

provitamin A Maize

Vitamin A deficiency is widely prevalent in Africa and afflicts millions of children, resulting in morbidity, blindness, and even death. For many millions of people in sub-Saharan Africa (and Latin America) maize is a subsistence crop. Maize is also one of the most genetically diverse crops in the world, and scientists have found varieties that have naturally high levels of provitamin A. HarvestPlus is using these lines to breed high yielding varieties of biofortified maize with higher levels of provitamin A to combat vitamin A deficiency.

At a Glance

Nutrient Target

Provitamin A content ($\mu\text{g/g}$)

Average Nutrient Content: 0.5

HarvestPlus Target: 15

Agronomic Traits

High yielding

Disease resistance

Drought tolerance

Strategy: Conventional breeding

Release Year: 2012

Target Countries:

Zambia

Spillover Countries in Africa:

Kenya, Malawi, Angola, Zimbabwe, Tanzania, Uganda, Ethiopia



Photo: CIMMYT

Target Country: Zambia

Vitamin A deficiency affects more than half of all Zambian children, despite a biannual vitamin A capsule distribution program, universally mandated sugar fortification programs, and a rigorous campaign to increase consumption of vitamin A-rich foods.

Maize is the predominant staple food in Zambia. Therefore, the introduction of a provitamin A maize in Zambia could significantly reduce vitamin A deficiency, especially in rural maize producing communities. However, provitamin A maize varieties are orange, while white maize is currently preferred by consumers. Thus, behavior change and marketing activities will accompany the introduction of provitamin A maize to inform consumers about the health benefits of new nutritious orange maize. Preliminary research by HarvestPlus suggests that consumers find orange maize a distinct product from yellow, and that the taste of orange maize may even be preferred over other varieties. HarvestPlus projects that by 2022, adoption levels of high-yielding, provitamin A hybrids and open pollinated varieties could benefit an estimated 4 million Zambians. Furthermore, millions more people in countries with similar agroecologies will also benefit by adopting, and adapting, the mid-altitude tropical provitamin A maize varieties being developed for release in Zambia.

Target Country Partners

CGIAR

- International Maize and Wheat Improvement Center (CIMMYT)
- International Institute for Tropical Agriculture (IITA)

National

Zambia:

- Ministry of Health
- Ministry of Education
- Ministry of Agriculture
- Program Against Malnutrition
- Zambia Consumers' Association
- Micronutrient Malnutrition Taskforce
- National Food and Nutrition Commission
- National Institute for Scientific and Industrial Research
- Tropical Disease Research Center
- Zambia Agriculture Research Institute

Other

- University of Wisconsin-Madison
- Iowa State University
- Purdue University

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

- Analyzed household consumption data from more than 20 countries and generated national-level data on maize production and prevalence of micronutrient malnutrition.
- Zambia identified as the first target country for biofortified provitamin A maize.

Step 2: Set appropriate nutrient target levels for selected populations

- Set initial breeding target at 15 micrograms provitamin A/gram of maize in order to provide 50% of the mean daily vitamin A requirement through normal consumption habits.*

*Adult women used as reference. Assumptions: a 400g maize intake/day, 50% retention of provitamin A after cooking, retinol equivalency of provitamin A of 12:1.

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

- Screened local African, Asian, and Latin American germplasm for provitamin A and minerals.
- Discovered genetic variation for provitamin A carotenoids in temperate maize that reached the target levels and could be bred into tropical varieties.

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

- Developed intermediate candidate varieties with 50% of the provitamin A breeding target.
- Establishing a breeding platform and protocols for open pollinated and hybrid varieties of maize.

Ongoing and Planned Research

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

- Genotype by Environment (GXE) testing by national partner in-country underway.

- Researchers determining effect of fertilizer use, planting, and harvesting time on maize yields and seed provitamin A content.

Step 6: Measure nutrient retention in crops and foods

- Will conduct laboratory and community-based studies of the provitamin A retention in processed maize under local conditions.

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

- Will study vitamin A deficiency in Zambian children. Resulting estimates will be used to confirm the need for HarvestPlus maize in specific communities and populations.
- Will determine bioefficacy of provitamin A-rich maize to improve vitamin A status in randomized, controlled intervention trials in Zambia.

Step 8: Officially Release Biofortified Varieties

- Provitamin A maize will be evaluated in field trials by national partners.
- Will establish partnerships with national agricultural research and extension services, private seed companies, non-governmental organizations, and community-based organizations in preparation for release.

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

- Completed consumer acceptance surveys on yellow and orange maize in Zambia.
- Will formulate marketing and dissemination plan with Zambian organizations, preceded by a landscape and market analysis.
- Will design and implement marketing, advocacy, and communication campaign with Zambian organizations to facilitate adoption and consumption of provitamin A maize.

Step 10: Measure improvement in nutritional status of target populations

- Will conduct an effectiveness trial to measure the impact of provitamin A maize in target communities within Zambia.

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

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