Miracle Rice

New semi-dwarf varieties of hybrid rice and wheat in India and Pakistan helped make those countries self-sufficient in a few years. [LOOK LOC]

The story of the Green Revolution in rice actually begins in India, moves to the Philippines and then throughout Southeast Asia,

As early as 1949, the new United Nations Food and Agriculture Organization (FAO) set up a rice breeding program in Cuttack, India. Rice has traditionally been the most important food source across Asia. Both rice and wheat are members of the grass family. So, when the Mexican dwarf wheat program produced such spectacular results, rice breeders took notice. The search for semi-dwarf rice varieties that could produce high yields under fertilization began at Cuttack.

In India, local scientists crossed a short japonica, Japanese or temperate, rice with taller indica, a tropical local varietu. They were able to produce two good strains known as ADT-27 and Mahsuri that yielded well and were adapted to the Indian environment. ADT-27, in particular, created the first phase of the Green Revolution in rice.

U.S. scientists thought even better rice varieties could be produced. The Ford and Rockefeller Foundations turned their attention to the rest of Asia where famine threatened. In 1960, they established and funded the IRRI, the International Rice Research Institute, in the Philippines with Dr. Robert Chandler as its director. Henry Beachell became IRRI's chief rice breeder. He worked with a team of professionals and trained other plant breeders from around the world.

Even before Beachell arrived, the IRRI team recognized that rice had the same problems as wheat with "lodging" or falling over when heavy heads were supported by tall, spindly stalks. So, they imported seeds for over 10,000 varieties of rice from around the world. Many of these were dwarf varieties to cross with taller varieties. They also borrowed the "shuttle breeding" program from the Mexican program – rice would be grown in one region during the winter months and then in another region during the summer, effectively cutting in half the time it took to develop new varieties.

In 1962, Dr. Peter Jennings made 38 crosses of various varieties at IRRI. The eighth was between a Chinese dwarf variety known as Dee-geo-woo-gen (DGWG) and a tall variety from Indonesia, Peta. This eighth cross was promising, but only 130 seeds were

produced. How those 130 seeds became the famous IR8 variety was a fascinating process –

- The 130 seeds were planted in pots to produce the first generation (F1) of plants. All were tall.
- The F1 seeds were planted and produced about 10,000 second-generation (F2) plants. One-quarter of those plants were dwarf. That meant that dwarfism was controlled by a single gene in the DGWG variety, making the job of producing a commercial variety a lot easier. Dr. Jennings was so excited, he cabled the good news to Beachell in Texas. "That's when we knew we had it!" Beachell recalled later. It was so exciting that IRRI was able to recruit Beachell to join them in 1963 and Dr. Jennings left to pursue other studies.
- All of the tall plants from the F2 generation were discarded, and the short plants were planted to become the F3 generation.
- From the F3 plants, Beachell used his plant judging skills to select 298 of the best individual plants. Seeds from each of those plants were planted in individual "pedigree rows" to produce the fourth (F4) generation.
- In that F4 generation, Beachell again selected the best individual plants. In row 288, the third plant in looked the best to him. He dubbed it IR8-288-3 and this F5 plant became the source for the revolutionary variety that became known simply as IR8.

This one seed line eventually produced uniform plants that were about 120 cm tall with strong stems that held huge heads up even when heavily fertilized. IR8 matured in 130 days, as opposed to 160-170 days for traditional varieties. Traditional varieties were averaging around one ton of rice per hectare of land (a hectare is 2.5 acres). In 1966, a young Indian IRRI agronomist, S. K. De Datta, tested the IR8 variety under different fertilizer conditions. He was amazed with the results – the IR8 rice produced around 5 tons per hectare with no fertilizer and rose to almost 10 tons with 120 kg of nitrogen per hectare. That was 10 times the traditional rice yield.

In the mid-60s, most of Asia was experiencing drought and potential famine conditions. So, IRRI decided to get IR8 out quickly to the rest of the world. "IRRI's policy was free access to all of our genetic material," Dr. Beachell said. "It was made available to the world."

The world responded when Dr. Datta's study results were published. Philippine President Ferdinand Marcos read about the new rice and came to IRRI to see for himself. He quickly declared that the Philippines would be self-sufficient in rice production during his first term in office. Soon, over 2.300 farmers had come to IRRI by bus, bicycle, and on foot to get seeds. The country did produce enough rice to meet its own needs.

Similar reports of dramatic yield increases began coming back to IRRI, including an 11-ton per hectare harvest in Pakistan. Beachell himself began traveling all across Asia on regular basis assessing the local breeding efforts and suggesting new research initiatives.

IR8 was not perfect. Certain pests and diseases attacked IR8 easily. It had a high breakage rate during milling. The grain it produced was actually bold and chalky, so it didn't look as good to the consumer as highly polished rice. In addition, it had a high

amylose content, which meant that it hardened after cooking. One Filipina woman told Dr. Beachell, "I don't like IR8 because it scratches my throat."

So, Beachell and, later, his colleague Dr. Gurdev Singh Khush began crossing IR8 with at least 13 other varieties from six nations. Eventually, they developed IR36, a semi-dwarf variety the proved highly resistant to a variety of pests and diseases and produced the slender rice grain preferred in many countries. In addition, IR36 matured rapidly – in 105 days instead of the 130 days of IR8 and 170 days for traditional varieties. That meant that many regions could finally grow two crops a year, instead of one. By the 1980s, at least 11 million hectares were planted with IR36 around the world.

In 1990, Dr. Khush produced IR72 which out produced even IR36.

From its base in the Philippines, IRRI sent its modern varieties of rice around the world. India, Pakistan, Bangladesh, China, Brazil, Argentina, Sri Lanka, Taiwan, Malaysia, Korea, Burma, and even the U.S. used IRRI varieties and agricultural techniques.

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