1. Identifying Information

Project title: Application of low-cost *in vitro* propagation techniques to preserve native varieties and produce quality cassava seed in southwestern Colombia

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2. Achievements and Constraints

During this phase of the project, activities focused on fine-tuning the phases of hardening *vitro*-produced material and transplanting it to the field. Several native cassava varieties were also collected and identified using morphological descriptors, and will be subsequently analyzed by AFLP technique.

Organizational and gender analyses helped strengthen community organization, according to the objectives agreed upon with L. Sperling and the late C. Gines in December 1991.

Main achievements include the following:

2.1 A methodology adjusted for the adaptation of *in vitro* material to the greenhouse phase and its subsequent planting in the field. Plants were placed for 8 days in water and then transferred as such to the definitive planting site, where they were planted in plastic bags containing sterilized soil. This practice eliminates the additional expenses incurred when transporting the material between the laboratory and the farms, while also reducing the possibility of lodging during transportation.

2.2 Continued incorporation of new equipment and less expensive reagents into the process. A laminar flow chamber was built with local materials, costing 10 times less than an imported chamber.

Advances were also made in the adjustment of the MS basal media. Cassava seedlings showed best growth when the commercial product Ferrovital–NF was used.

2.3 Use of the rapid propagation system based on two-budded cuttings by the group of farmers to complement the *in vitro* system. With this methodology, farmers multiplied nearly 6,000 plants of the variety MCOL 1468 from *in vitro* material certified by the Colombian Agriculture and Livestock Production Institute (ICA, its Spanish acronym)

2.4 Establishment of a bank in farmers fields with in vitro material from 6 clones of interest to farmers (MCOL 1522, HMC 1, CMC 523-7, CM 6740-7, MBRA 383, and MPER 183) to provide FSD-free material. When these clones are harvested in 2003, they will be multiplied by the rapid propagation system, using two-budded cuttings, and distributed to local farmers.

2.5 Collection of 14 native cassava varieties in the municipalities of Caldono, Piendamó, Morales, Santander de Quilichao, and Caloto (Department of Cauca) and their identification using the morphological descriptors applied by CIAT's germplasm bank. A sample of each variety was planted on two farms in the municipalities of Caldono and Piendamó, as well as in the greenhouse at CIAT-Palmira.

These varieties will be evaluated in CIAT's Biotechnology Unit Lab, using AFLP to determine the degree of diversity among materials. To continue this process, a project proposal has been submitted to the Cassava Biotechnology Network (CBN) to complete the identification of these materials during 2003, and subsequently distribute clean seed of these native varieties to farmers.

2.6 Systematization of the traditional knowledge of local men and women regarding native varieties, especially their tolerance to different stress factors and their resistance to the most common pests and diseases affecting cassava in the region, uses, starch quality, and use of plant parts (other than roots).

2.7 Definition of a participatory work scheme involving men and women to strengthen the formal cassava seed production system using *in vitro* technology and rapid propagation in the rural communities of Bajo Santa Ana, Alto Santa Ana, and Quinamayó.

2.8 Easy adoption by the group of farmers of the rapid propagation technique using two-budded cuttings. This method was implemented by the project as complementary to the *in vitro* method and farmers described it as easy and simple, and said it produced immediate results.

3. Outstanding Results

3.1 An *in vitro* cassava seed production scheme to be managed by small farmers was defined. The scheme consists of 6 phases: (1) receipt of certified material; (2) *in vitro* multiplication in the rural laboratory; (3) adaptation in the greenhouse of the material multiplied through tissue culture; (4) planting of material in farmer fields with adequate management of irrigation, pest control, and fertilization; (5) multiplication of cuttings obtained in the field by rapid propagation (two-budded cuttings); and (6) production of good quality cuttings through the conventional system.

3.2 During both phases of this project, rural laboratories were built with their corresponding work areas, and the use of locally available, low-cost materials in their construction was evaluated. In addition, most of the components of the culture medium, such as salts, hormones, and sugars, were replaced with products obtained in the local market. The multiplication rate (1:3-4) obtained when local inputs were used to prepare the culture media was similar to that obtained when imported raw materials were used.

3.3 Several of the native materials collected in central northern Cauca, for example Algodona Amarilla and Algodona Grande, present good starch quality and high percentage of starch. Therefore, an agreement was reached with several farmers and starch producers to increase the area planted to these two materials using *in vitro* propagation. FIDAR assumed production costs and CIAT provided the certified materials. These two cassava clones will hopefully be able to compete better with the varieties imported by starch factories in Ecuador and other regions of Colombia.

3.4 The women belonging to the group were able to reach a consensus about their needs and ways to solve them. Priority will be given to the search for income-generating alternatives. The *in vitro* production of cassava seed is one of these alternatives, but because of the time involved, they decided to participate in complementary production activities such as the planting of cassava, pineapple and bean, individually and in association, and the multiplication of commercial cassava varieties using rapid propagation.

3.5 The results of group participation reported in this phase are characterized by the empowerment and commitment of farmers, who have showed interest in undertaking other initiatives that benefit the community, for example a program to improve the quality and coverage of basic secondary education and allowing the access of young people and adults, who because of economic problems cannot attend nearby schools. An improved educational level has allowed the group to better understand and analyze the processes of *in vitro* technology.

4. Difficulties Encountered When Executing Work Plan

4.1 The cost of an *in vitro* cassava plant produced in the rural laboratory was estimated at US$0.29 (see final project report 2001). This value is still quite high and not

sufficiently competitive for small farmers to purchase these plants. The project continued working on this aspect during the current reporting phase and was able to integrate *in vitro* production technology with the rapid propagation system using two-budded cuttings. The data needed to determine whether the integration of these two systems reduced costs should be available at the end of 2003.

New systems are being studied to reduce the cost of handling and transporting cassava seed in the greenhouse, its definite adaptation in farmers' fields, and the diversification of use of rural laboratories for tissue culture of banana and fruit trees.

4.2 The sharing of a common language and the level of confidence demonstrated by the group of farmers in the facilitating farmer ensured that project participants completed the six phases of the *in vitro* cassava production process in the rural laboratory and the multiplication in the field. However, the lack of academic training prevented several farmers from converting measurements of volume and weight and from making decisions to solve problems of contamination.

4.3 Macro and microeconomic factors affected community participation in the project, for example:

- High fluctuations in the exchange rate of the Colombia peso versus the US dollar
- Low price of cassava roots in Colombia over the last 10 months
- Legal and illegal importation of sour starch by large companies in the region
- Increase in the number of agronomic and plant health problems (whitefly and diseases such as frog skin) over the last two years

However, the adoption of several complementary measures (production projects, training in cassava cultivation) has allowed the group to continue. The importance of acting in an organized fashion to achieve project/group objectives in benefit of the community has been recognized.

5. Communication and Dissemination of Information

Project results have been disseminated at the local and national levels through the participation in different forums and workshops on topics related to farmer application of cassava tissue technology.

5.1 Seminars and Workshops

Researchers and technicians working with the project participated in the following seminars and workshops in the capacity of lecturers:

- First Regional Workshop on Rapid Propagation (In Vitro) and Genetic Transformation of Cassava. CIAT, 25 February - 2 March 2002.

- Biotechnology in the Development of Colombia. First Colombian Congress on Biotechnology. Universidad Nacional de Colombia. Bogotá, June 2002.

- Intensive training course in modern cassava production and processing systems. CIAT, June 2002.

- Rapid propagation as a technology to support the multiplication of in vitro cassava materials by farmers. Santa Ana (Cauca), September 2002.

- Cassava seed production workshops held for the farmer associations of El Agrado, the Toez Indigenous Council, and La Arrobleda. August, September, and October 2002.

5.2 Publications

During 2003, two articles summarizing the project's experience will be submitted to the journals *Illeia* and *Scientific American Latinoamérica*

- Tissue culture for farmers: participatory adaptation of low-input cassava propagation by a resource-poor rural community in southern Colombia. R.H. Escobar, C.M. Hernández, G. Ospina, J. Restrepo, L. Muñoz, J. Tohme, and W.M. Roca. 2003.

- Applicación de la tecnología de propagación in vitro para producir semilla de yuca (*Manihot esculenta* Crantz) por pequeños agricultores: descripción y análisis de la experiencia. J.M. Restrepo, G.I. Ospina, C.M. Hernández, R.H. Escobar, J. Tohme and W.M. Roca. 2003

6. Lessons Learned and Future Work

By implementing and assessing this *in vitro* cassava seed multiplication technology, farmers were able to maintain informal cassava seed production systems that yielded propagation rates of 1:3-4 every 45-60 days. The system was capable of producing 3250 plants per initial explant (plant), reaching an efficiency of 400% compared with the conventional vegetative seed propagation system currently used by regional farmers. Outstanding results were also obtained in the identification of technical parameters to build a low-cost rural laboratory, that could be easily operated by farmers, as well as of equipment and inputs to prepare the culture media, achieving an efficiency similar to that of specialized laboratories.

In addition, the farmer-farmer training methodology implemented by project researchers and technicians proved to be correct because it ensured that participants understood the concepts and acquired the skills needed to operate the rural laboratory. However, more time was needed than that initially planned for the group to understand and self-manage the different processes (prepare the culture media, plant the tissues, hardening the plants, establish plantlets in the field).

Although the simplification of the tested technology significantly reduced the costs of the infrastructure, inputs, and culture media used, the labor costs implied by the different processes continue to be quite high and make it impossible for farmers to assume *in*

vitro seed multiplication. It is therefore important to continue evaluating new systems and diversify the use of the laboratory with other crops to ensure its long-term sustainability. Mechanisms must also be sought to attract the participation and support of different local institutions.

The use of *in vitro* technology by farmers is an alternative that solves the problem of availability of good quality seed, especially in the case of new varieties or when seed is scarce because of climatic and plant health problems.

The rural laboratory can also be used to multiply native cassava varieties of northern Cauca. These are currently being identified and cleaned at CIAT's Biotechnology Unit Laboratory for subsequent redistribution to the communities for their *in situ* conservation and multiplication of seed of those varieties enjoying greatest acceptance by farmers and starch producers.

Plant Breeding Small Grants Program
System-Wide Program on Participatory Research and
Cassava Biotechnology Network (CBN)

Small Grants Financial Report (US$)

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Institutions: FIDAR and CIAT

Reporting period: 30-01-2002 to 30-06-2002

	Income PRGA: US$7,000 CBN: US$13,000	Partner contributions CIAT-FIDAR: US$5,900
	Expenses	**Expenses**
Personnel	6,500	3,500
Services	2,000	
Travel	3,000	
Communications	800	
Workshops	1,000	1,000
Capital	4,000	1,400
Indirect costs	2,700	0
Total	20,000	5,900
Financial Statement	0	0

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