

New Rice for Africa... with a Little Help from Our Friends

AS OUR flagship Interspecific Hybridization Project comes to the end of its first phase, we look back at where we've come from and where we're going, and pay tribute to those who have 'paid the way' for us.

The Interspecific Hybridization Project (IHP) started in 1997 with support from the Japanese Government, the Rockefeller Foundation and the United Nations Development Programme (UNDP). It built on WARDA's major breakthrough—achieved in 1994—of producing fertile offspring of crosses between indigenous African rice (*Oryza glaberrima*) and Asian rice (*O. sativa*). Today, the new rice plant type—dubbed 'New Rice for Africa' or NERICA—is being grown on at least a few farms in every country in WARDA's mandate region, and the stage is set for a Green Revolution in rice in Sub-Saharan Africa.

Background: the breakthrough in rice breeding

The brains and driving force behind WARDA's interspecific hybridization research is Monty P. Jones, upland-rice breeder and program leader for rainfed rice at WARDA's Headquarters in Côte d'Ivoire.

"The whole concept goes back to the mid-1970s," explains Jones, "when I was working for my national program in Sierra Leone. WARDA had its Mangrove-swamp Rice Program based at Rokupr at that time, and I was seconded to the WARDA project." Jones's particular interest was in the short-season mangrove-swamp, where sea-water incursion gives a maximum three-month

salt-free ecology. "Rice varieties for this ecology need to be either very short-cycled or else salt-tolerant," continues Jones. "The only varieties which were sufficiently tolerant of the salt to be able to grow there were *glaberrimas*." In the years leading up to his groundbreaking attempts to hybridize the two rice species, Jones also noted that in marginal upland environments it was again *glaberrimas* that were growing, rather than the Asian *sativas*. "Thus, it seemed that the *glaberrimas* had genes for resistance or tolerance to local stresses, such as soil acidity, iron toxicity, and blast disease, which were not available among the *sativas*."



Oryza glaberrima was domesticated in Africa over 4500 years ago. It is well adapted to the local environments, but yields poorly because of lodging and grain-shattering

With a view to accessing and exploiting these useful genes, Jones brought all the available *glaberrima* material from the gene banks at the International Rice Research Institute (IRRI, The Philippines) and the International Institute of Tropical Agriculture (IITA, Nigeria) to WARDA in 1991 to evaluate it in the field. “We had 1500 accessions,” Jones recalls. “We grew them first during the main season at M’bé [WARDA Headquarters], then we were so impressed with the results that we took them south to Gagnoa [south-central Côte d’Ivoire] for re-evaluation in the off-season.” From these 1500 accessions, the team selected 48 promising varieties and tested their potential compatibility for the interspecific cross—only 8 survived this selection process!

Previous attempts to cross the two species had met with failure—the offspring were infertile, or else the few fertile seeds were not noticed among the infertile ones. Jones’s determination to succeed led the team to unprecedented lengths: even the eight compatible varieties set very little seed in the first generation of the cross (known as F₁ generation)—in fact, they were looking at less than 5% seed-set. “We were collecting 5 seeds or less from apparently sterile plants,” laughs Jones, “but what a goldmine we’d uncovered!”

These F₁ seeds were given extra-special care, and then the plants grown from them were used for ‘backcrossing’ with the *sativa* parent. After two or three backcrosses, the fertility of the plants increased to a ‘reasonable’ level, but the plants were still segregating—that is, not true-breeding—even after the fourth or fifth generation. So, in 1993 the team decided to adopt anther-culture to genetically fix the lines (*see* ‘Molecular Biology Facilities at WARDA,’ in this Report). In 1994, the first true-breeding interspecific lines were available at WARDA.

Birth and development of the Interspecific Hybridization Project

“With this breakthrough, we clearly wanted to expand the work,” Jones reflects, “but WARDA core funds at that

Partners in the Interspecific Hybridization Project

Donors

- United Nations Development Programme Technical Cooperation among Developing Countries (UNDP-TCDC)
- Japanese Ministry of Foreign Affairs (MOFA)
- Rockefeller Foundation
- CGIAR Systemwide Program for Participatory Research and Gender Analysis
- Donors who provide unrestricted financing to WARDA

Research Institutions

- West Africa Rice Development Association (WARDA/ADRAO)
- International Center for Tropical Agriculture (*Centro Internacional de Agricultura Tropical*, CIAT, Cali, Colombia)
- Cornell University (Ithaca, New York, USA)
- International Rice Research Institute (IRRI, Los Baños, The Philippines)
- *Institut de recherche pour le développement* (IRD, formerly ORSTOM, Montpellier, France)
- University of Tokyo (Japan)
- Yunnan Academy of Agricultural Sciences (YAAS, Kunming, China)

Research Institutions with staff based at WARDA

- *Centre de coopération internationale en recherche agronomique pour le développement* (CIRAD, France)
- Japan International Cooperation Agency (JICA)
- Japan International Research Center for Agricultural Sciences (JIRCAS)
- Ministry of Agriculture, Forestry and Fisheries (MAFF, Japan)
- Natural Resources Institute (NRI, UK)
- United Nations (UN Volunteers, from 2000)

time did not give us the scope to do so.” In 1995, the team submitted a ‘concept note’ to UNDP and the Japanese Ministry of Foreign Affairs (MOFA). UNDP’s immediate response was to fund a workshop on interspecific breeding, with special reference to rice, in December 1996. This meeting brought together all the institutions already involved in the interspecific hybridization research—*Centro Internacional de Agricultura Tropical* (CIAT, Colombia), Cornell University (USA), IRRI

and *Institut français de recherche scientifique pour le développement en coopération* (ORSTOM, France)—together with seven national programs from West Africa to assess the state-of-the-art in interspecific rice breeding and identify the major problems still to be tackled. The workshop was immediately followed by a strategic planning meeting financed by MOFA. The upshot of these two meetings was that both the Japanese Government (through MOFA) and the UNDP's Technical Cooperation among Developing Countries (UNDP-TCDC) agreed to fund the ongoing research; thus, the 'Africa/Asia Joint Research on Interspecific Hybridization between African and Asian Rice Species (*Oryza glaberrima* and *O. sativa*)' was born.

The MOFA/UNDP-TCDC Project (known as IHP) was set for three years, 1997/98 to 1999/2000, with funding to the tune of US\$ 450,000 per year, and an additional \$ 474,000 from WARDA core over the three-year period.

Stringent reporting

Our friends in Japan and at UNDP were conscientious, and wanted to ensure that we are making the most of our new knowledge and resources. Thus, evaluation meetings were held both mid-term (November–December 1998) and toward the end of the first phase (November 1999). These were good for the scientists who can tend to be a bit sloppy in reporting, and the IHP's progress has been well documented, with informal annual reports prepared for each year (1997, 1998 and 1999) for the evaluation meetings, reports of the meetings themselves, and formal publication of annual research highlights in *Focus: Interspecifics* (1998 highlights) and *Rice Interspecific Hybridization Project Research Highlights 1999*.

The evaluation meetings brought together WARDA researchers and Board members, representatives of the collaborating institutions, and representatives from the principal donors; in addition, the World Bank and USAID showed a keen interest in the proceedings—the former

sent a representative to both meetings, and the latter would have done so, but for logistical problems with travel. The meetings were 'earthed' by presentations from the national agricultural research and extension services in Côte d'Ivoire and Guinea, and farmers from Côte d'Ivoire. Madame Delphine Koudou received a standing ovation at the mid-term meeting—she is the original 'small-screen' Bintu (see below)!

Participatory varietal selection

A major feature of the IHP, and one strongly favored by the donors, was the use of participatory varietal selection, or PVS, as a dual mechanism for obtaining feedback on farmers' preferences in new rice varieties, and for technology transfer. Conventional varietal release mechanisms involve several years of on-station and on-farm testing before release, then it often takes several years to produce enough seed to disseminate to farmers. WARDA, and its partners, desperately wanted to get the new rices out to farmers as quickly as possible. So, WARDA organized a meeting of rice stakeholders—scientists from national research programs, extension workers, farmers and non-governmental organizations—in March–April 1996 to discuss strategies for getting the new rices to farmers. Aware that participatory research had catalyzed agricultural adoption in India and Nepal at a relatively low cost, and that it had also been adapted for farmers to select beans in Rwanda, the delegates opted to pursue the PVS approach.



The basic PVS adopted by WARDA is a three-year program. In the first year, WARDA and extension-agency staff establish a 'rice garden' in a target village, often in the field of a leading or innovative farmer. The rice garden comprises a demonstration plot of between 60 and 100 varieties, not just interspecifics, but also modern, improved *sativas*, popular local and regional varieties, and a few



The participatory varietal selection program was designed to reach as many farmers as possible. Men and women are usually kept separate so that researchers get important gender-differentiated data

glaberrimas. Farmers from the host and surrounding villages are encouraged to visit the garden as often as they wish to monitor progress, but three formal evaluation sessions are established. The first, at maximum tillering, enables farmers to select varieties on the basis of vegetative characteristics such as speed of growth, ability to compete with weeds, and performance in the face of diseases and insects. The second visit, at maturity just before harvest, enables the farmers to assess plant height and panicle structure, growth rate, pest resistance and plant type. At the third visit, after harvest, farmers look at yield and quality aspects such as percentage of broken grains, cooking ability and taste.

These three assessments give the farmers the information they need to select up to five varieties from the rice garden, which they will then grow on their own farms under their own management conditions in year 2. Here they can make direct comparison with their traditional varieties. In the third year, farmers are asked to pay for seed of their favorite varieties—this provides a test of how much they really prefer them over their traditional varieties.

Having started the approach in Côte d'Ivoire in 1996, and then taken it on to Ghana, Guinea and Togo in 1997, WARDA decided to 'spread the news' among its other member states. A training workshop was organized in May 1998, to which an additional six countries were invited—Benin, Burkina Faso, The Gambia, Guinea Bissau, Nigeria and Sierra Leone. With additional teams coming from the original four countries, 10 West African countries were now equipped to conduct the PVS on their own. In April 1999, WARDA held two consecutive meetings. The first was a reporting and planning workshop, at which the 10 teams from 1998 reported on how farmers had accepted the participatory approach in their countries. The second meeting was a training seminar, at which teams from the remaining seven WARDA member states—Cameroon, Chad, Liberia, Mali, Mauritania, Niger and Senegal—were taught the PVS methodology. WARDA received extra funding for these meetings from UNDP and the CGIAR Systemwide Program for Participatory Research and Gender Analysis. A full report of the 1998/99 activities as presented at the April 1999 meetings was published by WARDA in a book, *Participatory Varietal Selection: The Spark that Lit a Flame*, in the second half of 1999.

The trouble with seeds

Having achieved a certain level of acceptance of new varieties among farmers, the next step is to make sufficient quantities of seed available for wider distribution. In many countries of West and Central Africa the state-operated mechanisms for seed production and distribution are under-resourced, over-stretched and unable to meet demand. Regular readers of this Annual Report will be aware of community-based seed systems promoted by WARDA to enable farmers to produce seeds for their own communities (*see* 'Farmers Producing Seed for Farmers,' *WARDA Annual Report 1998*, pages 40–44). With the initial success in Côte d'Ivoire, the system was adapted and adopted in Guinea, and is expected to be used in Nigeria during 2000. Mainly owing to its 'self-help'



Farmers have gladly adopted the idea of using their own resources to multiply NERICA seed for their own communities

nature, the community-based seed system is another popular activity of the IHP among our donors.

Telling the world about ‘Bintu and Her New African Rice’

Since the IHP has become very much our ‘flagship’ project at WARDA, our donors have provided resources for public awareness. Even before the official start of the IHP, we had released a brochure entitled *Unlocking the Treasures of African Rice Species: Bintu and Biodiversity* in 1996. Thus, the concept of Bintu as the typical West African woman rice farmer predates her later rise to ‘small-screen’ fame.

“I very much liked the concept of Bintu,” says WARDA Director General Kanayo F. Nwanze. “So much so that she has become the focus of numerous seminar presentations that I have given on behalf of WARDA since coming here in 1996.”

In 1998, our donors encouraged us to promote the ‘new rice for Africa’ both in print and in a video. The video, entitled *Bintu and Her New African Rice*, tells the story of Bintu, this time played by Ivorian farmer Delphine Koudou, participating in the PVS. It also includes inter-

What’s in a name?

The interspecifics have gone through several ‘incarnations’ in terms of naming since the first lines were fixed in 1994. However, the decision to use ‘New Rice for Africa,’ first in 1998, then as the standard from early 1999 was crucial. “After all,” explains Dr Tatsuo Fujimura of UNDP-TCDC, New York, “WAB 450-bla-bla really doesn’t mean very much to a farmer, it’s simply too long.”

In late 1999, the decision was taken to standardize on ‘NERICA.’ This will serve not only as a general label for the *glaberrima-sativa* interspecifics, but also as a numbered series for the released varieties.

In early 2000, the first seven varieties will be released on a wide scale in Côte d’Ivoire and Guinea. For those who have an interest in details, here they are:

- NERICA 1 = WAB 450-I-B-P-38-HB
- NERICA 2 = WAB 450-11-1-P31-1-HB
- NERICA 3 = WAB 450-I-B-P-28-HB
- NERICA 4 = WAB 450-I-B-P91-HB
- NERICA 5 = WAB 450-11-1-1-P31-HB
- NERICA 6 = WAB 450-I-B-P-160-HB
- NERICA 7 = WAB 450-I-B-P-20-HB

views with many of the WARDA researchers involved in various aspects of the IHP, and expounding the virtues of the new rices.

Meanwhile, a general brochure on the IHP had been released in 1997, to be followed by *New Rice for Africa* in 1998. “The published PVS proceedings—both the 1999 *Spark That Lit a Flame* and the upcoming 2000 *The Flame Spreads*—are also very much in the public-awareness arena,” explains WARDA Information Officer Guy Manners.

“In addition,” comments Monty Jones, “our annual research highlight publications were designed to play a dual role of solid science written in an easy ‘public-awareness style’ language.”



'Papa NERICA,' Monty Jones and 'Bintu' discuss the virtues of NERICA for the video *Bintu and Her New African Rice*, made in 1998



Where are we now?

By the end of 1999, two interspecific varieties were well advanced along the varietal-release process in Côte d'Ivoire. At the same time, four interspecifics were doing well in PVS and other variety adoption trials in Guinea. These important milestones had already been predicted by the early part of the year, and brought to a head a need that had been expressed by the donors at the mid-term evaluation in late 1998. That was, the need for a specific name for the new rices so that they could be recognized wherever they may be. "Having standardized on 'new rice for Africa'," explains Director General Nwanze, "it was a simple step to come up with the name NERICA."

Where next?

"The November 1999 evaluation meeting was dubbed 'final,' but we are expecting a delegation from UNDP to visit and prepare a final evaluation report in June and July 2000," explains Jones. "This will not be formal seminars

like in the Project-wide evaluations with all parties, but rather one-on-one and round-table discussions with individuals and groups of scientists." The evaluation team will also be discussing the financial management of the project with WARDA's finance division. This will be the official end of phase 1 of the IHP, but the main donors—MOFA and UNDP-TCDC—have already committed themselves to a second phase. Phase two is also attracting other donors. "The PVS seems to be a particular attraction to other donors," explains Jones. The Rockefeller Foundation first showed interest in PVS in 1998 with a small cash injection, and is now planning to fund activities in Mali and Nigeria for three years from 2001. Meanwhile, the Gatsby Foundation is supporting PVS in Ghana and Nigeria from 2000 to 2002, and USAID is supporting the work in Nigeria in 2001.

"The future is opening up before us," enthuses Jones. "We really are on the verge of a green revolution in rice in West and Central Africa, if not throughout Sub-Saharan Africa! NERICA 1 and NERICA 2 will be released in Côte d'Ivoire by the middle of 2000, and some 500 hectares will be planted with them." Meanwhile, NERICAs 3 through 7 are spreading from sites where they proved initially popular in Guinea. Amadou Moustapha Bèye, technology transfer agronomist, is spearheading the community-based seed system work and is intimately involved 'on the ground' in Guinea. "Despite the lack of official varietal release mechanism," he expounds, "the national agricultural research program has already 'released' NERICAs 3, 4 and 5 to farmers. In 2000, we expect Guinean farmers to be growing some 5000 ha of five NERICA varieties." Projections for Guinea run to 400,000 ha of NERICAs in 2002.

"The first decade of the new millennium promises to be really exciting," says Nwanze. "With the early success of the upland NERICAs, we started to target rainfed lowland and irrigated systems with interspecific crosses of their own." For the irrigated ecology, the first targeted NERICAs are just beginning to be fixed—the point at which the upland material was 5–6 years ago. "WARDA is moving

into the new millennium,” explains Nwanze, “looking at a three-pronged strategy: stabilization of upland rice production, in which the NERICAs and associated technologies are playing a vital role; intensification and diversification of the rainfed lowlands, especially inland valley bottoms; and, maximizing resource use efficiency in the irrigated systems. We now have plant material—especially the NERICAs—that can resist or tolerate most of the region’s stresses, that survive *and produce* with

minimal inputs, and yet respond bountifully once inputs become available. What we are looking at is an *upward* spiral, with productivity gains generating income, income being invested in inputs, and inputs producing even greater productivity gains. We truly will see subsistence rice farmers being drawn up out of the poverty trap.”

With that sort of prospect, it is no wonder that the IHP phase 2 is attracting more donors than any other project in the Association.



Just part of the wide network that makes up the IHP team: WARDA and collaborating researchers, donor representatives and support staff, who attended the Mid-term Evaluation of the project in 1998