

## Executive Summary

### Project IP-4. Improved Rice Germplasm for Latin America and the Caribbean

#### Project Description

**Objective:** To increase rice genetic diversity and enhance gene pools for higher, more stable yields with lower unit production costs and which proportion lower prices to consumers and reduce environmental hazards.

#### Outputs:

1. Enhancing Gene Pools
2. Integrated Pest And Disease Management
3. Education and Rice Cultivation as a Vehicle to Alleviate Poverty

**Gains:** Robust high yielding rice varieties requiring lower inputs will be developed. We will provide well-characterized progenitors and advanced materials with an ample genetic base as well as training to our partners. The focus will be on developing the capability to increase the number of desirable traits in varieties. This will lower unit costs giving farmers higher profits as well as maintain rice as an affordable food for the consumers.

#### Milestones:

- 2003 Improved rice populations with high yields and high quality grain will be made available for their evaluation by national organizations. These populations will include advance materials from the interspecific breeding activities that are designed to broaden the genetic base of rice. Molecular markers for resistance to partial and dominant blast resistance genes, sheath blight, crinkling disease, RHBV, and *T. orizicolus* will be developed. Sources of improved progenitors with combinations of blast resistance genes will be distributed to national programs. Improved rice populations with broader genetic base enhanced by recurrent selection will be distributed to national programs. Studies to assure the safety of transgenic rice will be made and novel traits for hoja blanca and sheath blight will be tested. Participatory breeding will be used to reach the resource poor rice farmers.
- 2004 Genetic progress and gains for populations enhanced by recurrent selection for different traits will be assessed in several countries. Studies of the genetics of complex traits including yield that used interspecific crosses and molecular markers will be completed. Marker aided selection will be used to combine partial and complete resistant genes to produce rice that has durable blast resistance. Molecular and virulence characterization of other rice pathogens including brown spot and sheath rot. Advanced populations using wild rice genes and recurrent selection will continue to be developed. These populations will include characteristics additional traits such as resistant to crinkling disease and drought tolerance. The use of marker aided selection, as a breeding tool will be implemented selected characteristics.
- 2005 Marker aided selection for some traits will become a routine activity. Participatory rice selection and breeding will be releasing new rice varieties for resource poor farmers. Advanced lines with multiple traits from wild species of rice will be tested for national programs for their release as varieties. An interactive training for rice researchers through the Internet or available as CD-ROMs will be available. Many of the modules will be appropriate for farmers. The developing systematic selection methods for complex traits will increasingly become the focus of the genetic studies. Near isogenic lines for blast resistant genes will be used in regional studies to understand the dynamics of the pathogen and develop locally resistant varieties.

**Users:** Rice researchers especially in Latin America. Ultimate beneficiaries are the LA rice farmers most of whom are small farmers, and the resource poor consumer who are eating rice because it is available and affordable.

**Principal Collaborators:** France CIRAD & IRD, FLAR, IRRI, WARDA, Japan JIRCAS, Korea RDA, Brazil EMBRAPA, Colombia FEDEARROZ & CORPOICA, Peru INIA, Venezuela INIA & DANAC, Cuba IIA, Nicaragua, Bolivia CIAT, Chile INIA & U. La Plata, Uruguay INIA, Argentina U. Corrientes, China, US Universities: KSU, Cornell, Purdue, LSU, U. Arkansas, Texas A&M and Yale.

**CGIAR system linkages:** Enhancement and Breeding (50%); Protecting the Environment (20%); Saving Biodiversity (15%); Transfer of Technologies (10%); Crop Systems (5%). Linked to IRRI and WARDA.

**CIAT project linkages:** Germplasm conservation SB-1, genomics SB-2, participatory research SW-3 for upland in hillsides PE-3 and cropping systems SW-2 for the savannas. Provide improved germplasm to PE-1 and PE-2.

## Project IP-4 Log-Frame 2003

### Improved Rice Germplasm for Latin America and the Caribbean

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
<p><b>Goal</b> To add to the well being of the rice sector with emphasis on the resource poor rice farmers by increasing genetic diversity and the stability of high yielding varieties.</p>	<p>Increased rice production with farmers having more access to improved germplasm and information, and markets.</p>	<p>National production statistics</p>	
<p><b>Purpose</b> To produce robust high yielding rice varieties requiring lower inputs, we will provide well-characterized progenitors and advanced materials with an ample genetic base as well as training to our partners.</p>	<p>Monitoring of yields of new varieties that were developed using our improved germplasm. Reductions in pesticide use and lower costs of production due to adoption of ICM practices leading to stable production and a cleaner environment.</p>	<p>Project, CIAT, FLAR and NARS annual reports. Publications. Impact assessment reports</p>	<p>Stability (internal and external) National policies favor adoption of new technology.</p>
<p><b>OUTPUT 1.</b> Enhancing Gene Pools</p>	<p>Rice populations with improved tolerance to biotic and abiotic stresses with good grain quality and physiological traits. Number of populations and lines selected as well as the distribution of these for line development. Number of double haploid produced and used.</p>	<p>Project, CIAT, FLAR and NARS annual reports. Publications. Improved varieties released by partners.</p>	<p>Continued donor support. Maintaining multidisciplinary team</p>
<p><b>OUTPUT 2.</b> Integrated Pest and Disease Management</p>	<p>Understanding components of resistance and virulence of rice blast, rhizoctonia, hoja blanca, crinkling disease, and other selected pathogens. Molecular markers associated and number of resistance genes for rice pathogens and pests. Crop management components developed. Using novel genes resistance to rice pathogens including hoja blanca and rhizoctonia.</p>	<p>Project, CIAT, FLAR and NARS annual reports. Publications. Pest and disease resistant varieties released by partners.</p>	<p>Continued donor support. Maintaining multidisciplinary team</p>
<p><b>OUTPUT 3.</b> Education and Rice Cultivation as a Vehicle to Alleviate Poverty</p>	<p>Number of communities participating New varieties and small equipment for rice Number of workshops and scientists trained. Published reports of courses. Development of web pages</p>	<p>Project, CIAT, FLAR and NARS annual reports. Publications. Impact assessment reports CIAT's Rice Web page</p>	<p>Continued donor support. Maintaining multidisciplinary team</p>

## Project IP-4: Improved Rice Germplasm for Latin America and the Caribbean

### Summary of Annual Report 2003

#### Inputs

<b>Principal Staff</b>	<b>Allocation of time</b>	<b>Affiliations</b>	<b>Work Location</b>
Dr. Lee Calvert	70%	CIAT	CIAT HQ
Dr. Marc Chatel	100%	CIRAD/CIAT	CIAT HQ
Dr. Fernando Correa	80%	CIAT	CIAT HQ
Dr. Zaida Lentini	20%	CIAT	CIAT HQ
Dr. Mathias Lorieux	50%	IRD/CIAT	CIAT HQ
Dr. César Martínez	51%	CIAT	CIAT HQ
Dr. Rafael Meneses	50%	IIA Cuba/CIAT	CIAT/Cuba
Dr. Gilles Trouche	50%	CIRAD/CIAT	Managua, Nicaragua
Dr. Michel Valès	75%	CIRAD/CIAT	CIAT HQ

Total 5.46 Principal Staff positions

Dr. Carlos Bruzzone worked as a consultant 50% CIAT Chiclayo, Peru

Dr. Douglas White worked as a consultant 5% CIAT CIAT/HQ

There are 14 associates or assistants, 3 visiting scientists and 28 technical and support staff.

#### Budget 2003

##### PROJECT IP4. Improved Rice Germplasm for Latin America and the Caribbean

<b>SOURCE</b>	<b>AMOUNT US\$</b>	<b>PROPORTION (%)</b>
Unrestricted Core	0	0
Restricted Core	618,220	54%
Carry over from 2002	23,231	2%
Sub-total	641,450	56%
Special Projects	513,972	44%
Total Project	1,155,422	100%

## **The CIAT Rice Project Strategic Summary**

### **Our Project and its Supporters**

The CIAT Rice Project IP-4 has nine senior scientists, which devote most of their time to rice. Some have part of their time in the Biotechnology, IPM, and Watershed projects. In addition, the project has fifteen junior staff and twenty-eight technical support staff. There is additional support staff in the Biotechnology project.

Since 2000, the CIAT Rice Project has received substantial contributions from the European Union. Their contribution has allowed the Rice Project to prosper and develop new initiatives that are directed improving the small rice farmer. This year, the Rice Project was reviewed by the EU, and their report is favorable to the strategy and actions of the project. The views and suggestions in this report are being critically evaluated to improve our strategy and tactics.

The CIAT Rice Project and CIRAD/IRD have a special relationship. The French institutions have maintained an average of three senior scientists and financial support during the last three years. Before that there were two senior scientists from CIRAD. We work together as a team with credit for our success going to all three organizations. A summary of the impact of some of our collaborative work is in the 2002 Annual Report. This is briefly covered this year in the section on Impact.

The CIAT Rice Project has received substantial contributions over the last decade from the Colombian Ministry of Agriculture. This contribution is for specific activities and assures that we attend to the priorities of the Colombian Ministry of Agriculture. An impact study over the impact of rice in the Llanos of Colombia demonstrated that this investment has paid off for Colombia. We maintain collaborative research with FEDEARROZ of Colombia and they post an average of two of their scientist in CIAT. Both organizations have benefited through this close collaboration and have increased our impact because of the contribution of Colombia. We also receive support through Pronatta and Colciencias for activities not covered by the funds from the Colombia Ministry of Agriculture.

The CIAT Rice Project has direct support from Peru. With these funds we partially support one rice breeder who recently was named as the Project Leader for Rice in INIA of Peru. These activities are in the third year and we expect new varieties will soon be released that are the fruits of this collaboration. We also have a collaborative agreement with IIA of Cuba. We fill our entomology position by contracting a scientist of IIA 50-60% of the time. This has allowed us to expand our efforts in integrated pest management and develop a more intensive set of activities with Cuba.

The Rice Project wishes to express our sincere gratitude to all financial supporters of the project. The Annual Report and this Summary helps inform our partners, donors and other interested parties of some of our work including the major advances.

## **The International Year of Rice**

For the first time, the United Nations has declared a year in honor of a crop, and 2004 will be The International Year of Rice (IYR). We are working with our partners and expect that there will be activities in many countries in the region that will be done use the IYR as the theme. We will be collaborating with our partners to develop new activities that will have lasting impact. An example is the network of rice breeders. We agreed to activate this network in workshop on Aerobic Rice in August with the goal of increasing regional collaboration. The network will be inaugurated next year in a combination of Workshop and Forum on the theme of Rice Breeding. This will be held in Brazil and will include both Irrigated and Aerobic Rice. Other activities will include a workshop in Cuba, a Forum in Colombia and rice biotechnology will be a major theme in a Congress on Molecular Biology that will be held in the Dominican Republic. We expect additional activities will be announced during the following months.

## **Why We Use Wild Relatives of Rice in our Breeding Program?**

The genera *Oryza* consists of 21 wild rice and two cultivated species. After 6,000 years of continuous selection by man and intensive breeding efforts during the last 100 years, the genetic base of the crop, exemplified by the modern rice varieties that ushered in the green revolution and brought about dramatic increases in rice production worldwide, is narrower than ever. There are many reports of rice production in farmers' fields reaching a yield plateau, and the narrow base is contributing to instability of rice yields caused by biotic and abiotic factors. The *Oryza* wild species represent a potential source of new alleles for improving the yield, quality and stress resistance of cultivated rice. The narrow genetic diversity in the commercial varieties makes them susceptible to both biotic and abiotic stresses. The wild relatives of rice are resistant to many pests and diseases for which there is not sufficient genetic resistance in cultivated rice. There may even be components in the wild species that will increase the yield potential of rice. Interspecific crosses are being made for many traits including *O. rufipogon* as a source of aluminum tolerance and vigorous root growth. High levels of resistance to the rice stripe necrosis virus were found in *O. glaberrima*, and this resistance has been transferred through interspecific crosses to Bg90-2 and Caiapo. The results for disease resistance are also impressive. Advanced breeding lines with resistance to *Rhizoctonia solani* were derived from the interspecific crosses of *Oryzica3/O. rufipogon*. Advanced lines from the crosses of Lemont/*O. barthii* mature early having good yields and excellent grain quality. The diversity of the parents makes these interspecific crosses ideal in studies to develop molecular markers. Already, they have been used to mark regions of the chromosome of rice for important traits. The wild rice species are also an important source of traits for our efforts to develop rice that uses water more efficiently.

## **Rice Blast and the Search for Durable Resistance**

Most commercial varieties remain resistant to rice blast for only one to three years. There is a tug of war between the pathogen and the host. While a host may be resistant to many of the rice blast isolates, there always seem to be a subset of the population that is not recognized by the plant's defenses and it soon becomes the predominant. When this happens the resistance is broken and the new variety becomes susceptible to rice blast. Hot spot selection under high disease pressure and pathogen diversity has been the principal method for breeding rice blast resistant lines and

varieties. For example, the variety Fedearroz 50 is widely grown in Colombia and has remained highly resistant to rice blast for over three years. The genetic resistance profile of Fedearroz 50 is similar to that of Oryzica Llanos 5. This contrasts with many varieties that start to have problems one to two years after their release. Much work remains before we can declare that we have the knowledge and methods to consistently develop rice with durable resistance, but there is evidence that step-by-step, we are making progress. Oryzica Llanos 5 is a variety that was developed through hot spot breeding and is exceptional because it has remained resistant to rice blast for more than a decade. The genome of Oryzica Llanos 5 is being analyzed to identify its combination of resistance genes. And this is part of a larger effort to catalog both the resistance genes in the plant as well as the virulence genes in the fungus. Using near isogenic lines carrying individual resistant genes and biological testing with the known rice blast lineages, progress is being made. The search is on for molecular markers, and with the information from the rice genomic sequencing project, the rate of discovery of rice blast resistant genes is increasing. This will facilitate the isolation, characterization and utilization of these genes. Already, we are testing associations of these genes in order to develop rice varieties that have a series of resistant gene combinations that confer durable resistance.

### **The New Rice Hoja Blanca Resistant Varieties are Better than their Parents**

Developing rice varieties with resistance to rice hoja blanca virus (RHBV) has been a research objective even before the CIAT came into existence. For many years, it seems like there was only marginal progress and most commercial varieties are not resistant to hoja blanca disease. In the mid-1990s, it appeared as if a new epidemic was imminent. CIAT, Fedearroz in Colombia and Danac in Venezuela made the development of RHBV resistant varieties a priority. In addition to the mass screen method that has been in place since the mid 1980's, we introduced an evaluation scheme using different levels of disease pressure. Since the capacity is more limited, only selected advanced lines can be evaluated by intensive screening. Nevertheless, this has led to the liberation of five varieties with resistance to hoja blanca disease in Venezuela and Colombia. Two varieties, Fedearroz 2000 and Fedearroz Victoria 1 have resistance to hoja blanca disease that is superior to any of their parents including the principal source of resistance Colombia 1. Fedearroz 2000 is the most resistant variety and is now considered the standard for high resistant to hoja blanca disease. The release of these varieties confirms the success of the two-step breeding strategy, and these new commercial varieties are recommended as parental sources for hoja blanca resistance.

### **The Role of Biotechnology**

The CIAT rice project is positioned in the middle of another agricultural revolution. Both the entire sequences of the rice genome and the genome of the rice blast fungus are in the public domain. The challenge is to use the increasing knowledge to benefit all the rice farmers. Most rice farmers in Latin America and the Caribbean are small farmers with limited resources. The rice project at CIAT is working to broaden the genetic base of the rice crop by bringing in useful traits from the wild relatives of rice. Recurrent selection, anther culture and transgenesis are methods that we have been utilizing to increase the efficiency of our breeding efforts. We are working to understand the mechanisms and genetics of resistance to rice blast and rice hoja blanca virus to facilitate the development of rice cultivars with durable resistance to these

diseases. Many agronomic traits such as drought resistance, earliness, yield and quality are essential for the success of new varieties. The entire process of breeding will soon change. For more than 100 years, it has been an empirical science and the breeder has needed to be both a scientist and an artist. By knowing the genetic basis of characteristics of agronomic importance and where they are located on the genome, we expect that our breeders will be able to juggle many more traits and produce rice varieties more efficiently.

To help facilitate the understanding of the rice genome, we are collaborating with advanced research centers. For example, in the framework of its work plan for functional analysis of cereal genomes, the Génoplante consortium constructed a rice T-DNA insertional mutagenesis collection. This T-DNA mutant collection is a library of 35,000 lines obtained from transformation by *Agrobacterium tumefaciens*, using a specific construct called the *T-DNA insert*. A T-DNA mutant collection is a powerful tool for discovering gene functions.

Génoplante in collaboration with CIAT initiated a program of seed multiplication and phenotypic analysis of a rice T-DNA mutant collection. This year, the first set of 5,000 lines were evaluated. An English-Spanish-French lexical of botanical and agronomic terms was established to facilitate phenotype identification. A phenotypic database was set up to serve the functional genomics studies. Numerous interesting phenotypes were observed, including modifications of size, tillering, lesion mimics, panicle development, general architecture, and chlorotic or albino leaves. The T2 seed was harvested and constitutes a rice T-DNA mutant stock center for future distribution and collaboration with Génoplante partners. It will be sent to Génoplante, France as well as stored at CIAT. CIAT is well positioned to be part of this basic effort of gene discovery.

### **Rice for the Small Resource Poor Small Landholders**

Impact assessment has shown that both large and small farmers benefit equally from new technologies when they are in the same agroecosystem. In the Latin America and Caribbean region, most rice producers are small farmers living in marginal areas and they have not benefited from the technologies that are improving production in major rice growing zones. The CIAT rice project is increasing our efforts to reach these resource poor rice farmers. Very high rainfall agricultural systems have unique problems. These include flooding, low luminosity, high disease incidence as well as post harvest problems including the drying of the grain. Most small rice farmers produce their crop in areas with at least one season of adequate rain. They do not have irrigation infrastructure and they suffer when the rainfall is less than normal. In these environments drought, pests and diseases are all major problems. Breeding populations have begun for many of these difficult environments. Also there are several projects where we are working with farmers groups to select the best varieties for their needs. This is becoming an important in understanding the problems of the small farmers and being able to direct our efforts to better serve them.

### **Rice, a Crop with Impact**

The combined effort of CIAT and our many partners has led to higher yielding rice varieties throughout the region. The successful use of these genetic resources as the parents of varieties was documented for upland rice. Over 90% of the approximately 40 upland varieties released in the last 20 years have at least one CIRAD parent. Germplasm that has been developed by CIAT

has also been crucial as parents, and often the crosses for these varieties were made at CIAT. For the last decade, CIRAD and CIAT have had a strategic alliance that has worked synergistically by bring the critical human capital, resources and infrastructure together to help serve the Latin American and Caribbean rice sectors. Since the mid-1990s recurrent selection was emphasized as a new tool in the breeders arsenal, and the CIAT/CIRAD collaborative project in Brazil is now bearing fruit. In the State of St. Catarina Brazil in 2002, the release of “Tio Taka” was a milestone since it is first variety to be developed by recurrent selection in the region. There are currently populations that have been developed using recurrent selection in eleven countries, and there are many advanced lines that could soon be selected as new varieties. We expect that Tio Taka will be the first of many varieties that have their origins in recurrent selection populations, and this shows the importance of maintaining a consistent effort over a sufficient period of time.

An example, where CIAT, CIRAD, CORPOICA, and FEDEARROZ worked together, is documented in the impact study “Un negocio de amplios horizontes para el Llano”. It is estimated that the economic impact of CIAT rice projects contribution is \$450 million between 1994-2001. The strategic alliance of CIRAD/CIAT with many local partners will continue to have lasting impact in the Llanos of Colombia and throughout Latin America.

In the last few years, FEDEARROZ has released 5 new varieties for Colombia. FEDEARROZ and CIAT have worked closely together in the development of these varieties. Traits including resistance to rice blast and rice hoja blanca virus and its vector as well as quality analysis were areas of collaboration. The success of Fedearroz 50 has surpassed expectations. Released late in 1998, more than 60% of the rice grown in Colombia is now Fedearroz 50. This variety is yielding on average 7 t/ha and this is the principal reason that Colombia returned to self-sufficiency in rice production after several years of deficits. More recently Fedearroz 2000, Victoria 1, Victoria 2, and Colombia XXI were released. FEDEARROZ will soon release this year two new commercial varieties: CT 11275-3F4-8P-2 and CT 11369. Several of these promise to become important varieties, but they must compete with Fedearroz 50.

Another example of varieties that fit the needs of small farmers is the release of an early variety in Pucallpa Peru. Although the early variety did not have higher yields than the local varieties, it did allow the farmers to grow more rice during the season. This is because of labor constraints at the time of harvest. We expect to continue to learn about the special needs of small farmers and attempt to help fill some of their needs using participatory activities.

Many other varieties, most of which have CIAT/CIRAD parentage, were released in countries throughout Latin America and the Caribbean region. We are reactivating international observational nurseries to assure the continued flow of diverse genetic resources. We are confident that our partners will continue to make good use of these genetic resources.

## **Future Perspectives**

The rice project has the challenge of being part of the bridge between the rapid advances in the molecular characterization of rice and producing usable products for the rice farmers. The Rice project (IP-4) and Biotechnology (SB-2) are working together to develop the strategic alliances to bring the advances of molecular biology into practical applications. The Rice project is also

strengthening partnerships to better meet the needs of rice farmers with emphasis on the resource poor small farmer. Water efficient rice and developing information systems will both be important to assure that the small farmers continue to receive their share of the benefits from the research done by CIAT and our partners.

## **Problems Encountered and their Solutions**

### **Quarantine Restrictions**

Quarantine restrictions are increasing for both the export and import of rice germplasm. In Colombia, we are having problems meeting the requirements of some countries. Better facilities are needed for the production of exceptional clean rice for export. This is not an issue for rice but all of the CIAT crops. CIAT should have a facility for the production of clean seed.

### **Demand for Region Breeder's Workshops**

This activities has a very high priority with our partners, and we had a very successful meeting this year in Villavicencio. This is in effect a renewal of the INGER workshops that were stopped in approximately 1992. In order to reduce costs, it was decided to join Irrigated and Aerobic rice workshops. A stable source of funding would allow the meeting to be better attended and have greater regional impact. The long term funding of these workshops is needed.

### **Capital Equipment**

The recommendations to purchase capital equipment are now made by the disciplinary groups. The projects are not consulted, but it is the projects not the disciplinary groups that are responsible for accomplishing their workplans and outputs. While the advice of the disciplinary groups is valuable to prevent undo redundancy of capital equipment, the needs of each project should be taken into account. Under the present system, disciplinary projects are getting most of the capital allocations and the needs of many projects are being ignored.

## **Plans for Next Year**

- Develop interspecific rice with characteristics that are hard to find with cultivated rice
- Release varieties that were developed using recurrent selection techniques
- Identify and implement marker assisted selection for incorporating rice blast resistance genes into commercial rice cultivars resistance especially for the genes Pi-ta<sup>2</sup>, Pi-kh, and Pi-sh conferring resistance to different genetic lineages of the pathogen
- Identify new blast resistance genes in wild species of rice and unutilized germplasm within *O. sativa*
- Identify molecular markers associated to tolerance to sheath blight
- Characterize molecular and pathogenicity diversity in populations of the sheath blight pathogen
- Develop germplasm nurseries with potential donors of resistance to different rice pathogens
- Develop molecular markers of for RHBV and *T. orizicolus*
- Increase activities with additional pests including *Spodoptera* and *Hydrellia*.
- Develop web based IPM information
- Research on biosafety and introduction of novel traits use transgenic approaches.

- Continue the characterization of the Genoplante T-DNA mutant collection
- Develop comprehensive research strategy for Water Use Efficiency in rice
- Develop rice varieties using participatory methods

## **Project Performance Indicators**

### **1. Technologies, Methods and Tools**

#### **1.1 Released Varieties**

##### **Conventional Breeding**

- **Brazil**

##### **CURINGA**

Origin: CIAT Line (CT13226-11-1-M-BR1)

Adaptation: Upland and Irrigated Rice Ecosystems (Cerrados and Varzea)

Launching: Second Semester 2003

- **Bolivia**

##### **JACUÚ**

Origin: CIRAD Line (IRAT 357)

Adaptation: Upland Small-farmer's Rice Ecosystem

Launching: February 2003

- **Colombia**

##### **“Línea 30”**

Origin: CIRAD/CIAT Line (CT 11891-2-2-7-M or CIRAD/CIAT 409)

Adaptation: Upland Savannas Rice Ecosystem

Launching: October 2003

FEDEARROZ is going to release two new varieties and will announce them during their national rice congress in December. They are the lines CT 11275-3F4-8P-2 and CT 11369.

##### **Composite population breeding**

- **Bolivia**

##### **PCT-4\0\0\1>S2-1584-4-M-5-M-6-M-M**

Origin: CIRAD/CIAT (Upland *japonica* composite population PCT-4)

Adaptation: Upland Small-farmer's and Mechanized Rice Ecosystems

Launching: February 2004

First Upland variety coming from the Composite Population PCT-4

## 1.2. Elite Materials

- **Colombia**

PCT-4\SA\1\1>975-M-2-M-3

Origin: CIRAD/CIAT (First cycle of recurrent selection of the Upland *japonica* composite population PCT-4)

Adaptation: Upland Savannas Rice Ecosystem

*Promising line coming from Recurrent Selection of the Composite Population PCT-4*

### **Rice Blast RILs**

Development and distribution to Latin American partners (Brazil, Argentina, Uruguay, Venezuela) of near isogenic lines with combination of different blast resistance genes

### **Aerobic and Irrigated CIAT ION**

These nurseries were developed during 2002 and 2003 and are composed of elite lines.

## 1.3. Genetic Materials Distributed

### **Distribution of Germplasm:**

#### **Aerobic Rice CIAT-ION**

- 3 Upland Rice Nurseries (211 lines)
- Seed Increase: November 2002-March 2003  
Shipping: April-September 2003  
Receptors:

Bolivia	CIAT Santa Cruz
Brazil	Embrapa Rice and Beans Center
Colombia	CORPOICA Regional 8
Costa Rica	National Rice Corporation
Cuba	IIA
Nicaragua	INTA
Honduras	DICTA
Venezuela	INIA-Guárico

#### **Irrigated Rice CIAT-ION**

Three types of nurseries were distributed to 18 collaborators from Colombia (10), Brazil (2), and one each to collaborators in Argentina, Dominican Republic, El Salvador, Nicaragua, Surinam and Venezuela.

### **Participatory Breeding**

- **Elite Materials Developed :**
  - 3 new site-specific and narrow genetic base populations for Nicaragua in creation
  - 71 S<sub>1</sub> lines from PCT-18 and PCT-17 populations using PPB schemes

- **Participatory Varietal Selection**
- 40 PVS on-farm trials carried out in Nicaragua and Honduras
- identification of 2-3 preferred varieties with better performances than commercial checks at each PVS site

#### **1.4. Genetic Mechanisms Understood**

- Resistance to blast in commercial cultivars with durable resistance is controlled by the action of both major and minor genes
- Resistance to sheath blight seems to be controlled by the action of minor genes which can be accumulated to improve the resistance over the parents
- Genetic studies of the inheritance of RHBV were made and fits a 2 or 3 gene model. These populations are being analyzed by molecular markers.

#### **1.5. Methods and Tools**

- Improved greenhouse methodology for evaluating tolerance to sheath blight (*Rhizoctonia solani*)
- Improved evaluating scale for differentiating tolerant and susceptible germplasm to sheath blight
- Identify molecular markers for improving blast resistance through marker assisted selection
- Developed field methodologies for selection of potential donors of stable blast resistance involved in genetic crosses yielding a higher number of resistant lines
- Implemented molecular markers for analysis of the genetic diversity of the sheath blight pathogen
- Developed quantitative method to determine “dosage” of RHBV in the vector and correlate that with field experience in the mass screening trials. This allows more precise screening for RHBV.

#### **1.6. Sources Identified**

- Sources of resistance to blast giving origin to stable blast resistant lines in different genetic crosses
- Sources of tolerance to sheath blight selected within interspecific crosses with the species *O. rufipogon* and identification of unknown tolerance within the cultivated species *O. sativa*
- Sources of resistance to crinkling disease selected within interspecific crosses with the species *O. glaberrima*
- Sources of resistance to grain discoloration and leaf scald selected over several years of field evaluations

## **2. Publications**

### **2.1. Referred Journals**

#### **Published**

Eleven articles were published in referred journals.

#### **Submitted**

One was submitted and accepted for publication.

### **2.2. Books**

#### **Book Chapters**

Nine book chapters were published.

#### **Published Proceedings**

Five articles were published in Proceedings.

#### **Scientific Meetings or Publications**

Nineteen abstracts, posters and newsletters were published.

## **3. Strengthening NARs and NGOs**

Workshops to help strengthen NARs and/or NGOs were carried out in five countries including Colombia, Cuba, Nicaragua, Peru and Honduras.

### **Individual Training**

The Rice Project worked with 20 scientists for intensive specialized training.

#### **3.1. PhDs, MS & BS**

The Rice Project is involved in the thesis with 3 Bachelor of Sciences, 10 Masters of Sciences and 3 PhD Students.

#### **3.2. Workshop and Meetings**

The Rice Project sponsored or participated in 23 workshops.

#### **3.3. Advanced Research Organizations Research Partnerships**

CIRAD, IRD, JIRCAS, KSU, Cornell, Purdue, LSU, U. Arkansas, Texas A&M and Yale.

## 4. Resource Mobilization

### 4.1. Proposals Funded

1. Colciencias grant (3 year) for US\$4,500
2. FONTAGRO project on characterization of rice blast populations for Argentina and Uruguay (US\$5,000).
3. Génoplante. Project for phenotypic and characterization of a new series of T-DNA mutants, funded for US\$ 66,000.
4. PERU and GTZ project on characterization of rice blast populations from Peru (US\$2,000).
5. Peru STC-CGIAR was funded US\$50,000 for 2003.
6. A project proposal on sorghum PPB was accepted by the French regional office of cooperation for Central America for US \$ 12,000.
7. PRONATTA was funded US\$20,000 for 2003

#### a. Proposals and Concept Notes Submitted

- FONTAGRO Costa Rica-CIAT: Búsqueda de Fuentes de resistencia a *Magnaporthe grisea* a partir de la especie silvestre *O. glumepatula*, variedades comerciales, criollas, y arroz rojo.
- Genetic Resource Challenge Program “Unlocking Genetic Resources in Crops for the Resource-Poor”. Three concept notes presented requesting US\$ 50,000.
- Challenge Program on Water and Food “Developing Cereal and Pulse Cultivars for Sustainable Cropping Systems, Increased Food Security and Community Well-Being in the São Francisco Basin. Presented Full Proposal requesting US\$ 125,000.
- Elaboration of two concept notes on participatory rice production improvement for Atlantic area of Nicaragua and High altitude hillsides in Honduras

#### b. Resource Mobilization Activities

FAO/IAEA Developing a proposal on the Identification and Pyramiding of Genes Responsible for Crop Quality Characters and Resistance to Quality Affecting Stresses

#### Impact Monitored

Impact of CIAT Upland Rice Varieties on Resource-Poor Farms in the Peruvian Amazon  
Douglas White, Efraín Leguía, José Sánchez and Sam Fujisaka