HarvestPlus Progress: 2012-2014

Howarth Bouis
October 2, 2014
Hidden Hunger

2 billion+ affected

Photo: C. Hotz
75% of the poor

25%
### Copenhagen Consensus

#### TOP FIVE SOLUTIONS

<table>
<thead>
<tr>
<th>TOP FIVE SOLUTIONS</th>
<th>CHALLENGE</th>
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<tbody>
<tr>
<td>1 Micronutrient supplements for children (vitamin A and zinc)</td>
<td>Malnutrition</td>
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<td>2 The Doha development agenda</td>
<td>Trade</td>
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<tr>
<td>3 Micronutrient fortification (iron and salt iodization)</td>
<td>Malnutrition</td>
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<td>4 Expanded immunization coverage for children</td>
<td>Diseases</td>
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<tr>
<td>5 Biofortification</td>
<td>Malnutrition</td>
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</tbody>
</table>
Current Scale/Pipeline of Biofortified Crops

NUTRITIOUS STAPLE FOOD CROPS: WHO IS GROWING WHAT?
These crops have been conventionally bred to be rich in essential vitamins and minerals that are needed for good health.
Biofortification Success

• Crop Breeding will be successful, and nutrient levels increased to high enough levels in high-yielding crop varieties
• Extra nutrients absorbed at sufficient levels that micronutrient status will be improved
• Farmers adopt and consumers buy/eat in sufficient quantities
• Biofortification taken up by other countries
#1 Breeding must increase nutrient to levels that improve nutrition
Progress in Breeding I

• Genetic variation sufficient for conventional breeding

• No tradeoff between yield and mineral/vitamin content of seed

• Low-cost, efficient methods to quickly screen promising crop lines (spectrometry and genetic markers)
• Genes identified/ MAS implemented
• Invested to strengthen NARS capacity
• Biofortified lines have been submitted to Varietal Release Committees
#2 Will extra nutrients be bioavailable at sufficient levels to improve micronutrient status?
Biofortified orange maize is as efficacious as a vitamin A supplement in Zambian children even in the presence of high liver reserves of vitamin A: a community-based, randomized placebo-controlled trial 1-6

Brian Gamon, Chiria Kativhile, Sara A Arcan, Samantha Schmidtke, Justin Ollehle, Njugwe Kishungo, Meja Manda, Keith Peter, Cassian Muti, and Sherry A Tomich

ABSTRACT

Background: Biofortification is a strategy to enhance vitamin A (VA) deficiency. Biofortified maize can enhance provitamin A carotenoids and has been trialed in several studies and a small number of human studies.

Objectives: The study sought to determine changes in retinol and total vitamin A (TVA) concentrations and carotenoids in a biofortified maize within households and in children.

Methods: The trial was conducted in 3 rural Zambian communities. An enriched maize was grown and consumed by 200 households for 8 weeks. Retinol and TVA concentrations were measured before and after the intervention.

Results: The study determined that biofortified maize can enhance provitamin A carotenoids in children.

Key words: Biofortified maize, vitamin A, children, carotenoids.

INTRODUCTION

Vitamin A (VA) deficiency is a major global public health problem. The World Health Organization (WHO) estimates that 190 million preschool-aged children and 19.1 million pregnant women are at risk of vitamin A deficiency based on current global VA (50 

intake of vitamin A (VA) in children, which was assessed through the use of the WHO WHO-4000 questionnaire and measurement of retinol in blood.

METHODS

The trial was conducted in 3 rural Zambian communities. An enriched maize was grown and consumed by 200 households for 8 weeks. Retinol and TVA concentrations were measured before and after the intervention.

RESULTS

The study determined that biofortified maize can enhance provitamin A carotenoids in children.

CONCLUSIONS

Biofortified maize can enhance provitamin A carotenoids in children.

REFERENCES


#3 Farmers must adopt crops and consumers must buy & eat these.

Photos: Neil Palmer (CIAT)
One Crop Released...

2007-09

Orange Sweet Potato (OSP)
Vitamin A
Mozambique
Uganda

24,000 Households reached

Up to 68% of project HHs adopted OSP.

Up to 47% increase in share of OSP in total sweet potato area.

Up to a 100% increase in vitamin A intakes for infants, children and women.
Impact on vitamin A intakes

**Figure 5** Impact of REU Intervention on mean vitamin A intakes (µg Retinol Activity Equivalents (RAE)/day), Mozambique and Uganda

**Mozambique**

- Children 6-35 mths.
- Children 3.5-6 yrs.
- Women

**Uganda**

- Children 6-35 mths.
- Children 5-7 yrs.
- Women

- Impact
- Control at project end
Percent EAR from Staple Crop

Ear = Estimated Average Requirement (from IOM, Dietary Reference Intakes-DRI;
Crops Released: Africa

- **OSP**
  - Vitamin A
  - Uganda

- **Cassava**
  - Vitamin A
  - Nigeria
  - DR Congo

- **Beans**
  - Iron (Zinc)
  - Rwanda
  - DR Congo

- **Maize**
  - Vitamin A
  - Nigeria
  - Zambia

Crops are high-yielding and with other traits farmers want.
Crops Released: Asia

- **Pearl Millet**
  - 2012
  - **Iron (Zinc)**
  - **India**

- **Rice**
  - 2013
  - **Zinc**
  - **Bangladesh**
  - **India**

- **Wheat**
  - 2013
  - **Zinc**
  - **India**
  - **Pakistan (2015)**

Crops are high-yielding and with other traits farmers want...
Biofortified crops released in 27 countries
18 in Africa, 4 in Asia, 5 in LAC
In-testing in 43 countries
26 in Africa, 8 in Asia, 9 in LAC

Sorghum
Banana
Cowpea
Potato

Lentil
## Nutrition research to date

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<tr>
<th></th>
<th>Dietary Intake &amp; Nutrition Status</th>
<th>Nutrient Retention</th>
<th>Absorption/Bioavailability</th>
<th>Efficacy</th>
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<td>2014-15 (2)*</td>
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Complete: ✓  Ongoing: ✓

* Period of implementation
Iron biofortification meta analysis: summary of results

• Anemia and iron deficiency were common: 39% of participants were anemic and 44% were iron deficient at baseline

• Iron interventions significantly increased hemoglobin concentrations

• Iron interventions significantly increased serum ferritin concentrations and total body iron

• Iron interventions significantly increased the likelihood of resolution of iron deficiency

Vitamin A summary (efficacy)

• β-carotene from maize, cassava & OFSP is highly bioavailable (βC:retinol ratios 3:1, 5:1 & 12:1, respectively);
• Results of maize efficacy trials on ~1500 preschoolers in Zambia show that:
  – β-carotene is efficiently absorbed
  – Regular consumption maintained or improved vitamin A stores and dark adaptation despite high burden of malaria & other stresses in rural villages
• Kenya efficacy trial proves cassava efficacious improving serum retinol among school children (Wageningen doctoral thesis)
• OFSP *effectiveness* trials demonstrated high rates of adoption, increased vit. A intake among women and children, & improved vit. A status in children (Uganda)
Zinc summary (bioavailability)

- Biofortified wheat provides nearly 70% more absorbed Zn than control wheat for women, irrespective of the extraction rate.
- US-Institute of Medicine & IZiNCG physiological zinc requirements should be revised;
- Regular biofortified pearl millet consumption results in significant amounts of zinc absorbed by children (meeting the entire daily estimated average requirement);
- Two wheat efficacy trials underway in India (women and children under 5 years)
Adoption/Effectiveness: OSP Example

- Vitamin A-rich orange sweet potato (OSP) was released to **24,000 households** in Mozambique and Uganda from 2007-2009.

- Findings from the project show **high rates of adoption and consumption**, resulting in **increased vitamin A intakes** among women and children.

- Distribution of OSP is being scaled-up in Uganda by HarvestPlus to reach **225,000 households** by 2016.

- CIP is deploying OSP to 10+ other African countries.
> 1.1 million farming households targeted in 2014

> 1.5 million farming households reached

> 7.5 million household members consuming nutritious crops
Roles Identified for HarvestPlus: Supporting Scale

- **Resource/Tools for Countries and Organizations**
  - Serve as a resource to help countries scale up and better integrate biofortification into their programs (e.g., BPI)

- **Communicating Evidence**
  - Broadly disseminate established and ongoing impact evidence

- **Partnership Development**
  - Engage implementing partners from across sectors to integrate best practices and new knowledge

- **Coordinating and Encouraging Action**
  - Support and enable the realization of the commitments made by so many stakeholders in Kigali
Mainstreaming Through Key Stakeholders

- National governments & regional frameworks (e.g. Brazil, Nigeria, Rwanda)
- Seed companies (e.g. Nirmal in India)
- Wholesaling, retailing
- International NGOs (e.g. World Vision)
- Multi-lateral agencies (e.g. World Food Program, Codex)
- International financial institutions
Discovery/Research
Crop Development
Crop Delivery
Establish new partnerships and delivery modalities
Scientific proof of concept
Advocacy+ fundraising

Mass-scale delivery

Phase I
2004 - 2008
Phase II
2009 - 2013
Phase III
2014 - 2018

2018 >

Institutionalize & Integrate
## Broad Activities By Phase

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## Future Broad Activities By Phase

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Challenges for Phase 3 (2014-18)

Make Biofortification Sustainable

• Core breeding activity at ag. research centers
• Work with International NGOs
• Approval from WHO, SUN etc
• UN Agencies, e.g. World Food Program
• Funding from Health donors
• Spinoff institution – Fund, technical
Standards - Current Focus

- **Global bodies** – CODEX – among 183 member governments and 200 NGOs – seeking support for Biofortification

- **Country level** – Supporting engagement with national standard and regulatory offices to enhance ‘enabling environment’ and national level acceptance critical for scale-up
The 2nd Global Conference on Biofortification

- Kigali, Rwanda: March 31 - April 2, 2014
- 300+ leaders from many countries and sectors
- Purpose:
  - How to Bring Biofortification to Scale: Translating evidence into wide-scale adoption and reach
  - Discussion of gaps and challenges, opportunities and solutions, and developing a plan of action
“The CGIAR Consortium and its members, the CGIAR Research Centers, commit to mainstreaming breeding for mineral and vitamin traits into conventional food crop development programs”

Frank Rijsberman
CEO, CGIAR Consortium
“We can see that after years of scientific research we are just at the point where the research is no longer being argued or debated, but we are at that tipping point where we can start taking the product of all of that work and push it out into the world at scale.”

Rachel Kyte, Vice President and Special Envoy for Climate Change, World Bank
“For me, the challenge is no longer the science of biofortification – we know it works – our challenge as policy makers is to scale up biofortified crops to reach millions of households through institutional, regulatory and financial policy.”

~ The Honorable Akinwumi Adesina
Minister of Agriculture and Rural Development, Nigeria
Breeding Crops for Better Nutrition