SUMMARY ANNUAL REPORT 2002

PROJECT IP - 1

Bean Improvement for the Tropics

CIAT
Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture

Project (IP-1 and IP-2): Bean Improvement for the Tropics

Project Description

Objective: To increase bean productivity through improved cultivars and management practices in partnership with NARS, regional networks and farmers.

Outputs:

1. Higher and stable bean production with less dependency on inputs such us pesticides, fertilizers, and water.
2. Integration of traditional and advanced (e.g. marker-assisted selection) crop improvement techniques and farmer participatory research activities to facilitate the rapid adoption of improved bean cultivars.
3. Strengthening of NARS, regional networks and farmers in basic food production and technology adoption.
4. Higher rates of bean technology adoption achieved through NARS, regional networks and farmers.

Gains: Improved varieties grown in 40% of Latin America and 10% of Africa (in network countries) by year 2005. Bean productivity stabilized, and bean availability secured for poor rural and urban consumers in restricted areas. Pesticide use cut by 20% in selected areas, thus reducing hazards to environment and health. Farmers growing the new cultivars will see a 10-50% increase in their income from marketing beans. Public and private researchers have access to beans with multiple stress resistance and greater nutritional value. Research capacity strengthened through regional networks.

Milestones:

2003 Marker-assisted selection developed for various biotic constraints. Lines with resistance to angular leaf spot, drought, bean common mosaic virus, and bean golden mosaic virus developed. Specialty types developed in Andean beans.

2004 Lines resistant to bean common mosaic virus, black root, beanfly, root rots and angular leaf spot made available to partners in Africa. Advanced lines with improved drought tolerance validated with partners. Progeny from marker-assisted selection for P-efficiency made available to partners.

2005 Nutritional quality traits incorporated into high-yielding and stress-tolerant cultivars.

Users: Small farmers in tropical America and Africa (mainly women) will obtain higher and more stable yields. Poor consumers, especially women and children, will benefit from low-cost protein and micronutrients. The environment and community at large will benefit from reduced pesticide and fertilizer use. Food legume researchers will access an enhanced knowledge base and germplasm.

Collaborators: *Regional networks and institutions*: PABRA (Africa); PROFRIJOL and PROFRIZA (Central and Andean America). *Developing improved germplasm:* NARS and farmers for FPR. *Improving soil, pest, and disease management:* ICRAF, CIMMYT, IITA, CIP, TSBFI, and national partners in the Systemwide IPM program and African Highland Initiative (AHI). *Training in breeding and IPM:* Bean/Cowpea CRSP and ICIPE. *Diffusing new technology:* NGOs, churches, relief and governmental agencies, and entrepreneurs. *International institutions* like CATIE and EAP-Zamorano (Central America). Universities and other institutions in: Australia, Belgium, Canada, France, Netherlands, Spain, Switzerland, UK, and USA. *Resistance breeding and gene tagging* Bean/Cowpea CRSP.

CGIAR system linkages: Enhancement & Breeding (70%); Crop Production Systems (10%); Protecting the Environment (10%); Networks (5%); Training (5%).

Log Frame Work Plan for IP-1 and IP-2, 2003-2005

Area: ***Competitive Agriculture***
Manager: **César Cardona**

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal To obtain a lasting increase in food availability and income for the poor through improved bean productivity.	Increased bean production, better income distribution and nutrition with improved cultivars and management practices.	National production statistics.	Adoption continues at rates at least comparable with those in the past.
Purpose To increase bean productivity through improved cultivars and management practices in partnership with NARS, regional networks and farmers.	Improved cultivars and/or management practices are used by NARS, regional networks and farmers in 40% of Latin America and 10% of Africa (in network countries) by year 2005. Farmers growing new varieties see a 10% increase in income from marketing of beans. Regional networks fully devolved to local management, with CIAT participating as a research partner.	Reports of NARS and regional networks. Adoption survey reports. Publications. CIAT reports. End-of-project and evaluation reports.	Core of bean researchers and operation budgets are maintained. Continued donor support to regional networks. Access to resources from challenge programs. Regional bodies and national governments continue to give priority to bean production.
Output 1 Improved, small-seeded, bean germplasm resistant to major biotic and abiotic stress factors and combined with greater nutritional and market value.	Improved parents, populations, and/or lines available to NARS, regional networks and farmers.	Reports from NARS and regional networks. Annual reports. Publications.	Continued donor support to PROFRIJOL, the African networks and CIAT. Continued input of breeders, molecular geneticist and plant nutritionist.
Output 2 Improved, large-seeded, bean germplasm resistant to major biotic and abiotic stress factors and combined with greater nutritional and market value.	Improved parents, populations, and/or lines available to NARS, regional networks and farmers.	Reports from NARS and regional networks. Annual reports. Publications.	Continued donor support to PROFRIZA, PROFRIJOL, the African networks and CIAT. Continued input of breeder and molecular geneticist.
Output 3 Strategies developed for managing diseases and pests in bean-based cropping systems	IPM strategies developed. Gene combinations to control insects and pathogens determined.	Reports from NARS and regional networks. Annual reports. Publications.	Continued input of Pathologist, Entomologist, and Virologist. Continued donor support to whitefly IPM project.
Output 4 Improved cultivars and management practices developed and tested in partnership with NARS, regional networks, NGOs and farmers.	Bean productivity increased. Farmers' dependence on inputs reduced. Nutritional value of beans increased. Production costs reduced. Climbing bean widely adopted in Kenya and at least one other country in Africa. Improved crop management practices adopted by 10% of farmers by 2005.	Trials on experiment stations and on farms. National statistics. Publications.	Continued donor support. Active collaboration with all partners involved, including farmers.

SUMMARY ANNUAL REPORT 2002

IP-1 PROJECT

Title: Bean Improvement for the Tropics

Investigators:

At Headquarters:

César Cardona, Entomologist, Project Manager (50% IP-1, 50% IP-5)
Stephen Beebe, Breeder, Geneticist (70% IP-1, 30% SB-2)
Matthew Blair, Germplasm Characterization Specialist, Bean Breeder (70% SB-2, 30% IP-1)
George Mahuku, Plant Pathologist (100% IP-1)
Francisco Morales, Virologist (30% IP-1, 20% Special Projects, 50% IPGRI)
Idupulapati Rao, Plant Nutritionist, Physiologist (30% IP-1, 30% IP-5, 40% PE-2)
Oswaldo Voysest, Agronomist, Consultant Bean Project

In Africa:

Robin Buruchara, Pathologist (70% IP-1, 30% PE-1)
Rowland Chirwa, Breeder (100% IP-1)
Minja Eliaineny, IPM Specialist (10% IP-1, 90% PE-1)
Paul Kimani, Breeder (100% IP-1)
Mukishi Pyndji, ECABREN Coordinator (100% IP-1)

Cooperators:

Within CIAT:

Personnel in Projects SB-1, SB-2, PE-1, PE-2, PE-3, PE-4, BP-1, SN-1, SN-3, and Communications Unit.

Outside CIAT:

National Programs: Argentina, Bolivia, Brazil, Cameroon, Colombia, Costa Rica, Cuba, Democratic Republic of Congo, Dominican Republic, Ecuador, El Salvador, Ethiopia, Guatemala, Haiti, Honduras, Kenya, Madagascar, Mexico, Mozambique, Nicaragua, Panama, Peru, Rwanda, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. Scientists at University of Gent, Catholic University of Leuven in Belgium; University of Guelph in Canada;

INRA in France; Escuela Agrícola Panamericana (Zamorano) in Honduras; University of Norway, Aas, in Norway, ICIPE in Kenya, Alemaya University in Ethiopia, University of Nairobi in Kenya, Rockefeller Foundation in Uganda, University of Puerto Rico, Mayaguez, Puerto Rico; University of Freiburg, Germany; ARC-Grain Crops Institute in South Africa, ETH University at Zurich, Switzerland; University of Adelaide, Australia, University of Minnesota, Michigan State University, Pennsylvania State University, Clemson University, and University of Montana in the U.S., and IACR-Rothamsted in UK.

Research Highlights in 2002

We will highlight five areas of our current research portfolio:

1. Development and testing of segregating populations combining drought tolerance and disease resistance in small red and small black grain types

Last year we reported on positive results with F_2 populations which represented our first experience with combining drought tolerance with other traits. In the course of the past year we have advanced these populations through three more generations. Selected F_5 families of red seeded beans yielded very well, as high as 1515 kg ha^{-1} and significantly more than all common bean checks. The most striking aspect of these trials was the excellent grain quality that many families presented, in spite of the intense drought pressure during the grain fill stage. All of the 138 selected families produced a very high percentage of commercially acceptable grain, and some produced grain in the drought treatment that was superior to the quality of the commercial checks under normal conditions. This represents an advantage not only in amount of marketable grain, but in labor saved in selecting grain, and also in seed quality for subsequent plantings. The families in the black seeded trials did not show as wide an advantage over Tio Canela as did the red seeded families, but still yielded far better than the black seeded commercial check, and again with excellent grain quality. Families that were selected for Central America carry either the bgm-1 or the W12 markers for BGYMV resistance. Additionally, several families presented resistance to the ALS pathogen. This is another important advancement in these lines. Elite lines are being crossed with each other, with sources of ALS resistance, with sources of high seed iron content, as well as with sources of BGMYV resistance to reinforce this indispensable trait.

2) The old and the new in the fight against Bean Golden Yellow Mosaic Virus

The selection and release of bean breeding materials possessing very high levels of resistance to whitefly-transmitted viruses, such as Bean golden yellow (BGYMV) and Bean calico mosaic viruses, has been particularly rewarding this year. Most of the new potential bean cultivars have been generated by national and international institutions in Central America, Mexico and the Caribbean, using the basic sources of virus resistance identified by the CIAT Bean Project in collaboration with national programs in the region most affected by these viral pathogens. To cite some examples, the Salvadorean and Honduran national programs are testing red-seeded materials developed by the Pan-American School in Honduras, from sources of resistance, such as DOR 483, DOR 391, DOR 364, and sources of resistance to other biotic problems, such as APN 83 and APN 102. The Bean golden yellow mosaic nurseries maintained by CIAT's Bean Program in Guatemala in the 1980s and 1990s are still yielding very valuable parental materials for the generation of bean cultivars exhibiting excellent yield and other desirable agronomic traits, such as earliness. ICTA-Ligero (DOR 385 X JU-90-4) is one example. This variety shows much higher levels of bean golden yellow mosaic resistance than any previously known improved common bean cultivar. We are now using new tools to facilitate and accelerate breeding for BGYMV. Since BGMYV cannot be selected in the field in

Colombia, marker assisted selection is employed to recover at least part of the resistance that is needed for this disease. We have reported extensively on the use of a marker for *bgm-1* gene in the past. In addition, a second marker for a QTL was identified in collaboration with the USDA-Puerto Rico and the University of Puerto Rico several years ago. This marker is identified as W12 and was converted to a SCAR by USDA-Prosser, Washington. Selection of the *bgm-1* gene for resistance to BGMV continued as reported in the last two years, as part of the gamete selection scheme with the purpose of identifying F_1 plants that carry the gene. This year we also tested heterogeneous F_3-derived F_5 families for the presence of the *bgm-1* marker, and also the W12 marker. The extension of large scale MAS to a second gene marked by W12 while maintaining the selection for *bgm-1* represents an important advance in our strategy to use markers to select resistance genes efficiently while we confront the challenge of the deployment of abiotic stress tolerance. MAS selection for the presence of the *bgm-1* and the W12 markers is also been used to introgress viral resistance into new climbing bean germplasm produced at CIAT (mid-altitude climbing bean (MAC) lines) which are more heat tolerant than traditional climbing bean varieties.

3. Understanding the mode of inheritance of resistance to angular leaf spot and developing molecular markers linked to these genes

We made significant progress in characterizing the nature of inheritance of resistance to ALS, elucidating the number of genes involved, and identifying molecular markers linked to these genes. Evidence of co-evolution of *P. griseola* and bean suggests that combining resistance from the Andean and Mesoamerican gene pools is a good strategy for disease control. New knowledge about the nature and inheritance of ALS resistance in common bean will facilitate our ability to use virulence data to precisely define the distribution of *P. griseola* races, which would facilitate deploying resistant genes in ways that prolong their durability. In addition, tagging the genes and identifying molecular markers for use in MAS will facilitate the transfer of resistance to well-adapted market class type bean. Using different segregating populations we found that inheritance of ALS resistance is complex. Both major (dominant or recessive) and minor genes, acting singly or duplicated that may interact in an additive manner with or without epistasis can be involved in conditioning resistance to ALS. This is the first step in identifying suitable Andean and Mesoamerican resistance genes to pyramid into susceptible but preferred market class beans. Pyramidation will be facilitated through identification and use of molecular markers that are tightly linked to resistance genes. In 2002 we identified RAPD, SSR, and AFLP markers linked to some of the ALS resistance genes in promising parental lines. SCARs have been developed for two of these markers and their utility in MAS is currently being evaluated.

4. Tackling the problem of low soil fertility in Africa

Bean production in Africa is severely constrained by low soil fertility. In Central, Eastern and Southern Africa, the major soil fertility related problems include low available N and P, low availability of exchangeable bases and soil acidity. A strategy based on the identification of genotypes adapted to soils with inadequate nutrient supply and low pH associated nutritional disorders as a component of integrated soil management is now considered as the most appropriate approach to improving bean productivity in this region. Hundreds of entries of five market classes (red kidneys, red mottled, small red, navy, and pintos) were tested for adaptation to harsh soil conditions. Tolerant lines were identified in all market classes. Our results indicate that genotypes tolerant to Al toxicity low soil N and P and other low pH associated problems exist in the materials being studied. Moreover, lines combining two or more stresses and preferred grain types have been identified. To confirm these results, we plan to evaluate these materials on large plots both on-station and on-farm following participatory approaches. Trials have already been planted in Tonga and Gikongoro (Malawi). Materials with high tolerance to specific stresses but otherwise deficient in other important agronomic traits such as resistance to major diseases and marketable seed types will be used as parents.

5. Release of CIAT-originated varieties

Since CIAT's establishment in 1967, national agricultural research programs have released 466 bean varieties -317 in Latin America and 156 in Africa- with Center support. The multiple disease resistance of these varieties has helped farm families by reducing crop losses and lowering production costs. Higher productivity has benefited consumers by permitting a steadier supply of beans at lower, more stable prices. Improved varieties have had environmental impacts as well. By decreasing the need for pesticides, the new beans have helped diminish contamination of water and soil. And by permitting more intensive production on land already in production, they have reduced pressure on fragile environments, such as hillsides and forest margins. The steady flow of improved varieties originated at CIAT has continued. The following CIAT-originated varieties were released in the period 2001-2002:

CIAT-originated varieties released in 2001-2002

A. Latin America

Country of release	New Name	Original identification or code	Type of germplasm[a]	Seed color or class	Year of release
BRAZIL	BR-IPAGRO 44	AN 512717	3		2002
	Guapo Brilhante	(XAN 125//BAT 336//A 83/ICA Pijao)			
COLOMBIA	Corpoica Radical Jiji	DRK 5 x A 487	2	Bola Roja	2002
MEXICO	Bayo INIFAP	MAM 45	2	Bayo	2002
	Alteño 2000	ARA 18	2	Jalinho	2001
	?	DOR 454	2	Black	2001
	?	DOR 445	2	Black	2001
	TLP 18	(EMPASC 20 x BAT 1647) x (FT83-120 x G12896)	3	Small black	2002
NICARAGUA	INTA Nueva Guinea	Negro Tacana x (DOR 364 x G18527) x (DOR 365 x LM 30-630)	2	Black	2001
	INTA Cárdenas	DOR 500 x (DOR 364 x G 18521) x (DOR 365 x LM-100)	2	Black	2001
	INTA Estelí	CM-12214-25	3	Red	2002
	INTA Rojo	EAP-9510-77 (MD-3075 x DICTA 105)	5	Red	

[a] 2, CIAT line; 3, CIAT cross locally selected; 4, NARS cross with CIAT parent; 5, Varieties or advanced lines from NARS distributed through CIAT Network; 6, Selection on local varieties or land races.

B. Africa

The following varieties are scheduled for release or were released in Africa in 2002:

- A197 in Ethiopia
- RAB 487 in Rwanda
- SCAM 80 CM/15 – in Rwanda and Kenya
- CAB 19 in Rwanda
- CAB 2 in Rwanda
- G2331 in Rwanda
- SUG 131 in Malawi
- UBR (92)25 –F_2 developed at CIAT and fixed lines selected by CIAT-Uganda (Malawi)

Problems encountered and their solutions:

Operational funding is always a concern. The Project solved part of this problem by actively seeking special funding for several research activities. The future of the regional networks in Latin America (Profrijol and Profriza) has been secured for two additional years but questions still remain on funding of these networks after the year 2005. A new proposal (jointly prepared with Precodepa and PRM in Central America) was presented to Cosude (SDC) in May 2002. This is being considered for possible funding.

As in 2001, we express that the lack of database support and biometrics support at CIAT is, in general, affecting the quality of research. We overcame part of this problem through collaborating partners outside CIAT.

At Headquarters, there are two areas in which we still need support at the senior staff level. These are Socio-Economics and Agronomy. We have not found a solution to this constraint.

Plans for next year:

- Strengthening of collaboration with the IP-2 Project (Africa) in all areas of research
- Positioning the IP-1 Project with respect to Challenge Programs. Mainly the Biofortification and Water CPs.
- Further use of marker assisted selection in breeding
- Identifying markers for disease and insect resistance genes: ALS, ANT, CBB, *Apion*, *Thrips palmi*, *Zabrotes subfasciatus*
- Root rot management
- Breeding for micronutrient enhancement in commercial grain types
- Breeding for higher yielding climbers adapted to lower elevations
- Incorporation of *bc-3* gene for black and red-seeded materials for Central America
- Exploitation of *Apion* and BGMV resistance
- Funding of new avenues for diffusion of new varieties in Latin America
- Development of IPM systems for management of whiteflies and thrips affecting beans and snap beans.

Performance indicators

1. TECHNOLOGIES, METHODS AND TOOLS

1.1 Released varieties

Brazil:	Guapo Brilhante
Colombia:	Corpoica Radical Jiji
Ethiopia:	A 197
Kenya:	SCAM 80 CM/15
Malawi:	RAB 487
	SUG 131
	UBR (92)25 (F_2 developed at CIAT, lines selected in Uganda)
Mexico:	Alteño 2000
	DOR 445
	DOR 454
	TLP 18
Nicaragua:	INTA Nueva Guinea
	INTA Cárdenas
	INTA Estelí
	INTA Rojo
Rwanda:	SCAM 80 CM/15
	CAB 2
	CAB 19
	G 2331

1.2 Genetic materials distributed

- 53 Dry bean-breeding nurseries were sent to 25 different countries
- 51 Germplasm characterization (mainly advanced lines) nurseries were sent to 17 countries
- 5 Specialized nurseries (ALS differentials, bean lines for *Acanthoscelides, Fusarium* differentials, and RAZ lines) sent to 6 countries
- 5 special breeding nurseries sent to colleagues in IP-1 in Africa

1.3 Elite material developed

- 138 Elite families selected for drought tolerance in combination with commercial grain type value and disease resistance
- 21 Interspecific *P. vulgaris* x *P. acutifolius* lines highly resistant to ALS race 63-63 and anthracnose were identified
- 4 Interspecific *P. vulgaris* x *P. acutifolius* lines resistant to *Acanthoscelides obtectus* were identified
- Six new large red kidney bean lines selected for higher yields and resistance to ALS, root rot and anthracnose enter on-farm trials in Africa

1.4 Genetic mechanisms understood

- Found evidence to support hypothesis that flavonoids accumulate under abiotic stress such as low P and drought
- Tolerance to drought in three genotypes may be associated with greater levels of nonstructural carbohydrates in shoot tissue at mid-pod filling and efficient utilization of acquired N and P for grain production
- Antixenosis and tolerance identified as mechanisms of resistance to *Thrips palmi*
- Found that inheritance of resistance to ALS is complex and conditioned by both major and minor genes that may act alone, epistatically or additively
- Showed that recessive genes condition resistance to Mesoamerican races of ALS in G 19833 while dominant genes located on different chromosomes condition resistance to Andean races in DOR 364
- Bulk segregant analysis and genetic mapping of response to the pod weevil (*Apion godmani*) allowed us to narrow down the number of chromosomes that contain genes for resistance and provides potential molecular markers for resistance to *Apion*

1.5 Sources identified

- Two accessions of *P. acutifolius* (G 40068 and G 40159) and one bred line (RAB 650) were outstanding in their adaptation to water stress conditions
- G 5273 identified as a good source of resistance to aluminum toxicity
- G 21212, G 1977 and two bred lines (IPA 7, MAM 38) identified as sources of resistance to low P conditions
- Additional sources of resistance to ALS, CBB, *Macrophomina phaseoli*, *A. obtectus,* and *T. palmi* were identified

1.6 Methodologies

- A screening procedure to evaluate genotypic variation for aluminum resistance was developed
- Found that the current anthracnose differential series can not discriminate between Andean and Mesoamerican isolates of anthracnose. A new set of differentials is being developed
- Identified IGS-RFLP fragments that can distinguish between Xap and Xapf
- Confirmed that loci specific markers can differentiate between *P. griseola* groups
- A bean bioassay method was developed to quantify soil inoculum of *Fusarium solani* f. sp *phaseoli*
- A molecular marker for ALS resistance in MAR 1 and MEX 54 was developed
- Several AFLP markers that segregate with genes for resistance to ALS were identified. SCARs are being tested

- Potential molecular markers for resistance to *Apion godmani* were selected
- Five molecular markers for arcelin-derived bruchid resistance selected as promising for substituting the serology-based assays presently in used for marker assisted selection
- A microsatellite markers survey allowed us to identify QTLs for resistance to *Thrips palmi*
- Reliable DNA-based tests were used to differentiate among species and biotypes of whiteflies

2. PUBLICATIONS (see complete list in Annual Report)

2.1 Refereed Journals

- Papers published in English: 20
- Papers accepted in English: 8
- Papers published in Spanish: 1
- Papers accepted in Spanish: 5
- Papers submitted in English: 2
- Papers submitted in French: 2

2.2 Books or Book Chapters

- Book chapters published: 5 (all in English)

2.3 Published Proceedings

- 2 papers in English
- 10 Papers in Spanish

2.4 Scientific Meeting Presentations

- 26 papers in English
- 21 Papers in Spanish

3. STRENGTHENING NARs

3.1 Training courses

- First International Course on Bean Breeding Assisted by Molecular Markers (CIAT HQ, October 21 - November 15, 2002)
- The Bean Entomology and Bean Pathology sections gave lectures and organized practicals during the I International IPM Course offered by CIAT
- A one-week course on data management and analysis was offered at Kawanda in Uganda

3.2 Individualized Training

- 3 Colombians received training on molecular markers
- 2 Colombians received training on Pathology
- 4 Colombians received training on management of whiteflies
- 2 Ecuadorians received training on management of whiteflies
- 3 Haitians received training on bean breeding
- 2 Salvadorians were trained on bean breeding and plant protection
- 3 Congolese received training on Agricultural Innovation Processes
- 3 Rwandese received training on Plant Pathology
- Several training workshops on IPM were offered in Kenya, Tanzania, and Malawi

3.3 Ph.D., M. Sc., and Pregraduate thesis students

- Ph. D.: 12
- M. Sc.: 12
- B. Sc.: 7

3.4 Workshops and Meetings

- The Project manager actively participated in Profrijol Executive Committee meetings
- The Breeder for the Andean Zone actively participated in the planning of collaborative activities for the PROFRIZA and FONTAGRO projects
- The PABRA and the ECABREN Coordinators attended the PRIAM Working Group in Kisii, Kenya
- The HQ and Africa Pathologists and the ECABREN and SABRN Coordinators attended the CRSP-Africa planning meeting at Bunda College in Malawi
- The Africa staff participated in the ECABREN Steering Committee meeting in Nairobi, Kenya, as well as the ISAR/ATDT/ASSS Stakeholders' and PABRA Steering Committee meeting
- The SABRN Network Coordinator attended the SADC Seed Security Network meeting

3.5 Technical Assistance

- Breeders in Latin America and Africa visited most countries in the target areas in order to review work and visit breeding nurseries
- Pathologists and Entomologists assisted national programs in research and reviewed work on collaborative projects
- Personnel in the Participatory IPM Development and Promotion in Eastern and Southern Africa assisted NARs in Kenya, Tanzania, and Malawi

- Likewise, personnel in the Whitefly IPM Project assisted NARs in Guatemala, El Salvador, and Ecuador

3.6 ARO Research Partnerships

- The Project has maintained excellent collaboration with the following research organizations: University of Adelaide (Australia), University of Gent (Belgium), University of Gembloux (Belgium) Catholic University of Leuven (Belgium), Agriculture and Agri-Food Institute (Canada), University of Guelph (Canada), INRA (France), University of Freiburg (Germany), the Volcani Center (Israel), University of Norway, ETH University of Zurich (Switzerland), University of Minnesota, Pennsylvania State University, Michigan State University, University of Montana, Clemson University, Horticultural Research Institute (UK), John Ines Institute (UK)

4. RESOURCE MOBILIZATION

4.1 Proposals funded:

- Candidate Genes for Tolerance of Symbiotic Nitrogen Fixation (SNF) to Phosphorus Deficiency in Common Bean (*Phaseolus vulgaris L.*). Approved by *Plate-forme de recherches avancées Agropolis - 2ème appel d'offre.* (partnership INRA, CIAT and INIFAP, Mexico) (2001-2003).

- Breeding staple-food crops with high micronutrient density for better human nutrition (Sub-project: Improvement of Common Bean) project funded by DANIDA and coordinated at IFPRI (1998-2002).

- Breeding staple crops for improved micronutrient value, a proposal approved by USAID for biofortification research (2002-2004).

- Frijol voluble para la zona Andina, approved by Fontagro/BID in agreement with IICA (2002-2005).

- Mejoramiento de frejol para el programa nacional de leguminosas de Bolivia, a bilateral project approved by COSUDE - PRONALAG, La Paz (2002-2004).

- Desarrollo de la Producción y Comercialización de Leguminosas de Grano en el Perú-Profriza II, a bilateral project approved by COSUDE - PROMPEX Lima (2002-2004).

- Estudio de la factibilidad de la selección asistida por marcadores para obtener cultivares de frijol con resistencia simultánea al virus del mosaico común y la antracnosis, approved by Ministerio de Agricultura - Colombia. Submitted by CORPOICA - Rionegro, Antioquia, with activities at CIAT (2002).

- Mejoramiento genético para el manejo del virus del mosaico común, la antracnosis y la ascochyta limitantes del cultivo de frijol en la Zona Andina, approved by Ministerio de Agricultura - Colombia. Submitted by CORPOICA - Rionegro, Antioquia, with activities at CIAT (2002).

- Incorporación de resistencia al Mosaico Común del Frijol Cargamanto, approved by Ministerio de Agricultura - Colombia. Submitted by CORPOICA - Rionegro, Antioquia, with activities at CIAT (2002).

- Plan de manejo integrado de mosca blanca en el cultivo de frejol en comunidades del Valle del Chota, Carchi, Ecuador approved in agreement with Corporación Grupo Randi Randi and Manrecur II/Fundagro Project.

- Integration of biofertilisation in bean cultivation by optimizing the use of the Rhizobium-bean symbiosis, project funded by K.U. Leuven, Belgium.

- Biotechnology assisted development, deployment and nutritional efficacy testing of high mineral beans to combat iron deficiency anemia in East Africa. Approved by USAID.

- Bean Virology has also opened a new project in Yucatán, Mexico, where the DFID-funded Whitefly Project will be looking at the management of whitefly-borne viruses affecting common bean and other commodities.

4.2 Proposals and Concept Notes submitted

- A full proposal on “Genes, environment and biological response: Complex systems that defy understanding” was prepared and submitted to the James S. McDonnell Foundation for funding. It was not approved for funding.

- A collaborative project with 3 other CIAT projects (SB-2, PE-2 and PE-3), one network (PROFRIJOL) and one systemwide program (PRGA) was prepared and submitted for funding by BMZ-GTZ. The project is entitled “Bean genomics for improved drought tolerance in Central America”.

- Breeding staple crops for improved micronutrient value, a proposal submitted to a consortium convoked by the Gates Foundation, to improve the nutritional status of bean.

- Bioavailability and clinical response to the consumption of high mineral beans and quality protein maize, a proposal presented to the Micronutrient Initiative for funding of nutrition research in Colombia. Submitted by Universidad del Valle with CIAT.

- Expressed sequence tags for common bean, a pre-proposal submitted to Brazilian (Sao Paulo) funding agency FAPESP by ESALQ, Univ. de Sao Paulo with participation by CIAT.

- Nitrogen fixation capacity of tepary bean. South Initiative-Belgium. Submitted by Univ. of Lueven with CIAT collaboration.

- Phaseomics RUIG-GIAN. Submitted by Univ. of Geneva with CIAT collaboration.

- Manejo de germoplasma local y aumento de la agrobiodiversidad de frijol y maiz con variedades biofortificadas para mejorar la nutrición en comunidades rurales y urbanas de Nariño. Cuenta de las Américas. Submitted by FIDAR with CIAT.

- Mejoramiento de la nutrición humana en comunidades pobres de América Latina utilizando maiz (QPM) y frijol común biofortificado con micronutrientes, a proposal presented to Fontagro (IDB), to improve nutrition in rural and urban communitities in Colombia and Guatemala with NGO partners. Submitted by FIDAR with CIAT.

- Plant Research for Food of the Future: Biofortification in bean. Submitted to DANIDA.

- Angular Leaf Spot of Common Beans submitted to the Rockefeller Foundation.

- Developing strategies for integrated management of root rot pathogens in Latin America bean cropping systems submitted to the Toyota Foundation through EMBRAPA.

- Desarrollo de innovaciones tecnológicas en los sistemas de producción de maíz, frijol y papa, para pequeños y medianos productores de América Central, Sur de México y El Caribe, submitted to COSUDE through PROFRIJOL-CIAT-CIMMYT-CIP.

- Nutritional Genomics, Nutritional Diversity: Importance of Phaseolus Species for Nutritional Quality in East Africa, submitted to Belgium.

- Characterisation of Bean Markets in Eastern and Southern Africa, submitted to SDC.

- Nutritional Efficacy Testing of a Biofortified Diet of High Mineral Beans and Vitamin a Rich Sweet Potatoes to Combat Iron Deficiency Anemia in East Africa, submitted to IDRC.

- Achieving Wide Impact with Climbing Bean and Agroforestry Interventions in the Eastern and Central Africa Highlands, submitted to USAID.

- Meeting Demand for Bean Production Technologies in a Sustainable Manner in 7 SADC Countries, submitted to USAID.

- Improved Nutrition, Food Security and Community Empowerment For Poverty Alleviation, a SABRN proposal presented to Food and Agriculture and Natural Resources (FANR) for African Development Bank Grant

- Supporting Improved Nutrition, Food Security and Community Empowerment for Poverty Alleviation, a PABRA project submitted to CIDA

- Catching Up with other High Potential Areas in Economic and Social Well-Being: Community Partnerships for Agricultural Development in Highland Areas of Kenya, Malawi and Uganda, submitted to ICW000.

- The Development of Bean Research in Africa - enriching Africa's bean germplasm, submitted to FDT for Deep Ecology.

- Seeds of Hope for Central America, Phase II: A 3-Year Project to Enhance the Resilience of Agriculture in Drought-prone Areas in Nicaragua

- *Food security* for Central America and the Caribbean through a regional collaborative bean research network, submitted to the government of Spain in 2001.

- Seguridad alimentaria para Cuba y Nicaragua mediante mejoramiento de frijol por tolerancia a condiciones de sequía, submitted to INIA, Spain in May, 2002.

- Bean genomics for improved drought tolerance in Africa and Latin America, a concept note prepared for BMZ-Germany.

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

- Nutritional efficacy testing of a biofortified diet of high mineral beans and vitamin A rich sweet potatoes to combat iron deficiency anemia in East Africa, a concept note prepared for Micronutrient Initiative.

5. IMPACT MONITORED

- The Strategic Planning and Impact Assessment Unit of CIAT ordered an impact study on the role of improved bean varieties in the creation of variability and on how important CIAT's role has been in the introgression of useful genes. Four important papers have been published, all authored by Oswaldo Voysest, the consultant in charge of this study:

i. Role of international cooperation in the creation of new variability in common bean (*Phaseolus vulgaris* L.)
ii. Patterns in the flow and use of common bean genetic resources in Latin America. I. The case of designated germplasm
iii. Patterns in the flow and use of common bean genetic resources in Latin America. II. The case of the bean germplasm in general; a. The development of varieties by selection 1950-2000
iv. Patterns in the flow and use of common bean genetic resources in Latin America. II. The case of the bean germplasm in general; b. The development of varieties by hybridization 1950-2000

- An adoption study was carried out in three impact areas where the Bean Project had, over several years, various promotion activities for the new bean varieties that were released in 1995. See details in full report

- A strategy for creating wider impact with bean based technologies in Africa was developed and is being tested in collaboration with NARs in Eastern and Southern Africa.

6. AWARDS

- An M. Sc. Thesis by H. Terán, supervised by S. Beebe and J. A. Gutiérrez, received a Meritorious award (National University of Colombia)
- A B.Sc. Thesis presented by A. Henríquez and supervised by G. Mahuku received an award as Outstanding Thesis of the Year (National University of Colombia)
- Two B. Sc. Thesis presented by J. Osorio and J. Díaz received meritorious awards. Both supervised by C. Cardona (National University of Colombia)
- A B. Sc. Thesis presented by H. F. Buendía received meritorious award. Supervised by S. Beebe and M. Blair (University of Tolima, Colombia)
- A B. Sc. Thesis presented by G. A. Iriarte received meritorious award. Supervised by M. Blair (University of Tolima, Colombia)
- The "Hernan Alcaraz Viecco" award was given to J. M. Bueno and C. Cardona for the best paper presented during the XXIX Congress of the Entomological Society of Colombia
- The "Francisco Luis Gallego"Award was given to J. Osorio and C. Cardona for the best paper presented by a student during the XXIX Congress of the Entomological Society of Colombia
- The Breeding-Marker Assisted Selection group received the 2001 Outstanding Team of the Year Award (OTYA), conferred by the CIAT Board of Trustees