the Andean region

Team members will continue their activities within the HarvestPlus challenge program in the area of iron and zinc biofortifed bean and beta caroten cassava Teams members will also interact with the Generation challenge program and participate in the implemetation of the different clusters established in the CP either thru commissed research or competitve grants

In the area of transgenic research the team members will continue to develop the tools for risk assessment and gene flow studies for rice and bean as part of the biosafety risk assessment project The issue of deregulation of transgenic will be analyzed and a strategy will be formulated to move CIAT product towards field and food safety testing

In the area of new tools microarray technologies already implemented and Single Nucleotide Polymorphism (SNP) will continue to be incorporated into the screening of germplasm and marker assisted selection Microarray and real time PCR analysis will be expanded to gene expression studies to better understand abiotic and biotic stresses Virus Induced Gene Silencing (VIGs) protocols will be implemented to assist in the gene cloning of disease resistance genes The use of the unigene set of cassava will be expanded Additional microarray chip for abiotic stress for rice and beans and post harvest deterioration in cassava will be developed

The implementation fo the project strategy to integrate CIAT work on biotechnology in Africa with breeding will be expanded Biotechnology projects with colleagues in Rwanda are being developed in the area of MAS in beans and Cassava The work already intiated with RF funding on cassava MAS in Tanzania will be expanded thru additional training and site visits

A newly funded project on biotechology training in Southern Africa from USAID to CIAT and Michigan State University will provide the means to initiate the collaboration African NARS

Collaborations with NARS in Latin America will be pursued in the area of genetics genomics tissue culture and genetic transformation Public awareness in the area of biotechnology and biosafety for policy markers and journalists will continue

I Project Performance Indicators

1 TECHNOLOGIES METHODS & TOOLS

1 1 Genes tagged more than 12 genes and QTLs identified in bean rice cassava and *Brachiaria*

1 2 Methods implemented Microarray full lenght cDNA libraries Substraction cDNA libraries construction Single Nucleotide Polymorphism real time PCR BAC sequencing and annotations Biosafety field assessement sequence annotations and analysis DArT

1 3 Support Tools Libraries developed Gene Libraries/Construct

cDNA

A root specific cDNA library was constructed from a substractive hybridization using cDNAs from the aerial part (Leaves & stem) as driver A mix of five white rooted cultivars were selected to make the library

768 clones form potato leaves vareties 703508 CHS 625 PS 3 704746 705428 700347 (CIP number identification) DNA digested with PstI and TaqI for evaluating diversity with DArT

5760 clones from potato leaves vareties 703508 CHS 625 PS 3 704746 705428 700347 (CIP number identification) DNA digested with PstI and ApoI for evaluating diversity with DArT

Cassava Unigene Set

Two economically important characters starch content and Cassava Bacterial Bligth resistance were targeted to generate a large collection of ESTs Two libraries were constructed from cassava root tissues of varieties with high and low starch contents (MPER 183 and CM523 7) the number of generated sequences of each library was 5 376 and 4 992 respectively that resulted in 4 992 unique sequences Other libraries were constructed from plant tissues challenged by the pathogen *Xam* and were generated 4134 unique sequences In total a cassava unigene set with 5 700 sequences was constructed

Library	No. of genes targeted	No. of genes analyzed	Singletons (%)	Tentative Contigs	Unigene (%)
CM	5,376	3 608	555 (15)	642	1 197 (33)
MP	4 992	3 391	1 127 (33)	607	1 734 (51)
MC 1-48h	2,304	1 721	1 178 (68)	184	1 362 (79)
MB	2 688	1 560	1 049 (67)	158	1 207 (77)
mb_no_b	384	258	124 (48)	22	146 (57)
mb_ds	768	438	41 (9)	54	95 (22)
sg_no_b	288	128	95 (74)	6	101 (79)
g_ssh	384	210	128 (61)	24	152 (72)
sg_dsc	768	382	17 (5)	29	46 (12)
m_s h	384	258	142 (55)	45	187 (73)
DNA AFLP		241	179 (74)	27	206 (86)
Geb_k		848	534 (63)	98	632 (75)
Total	18 316	13 043	3 825	1 875	5 700

DNA

BAC Two BAC libraires for bean and cassava

Data Bases united/ improved

A Database from cassava with a total of 11 954 cDNA sequences from the 5 ends and 111 from the 3 ends All sequences were clustered in 5 700 unique sequences Currently this database is available locally at CIAT and the user can perform sequences retrieval and batch BLAST search

Publications

Refereed journals Published 22
Refereed journals submitted 21
Book chapters Published 6

Strengthening NARS

The project concentrated its efforts this year on strengthening NARS through a series events either at CIAT headquarters or at NARS facilities A total of more than 562 persons from national and international institutions received training with SB 2 Project Staff or participated in SB 2 led events

1 Sixth international Scientific Meeting of the Cassava Biotechnology Network March 8 14 2004 **(150 participants)**
2 Introduction to biotechnology for Syngenta – Colombia Biotecnologia Basica y Plantas Modificadas Geneticamente I Taller Syngenta March 26 2004 **(21 participants)**
3 Training on *in vitro* tissue culture to farmers associations Nuevas variedades de yuca manejo y control de la mosca blanca y el cuero de sapo Caseta Comunal de la Vereda Alegrias Santander de Quilichao Cauca August 25 2004 **(70 participants)**
4 Introduction to genomics and transformation one Day Pre Congress Workshop for biology students on Genomics and Transformation Bogota Universidad Nacional August 31 2004 **(200 participants)**
5 Bioinformatics May 28 04 **(15 participants from Cenicana Cenicafe Cenipalma Parque Software)**
6 Planning workshop on Combating Hidden Hunger in Latin America Biofortified Crops with Improved Vitamin A Essential Minerals and Quality Protein Sept 29 Oct 1 04 **((51 participants)**
7 Biosafety workshop for national organizations and ministries in Colombia Oct 4 6 2004 **(43 participants)**
8 Gene flow and biosafety workshop Oct 7 9 2004 **(41 participants)**
9 Workshop on biotechnology and genetic transformation for Sciences and Agriculture committee of the Colombian Congress Oct 7 9 2004 **(12 participants including six senators from the Colombian congress)**

Strengthening the technical capacities of CIAT SB 2 assistants

In addition to strengthening the capacity of NARS the project put emphasis this year on training CIAT SB 2 assistants The mechanism for the trainings was either thru site visits to CIAT collaborators in the US and France to learn new techniques or thru attendance of selected courses It is worth mentioning that as of 2005 5 CIAT assistants managed to get accepted with either full or partial fellowship to attend several of the very competitive courses provided by the Cold Spring Harbor lab

1 Mauricio Soto full fellowships to the Workshop on NSF Rice Oligonucleotide Array The Institute for Genomic Research (TIGR) Rockville MD September 20 22 2004

2 Catalina Romero partial fellowship to the Advanced Techniques in Plant Science Cold Spring Harbor USA July 1 21 2004

3 Juliana Chacon partial fellowship to attend the Workshop on Molecular Evolution Woods Hole Mass July 26 Aug 6 2004 10 28

4 Paul Chavarriaga Training in Richard Sayre s Lab at Ohio State University Follow up on USAID funded project Expanding the range of uses of cassava starch A source of income generation OH USA February 2004

5 Myriam C Duque Summer Institute in Statistical Genetics at North Carolina State USA Introduction to Genomic Science May 26 y 28 04 Introduction to Bioinformatics June 2 4 04 Microarray Analysis June 7 9 04

6 Roosevelt Escobar Visit to Richard Litz Laboratory on tissue culture for fruits U Florida USA Nov 17 2003

7 Eliana Gaitan bioinformatics training at Cornell University USA July 2004 SNP training at the USDA soybean lab Dr Perry Cregan Belstville March 2004

8 Fernando Rojas Participation in the Consultation Workshop for Subprogram 4 informatics in the Challenge Program unlocking Genetic Diversity in Crops for the Resource Poor IPGRI – Rome Participation in the Workshop for Subprogram 4 – Generation Challenge Program Information Systems Platform & Network Design CIMMYT – Mexico Participation in the Generation Challenge Program (GCP) Information Systems Platform and Network Implementation Workshop IRRI – Phillipines

9 Morgan Echeverry Training in Real Time PCR Biomol Laboratory Bogota April 2004

3 2 Individual training 31 NARS researcher received training with SB 2 staff (Oct /03 – Oct 04)

3 3 Visitors Aprox 430 persons visited the facilities of the project which amount to 43% the total of CIAT visitors

3 4 Current graduate students

PhD 6
MSc 5
Undergraduate 18
Completed Thesis 14

J Resource Mobilization

Project approved or on going

- High through put genetic diversity characterization of germplasm with a DNA chip Donor IPGRI

- Development of strategies for better targeting of seed relief and linking relief and rehabilitation Donor FAO

- Biofortified Crops for Improved Human Nutrition Donor WB/IFPRI

- Bean Genomics for Improved drought Tolerance in Africa and Latin America Donor GTZ

- Genetic Mapping of the Linamarin biosynthetic genes CYPD1 and D2 and the development of markers for CNP in Cassava in collaboration with Prof Birger Moller Royal Agriculture and Veterinary University Copenhagen (DANIDA)

- Genoplante Project for phenotypic and characterization of a series of T DNA mutants Evaluation and multiplication of 5000 lines de T DNA mutants

- An integrated approach for genetic improvement of aluminium resistanse of crops on low fertility acid soils

- Knowledge and tools for the modulation of post harvest physiological deterioration in cassava

- Seed aid and germplasm restoration in disaster situations Sintesis of Lessons learned and promotion of more effective practices

- Model of food safety assessment of transgenic crops

- Bean genomics for improved drought tolerance in Africa and Latin America

- Delivery of transgenic rice cultivars to seed producers and farmers in Tropical America

- Following a multi step approach involving biosafety assessment mutritional testing and negotiations

- Gines Mera memorial fellowship fund for prostgraduate studies in biodiversity

- Cassava biotechnology network IV

- Gene flow analisis for assessing the safety of Bio engineered crops in the tropics

- Combating hidden hunger in Latin America Biofortified crops with improved Vitamin A essential minerals and quality protein A collaborative project submitted to CIDA on behalf of A Partnership of International Agricultural Research Centers and National Agricultural Research Systems in Latin America

- Development of micro satellite markers to facilitate use of the cassava

- Molecular genetic maps by African collaborators working on gene mapping resistanse to CMD

- Towards the development of industrial cassava varieties genetic and molecular analisis of early bulking in cassava germplasm collection

- Sustainable oil palm production as a source of employment and income for rural communities and small scale farmers in tropical Latin America

- Molecular Characterization of Genetic Diversity and the Definition of Heterotic Groups in Cassava

- Developing and exploiting expressed sequense Tags for cassava Starch and Bacterial Blight Resistanse

- Expanding the range of uses of cassava starch A source of income generation

- Seed aid and germplasm restoration in disaster situations sintesis of lessons learned and promotion of more effective practices

- Development of an in vitro protocol for the production of cassava doubled haploids and its use in breeding

- Comparative genomics and genetics in legumes a collaborative research Project between CIAT and University of Aarhus concept note prepared for DANIDA

- Phaseomics wRUIG GIAN (Submitted by Univ Of Geneva with CIAT collaboration)

- Utilizacion de hierro y zinc en modelo animal y respuesta clinica al consumo habitual de frijol de alta densidad mineral en mujeres y ninos Submitted by Universidad del Valle (with CIAT) to Colciencias

- The molecular diversity network of Cassava (MOLCAS)

- Mutagenesis of Cassava (Manihot esculenta Crantz) for the generation identification and Molecular Analisis of Novel traits Research Contract submitted to the International Atomic Energy Agency (IAEA) Viena Austria

- Challenge Program Unlocking Genetic Resources in Crops fort the Resource Poor

- Development of an In vitro Protocol for the Production of Cassava Doubled Haploids and its Use in Breeding Submitted to ZIL Switzerland

Proposal and concept notes

- Rice improvement for the Caribbean Region through molecular breeding
- Understanding genetic diversity of cassava (Manihot esculenta) and wild relatives for broadening the crops genetic base and sustainable agricultural development
- Production of Quality planting material of tropical fruits through biotechnology to supplement small farmers income in the Colombian Llanos
- Produccion entable y sostenible de guanabana mediante el desarrollo de tecnologias de post cosecha y el aprovechamiento de subproductos
- Combating hidden hunger in Latin America Biofortified crops with improved vitamin A essential minerals and quality protein
- Gene discovery for Aluminum resistance in common bean and Brachiaria
- Light water and stomata gene targets for multiple abiotic stress tolerance
- Development of a common plant stress DNA chip and its application for crop imrpovment
- Request to Syngenta for Bt genes or other insecticidal genes available to produce transgenic cassava plants that help control the hornworm Erinnyis ello in Colombia Prepared by Paul Chavarriaga and Manabu Ishitani February 2004
- Flowers Fruits and Roots Modification of Flowering to Improve Traits of Agricultural Importance A Proposal Submitted to the Rockefeller Foundation Prepared by The Department of Plant Developmental Biology Max Planck Institute for Plant Breeding Research Cologne 50829 and The International Center for Tropical Agriculture AA 6713 Cali Colombia April 2004
- Engineering the Plastid Genome of Staple Crops for High Expression and Containment of Transgenes A proposal submitted to the Generation Challenge Program
- Improvement of Iron Zinc and Protein Levels in Crops Using Selected Transgenes A proposal submitted to the Global Challenges in Global Health initiative of the National Institute of Health
- Engineered chromosomes for delivering sets of genes to staple crops Submitted to the Grand Challenge in Global Health Initiative of the National institute of Health
- Cooperative Project to Enhance and Exchange Technologies for Producing High Quality Seed of Staple Crops in Uganda Kenya Rwanda and Colombia A concept note submmited to the Rockefeller Foundation

- Interdisciplinary Center for Non Conventional Breeding of Crops Relevant to Colombia (ICNCB) A proposal submitted to COLCIENCIAS seeking funding for the creation of a Center of Excellence in Colombia