

# Golden Rice

*40g consumed daily will save many children's lives and sight*

## What is Golden Rice?

Golden Rice is the name given to rice varieties that carry a novel trait enabling the plant to accumulate beta-carotene in the grain and not only in the leaves as is the case in white rice plants. Originally genetically engineered in 2004 to produce and accumulate beta-carotene in the grains, the trait has been introduced through conventional breeding into white *indica*-type rice varieties common in Asia. The colour induced by the beta-carotene in the grains suggested the name "Golden Rice". Beta-carotene, also known as provitamin A, obtained from any food source is converted into vitamin A by the human body as required, with any excess to requirements excreted without conversion.

Golden Rice was created after 10 years research by Prof Ingo Potrykus, from ETH Zürich, and Prof Peter Beyer, from the University of Freiburg. The current version of Golden Rice received two genes, one from a commonly ingested soil bacterium and one from maize, to reconstitute in the normally white part of the seed the complex metabolic carotenoid pathway. This pathway is active in green plant tissues and many flowers but not otherwise activated in white rice seed. Generations of earlier rice breeders concentrated, through thousands of plant breeding generations, on improving yield, mainly in the form of starch. They had no knowledge of the importance of micronutrients, and no way to increase provitamin A anyway. Modern molecular biology combined with genetic knowledge and techniques have made this possible in Golden Rice.

## Golden Rice has what it takes to improve human nutrition

Despite existing interventions and the Millennium Development Goals of reducing child mortality by two-thirds between 1990 and 2015, several million children under the age of five are still dying every year: 8.1 million child deaths were recorded in 2010. A universally available source of vitamin A would save around 28% of those child deaths (2 – 3 million preventable child deaths annually) by strengthening

their immune systems, and additionally prevent blindness in another 500,000 annually.

Rice is the staple crop for 3.5 billion people, half of humankind. In Southeast Asia, where almost 70% of the world's population lives, rice can make up to 80% of the daily diet. While rice is an excellent source of calories, its micronutrient (vitamins and minerals) content is deficient. Unfortunately, resource-poor people dependent on rice often cannot obtain a balanced diet. Nor have they access to industrially fortified foodstuffs or, in most cases, vitamin A capsule supplements. While the fight to reduce poverty must continue, a biofortified rice variety capable of providing a source of vitamin A – as Golden Rice is – represents a uniquely sustainable additional intervention to the vitamin A deficiency problem. Farmers and consumers can benefit from such a seed-borne solution, which does not imply any additional costs or labour, does not affect food preparation or consumption traditions, or any other aspect of culture, and creates no new dependencies.

US National Institutes of Health funded human research in USA, and especially research with children, jointly funded by the Chinese and US Governments in China, concluded that: "Golden Rice may be as useful as a source of preformed vitamin A from vitamin A capsules, eggs, or milk to overcome vitamin A deficiency in rice-consuming populations."<sup>\*\*</sup>



About 40g of Golden Rice consumed daily will save lives and sight. The Petri dish holds about 120g of Golden Rice grains. Golden Rice plants growing in the background.



For additional information visit [www.goldenrice.org](http://www.goldenrice.org) or write to [contact@goldenrice.org](mailto:contact@goldenrice.org)

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## The current status of *Golden Rice*

The Golden Rice trait can be crossed into any locally adapted rice varieties by conventional breeding. This process takes about two years for each variety and can be performed in parallel for many varieties. It has already been done for a number of widely consumed varieties.

Current regulatory processes for GM crops are based on UN conventions resulting from concerns initially expressed 50 years ago and now known to be scientifically unjustified. Nevertheless these regulations delay the application of traditional seed breeding skills, reliant on observing plants grown in the open field, until late in the development process. Only then can the true phenotype be observed, and plant breeders select the most useful traits and literally weed out the rest using their traditional skills of observation and comparison. In the case of Golden Rice, this impediment has so far delayed the programme by more than four years, during which about 6000 children a day have been dying from vitamin A deficiency, with many of them in countries where rice is the staple food.

Golden Rice is a purely humanitarian project. No organisation or individual associated with its development has, or will have, any financial benefit from its adoption. The inventors have worked with Dr Adrian Dubock since 2000, initially and importantly to secure the ongoing technical assistance of Syngenta. Licences were also secured for necessary technology for humanitarian applications of the inventors' patented technology from Bayer, Mogen, Novartis, Monsanto, Orynova, and Zeneca, together with a Japanese company wishing to remain anonymous. The inventors and Dr Dubock were thus able to provide free licences to the full technological support package to national research institutions in developing countries. Resource-poor farmers will be able to plant Golden Rice seeds, consume their produce, sell it locally, and replant the seed at will. It is a licence term that there will be no additional charge for the nutritional trait: Golden Rice will cost the same as the equivalent white rice variety.

The continuing support of the Golden Rice Humanitarian Board has been of significant assistance, and especially the network of public sector rice research institute licensees and their skilled staff in, so far Bangladesh, China, India, Indonesia, Philippines (both the Philippine Rice Research Institute and the International Rice Research Institute), and Vietnam. Financial support has been gratefully received at different times, from the European Commission, Prof Potrykus, The Rockefeller Foundation, USAID,

Syngenta, The Syngenta Foundation, The Bill & Melinda Gates Foundation (including also Mr Warren Buffett's contribution to it), and the national budgets of the countries involved.

All involved continue to strive against political and research obstacles to achieve their commonly shared objective: to provide an additional nutritional intervention to combat the misery of vitamin A deficiency to those countries and individuals which can benefit from and want Golden Rice.

The science is clear: "Golden Rice may be as useful as a source of preformed vitamin A from vitamin A capsules, eggs, or milk to overcome vitamin A deficiency in rice-consuming populations." Together we will deliver it.

\*Tang et al., American Journal of Clinical Nutrition, 2012, 96(3):658-664