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IDENTIFICATION OF TROPICAL FORAGE VIRUSES

IDENTIFICATION OF VIRUSES THAT HINDER THE EVALUATION,
UTILIZATION, AND INTERNATIONAL EXCHANGE OF
TROPICAL FORAGE GERMPLASM

A Proposal for: Bundesministerium für Wirtschaftliche
Zusammenarbeit (BMZ)

Special Project Funding



Submitted by:



Centro Internacional de Agricultura Tropical
Cali, Colombia

13 DIC. 2005

**Collaborating
Partners:**

Federal Biological Research Centre for Agriculture and
Forestry (BBA). Institute for Biochemistry and Plant
Virology (IBPV), Braunschweig, Germany

Selected Institutions and National Programs in Africa
and tropical America

August 1993



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Acronyms

AGDIA	Commercial company
ATCC	American type culture collection
BBA	Biologische Bundesanstalt für Land- und Forstwirtschaft (Federal Biological Research Centre for Agriculture and Forestry)
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit (Federal Ministry for Economic Cooperation)
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
cDNA	Complementary DNA
CENARGEN	Centro Nacional de Recursos Genéticos, Brazil
CIAT	Centro Internacional de Agricultura Tropical, Colombia
ds-RNA	Double stranded ribonucleic acid
ELISA	Enzyme-linked immunosorbent assay
FAO	Food and Agricultural Organization of the United Nations
FONAIAP	Fondo Nacional de Investigaciones Agropecuarias, Venezuela
GRU	Genetic Resources Unit (CIAT)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
IARC	International Agricultural Research Center
IBPGR	International Board for Plant Genetic Resources, Italy
IBPV	Institute for Biochemistry and Plant Virology (BBA)
ICA	Instituto Colombiano Agropecuario
ICRAF	International Centre for Research in Agroforestry, Kenya
IITA	International Institute for Tropical Agriculture, Nigeria
ILCA	International Livestock Centre for Africa, Ethiopia

Acronyms (Cont'd)

ISABU	Institut des Sciences Agronomiques de Burundi
ISAR	Institut des Sciences Agronomiques du Rwanda
MAb	Monoclonal antibody
NARI	National Agricultural Research Institution
PCR	Polymerase chain reaction
RABAO	Réseau d'Alimentation du Bétail d'Afrique de l'Ouest et Centrale (West and Central African Forage Network= WECAFNET)
RIEPT	Red Internacional de Evaluación de Pastos Tropicales (International Tropical Pastures Evaluation Network)
VRU	Virology Research Unit (CIAT)

1.0 Summary

Title of Research Proposal

Identification of Viruses that Hinder the Evaluation, Utilization, and International Exchange of Tropical Forage Germplasm

Short Title

Identification of Tropical Forage Viruses

Objective of Research:

To detect and identify the viruses that infect forage legumes and grasses in the main germplasm collection and evaluation centers of Africa and tropical America. This information will contribute to the safe international exchange of tropical forage germplasm, and to increasing the probability of adaptation of exotic forage species to new environments in the absence of viral pathogens that usually exist in their centers of origin.

Abstract

The Tropical Forages Program at CIAT aims to identify and develop legume and grass forage species adapted to acid soils in the humid and subhumid tropics, and thus contribute to increased meat and milk production, soil enhancement, and erosion control in different production systems.

Currently, the Genetic Resources Unit (GRU) of CIAT maintains a germplasm collection of wild, undomesticated species with forage potential, represented by over 18,000 legume and about 2,000 grass accessions of American, Asian, and African origin. More tropical forage germplasm is being acquired through collection of native vegetation, and by exchange between continents. CIAT's GRU distributes worldwide between 3,000 and 4,000 samples per year to collaborating research institutions. The international exchange and evaluation of this germplasm have been hindered by the detection of numerous viruses.



The high incidence of viruses in local and exotic forage species represents a major concern of both tropical forage programs and quarantine agencies. Reliable methods are lacking to detect and identify tropical forage viruses, some of which caused severe damage to promising forage species, thus, preventing their adoption and utilization.

Cooperating Partners:

1. Institute for Biochemistry and Plant Virology (IBPV) at the Federal Biological Research Centre for Agriculture and Forestry (BBA), Braunschweig, Germany.
2. Selected National and International Institutions in Africa, such as ISABU in Burundi and ISAR in Rwanda, and ICRAF and ILCA, which collect and exchange tropical forage germplasm.
3. Selected National and International Institutions in tropical America, such as CENARGEN in Brazil, FONAIAP in Venezuela, ICA in Colombia and CATIE in Costa Rica.

Names of Principal Scientists (IARC and Partner Institutions)

BBA - Germany

Dr. Winfried Huth (German)
Virologist - Leader

Dr. Edgar Maiss (German)
Molecular Virologist
Co-Leader

CIAT

Dr. Francisco J. Morales (Colombian)
Virologist - Leader
Virology Research Unit (VRU)

Dr. Lee A. Calvert (USA)
Molecular Virologist
Co-Leader

Dr. Brigitte Lucie Maass (German)
Germplasm Specialist
Tropical Forages Program

Mrs. Amanda Ortíz (Colombian)
Forage Germplasm Curator
Genetic Resources Unit

IARCs - Africa

Dr. Jean Hanson (British)
Head of Genetic Resources Unit, ILCA

Mr. Douglas Boland (Australian)
MPTS Germplasm Resource Centre, ICRAF

Tropical America

Forage Germplasm Curator, CENARGEN

Forage Germplasm Specialist, CATIE

Staff to be Financed:

CIAT

1 Research Associate (M.Sc.)
1 Research Assistant

BBA

1 Research Associate (postdoc.)
1 Research Assistant

Budget	VRU, CIAT			IBPV, BBA		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Salaries	31,700	33,200	34,800	80,000	85,000	92,000
Materials	12,000	15,000	18,000	20,000	12,000	10,000
Equipment	20,000	10,000	-	13,000	-	-
Training	6,000	10,000	15,000	-	-	-
Travel	18,000	15,000	15,000	14,000	20,000	19,000
Publications	-	2,000	6,000	-	-	-
Indirect Costs	21,925	21,300	22,200	31,750	29,250	30,250
Total Request	109,625	106,500	111,000	158,750	146,250	151,250

2.0 Background and Justification



Milk and beef are staple food for Latin American low and middle socio-economic classes.

Milk and beef are staples in the Latin American diet, accounting for over 20% of the food budget, particularly, in the low and middle socioeconomic classes. Beef and milk production growth rates significantly declined in the last decade because of Latin America's economic recession and significant foreign debt. As a result, tropical America will continue to be a net importer of beef and dairy products (approx. 360,000 MT of beef by the year 2000). The low consumption of dairy products by children, and the replacement of high-protein foods, by carbohydrates and fats in children and adults, has a predictable negative effect in the well being of the Latin American poor. The shortages of beef and dairy products in tropical Africa are even more critical, contributing to the occurrence of chronic malnutrition and sporadic famines. The development of more productive pasture systems resistant to biotic constraints (diseases and pests) would greatly contribute to increase beef and milk production in the tropics.

Legume and grass germplasm has been actively collected throughout the tropics to form large germplasm collections with forage potential. The main purpose of these collections is to make the germplasm available to tropical forage research programs in developing and developed nations. CIAT's Tropical Forages Program, in collaboration with NARIs, makes use of regional networks, such as RIEPT in tropical America and RABAO in West Africa, to evaluate germplasm.

The development of more productive pasture systems resistant to diseases and pests would help increase beef and milk production in the tropics.

However, the international movement of plant germplasm is a regulated activity of most NARIs in Asia, Africa, and America, and the industrialized world. The exotic nature of most tropical forage grasses and legumes, and the scarce information available on the phytosanitary situation of these wild, undomesticated species used for pastures in the tropics, puts them in a high risk category, under strict quarantine regulations that even may prohibit the importation of such germplasm.

High incidence of viruses in tropical forage germplasm collection has led to official restrictions for importation and use.



Collaborative research between BBA and CIAT on African viruses in beans speeded up germplasm introduction

Guidelines and methodologies based on a true survey of viruses need to be developed to ensure a safe intercontinental exchange of germplasm

The high incidence of viruses in tropical forage legume germplasm collections, and the recent detection by Colombian quarantine authorities, of viruses of African origin in grass germplasm introduced by CIAT *in vitro*, has led to the classification of exotic pasture germplasm as 'high risk' by the Colombian Plant Health Division of ICA (M.Sc. Carlos Huertas, ICA's quarantine officer at CIAT). This official restriction for the importation and utilization of exotic forage germplasm will be in effect until proper guidelines and methodologies are developed to ensure a safe intercontinental exchange of germplasm, based on a thorough survey of the viruses that affect these forage species in their centers of origin.

As an example, several hundred accessions of beans (*Phaseolus vulgaris*) of African origin are stored at CIAT's Genetic Resources Unit but cannot be utilized or even increased to maintain their viability, because the accessions were considered as a high phytosanitary risk by Colombian quarantine authorities. However, a recent collaborative project was conducted by CIAT and German virologists from BBA, who surveyed the main bean-growing regions of East Africa for the presence of viruses. This produced information on the bean viruses of quarantine significance in that region, resulting in a reclassification of the risk category of African bean germplasm. These bean accessions will soon be available to plant breeders for evaluation and bean improvement purposes.

The plant virus laboratories at BBA, Braunschweig, and CIAT are two of the most complete virology facilities in the world. Both laboratories have the capacity to fully characterize and specifically detect plant viruses using conventional and state-of-the-art molecular techniques, such as nucleic acid hybridization, PCR, and sequencing of plant virus genomes. These techniques can rapidly be deployed to identify the main viruses that hinder the exchange and utilization of tropical forages germplasm. At present, CIAT's Virology Research Unit is the only unit conducting research on tropical forage virology, a formidable task for a single plant virology unit. Though, recently ILCA started to implement a virus screenhouse for forages, in collaboration with IITA.

3.0 Project Objectives

The project has clear goals and specific objectives and outputs



The main objective of the project is to expedite the intercontinental and international safe exchange of germplasm. Promising tropical forages germplasm would therefore be available to scientists and growers, ultimately increasing the production and availability of beef and dairy products in developing countries and to enhance soil fertility.

To achieve this, the specific objectives:

- (1) to detect and identify the viruses that affect forage germplasm collections in tropical America and Africa;
- (2) to develop and implement reliable and sensitive diagnostic methods; and
- (3) to disseminate the information generated to quarantine agencies involved in the elaboration of germplasm importation permits, and the inspection and processing of imported germplasm.

The project will be conducted in collaboration with plant germplasm specialists and curators from national programs (NARIs) and international centers (IARCs) involved in the collection, maintenance, and distribution of tropical forage grass and legume germplasm. This approach will give germplasm collectors, particularly those from NARIs, an opportunity to become familiar with the virus problems of tropical forages.

4.0 Work Plan



The principal activities and subactivities of the project as they relate to the project's outputs are graphically illustrated in Figure 1. Figure 2 shows the project organization concerning technical reporting and financial management. The implementation schedule (Gantt Chart), showing the beginning and duration of each main activity, is shown in Appendix A.

4.1 Year 1 and 2

4.1.1 Activity 1

Africa is the center of origin of many tropical forage grasses, while tropical forage legumes originated mainly from tropical America and Southeast Asia. Surveys by the virologists (project leaders) and germplasm specialist (local or CIAT) of the main tropical forage collections, selected as sources of germplasm, will be conducted. The forage viruses found in Africa will be identified by the collaborating German virologists at BBA. Identification of viruses found in tropical America are the responsibility of CIAT's VRU.

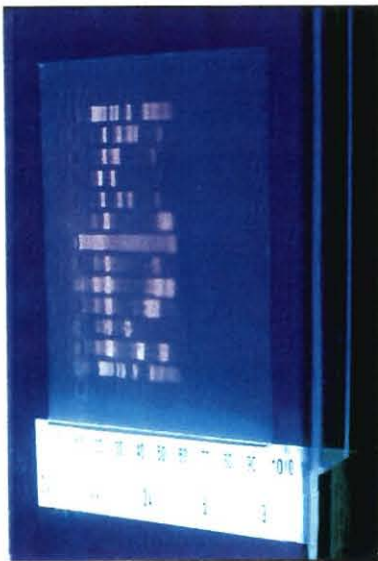
- A. In Africa (German collaborator and local germplasm specialist).
- B. In tropical America (CIAT virologist and local or CIAT germplasm specialist).

4.1.2 Activity 2

Plant samples suspected to be infected will be taken to the well-equipped virology laboratories at BBA, Germany, and CIAT, Colombia, to confirm the presence of viruses (detection) and identify the causal viruses (characterization). This division of labor is necessary to conform with quarantine restrictions both in Germany and in Colombia.



- A. Electron Microscopy**
 - a. Direct observation
 - b. Cytology
- B. Serology**
 - a. Immuno-electron microscopy
 - b. Double diffusion
 - c. ELISA
- C. Electrophoresis**
 - a. ds-RNA
 - b. Capsid protein and viral nucleic acid analyses
- D. Nucleic Acid Hybridization Techniques**
- E. Polymerase Chain Reaction (PCR) detection methods**

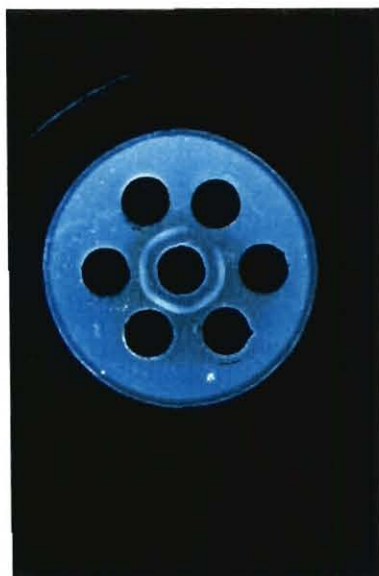


4.2 Year 2 and 3

4.2.1 Activity 1

Once tropical forage viruses are characterized, reliable and sensitive diagnostic methods will be implemented for use at advanced virology laboratories, NARIs pathology laboratories, and quarantine facilities around the world.

- A. Immunology**
 - a. Polyclonal antisera
 - b. Monoclonal antisera (at CIAT)
- B. Molecular Virus Detection Tests**
 - a. Nucleic acid hybridization
 - b. PCR
- C. Diagnostic Test Plants**
 - a. Indexing
 - b. Differential genotypes/species for virus strains



4.2.2 Activity 2

Results will be documented at different levels and in different forms. The information generated by this project will be mainly used to produce guidelines for the safe exchange of tropical forages germplasm. The collaboration and endorsement of FAO and IBPGR will be sought for. Once these guidelines have been produced, they will be distributed worldwide to quarantine agencies involved in the exchange of tropical forage germplasm.

- A. Survey and laboratory (technical) reports to inform collaborators and the funding agency
- B. Publications in plant pathology journals of local and worldwide coverage or distribution (joint publications)
- C. Production of a technical bulletin and guidelines for the safe exchange of tropical forage germplasm and distribution to interested/collaborating National Programs (IBPGR, FAO, BBA, CIAT)

Figure 1: Work Breakdown Structure, Linking Project Activities to Project Outputs

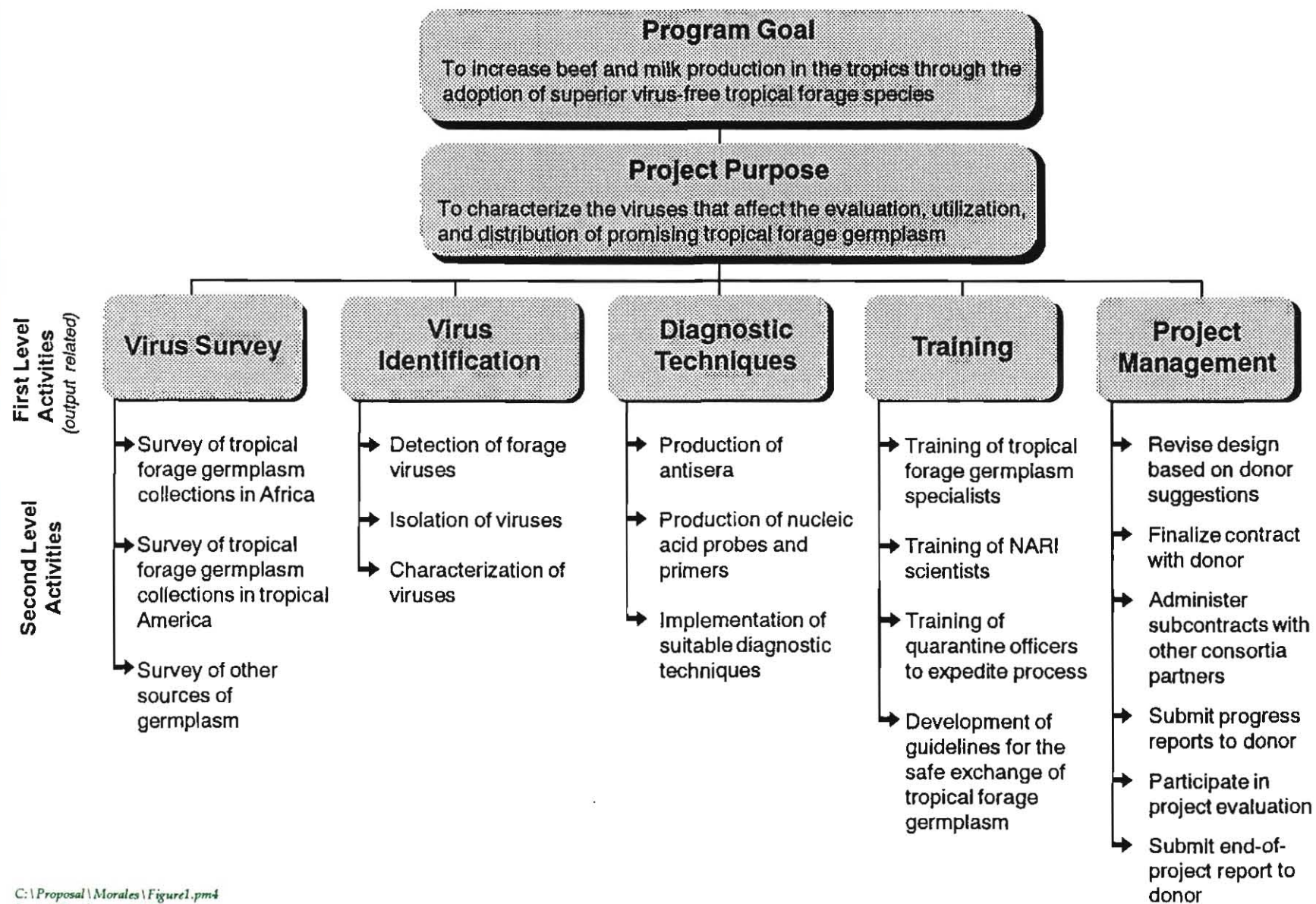
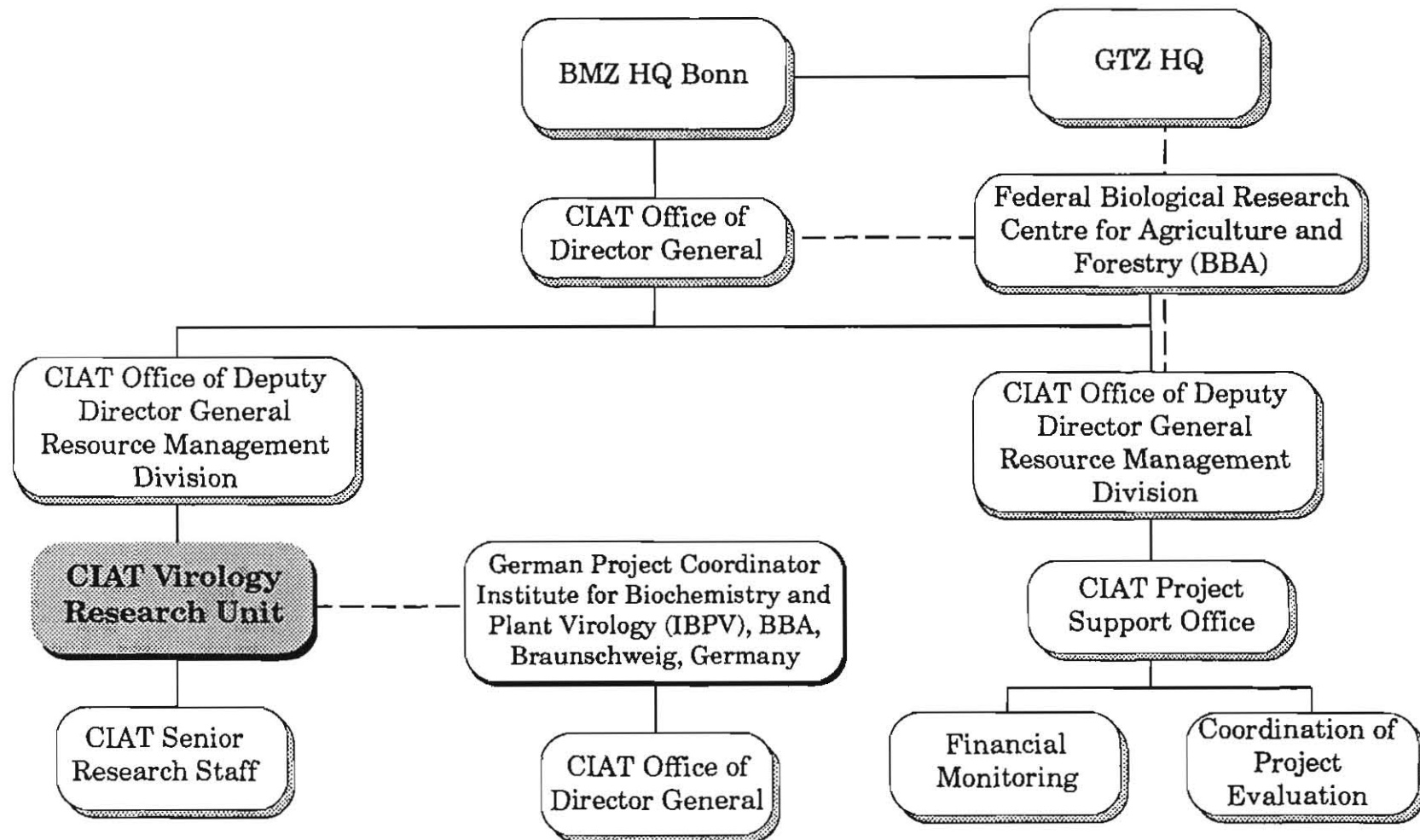


Figure 2
Project Organization Chart



Communication lines - - - - -
Management and Financial Reporting lines _____

5.0 Training



National Agricultural Research Institutions (NARIs)

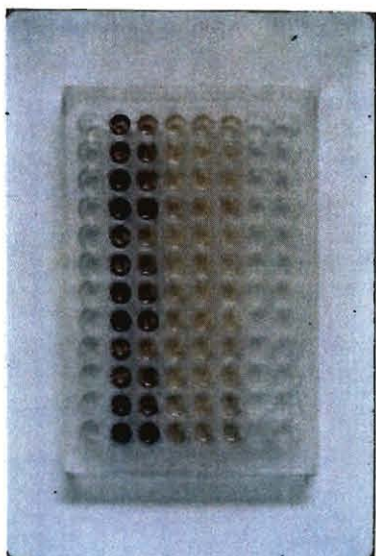
Germplasm Collectors/Curators will become familiar with virus-induced diseases during virus surveys.

Pathologists: Those who work at NARIs or at regional research institutions, with responsibilities for the phytosanitary evaluation of tropical forage germplasm, will be trained through personal contacts, local or regional workshops, and publications.

Quarantine officers who will be informed of the results of the virus survey through meetings, bulletins, and formal publications (guidelines) to expedite the international movement of germplasm in a safe manner.

Specialized training will be provided to key national program pathologists and technicians responsible for the detection of viruses and production of virus-free plants through tissue culture techniques both at the IBVP, BBA, in Braunschweig, Germany, and at the VRU, CIAT, Colombia.

6.0 Expected Patentable Research Results



We expect to produce a wide-spectrum monoclonal antibody (MAb) that recognizes those tropical forage potyviruses, such as guineagrass mosaic virus and peanut mottle virus, which are not recognized by the commercially available anti-potyvirus MAb, marketed by AGDIA (Elkhart, Indiana, USA).

This work will be conducted at CIAT during years 2 and 3, with a high probability of success because CIAT already has the specific antigens and a monoclonal antibody production laboratory.

Considering that potyviruses are the most ubiquitous viral pathogens, not only of tropical forage legumes but of plants in general, the potential market for this MAb is significant. As per CIAT policies, the Center will take the necessary steps in order to facilitate the access of scientists world-wide, and especially in developing countries, to the research output of this project.

7.0 Budget

7.1 Materials

Required supplies for Years 1 and 2 of the project are electron microscopy supplies, antisera, monoclonal laboratory supplies, PCR primers and enzymes, and laboratory reagents. Detection kits for NARIs will be acquired during Years 2 and 3 of the project. Year 3 includes all materials listed for Year 1, except antisera.

7.2 Equipment

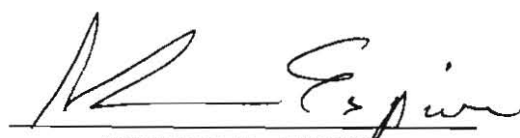
The equipment to be acquired in Year 1 includes a PCR apparatus, an ELISA plate reader and a CO₂ incubator. A refrigerated table centrifuge is included for Year 2 of the project.

TABLE 1 : BMZ – Identification of Tropical Forage Viruses
Proposed budget
(In US dollars)

LINE ITEM	Year 1	Year 2	Year 3	Total
CIAT COMPONENT				
1.0 PERSONNEL				
Research Associate	21,000	22,000	23,000	66,000
Research Assistant	10,700	11,200	11,800	33,700
Total Personnel	31,700	33,200	34,800	99,700
2.0 TRAVEL	18,000	15,000	15,000	48,000
3.0 OPERATIONS				
Materials	12,000	15,000	18,000	45,000
Publications	—	2,000	6,000	8,000
Total Operations	12,000	17,000	24,000	53,000
4.0 TRAINING (TRAVEL INCL.)	6,000	10,000	15,000	31,000
5.0 EQUIPMENT	20,000	10,000	—	30,000
6.0 INDIRECT COSTS	21,925	21,300	22,200	65,425
Total CIAT Component	109,625	106,500	111,000	327,125
BBA COMPONENT				
1.0 PERSONNEL				
Research Associate (postdoc.)	50,000	53,000	56,000	159,000
Research Assistant	30,000	32,000	36,000	98,000
Total Personnel	80,000	85,000	92,000	257,000
2.0 TRAVEL	14,000	20,000	19,000	53,000
3.0 OPERATIONS				
Materials	20,000	12,000	10,000	42,000
Publications	—	—	—	—
Total Operations	20,000	12,000	10,000	42,000
4.0 EQUIPMENT	13,000	—	—	13,000
5.0 INDIRECT COSTS	31,750	29,250	30,250	91,250
Total BBA Component	158,750	146,250	151,250	456,250
Grand Total	268,375	252,750	262,250	783,375

* Assumes 5% annual inflation on CIAT costs

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PROPOSED


ABRAHAM E. ESPINO
Financial Controller

Appendix A: CHRONOGRAM OF PROJECT ACTIVITIES BY YEAR

Activity	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
RESEARCH												
1. Survey of the main tropical forage germplasm collections in Africa and tropical America.												
2. Processing of infected plant samples in Germany and at CIAT.												
3. Development and Implementation of virus detection methods.												
4. Documentation and publication of results.												
TRAINING												
1. Preparation of training materials.												
2. Delivery of training workshops in Africa and tropical America.												
3. Specialized training at CIAT and in Germany.												

Appendix B-1



CIAT C.V.

Centro Internacional de Agricultura Tropical

Name:

Francisco Morales G.

Position in Project:

Project Coordinator

Citizenship:

Colombian

Country of Residency:

Colombia

Education:

Ph.D., Plant Virology
University of Florida, 1978

M.Sc., Plant Pathology
Cornell University, 1974

B.Sc., Agronomy
National University of Colombia, 1971

Languages:

Spanish	-Native
English	-Advanced
French	-Intermediate
Portuguese	-Advanced
German	-Beginner

**Management and
Administrative
Experience:**

Centro Internacional de Agricultura Tropical (CIAT)
Head, Virology Research Unit
Cali, Colombia. 1988 to present

Centro Internacional de Agricultura Tropical (CIAT)
Senior Staff Virologist, Bean Program
Cali, Colombia. 1980-1988

Centro Internacional de Agricultura Tropical (CIAT)
Postdoctoral Fellow, Bean Program
Cali, Colombia. 1978-1980

**International Research
Experience:**

University of Florida. Department of Plant Pathology
Research Assistant
1976-1978

**Institut für Viruskrankheiten der Pflanzen. Braunschweig,
W. Germany - CIAT, Cali, Colombia. IVP/CIAT/BMZ**
Distribution and Importance of Viruses Naturally Infecting
Phaseolus vulgaris and its Relatives in Africa.

**Instituto di Fitovirologia Applicata, Torino, Italy - CIAT,
Cali, Colombia. IFVA/CIAT**
Characterization of the Main Bean Yellow Mosaic Virus Strains
that Limit Bean Production in Northern Africa, West Asia, and
China.

Tel-Aviv University, Israel- CIAT, Cali, Colombia. CDR/AID
Identification and Characterization of Genetic Strains in White-
flies.

**Inst. for Molecular Virology and Dept. of Plant Pathology,
University of Wisconsin - CIAT, Cali, Colombia. Title XII/
CRSP/U WISC/ CIAT**
Molecular Approaches to Control of Bean Golden Mosaic Virus.

**Membership in
Scientific Societies:**

- ❖ American Phytopathological Society, U.S. and Caribbean Divisions
- ❖ Latin American Phytopathological Society
- ❖ Colombian Phytopathological Society
- ❖ Secretary in charge of organizing the Federation of American Phytopathological Societies

Publications:

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Appendix B-2



CIAT C.V.

Centro Internacional de Agricultura Tropical

Name:

Brigitte L. Maass

Position in Project:

Germplasm specialist, collaborator

Citizenship:

German

Country of Residency:

Colombia

Education:

Dr. sc. agr. (Doctor in Agricultural Sciences)
Georg-August-University of Göttingen, Germany, 1988

Dipl.-Ing. agr. (Diploma in Agricultural Sciences with
specialization in plant production)
University of Stuttgart-Hohenheim, Germany, 1978

Languages:

German	- mother tongue
English	- fluent
Spanish	- fluent
French	- working knowledge
Portuguese	- basic knowledge

Professional

1978-1980 Landscape-Planning Office Valentien & Valentien SRL, Stuttgart, Germany: Landscape-planner with emphasis on agriculture, forestry, and ecology in Southern Germany.

1980-1983 German Agency for Technical Cooperation (GTZ), Eschborn, Germany: Pasture expert in the project "Pasture Improvement in the Central Highlands of Peru" with responsibility in evaluation of native pasture species, plant introduction of exotic species into native pastures, agrostologic analysis of plant communities, and supervision of undergraduate thesis students. (Huancayo, Peru, Feb. 1981 - May 1983).

1983 Hendrikson Associierte Consultants GmbH (HAC), Eschborn, Germany: Ecological and agricultural expert in project identification mission for the Environmental Program of the United Nations (UNEP) in Peru.

1984-1987 Georg-August-University Göttingen, Institute of Crop Science and Plant Breeding, Göttingen, Germany: Visiting Research Associate at the International Center of Tropical Agriculture (CIAT), Cali, Colombia (Feb. 1984 - July 1986); and at the Federal Research Centre of Agriculture (FAL), Braunschweig, Germany (Aug. 1986 - Aug. 1987), responsible for germplasm evaluation of the tropical forage legume *Stylosanthes scabra* Vog.

1987-1988 Federal Research Centre of Agriculture (FAL), Institute of Grassland and Forage Research, Braunschweig, Germany: Visiting Researcher elaborating a doctoral thesis.

1989 International Center for Tropical Agriculture (CIAT), Tropical Pastures Program (TPP), Cali, Colombia: Postdoctoral Fellow in tropical pastures germplasm evaluation, and interim leader of the CIAT TPP Humid Tropics Screening Site at Pucallpa, Peru (Feb. - Oct. 1989).

1989-1992 CIAT, Genetic Resources Unit (GRU), Cali, Colombia: Postdoctoral, since Feb. 1992, Senior Research Fellow, Genetic Resources Specialist, responsible for the GRU Tropical Forage Germplasm Section (Cali, Colombia, Nov. 1989 - Aug. 1992).

1992- CIAT, Tropical Forages Program (TFP), Cali, Colombia: Senior Staff, Germplasm Specialist, head of the TFP Germplasm Section (Cali, Colombia since Sept. 1992 to present).

International Research Experience:

Royal Botanic Gardens, Kew, England - CIAT. RBG/CIAT/ODA.

Taxonomic revision of species from the genus *Brachiaria* held in CIAT's tropical forage germplasm collection.

Membership In Scientific Societies:

Gesellschaft für Pflanzenbauwissenschaften, Germany
Gesellschaft für Ökologie, Germany
International Mountain Society, Boulder, Colorado, U.S.A.
Tropical Grassland Society of Australia

Publications:

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- Maass, B. L. 1987. (Studies on the forage value of the tropical pasture legume *Stylosanthes scabra* Vog. applying Near-Infrared-Reflectance-Spectroscopy (NIRS)). Paper presented at the 2nd Meeting NIRS-Appliers Basic Forages. 27 October 1987, FAL Braunschweig, Germany. 9 pp. (In German)
- Maass, B. L. 1988. (Forage value determination in early stages of evaluation of genetic resources by the example of *Stylosanthes scabra* Vog.). *Giessener Beiträge zur Entwicklungsforschung - Reihe I (Symposien)*, 17:177-186. (In German)
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- Maass, B. L. 1992. Research needs and opportunities in CIAT's tropical forage germplasm collection. Abstract of seminar. June 30, 1992, CIAT, Cali, Colombia.
- Maass, B. L.; Torres, A. M. 1992. Outcrossing in the tropical forage legume *Centrosema brasilianum* (L.) Benth. Abstracts of the XIII EUCARPIA Congress, 465-466. 6-11 July 1992, Angers, France.
- Thomas, R. J.; Lascano, C. E.; Perdomo, P.; Maass, B. L. 1992. Woody forage legumes for the acid soils of tropical America. Abstract, Conference on Tropical Trees: The Potential for Domestication. 23-28 August 1992, Edinburgh, Great Britain.
- Maass, B. L.; Bojórquez, C. L. 1993. Performance of subterranean clover in the central Andes of Peru. Proceedings of the XVII International Grassland Congress. 8-21 February 1993, New Zealand and Queensland, Australia. (In press)
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- Torres G., A. M.; Belalcázar G., J.; Maass, B. L.; Schultze-Kraft, R. 1993. Manual de las especies del germoplasma de forrajes tropicales del CIAT/Tropical forages species at CIAT: Handbook of germplasm. Working Document No. 125. CIAT, Cali, Colombia. 36 p.
- Valls, J. F. M.; Maass, B. L.; Lopes, C. R. 1993. Genetic resources of *Arachis* and genetic diversity. In: Kerridge, P. C. (ed.). Biology and agronomy of forage *Arachis*. Proceedings Workshop May 25-28, 1993, CIAT, Cali, Colombia. (In press)
- Maass, B. L.; Schultze-Kraft, R. 1993. *Arachis pintoii*: an example of domestication of a tropical legume. Abstracts of the Symposium "Tropische Nutzpflanzen". 22-24 September 1993, Hamburg, Germany. (Accepted for publication)
- Maass, B. L.; Torres, A. M.; Ocampo, C. H. 1993. Morphological and isozyme characterisation of *Arachis pintoii* Krap. et Greg. *nom. nud.* germplasm. Euphytica. (In revision)
- Maass, B. L.; Ocampo, C. H. 1993. Isozyme polymorphism provides fingerprints in germplasm of *Arachis glabrata* Benth. Genetic Resources and Crop Evolution. (Submitted)

Appendix B-3



Centro Internacional de Agricultura Tropical

Name:	Winfried Huth
Position in Project:	German Project Coordinator
Citizenship:	German
Country of Residency:	Germany
Education:	Dr. rer. nat. Botany Georg-August-Universität, Göttingen, 1965 Diploma in Botany Georg-August-Universität, Göttingen
Languages:	German - native English - fluent
Professional Experience:	Since 1965 Scientific member, virologist, at Biological Research Station, Federal Biological Research Centre for Agriculture and Forestry (BBA), Braunschweig
Research Topics:	Gramineaceous viruses

Appendix B-4



Centro Internacional de Agricultura Tropical

Name:	Edgar Malss
Position in Project:	Molecular virologist, collaborator
Citizenship:	German
Country of Residency:	Germany
Education:	Dr. rer. nat. Plant Pathology (Virology) University of Hannover, Germany, 1985 Diploma in Biology University of Hannover, Germany, 1981
Languages:	German - native English - fluent
Professional Experience:	1981-1985 Ph.D. Student at Plant Pathology Department of University of Hannover. Since 1985 Research Assistant at the Institute for Biochemistry and Plant Virology at the BBA, Braunschweig.
Teaching Experience:	Since 1989 Undergraduate course Molecular Biological Methods in Plant Pathology at the University of Hannover.
Research Topics:	<ul style="list-style-type: none">◆ Studies of the genetic organization of plum pox virus (PPV) as well as different other potyviruses (BCMV, PVV, PSbMV)◆ Molecular cloning, sequencing and analysis of tomato spotted wilt virus (TSWV)◆ Expression of different viral genes with <i>E. coli</i> expression vectors, production of antisera◆ Transformation of tobacco varieties with viral genes

Appendix C

German Partner Confirmation Letter

30-JUL-1993 16:00

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+49 531 2993006

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BIOLOGISCHE BUNDESANSTALT FÜR LAND- UND FORSTWIRTSCHAFT

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Federal Biological Research Centre
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Telefon 05 31/2 99-5
Telefax 05 31/2 99-30 06 od. -30 13
Teletex 5318300=BBABS

Kernzeit im Rahmen der
gleitenden Arbeitszeit 9.00-15.00 Uhr

Ihr Zeichen/Ihre Nachricht vom

Mein Zeichen/Meine Nachricht vom

Durchwahl

Datum

2 99- 3710

30.07.1993

Dear Dr. Brigitte Maas,

Your proposed project on "Identification of viruses that hinder the evaluation, utilisation, and international exchange of tropical germplasm" covers necessary studies on the relationship between virus diseases and yield reductions in pastures and is a fundamental contribution which can help solving forage problems in tropical countries. We are interested in collaboration with CIAT and intent to encourage your project as far as possible.

Kindly regards

Dr. Winfried Hall.

CIAT

CIAT has in-house facilities for the production of high-quality training materials and video programs for scientific and extension agricultural activities.

This proposal was produced and published, using CIAT's computer layout and graphic composition facilities and outside low-cost copying services