

Updated as of
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GOLDEN RICE:

Frequently Asked Questions



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Golden Rice FAQs

I. About Golden Rice

General Questions:

What is Golden Rice?

Golden Rice is a new type of rice that contains beta carotene (provitamin A, a plant pigment that the body converts into vitamin A as needed). This compound is what gives this grain its yellow-orange or golden color, hence its name.

Golden Rice is developed through genetic engineering. While ordinary rice does produce beta carotene, it is not found in the grain. Thus, scientists used genetic engineering to add the compound to the grain – a minor tweak that improved the grain’s nutritive value. The beta carotene in Golden Rice, which was made possible by the addition of two new enzymes, is identical to the beta-carotene found in green leafy and yellow-colored vegetables, orange-colored fruit, and even in many vitamin supplements and food ingredients.

Like ordinary rice, Golden Rice does not require any special cultivation practices, and generally has the same yield and agronomic performance.

While vitamin A can be obtained from food products and supplements, challenges regarding their availability, accessibility, and affordability make it difficult to address the problem of vitamin A deficiency (VAD). As rice is a staple food in many vitamin A-deficient communities in Asia, Golden Rice can be a significant help in improving these areas’ vitamin A status once the grain becomes available for public consumption.

How is Golden Rice better than regular rice?

Golden Rice is an enhanced version of ordinary rice designed to handle a specific nutrition issue, without any additional cost or difference in taste.

While Golden Rice is expected to cost and taste the same as regular rice, its beta carotene content makes it a valuable asset in the battle against VAD. Vitamin A is an essential micronutrient for growth, development, and keeping the body’s visual and immune systems healthy. VAD weakens the body’s resistance to diseases and infections, causes blindness, and may even result in death if left untreated.

In the Philippines where rice is a staple of nearly every meal, beta carotene-enriched Golden Rice can supply up to 30-50 percent of the estimated average vitamin A requirement, particularly for sectors that are most vulnerable to VAD: preschool age children and pregnant or lactating mothers.

Is vitamin A deficiency that big of a problem?

Yes, VAD remains a major public health problem across the world, with women and children being the most vulnerable to it.

According to the World Health Organization (WHO), VAD afflicts 250 million people worldwide, most of which are preschool children (190 million) and pregnant women (19 million).

VAD is the leading cause of preventable blindness in children, and increases the risk of disease and death from severe infections. Each year, up to 500,000 children go blind as a result of VAD. Half of them die within 12 months of losing their sight.

In the Philippines, VAD incidence continues to be a significant public health issue affecting nearly 17 percent, or 2 million Filipino children under the age of 5. This is based on the 2018 Expanded National Nutrition Survey of the Department of Science and Technology – Food and Nutrition Research Institute.

There are existing interventions in place against vitamin A deficiency. Is Golden Rice really necessary in this fight?

Yes. Current approaches (such as vitamin A supplementation, food fortification, diet diversification, and promotion of optimal breastfeeding), have made some successes in combating vitamin A deficiency. However, more work is necessary to address the needs of certain target populations, especially those in remote areas. Additionally, millions continue to suffer from VAD to this day.

Studies have shown that the addition of vitamin A (or some form of vitamin A) to the diets of children below the age of 5 could reduce all mortality by 24–30 percent. Meanwhile, vitamin A availability could prevent 1.3–2.5 million of the nearly 8 million late-infancy and preschool-age child deaths annually in developing countries with the highest risk.

With rice being a staple food in many vitamin A-deficient communities, Golden Rice presents a unique opportunity for meeting the nutritional needs of these populations. A simulated analysis study by De Moura et.al (2016) suggests that beta carotene rice (i.e. Golden Rice) could improve vitamin A intake and could reduce the prevalence of vitamin A deficiency among women and children.

It is clear that multiple approaches are required in fighting VAD. An additional tool in the toolbox such as Golden Rice—one that can be seamlessly integrated into the everyday lifestyles of even the poorest sectors of society—can be a concrete, sustainable solution to ensure proper nutrition.

Who developed Golden Rice?

Emeritus Professor Ingo Potrykus of the Swiss Federal Institute of Technology and Prof. Peter Beyer of University of Freiburg, Germany, started the research on Golden Rice in 1982 as a Rockefeller Foundation initiative.

In 1992, after years of research, various groups came together in New York and decided to pursue the project, successfully causing beta carotene to be present in rice grains in 1999 after using genetic engineering to add genes from daffodil and a common soil bacterium to rice.

The inventors of Golden Rice partnered with Syngenta and other scientists, producing an improved version—which was the result of adding a gene from maize and the same soil microorganism—with a level of beta carotene content twenty times higher than the first version. To help combat VAD, they donated this new version to developing countries (including the Philippines, Bangladesh, and Indonesia) through the Golden Rice Network in 2004.

When will Golden Rice be available to farmers and consumers?

As of now, Golden Rice is being prepared for deployment. It has achieved the target levels of beta carotene content, and has also been shown to produce equivalent yield to other varieties across multiple environments.

Product safety testing for Golden Rice has also been completed. This is in fulfillment of the requirements of various regulatory agencies worldwide. Golden Rice received positive food safety evaluations from Food Standards Australia New Zealand, Health Canada, and the United States Food and Drug Administration in 2018. In December 2019, Golden Rice passed a rigorous biosafety assessment in the Philippines, and was declared “as safe as conventional rice” by the country’s Department of Agriculture – Bureau of Plant Industry. As soon as the necessary approvals are in place, Golden Rice can be made available to the public.

I read an alleged negative effect of Golden Rice that was not discussed in the FAQ. Can you clarify it to me?

Yes. This FAQ page answers the most common questions about Golden Rice, but the science and data on Golden Rice are open to the public, in order to ensure transparency. For more information, please contact prri.mail@philrice.gov.ph.

Where can I find biosafety data on Golden Rice?

Information on the safety and performance of GR2E Golden Rice are publicly accessible in various formats. The regulatory safety studies and associated application files for 1) direct use as [food, feed, or for processing \(FFP\)](#) and 2) [commercial propagation](#) are downloadable on the DA-BPI Biotechnology Secretariat website.

[Swamy et al, 2019. Compositional Analysis of Genetically Engineered GR2E “Golden Rice” in Comparison to That of Conventional Rice](#)

[Oliva et al, 2020. Molecular characterization and safety assessment of biofortified provitamin A rice](#)

[Swamy et al, 2021. Development and characterization of GR2E Golden rice introgression lines.](#)

[Biswas et al, 2021. Development and Field Evaluation of Near-Isogenic Lines of GR2-EBRRI dhan 29 Golden Rice.](#)

IEC materials summarizing these findings are also publicly available on the [Golden Rice Communication Toolkit](#) page.

Who will produce and distribute Golden Rice seeds?

DA-PhilRice will produce the seed planting materials (i.e., breeder, foundation, registered seeds). Then the registered seeds will be sold to accredited seed growers to produce the certified seeds, which will eventually be sold to farmers for commercial rice production. As Golden Rice is developed for humanitarian purposes to help curb vitamin A deficiency, its initial deployment will be in areas with high incidence of VAD. Our timeline suggests that considering the amount of time to produce the seed planting materials, Golden will be deployed in limited production farms during WS 2020 and in our target pilot-scale deployment areas beginning 2022-2023 DS.

How do we ensure purity and quality of Golden Rice across the value chain?

A comprehensive quality assurance and stewardship program that covers all steps in the chain from seed production, to post-harvest processing, to marketing is being developed by DA-PhilRice to ensure the quality and purity of the Golden Rice that will reach farmers' fields and consumers' tables.

How was Golden Rice enriched with beta-carotene?

Golden Rice is a genetically modified crop; scientists added genes from yellow corn and a common soil microorganism to enable the plant to produce beta-carotene in its grain, while also maintaining all other characteristics of ordinary rice. The yellow grains of Golden Rice demonstrate the presence of beta-carotene, which is only available in the leaves and stem of ordinary rice plants.

II. Use and Safety

For Consumers:

What exactly is in Golden Rice? Does it contain new toxins or allergens?

The presence of beta carotene in GR2E Golden Rice is made possible via three newly expressed proteins (encoded information converted into proteins through genetic engineering). After fulfilling their functions, these proteins gradually diminish as the plants mature.

- ZmPSY1 from maize, which makes the first step in adding beta carotene to rice possible;
- CRTI from the *Pantoea ananatis* bacterium, which accelerates the creation of the precursor to beta carotene; and
- PMI from the *Escherichia coli* bacterium, normally found in the intestinal flora of humans and animals, which plays a crucial role in completing the overall process.

Based on an extensive “weight-of-evidence” assessment, these three proteins:

- Do not have any significant amino acid sequence similarity to proteins known to be toxic via oral exposure or to allergens (confirmed by bioinformatics studies);
- Rapidly degrade in the presence of simulated gastric fluid containing pepsin (confirmed by digestibility studies); and

Demonstrate rapid inactivation at temperatures below those used for cooking or processing (confirmed by heat stability studies).

Additionally, oral toxicity testing of the CRTI and PMI proteins showed a lack of toxic effects, even at dosages thousands of times more than any realistically conceivable dietary exposure from consuming GR2E Golden Rice.

What this means is that the three proteins are highly unlikely to be toxic or produce allergic reactions in humans or animals. Furthermore, engineering GR2E Golden Rice does not alter the safety profile of conventional white rice, which is not considered a source of toxins or a common allergenic food.

How can you be sure that Golden Rice is safe?

Yes. Golden Rice is safe to eat, just like other genetically engineered foods developed under strict regulation by experts.

Genetic engineering is simply a more precise method of breeding than conventional breeding. It makes it possible to accurately and effectively transfer a specific gene with a favorable trait (like additional nutrients or drought resistance in plant breeding) from one organism to another.

In the case of Golden Rice, it is impossible to use conventional breeding methods to achieve the desired level of beta carotene in the grain. Scientists know that rice plants do have the right mechanism for producing beta carotene; however, the pathway that makes it possible for beta carotene to be present in the grain itself is turned off. The two genes added via genetic engineering basically switch the pathway on.

Before any GM foods become available in the market, they must pass rigorous safety assessments and must not demonstrate a high likelihood of putting human health at risk. In the countries where GM foods have been approved, there have been no scientifically proven negative effects on human health due to consumption of GM foods.

The May 2016 report of the National Academies of Science, Engineering and Medicine, which was based on over 20 years' worth of data across nearly 900 studies and publications on GMOs, attests that GM crops are safe.

Global health authorities (i.e. World Health Organization, American Medical Association, Royal Society of Medicine, etc.); scientific experts (i.e. American Association for the Advancement of Science, National Academies in many countries, International Council for Science, Pontifical Academy of Science, etc.); and government agencies (European Commission, Food and Agriculture Organization of the United Nations, US Food and Drug Administration, etc.) worldwide have also overwhelmingly endorsed the safety of GM foods. Moreover, in 2016, over 100 Nobel Prize winners signed a letter affirming the safety of Golden Rice and other GM foods, and rallying support for their adoption and distribution.

Is Golden Rice safe for pre-school children, pregnant and lactating women?

Yes. Golden Rice has already been assessed and approved to be safe as conventional rice by DA-BPI. It will be a potential complementary approach in providing needed micronutrients in the daily diet of Filipinos, especially preschool children and mothers or women of productive age. A cup of cooked Golden Rice can provide 30-50% EAR of vitamin A for preschool children and two cups for school children and adults.

Have there been any unexpected changes in the nutrient content of Golden Rice?

None. Aside from the expected levels of beta-carotene and other provitamin A carotenoids in the grain, the composition of Golden Rice remains equivalent to conventional rice.

I read about a US FDA letter stating that “concentration beta-carotene in GR2E rice is too low to warrant a nutrient content claim. Does it mean that Golden Rice contains insufficient vitamin A?”

No. Consider the fact that Americans eat very little rice; on average, about 45g of dry rice per day. As Golden Rice is meant to be a complementary, food-based solution for communities whose staple food is rice (about 200 to 300g per day), it follows logic that American consumers would not benefit from Golden Rice as much as the average Filipino (who consumes 290g of rice daily).

Can I eat Golden Rice with other vitamin A-enriched food or will I overdose?

Yes. Golden Rice can be eaten with other sources of beta-carotene such as malunggay, carrots, squash, and other green and leafy vegetables. In other words, Golden Rice can be consumed as part of a diversified and balanced-diet like Pinggang Pinoy. There will be no overdose as the beta carotene present in these foods can only be converted into vitamin A as the body needs it.

III. Consumption

When can I eat Golden Rice?

It is ready to eat once supply is available. Considering the amount of time needed to produce enough seeds for farm cultivation and eventually for consumption, Golden Rice will be made available initially in areas with high prevalence of vitamin A deficiency by the last quarter of 2023.

Is Golden Rice effective as a complementary supplement for vitamin A deficiency?

Golden Rice is intended to be used in combination with existing approaches to overcome VAD including eating foods that are naturally high in or fortified with vitamin A or beta-carotene, breastfeeding and complementary feeding practices, or oral supplementation.

An independent bioefficacy study will be conducted by an organization with expertise in public health to determine the impact of Golden Rice on vitamin A intake.

How much Golden Rice will I have to eat to have enough vitamin A in the body?

One cup of cooked Golden Rice can provide 30-50% EAR of vitamin A for preschool children and two cups for school children and adults. It will have to be eaten regularly replacing the existing white rice in order to have a long-lasting result.

Will Golden Rice taste different from regular rice?

No, the beta carotene concentration present in Golden Rice is not expected to affect its taste. This will be confirmed before commercial release by sensory panels. Beta carotene is a nature-derived color additive; it affects the color, not the taste, of the foods it is added to. This is different from how colored rice dishes (such as paella and Java rice) don't taste like regular white rice; that's because of the ingredients used in preparing the dishes, and not the rice itself.

Is Golden Rice only available in the Philippines?

Bangladesh scientists are also developing Golden Rice using their popular inbred local varieties. It is currently undergoing regulatory review.

How much will Golden Rice cost?

As Golden Rice is developed for humanitarian purposes to help address malnutrition, especially vitamin A deficiency, it will be deployed through market-based programmatic approaches (e.g. feeding program) in partnership with appropriate agencies. The project will lobby for policy support to make this vitamin A-infused rice available, accessible, and affordable to Filipinos, especially in areas where malnutrition is high.

For how long should I eat Golden Rice to achieve vitamin A sufficient body?

It is recommended to consume Golden Rice regularly to make it effective. This means that in areas where the risk of vitamin A deficiency is high, households are recommended to replace the existing white rice with Golden Rice to have a long-lasting result.

IV. Production

For Farmers:

Will I have to change the way I farm if I plant Golden Rice? If so, will those changes harm the environment?

No. Golden Rice is not expected to require any changes in farm management or cultivation practices. Everything about local cultivation practices currently followed for conventional rice varieties, including the application of fertilizer, crop protection products, and labor, are directly applicable to the cultivation of Golden Rice.

Will I have to spend more on pest control if I plant Golden Rice? Will it result in stronger pests (because it's more nutritious than regular rice)?

No. Golden Rice does not have any modified or introduced resistance to insect pests or diseases. As a result, it is not expected to drive the evolution of resistant pest populations or require any changes in pest control practices.

Will I have to deal with more pests or new crop disease problems if I plant Golden Rice?

No. Occurrences of pest and beneficial insect species were observed in the Philippines during confined Golden Rice field tests. Golden Rice was not seen as a preferred host for pest insects, nor did it cause any harmful effects on the prevalence of beneficial species.

Will planting Golden Rice have any harmful effects on other rice varieties through cross pollination or out-crossing? And can it make weeds a bigger problem?

No, Golden Rice is not likely to impact organic agriculture through cross-pollination.

- Cross-pollination in rice is rare if plants are separated by a short distance of a few feet or meters.
- Cross-pollination is uncommon in rice, unless all the rice plants are flowering at the same time.
- Rice pollen is normally viable for only a few minutes after flowering.

In other words, organically-grown rice will not cross-pollinate naturally with other cultivated rice, unless they are growing close together and flowering at the same time.

Additionally, the beta carotene-producing trait in Golden Rice is not intended to affect the growth-related characteristics of rice. It will also not make it any more or less viable than conventional varieties.

Confined field tests of Golden Rice at multiple locations in the Philippines have confirmed that there were no unintended or unexpected changes in the characteristics of rice concerning seedling germination and vigor, plant growth and morphology, reproductive characteristics, and susceptibility to pests and diseases resulting from genetic engineering.

Golden Rice can co-exist with organic agriculture and other production systems, and will not make any other species more invasive or less viable.

Is there any difference in the availability of pollen from Golden Rice to live, grow, or develop?

No, there are no unintended effects on Golden Rice's pollen viability due to genetic engineering.

Based on comparisons of pollen morphology and viability between GR2E Golden Rice and conventional rice, there are no significant differences in pollen viability or appearance.

Is Golden Rice expected to produce more or less grains than other rice varieties?

No. Results of recently conducted tests have shown that Golden Rice has no unintended effects on yield or grain quality. Aside from the beta carotene content of the grain, Golden Rice is basically the same as conventional rice varieties.

Additionally, based on germination tests conducted under two different temperature regimes, genetic engineering did not result in any unintended changes that could affect Golden Rice's seedling development or environmental growth.

Will I be able to plant Golden Rice on my farm?

Yes. Any farmer can grow Golden rice on his/her farm once seed supplies are available. If you are a farmer or seed grower located in our initial priority provinces, then you may have an opportunity to plant Golden Rice first. Priority is based on a number of key factors, including high incidence of VAD and other micronutrient deficiencies.

Would DA require or enforce farmers to exclusively plant Golden Rice?

The DA ensures that Filipino farmers are empowered to make decisions on what best serves them and their family based on the best-possible options to improve their crops, raise their

farm productivity, and increase their income. Golden Rice is a nutrient-dense type of rice like brown rice, black rice, and red rice: an additional option for farmers to plant that can help in ensuring micronutrient sufficiency.

The Department promotes a range of technologies, interventions and safety nets to attain its vision of a food secure and resilient Philippines with prosperous farmers and fisherfolk.

Is Golden Rice an inbred or hybrid rice?

The beta-carotene producing Golden Rice trait is transferred into popular local inbred rice varieties, which can be saved for future planting.

V. Status and Update

Golden Rice Status and Updates:

What is the status of the Golden Rice Project?

In the Philippines, Golden Rice is being bred into a range of well-known Philippine local inbred rice varieties (such as PSB Rc82) readily acceptable by farmers and consumers. In partnership with IRRI, DA-PhilRice continues to conduct research in accordance with regulatory requirements. Field trials for further environmental risk assessment were completed in September and October 2019, a necessary step towards its approval for commercial propagation. The Department of Agriculture-Bureau of Plant Industry (DA-BPI) declared Golden Rice to be “as safe as conventional rice” in December 2019, after a thorough biosafety assessment. In October 2020, DA-PhilRice lodged an application with the DA-BPI for the commercial propagation of Golden Rice. Meanwhile, the biosafety permit for the commercial propagation of Golden Rice was issued by DA-BPI on 21 July 2021. For more information and updates you may follow Golden Rice Project on [Facebook](#) and [Twitter](#)

There have been reports that Golden Rice field trials resulted in stunted plants and reduced grains yield. Is it true?

Yes, but this was for an earlier version (or “event”) of Golden Rice called GR2R. This prompted the use of the G2RE event, which retains all the nutritional and agronomic characteristics of conventional rice.

This outdated piece of information comes from multilocation trials conducted in 2012-2013, which used GR2R, which was the most advanced event of Golden Rice at the time. Results showed that while the target level of beta carotene in the grain was attained, the average yield was lower than that of comparable local varieties. Thus, a decision was reached to use more promising events such as GR2E to advance the development of Golden Rice.

From October 2014 to July 2017, a series of confined field tests were successfully conducted at IRRI and PhilRice in the Philippines, and at five different locations within Bangladesh. The results showed that there were no unintended effects of the GR2E event on agronomic performance, yield, and grain quality, nor were there any observed differences for their pest and disease reactions. Additionally, besides the intended production of beta carotene in the grain, Golden Rice maintained all other nutritional components of conventional rice.

I first heard about Golden Rice in 2000. Why has Golden Rice taken this long to develop?

As with any type of research project done properly—especially when it is meant to have a significant impact on human health, nutrition, and safety—Golden Rice must pass all required tests and be approved by regulators before it could be released to the public.

Despite advances in modern biotechnology, the process of genetic modification normally takes many years. With each test in the sequence typically serving as a precursor before moving to the next step, the entire testing process, including meeting the requirements for moving from phase to phase, takes a long time to complete.

When Golden Rice made headlines in 1999, it was in its “proof of concept” phase. The process of researching and developing Golden Rice is rigorous, complex, and meticulous, and under no circumstances must it be rushed. For instance, climate-smart, flood-tolerant rice, which millions of farmers can now access, took more than two decades to develop.

If anything, this long, rigorous process of research, testing, and approval should be a source of assurance to the public—especially to the people who need a sustainable nutrient deficiency solution like this—that when it becomes commercially available, Golden Rice will be safe for consumption and effective in fighting VAD.

We are a government corporate entity (Classification E) under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding and cost-reducing technologies so farmers can produce enough rice for all Filipinos. With our "Rice-Secure Philippines" vision, we want the Filipino rice farmers and the Philippine rice industry to be competitive through research for development in our central and seven branch stations, including our satellites, coordinating with a network that comprises 60 agencies strategically located nationwide. We have the following certifications: ISO 9001:2015 (Quality Management), ISO 14001:2015 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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