

iron

Pearl Millet

Iron deficiency, which is widely prevalent in India, impairs children's physical growth, mental development, and learning capacity. Anemia is often induced by iron deficiency, and when severe it can increase women's risk of dying in childbirth. Pearl millet is an important cereal crop in arid and semi-arid tropical regions of Asia and Africa. It is a significant source of dietary energy and nutritional security for poor farmers and consumers in several highly populated regions of India. Pearl millet with elevated iron levels can help reduce iron deficiency, and to some extent, zinc deficiency, in regions of India where it is a staple food crop. It is hoped that some benefit will also be realized in parts of Africa where pearl millet is consumed.

At a Glance

Nutrient Target

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

Average Nutrient Content: 47

HarvestPlus Target: 77

Agronomic Traits

Mildew resistance

Drought tolerance

Strategy: Conventional breeding

Release Year: 2010

Target Countries:

India

Spillover Countries:

Mali, Niger



Photo: ICRISAT

Target Country: India

Unlike rice and wheat, pearl millet is not a mega-staple in India. However, it is still an important staple food in Maharashtra, Rajasthan Gujarat and Uttar Pradesh, where it is commonly grown and consumed by millions of people. In these regions, the prevalence of anemia among children is a staggering 66%. At the same time, per capita consumption of pearl millet is very high, thus presenting significant potential to provide additional iron in the diet.

To meet an expected increase in demand for higher-yielding cultivars, the HarvestPlus breeding strategy is to develop high-yielding and iron-rich hybrids and improve some of the currently commercial open-pollinated varieties (OPVs) for iron density. Strong positive association observed between iron and zinc in pearl millet suggests that both minerals can be increased simultaneously. Thus, these new varieties will also have higher levels of zinc, as a secondary nutrient, that will also benefit malnourished consumers.

Breeding for high iron pearl millet has progressed rapidly and release of improved OPVs is planned for 2010, and improved hybrids for 2011. HarvestPlus estimates under an optimistic scenario that, 10 years after release, 28 million people in India will be consuming new iron-rich pearl millet.

Target Country Partners

CGIAR

- India:**
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

National

- India:**
- All India Coordinated Pearl Millet Improvement Project
 - CCS Haryana Agricultural University-College of Home Science, Department of Food and Nutrition
 - Pearl Millet Hybrid Parents Research Consortium
 - Haryana Agricultural University
 - Junagadh Agricultural University
 - Mahatma Phule Krishi Vidyapeeth
 - National Institute of Nutrition
 - Rajasthan Agricultural University- College of Home Science, Food and Nutrition Department

Other

- Australia:**
- Flinders University
 - Waite Analytical Services
- USA:**
- University of California-Davis
 - University of Colorado
- Switzerland:**
- Swiss Federal Institute of Technology (ETH-Zurich)



Breeding
Crops for
Better
Nutrition

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

- India identified as the first target country for biofortified iron pearl millet.
- Mali and Niger identified as additional recipient countries once prototypes developed.

Step 2: Set appropriate nutrient target levels for selected populations

- Set initial breeding target at 77 µg/g of pearl millet to provide 30% of mean daily iron requirement and 40% of mean daily zinc requirement through normal consumption habits.*

*Adult women used as reference. Assumptions: 300g pearl millet intake/day, 90% retention after processing and cooking, 5% bioavailability for iron, and 25% for zinc.

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

- Assay improved pearl millet lines and populations, and germplasm for high iron and zinc.
- Identify inbred lines, populations, and germplasm with high iron and zinc content.
- Validate identified lines, populations, and germplasm for high mineral concentration.

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

- Develop breeding lines and hybrid parents meeting the target levels.
- Develop cultivars with at least 75% of the iron breeding target.

Ongoing and Planned Research

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

- Gentotype by Environment (GXE) testing by national partners in-country underway.
- Assist research partners in on-farm farmer-participatory evaluation of promising hybrids.

Step 6: Measure nutrient retention in crops and foods

- Determine processing methods for pearl millet in central and northern India and their effects on iron, zinc, phytate, and polyphenol contents.

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

- Will conduct a study to determine the bioavailability of iron and zinc.
- Will conduct a randomized efficacy trial to determine impact on iron and zinc status.

Step 8: Officially Release Biofortified Varieties

- Assist research institutes and private seed companies with breeding for mineral content.
- Provide support to national partners to generate agronomic and nutritional data and research material required by national varietal release committees.

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

- Conduct preliminary landscape and market analysis to support deployment of biofortified crops.
- Work with research partners for breeder seed production to effect rapid cultivar adoption.
- Develop advocacy strategy with national partners for the dissemination of biofortified pearl millet.

Step 10: Measure improvement in nutritional status of target populations

- Conduct baseline study in target communities in target regions to measure change in nutritional status after introduction of high iron pearl millet 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).

Donors

HarvestPlus is funded by generous contributions from the following institutions: Asian Development Bank • Austrian Ministry of Finance • Bill and Melinda Gates Foundation • The International Fertilizer Group • International Life Sciences Institute • Royal Danish Ministry of Foreign Affairs •

Swedish International Development Agency • Syngenta Foundation for Sustainable Agriculture • United Kingdom Department for International Development • United States Agency for International Development • United States Department of Agriculture • The World Bank

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