For the first time, farmers in the Philippines cultivated Golden Rice on a larger scale and harvested almost 70 tons

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On the Philippine island of Antique, several dozen tonnes of Golden Rice were harvested for the first time this autumn. Credit: Antique Provincial Information Office

For the first time, farmers in the Philippines have cultivated Golden Rice on a larger scale and harvested almost 70 tons of grains this October. This nearly never-ending story began at ETH Zurich.

This autumn will probably go down in agrarian history. In October, farmers in the Philippine Province of Antique harvested a substantial amount of beta-carotene-enriched Golden Rice for the first time—namely a total of 67 tons from 17 fields.

The dried and polished grains are going to be distributed to households with pregnant women, breastfeeding mothers or preschool children who are at risk of diseases caused by vitamin A deficiency.

ETH Professor Emeritus Ingo Potrykus, the father and inventor of Golden Rice, sees its cultivation in the Philippines as a breakthrough: "Finally, the step towards practical utilization has been taken. After decades during which genetic engineering has been used exclusively for commercial agriculture, the first instance of a humanitarian project using it to solve a major health issue is now becoming a reality."

Vitamin A deficiency threatens millions of children

Vitamin A deficiency is a major health problem in many areas of the Philippines as well as in other Southern countries. It causes children in particular to go blind, suffer cognitive impairments and die of a weak immune system. Globally, several hundred million children are at risk of these deficiency-related diseases.

Many other countries, such as Bangladesh, Indonesia, Vietnam, India and China, have therefore followed suit with the Philippines and have made considerable progress in introducing the vitamin-A-enriched rice.

Milestones

- 1991: Ingo Potrykus floats the idea of a vitamin-A-enriched rice variety to fight malnutrition. Experiments start in 1992.

- 1993: Carotenoid specialist Peter Beyer joins the project.
- 1999: The two researchers present the prototype of Golden Rice. This breakthrough demonstrates that it is possible to reconstruct the carotenoid metabolic pathway in rice grains.
- 2000: Potrykus and Beyer decide to advance the necessary product development as a humanitarian project.
- 2005: Moving from daffodil genes to corn genes increases the provitamin A content.
- 2006–2018: Compiling of all the necessary data for the regulatory dossier required before a genetically modified product can be grown in the open field.
- 2021: Philippine biosecurity authorities give the green light for the cultivation and consumption of Golden Rice.
- 2022: Cultivation commences in the Philippines under the supervision of national rice research institute PhilRice.

In the early 1990s, the former ETH Professor of Plant Sciences and his colleague Peter Beyer of the University of Freiburg decided to fight malnutrition—also known as "hidden hunger"—by genetically modifying rice in such a way that the plant would accumulate beta-carotene in its grains. The human body converts beta-carotene into vitamin A, which it needs to survive. This would help people in countries, where rice is the most important source of carbohydrates, to meet their daily vitamin A requirement.

In 1999, the year Potrykus retired, he and Beyer presented a prototype of what would become known as Golden Rice: a rice variety that accumulated beta-carotene in its grains due to a transferred construct consisting of several foreign genes. The grains had a golden yellow hue: the first Golden Rice (GR) had become a reality.

"But I'm also very upset that the delays meant millions of children had to suffer," says Ingo Potrykus.

Since the amount of beta-carotene in the prototype was still too small to meet a person's daily vitamin A requirement, Beyer developed a second variant—GR2—in collaboration with a team from the agricultural technology company Syngenta. Instead of daffodil genes, the plant scientists used genes from sweet corn. This led to a significant increase in the rice grains' beta-carotene content compared to the prototype.

Delayed and deferred

Golden Rice was controversial from the start. Its use was blocked, deferred and held up for years. Environmental groups fought tooth and nail against this and other genetically modified plants. Governments, too, refused to approve the cultivation of Golden Rice. Twenty-two years have passed between its development and large-scale cultivation.

Now almost 89 years old, Potrykus is delighted that Golden Rice has finally been planted on a large scale: "I'm very relieved to finally see cultivation commence after so many years of production delays," he says. That science beat ideology gives him great satisfaction. "But I'm also very upset that the delays caused further suffering among millions of children."

The challenge of deregulation

It's still a key challenge in many countries to reduce the strict regulation surrounding the use of genetically modified crops. "The data from the Philippines is freely available to other countries, making it much easier for them to develop their own national dossiers," Potrykus says.

But it also takes courage, he adds. The Philippine biosecurity authorities and minister of agriculture were courageous enough to endorse GR2.

Now the plan is to exponentially expand the cultivation of GR2 to another 17 carefully evaluated provinces. With more farmers being supplied with seeds, efficacy studies will determine the degree to which GR2 consumption prevents vitamin A deficiency. The aim is for the rice to go on sale locally once the research is complete.

According to Potrykus, no further improvement of GR2 in terms of vitamin A is planned. "Golden Rice contains enough beta-carotene to meet people's daily requirement."

Rice to become rich in iron and zinc

Plant scientists are currently in the process of adding iron and zinc to GR2's nutritional profile. Deficiencies in these trace elements also lead to severe health issues. It's another long story: The same 1999 retirement symposium where Potrykus and Beyer presented their Golden Rice, also saw doctoral student Paola Lucca present a transgenic rice variety richer in iron.

In many countries in Southern and Southeast Asia, the rice varieties are currently being optimized for each country. In Bangladesh, GR2 is all set for sowing. "Everything's ready there. But the country's environment minister is blocking it due to ideological reasons," Potrykus says. He is convinced, however, that the minister is running out of arguments—and hopeful that the success story of Golden Rice in the Philippines will be heard at the environment ministry in Bangladesh.

Provided by ETH Zurich