

# Golden Rice

## Sustainable Biofortification for the Poor Rural Population

### What is Golden Rice?

*Golden Rice* refers to a rice line that has been genetically engineered to produce and accumulate beta-carotene in the grains, thus making the grains look yellow to orange; hence the name. The human body then converts the beta-carotene, also known as provitamin A, into vitamin A, as required by the organism. *Golden Rice* was developed by Prof Ingo Potrykus, from ETH Zürich, and Prof Peter Beyer, from the University of Freiburg.

Two foreign genes were introduced into rice to produce *Golden Rice*, one from a soil bacterium (*Erwinia uredovora*) and one from daffodil (*Narcissus pseudonarcissus*) or maize (*Zea mays*), depending on the version. The corresponding gene products have enzymatic activities that are usually present in green plant tissues and many flowers, where beta-carotene and other related compounds (carotenoids) are produced, but not in the seed. In *Golden Rice*, the pathway leading to the synthesis of carotenoids has been reconstituted by replacing the turned-off genes.



### How can Golden Rice contribute to the improvement of human nutrition?

In developing countries, around 12 million children under the age of six die every year from micronutrient malnutrition, mainly due to lack of vitamin A, iron and zinc. Breastfeeding, together with vitamin A and zinc alone could save around 25% of those children, by strengthening their immune system and preventing diarrheic diseases.



Rice is a basic staple crop for half the 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 content is very deficient, a fact which comes to bear under circumstances of one-sided diets. Unfortunately, poor people in remote rural areas cannot afford a varied diet nor have they access to industrially fortified foodstuffs. A rice variety capable of producing or accumulating the missing micronutrients represents a sustainable solution to the problem. Farmers and consumers can benefit from such a solution, which does not represent additional costs or labor, and moreover, they do not need to modify their eating habits and traditions. Our latest findings indicate that *Golden Rice* should be able to provide the full recommended daily intake of provitamin A in rice-eating societies, while contributing to an improvement of the vitamin A status in countries where less rice is eaten.

### When is Golden Rice going to grow in farmers' fields and how much is it going to cost?

The *Golden Rice* trait can be easily crossed into locally adapted rice varieties by conventional breeding. This process takes about two years, and can be carried out in parallel for many varieties. Unfortunately, it could take another four years before *Golden Rice* is released into the fields because of the complications and costs of the biosafety assessments and regulatory compliance. Regulatory approval must be obtained from every country where *Golden Rice* is going to be delivered. We hope that target countries will support this humanitarian process and be also prepared to adopt regulatory data from other countries in order to speed up the process and to start reducing morbidity and mortality among innocent children as soon as possible.

*Golden Rice* is a purely humanitarian project. The inventors and the owners of ancillary technologies that were needed to develop *Golden Rice* have provided a free licence for smallholders in developing countries. Farmers will be able to consume their produce, sell it and replant the seed at will.