

# zinc Rice

*Millions of poor people in Asia suffer from hidden hunger, which includes zinc deficiency. Zinc is required for more body functions than any other mineral and is essential for survival. Lack of zinc in the diet inhibits normal growth and development and restricts functioning of the immune system. Rice is the staple food for more than half the world's population. In several populous Asian countries, rice provides up to 80% of the energy intake of the poor. Because of this high daily consumption, rice is an ideal staple crop to biofortify with zinc.*

## Target Countries: Bangladesh and India

More than half of Bangladeshi and Indian children under five years old are at risk of from zinc deficiency. The average rice consumption in Bangladesh and in parts of India is among the highest in the world, at about 400 grams per capita per day. Given these similar food production and consumption patterns, research will take place in both countries. In India, it will take place in the eastern region that is adjacent to Bangladesh. The HarvestPlus strategy converts widely grown popular varieties of rice into micronutrient-rich versions. HarvestPlus estimates that new varieties of zinc rice could provide about 40% of daily zinc requirement if eaten daily. HarvestPlus envisions that 10 years after release, more than 200 million people in Bangladesh and India will be consuming biofortified rice.



Breeding  
Crops for Better  
Nutrition

## At a Glance

### Nutrient Target

*Zinc content (µg/g)*

Average Nutrient Content: 16

HarvestPlus Target: 24

### Agronomic Traits

Disease and pest resistant

Submergence tolerant

**Strategy:** Conventional breeding

**Release Year:** 2012-2013

### Target Countries:

Bangladesh, India

### Spillover Countries in Asia:

Indonesia, Philippines,  
Vietnam, Cambodia



Photo: IRRI

## Target Country Partners

### CGIAR

**Philippines:** • International Rice Research Institute (IRRI)

**Benin:** • Africa Rice Center (WARDA)

### National

**Bangladesh:** • Bangladesh Agricultural Development Council  
• Bangladesh Agricultural University  
• Bangladesh Rice Research Institute  
• BRAC  
• ICDDR, B  
• Mymensingh University  
• University of Dhaka

**India:** • Bidhan Chandra Agricultural University  
• Birsa Agricultural University  
• India Biofortification Program  
• Indian Council on Agricultural Research  
• Indira Gandhi Agricultural University  
• National Institute of Nutrition  
• Samridhi

### Other

**Australia:** • Commonwealth Scientific and Industrial  
Research Organization  
• Flinders University  
• University of Adelaide  
• Waite Analytical Services

**USA:** • Harvard School of Public Health  
• University of California-Davis  
• USDA Western Human Nutrition  
Research Center

For each crop under development, HarvestPlus and its partners work along an impact pathway. Accomplishments, as well as ongoing and planned activities, are described sequentially under each step of the pathway.

## Achievements

### Step 1: Identify target populations who can benefit from biofortification

- Bangladesh and India identified as the first HarvestPlus target countries for high zinc rice.
- Developed rice varietal map for Bangladesh to assist in variety selection.
- Will develop varietal map for India with particular focus on the Eastern Gangetic Plains.

### Step 2: Set appropriate nutrient target levels for selected populations

- Set initial breeding target at 24 micrograms zinc/gram of polished rice in order to provide 40% of the mean daily zinc requirement through normal consumption habits.\*

\*Adult women used as reference. Assumptions: 400g rice intake/day, 25% bioavailability

### Step 3: Screen crop varieties and germplasm for use in breeding

- Screened germplasm using tested milling and polishing protocols to identify micronutrient-rich genotypes.
- Disseminated standardized, non-destructive screening protocol for zinc to research partners.

### Step 4: Breed new biofortified varieties of staple food crops with higher micronutrient levels

- Developed prototype high-yielding candidate varieties with more than 75% of the zinc breeding target.
- Candidate varieties with 100% target levels of zinc in the pipeline.

## Ongoing and Planned Research

### Step 5: Test performance of new crop varieties in the field

- Expanded Genotype by Environment (GXE) testing by Indian and Bangladeshi national partners.

- Establishing knowledge base for environments, genotypes, and management practices.

### Step 6: Measure nutrient retention in crops and foods

- Retention studies showed that the zinc content of rice is not significantly reduced after milling.
- Evaluating retention of zinc (and iron) in biofortified prototypes after parboiling in Bangladesh.

### Step 7: Evaluate the body's capacity to absorb and use micronutrients from biofortified crops

- Showed that bioavailable zinc did not differ across genotypes and no significant correlation between phytate concentration and percent bioavailable zinc.
- Will establish the bioavailability of high zinc rice in humans.
- Will assess efficacy of zinc biofortified rice to improve zinc intake and nutritional status in Bangladeshi populations.

### Step 8: Formally release biofortified varieties

- Identifying factors important for release of zinc rice in Bangladesh including drivers of farmer adoption, source of farmer seed, local seed distribution partners, and current cultivated area.
- Activities underway to incorporate zinc breeding into national breeding program strategies.

### Step 9: Promote marketing and consumption of biofortified crops and foods

- Will conduct landscape and market research to support deployment of high zinc rice.
- Will develop consumer and farmer communication strategies to ensure adoption and consumption of high zinc rice in Bangladesh and India.

### Step 10: Measure improvement in nutritional status of target populations

- Will conduct baseline study in target communities in target regions to measure change in nutritional status after introduction of high zinc rice in diet.

HarvestPlus is a global alliance of research institutions and implementing agencies that are working together to breed and disseminate crops for better nutrition. It is coordinated by the International Center for Tropical Agriculture (CIAT) and the International Food Policy Research Institute (IFPRI). HarvestPlus is an initiative of the Consultative Group on International Agricultural Research (CGIAR).

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