

zinc Wheat

Zinc is vital to more body functions than any other mineral. In humans it is a component of more than 200 enzyme systems and is required for normal growth and maintenance of body tissues and of the immune system. Zinc, in short, is essential for survival. Wheat is the second most consumed cereal in Asia, after rice. In South Asia, where micronutrient deficiencies are widespread and wheat consumption is high, this major staple food crop is an ideal candidate for biofortification. Providing zinc through biofortified wheat could improve nutrition for millions of zinc-deficient people.

Target Countries: India and Pakistan

HarvestPlus wheat research in India focuses on the Punjab and the Eastern Gangetic Plains. In northern Indian states, per capita wheat consumption exceeds 400 grams per capita per day, much of it in whole wheat form. It is also estimated that 26% of the Indian population are at risk of zinc deficiency from inadequate zinc intake. Approximately 54% of Indian preschool children are stunted, which is often used as proxy indicator for zinc deficiency.

In Pakistan, scientists are developing zinc wheat for the Pakistan Punjab. Per capita wheat consumption averages 350 grams per day, much of it also in whole wheat form. According to the last national survey in 2001, one-third of preschool children exhibit low serum zinc concentration. Linear growth stunting, an indicator of chronic malnutrition and a proxy indicator of the risk of zinc deficiency, is also a significant nutrition-related problem in Pakistan. Approximately 37% of children under five years are stunted.

A few modern varieties account for most of the wheat production in India and Pakistan. Farmers must replace these modern varieties periodically, as they lose their resistance to new evolving strains of disease. The HarvestPlus breeding strategy is to incorporate high zinc and iron traits into new replacement wheat varieties that

are resistant to new strains of yellow and stem rust. HarvestPlus estimates, under an optimistic scenario, that high zinc wheat varieties would be consumed by 120 million Indians and 100 million Pakistanis 10 years after release.

Target Country Partners

CGIAR

Mexico: • International Maize and Wheat Improvement Center (CIMMYT)

National

India: • Benares Hindu University
• Indian Agricultural Research Institute
• India Biofortification Program
• Punjab Agricultural University

Pakistan: • Aga Khan University
• Pakistan Agricultural Research Council
• University of Faisalabad

Other

Australia: • Flinders University
• University of Adelaide

Turkey: • Sabanci University

USA: • Cornell University
• University of California-Davis
• University of Colorado

At a Glance

Nutrient Target

Zinc content ($\mu\text{g/g}$)

Average Nutrient Content: 25

HarvestPlus Target: 33

Agronomic Traits

Disease resistance

Resistant to lodging

Strategy: Conventional breeding

Release Year: 2012



Photo: CIMMYT

Target Countries:
India, Pakistan

**Spillover Countries
in Asia:**
Afghanistan,
Bangladesh, Nepal

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

Achievements

Step 1: Identify target populations who can benefit from biofortification

- India selected as an initial target country for biofortified wheat varieties based on extensive data collection on micronutrient malnutrition prevalence rates, consumption habits, and modeling exercises.

Step 2: Set appropriate nutrient target levels for elected populations

- Set initial breeding target at 33 micrograms zinc/gram of wheat in order to provide 40% of the estimated average daily zinc requirement through normal consumption habits.*

*Adult women used as reference. Assumptions: 400g wheat intake/day, 90% retention after cooking whole wheat, and 25% zinc absorption.

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

- Validated mineral content of local germplasm from winter, facultative and spring wheat gene pools, identified from screening.
- Will screen advanced breeding lines developed for grain yield and disease resistance.

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

- Developed final products with more than 30% of the zinc breeding target.
- Ferritin genes are being studied to also enhance iron content in wheat pipeline.

Ongoing and Planned Research

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

- Partners will conduct trials under agroecological environments representative for the target zones in India and Pakistan.
- Will conduct zinc fertilizer trials to determine effect of soil and foliar applications at different growth stages on zinc concentration and yields.

- National partners will fine-tune best management practices in adaptive research in India and Pakistan.

Step 6: Measure nutrient retention in crops and foods

- Will determine common milling practices in the Indian Punjab and how much zinc is retained in biofortified wheat test samples after processing.
- Will initiate screening of select wheat samples for zinc bioavailability studies.

Step 7: Evaluate capacity of body to absorb and use micronutrients from biofortified crops

- Will conduct a dose-response wheat zinc absorption trial to study bioavailability and different indicators of zinc status in Bangladesh.
- Will determine efficacy of zinc wheat on the zinc status of children in the context of a randomized, controlled trial.

Step 8: Formally release biofortified varieties

- Identifying factors critical to elements in release of zinc wheat in India and Pakistan including drivers of farmer adoption, source of farmer seed, local seed distribution partners, and current cultivated area.
- Support provided to national partners to generate agronomic and nutritional data and research material required by national varietal release committees.
- Will work with national partners in releasing biofortified high zinc wheat in India and Pakistan.

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

- Will support production of seed for large-scale multiplication in India via formal and informal seed multiplication systems.
- Will provide support to the National Agricultural Research and Extension Systems (NARES) to coordinate all activities related to in-country product development and delivery.

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 wheat 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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For more Information

HarvestPlus

c/o IFPRI
2033 K Street, NW
Washington, DC 20006-1002 • USA
Tel: 202-862-5600 • Fax: 202-467-4439
HarvestPlus@cgiar.org
www.HarvestPlus.org

Wheat Crop Leader

J. Ivan Ortiz-Monasterio
c/o CIMMYT
Apdo. 370, P.O. Box 60326
Houston, TX 77205 • USA
Tel: 52(55)-5804-2004 • Fax: 52(55)-5804-7558
I.Monasterio@cgiar.org • www.cimmyt.org

