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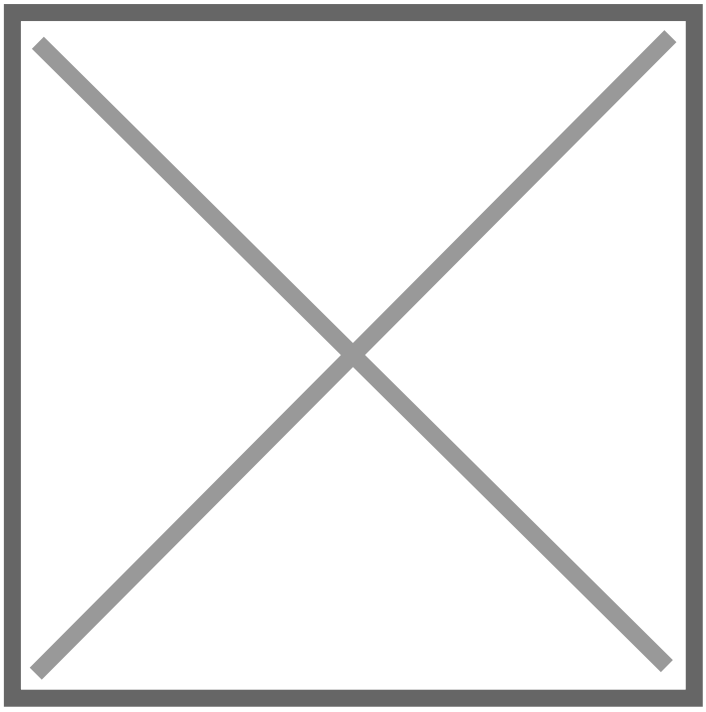
The Father of Rice Revolution

05 October 2004 | News



Dr Gurdev Singh Khush

Dr Khush is one of the global leaders on crop breeding and a major brain behind the development of productive rice varieties and the Green Revolution in plant breeding. Born in the village of Rurkee in Punjab, this son of a farmer finished his Bachelor of Science from Punjab Agriculture University and went to University of California, Davis, to do his PhD. He in fact worked as a laborer in a canning factory in England to earn his money to go to America. At the age of 25, Dr Khush completed his PhD in genetics in less than three years after joining the University of California. In 1967, Dr Khush joined the International Rice Research Institute (IRRI), Manila and he was there till 2000 and since the past few years he has been with University of California, Davis, as adjunct professor.

Dr Khush, who joined the IRRI after postdoctoral studies on tomato breeding, became principal plant breeder and head of the Plant Breeding, Genetics, and Biochemistry Division, and took IRRI to the vanguard of developing 300 new rice varieties and trigger the green revolution in Asia. Dr Khush may not be a household name. But his rice varieties touch the lips of every person in Asia. In the last 35 years, he and his team at IRRI in Manila introduced several varieties like IR8, IR36, IR64 and IR72. IRRI rice varieties and their progenies are planted in over 70 percent of the world's rice-fields. The rice production around the world in 1966 was close to 257 million tonnes and today it has increased to over 700 million tonnes. Thanks to Dr Khush and IRRI.

In less than five years of joining IRRI, Dr Khush became the head of IRRI's plant breeding department and had developed his own new variety of "miracle rice", IR36. This was developed using IR8 as a genetic base and cross breeding it with 13 parent varieties from six nations. IR36 is a semi-dwarf variety that proved highly resistant to a number of the major insect pests and diseases. Further, IR36 matures rapidly in about 105 days compared to 130 days for IR8 and 150-170 days for traditional types and produces a slender grain that is preferred in many Asian countries. The combination of these characteristics soon made IR36 one of the most widely planted food crop varieties the world has ever known. However, it was not an easy acceptance though. According to Dr Khush the farmers were initially skeptical about IRRI's new grain varieties. It took almost 25 years for Dr Khush's rice initiative to see excellent results. The rice production doubled to 518 million tonnes in 1990. According to IRRI estimates, IR36 has added about 5 million tonnes of rice annually to Asia's food supply and accounts for an additional $1 billion yearly income to Asian farmers. IR64 later replaced IR36 as the world's most popular variety and IR72, released in 1990, became the world's highest-yielding variety.

In 1994, Dr Khush announced a new type of "super rice", which has the potential to increase yields by 25 percent. His final work on what is called the New Plant Type (NPT) for irrigated rice fields is complete. Developing NPT almost took 12 years and the plants were yielding strongly in temperature areas of China and are expected to be ready for farmers in tropical Asia in 2005. It is a complete redesign of the rice plant from the roots up, making it higher yielding, more vigorous, and better able to resist pests and diseases without the use of environmentally damaging pesticides. It is designed to yield up to 12 tonnes

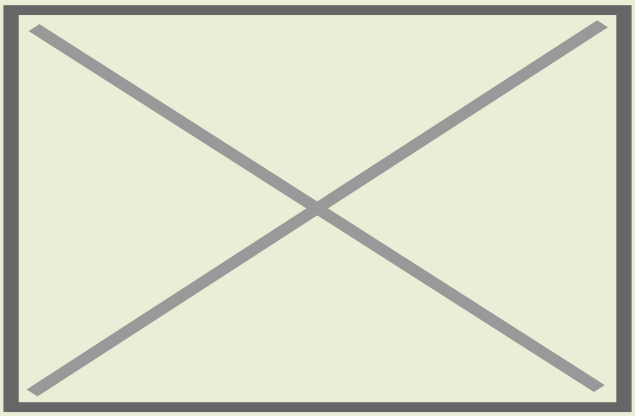
per hectare in irrigated tropical conditions, but adjusting its genetic characteristics to match tastes and environment conditions.

"When Gurdev Khush first started to develop rice varieties 34 years ago, there were few countries in Asia with the research infrastructure to work with him to adapt new varieties to local conditions," said former IRRI director general and ex-officio member Ronald P Cantrell in one of the Annual General Meetings. "But now, almost every Asian nation has some level of agricultural research capacity." Because of this, Asian countries have been able to feed their growing populations and, for the most part, maintain peace and stability. "The true Asian miracle through the 1970s and 1980s wasn't stunning economic growth. It was keeping people fed and societies relatively stable," Dr Cantrell said, "And now, with the new plant type ready for farmers' fields, we are hopeful of being able to maintain this level of progress."

Dr Khush is one of the most decorated scientists in the world, winning the Japan prize in 1987, the World Food Prize in 1996, the Wolf Prize from Israel and the Padma Shri Award from the government of India in 2000, and the China International Scientific and Technological Cooperation Award for 2001. The World Food Prize, widely regarded as the equivalent of a Nobel Prize for agriculture, is awarded by the World Food Prize Foundation based at Des Moines (USA), which he won for his contribution to "advancing human development by improving the quality, quantity or availability of the world's food supply." It cited that the increased availability of rice has not only lowered costs to consumers but also enhanced the nutrition of millions of people. Caloric intake in almost all Asian nations has improved. For example, caloric intake in Indonesia increased from 81 percent of the daily requirement in 1965 to 120 percent in 1990. And all of this happened while the population of rice consumers was growing by more than two percent annually, and the availability of rice production land remained stable.

"GM Crops Can Contribute In Several Ways,"

asserts Dr Gurudev S Khush



The BioSpectrum series on Biotech Gurus continues with Dr Khush who has joined the pantheon of eminent scientists from India who have made the world their home. Dr Khush was in Bangalore as a keynote speaker at Bangalore Bio in July this year. N Suresh and Ch. Srinivas Rao caught up with him to know the importance of bioagri products. Excerpts from the interview.

How important are GM crops?

I think GM crops can contribute in several ways. One is in introducing durable resistance to diseases and insects. That's very important and that's where the progress has been made until now. The second area is developing the crops, with drought tolerance and salinity tolerance and what we call the tolerance to abiotec stresses. Thirdly, GM crops can contribute to the improvement of the nutritional quality like improvement of vitamin A, iron and zinc content. The fourth area is the improvement in the yield potential. This is going to be the most difficult. So the progress is more in diseases and insect resistance crops, the drought tolerance is coming and in the nutritional content, we have the vitamin A rich rice and the yield potential is going to come later.

But there is stiff opposition to GM crops ...

I think it is just that the public has been so much confused with this anti-GM propaganda. They don't look at things in the right perspective and the average people read the information and cannot understand and sort out the science of the GMOs. So the public is generally confused. But if you see the records, there are 67 million hectares of transgenic crops grown world over and they have been consumed. Nobody has even had a stomach ache and nobody has had an adverse effect. So my answer is they should be properly regulated, biosafety tests done properly for food safety and environmental safety and if they are found to be safe, then we should go ahead and release these crops and consume them.

How can the industry counter this opposition?

If you are worried about the risk, then you can't release any technology. Why are you driving cars? Anybody can get killed on the roads. If you are worried, you can't release any pharmaceutical. How do we know what this pharmaceutical can do after 20 years? We may sometimes find that one of these pharmaceuticals had some side effects. If you think of any technology, which has happened in the last 20 years, nothing could have been released if we did not take the risk.

How can the industry get this message across to the public?

This is a problem. I am going to say a few words on that. There was a meeting at the Royal Society and they invited some people from the media, from science groups and from NGOs and the feeling was that the scientists should be more proactive and that they should talk to the media and the media should give out the right kind of information. So, I think, we have to get this idea across as most of the general public is confused about this. The scientists must develop skills to communicate with the media and public. The public must be able to recognize how scientific process takes place and understand relative risks. The governments should be involved in regulating the application of science but should not be a stumbling block.

Is the opposition to GM crops largely because the crops have been released mostly by giant multinational companies rather than public companies?

I think the agenda of the anti-GM group is to go against all this and criticize it whether it is released by the public sector groups or the private sector. So I don't think that's going to make too much of a difference.

What are the major challenges facing both global and Indian agriculture?

The challenge for the Indian agriculture is to produce more food. Although, we seem to be in a good shape now, you see there are 250 million people who go to bed hungry everyday. If they have the purchasing power, then we will have a shortage of the food situation. And our population is increasing at a fast pace. We are adding 18 million people every year. So the food production must continue to increase at about the same rate. Otherwise we will run into problems that we had in the 1950s and 1960s. Further investments in irrigation has virtually ceased and good land is being lost to industrialization. If present trends continue, it will not be possible to meet future demand for food.

GM crops will be helpful here. We can use both conventional methods as well as the biotechnology. Both should be used, wherever there is application. Globally there is a lot of work going on. The food security seems to be adequate. Only developing countries have some problem but most of the European countries have got good food security.

What is the status of the global agricultural production?

It has slowed down. It's not as good as in the 1970s and the 1980s. The rice grain and wheat were increasing at the rate of 2.5 percent in the 1970s, by 1980s this was down to 2 percent and in the 1990s it was down to 1 percent and it is now