# Next food revolution with 'super rice' near

by Marcia Merry Baker

On April 25 in Washington, D.C., Dr. Gurdev Singh Khush, the Principal Plant Breeder of the International Rice Research Institue (IRRI) in Manila, the Philippines, spoke on the prospects for vastly increasing rice production around the world, through research and development, and application of new, high-yielding rice varieties. Khush was hosted by the International Food Policy Research Institute, which, like the IRRI, is part of the Consultative Group on International Agriculture Research (CGIAR, now in its 26th year of operation as a network of research agencies).

In 1996, Dr. Khush won the World Food Prize, along with fellow researcher Dr. Henry Beachell, for work since the 1960s in developing "miracle rice"—new genetic lines of rice which have more than doubled the world's rice production over the last 30 years. But his point is, miracles aren't over. Khush stressed, in a speech to the Food Prize awards ceremony in Des Moines, Iowa on Oct. 18, 1996, that more food output revolutions lie ahead. In particular, newly developed rice varieties, "super rice," can be expected to increase yields by 25%.

Dr. Khush's work exemplifies the approach taken to expanding food output in the newly released report from the Chinese Academy of Sciences, on prospects for food surpluses in China (see p. 8), and Asia generally. New developments and applications of high-yielding cereal crop varieties will be an important factor in this expansion.

We here summarize some of the key points stressed by Dr. Khush, in his recent lectures and writings, on what he has called "breaking the yield frontier of rice."

## The first food revolution—miracle rice

**Table 1** shows the great increases in rice output for many nations, over the period from 1967-79 to 1991-93, from the adoption of modern, "miracle" varieties. China, the world's largest rice producer and consumer, saw a 90% increase in production. Fully 100% of the rice area in China is planted to modern varieties.

Dr. Khush points out, "These varieties have almost fully replaced traditional varieties in countries where rice is grown under irrigated conditions, such as Japan, China, South Korea, U.S.A., and Egypt. Also, in the Philippines, Vietnam, and Indonesia, more than three-fourths of the ricelands have already been covered by these varieties. The adoption rates are relatively low in South Asian countries, and in Thailand, Myanmar, Cambodia, and Brazil, where substantial portions of rice are still grown under rainfed conditions in both uplands and lowlands." (Traditional varieties yield better under "abiotic stresses—droughts, submergence, floods.")[1]

Dr. Khush described the international impact of the miracle rice developed at IRRI in the 1960s, in his speech in Iowa:[2]

"More than 250 rice varieties have been selected and released worldwide from IRRI-bred materials. At present, high-yielding varieties are planted on 70% of the world's rice area. It is estimated that 50% of the world's rice lands are planted to IRRI-bred varieties or their progenies.

"Wide-scale adoption of these materials and improved management practices have resulted in major increases in food production. World rice production doubled in a 25-year period—from 257 million tons in 1966 to 520 million tons in 1990. This increased production feeds 700 million more people annually. Indonesia used to be the world's largest importer of rice in the 1970s. . . . The availability of rice varieties and application of technology enabled Indonesia to become self-sufficient in rice in 1984. . . .

"Due to chronic food deficits, India was considered a a 'basket case' by some authorities in the 1960s. However, rice production in India increased from 46 million tons in 1966 to 122 million tons in 1995, and the country has not only become self-sufficient, it was able to export 4.1 million tons of rice in 1995. Similar increases in rice production have occurred in other Asian countries. The economic miracle now under way in Asia could not have been possible without food self-sufficiency and food security.

"We cannot rest on our laurels. The challenges ahead are even greater. The population in Asia is increasing at a rate of 2% annually. Rice consumption is going up because of rising living standards. Agricultural economists estimate that 70% more rice will be needed by 2025 to feed 5 billion rice consumers. . . . So the rice scientists must develop rice varieties with higher yield potential and better management technologies."

## Developing the new 'super rice'

Khush said that "in 1988, IRRI scientists conceptualized a 'new plant type' which will produce 10-15% higher yield. The breeding program to develop such plants was initiated in 1989, and, within five years, the new plant type became a reality.

"The pre-Green Revolution rice varieties produce a biomass (grains, stems, and leaves) of 12 tons per hectare, and 30% of that are grains, and the rest, straw. [These varieties are said to have a 0.3 harvest index]. Thus their maximum yield is about 4 tons/ha. Modern high-yielding varieties, when properly fertilized, can produce 18-20 tons of biomass and

1. "Modern Varieties—Their Real Contribution to Food Supply and Equity," by Dr. Gurdev S. Khush, pp. 275-84, *GeoJournal,* March 1995.

2. World Food Prize Laureate speech, Oct. 18, 1996, by Dr. Gurdev S. Khush, the World Food Prize Secretariat, Iowa State University College of Agriculture, Ames, Iowa.