



Biofortification in China

Xingen Lei (Cornell University)

DELIVERY

Current Status: Biofortification was first introduced to China in 2004. After a decade-long effort by over 100 domestic scientists and international collaborators, the national biofortification program, called HarvestPlus-China, has met initial success. A total of nine interdisciplinary teams have been formed to focus on enriching rice, wheat, maize, and sweet potato with bioavailable iron, zinc, and vitamin A. Since 2004, 18 enriched lines have been developed, and 8 of these lines (1 wheat, 1 rice, 1 maize, and 5 sweet potato varieties) have been approved for field dissemination. One additional maize line is in the final stages of approval. A human trial has been completed to determine the efficacy of a beta-carotene orange sweet potato (OSP) line in improving vitamin A status of school children. Two cost-effectiveness and impact analyses have shown significant public health benefit and economic gain from biofortification of sweet potato and wheat.

Biofortified Varieties Released in China

Crop and Variety Name	Release Year	Micronutrient Content (parts per million – ppm)	Comments on Agronomic Properties
Wheat – Zhongmai 175*	2008, 2010	Fe: 30–44.5 ppm Zn: 20.6–45.9 ppm	High yield potential, resistant to mildew and yellow rust, tolerant to high temperature during grain filling
Wheat —Zhongyou 9507*	2001	Fe: 34.9–57.8 ppm Zn: 17.7–41.1 ppm	Strong tiller capability, resistant to dry hot wind
Rice – Zhongguangxiang 1	2010	Fe: 7 ppm (polished)	Moderate resistance and yield
Maize— YR506	2015	β-carotene> 15 ppm	High yield
Sweet potato – Nanshu 010 (200730)	2010	β-carotene: 93 ppm	Low to medium starch content, high yield
Sweet potato – Jishu 08088	2014	β-carotene: 62 ppm	Medium starch content, high yield, resistant to root rot
Sweet potato - Xu083228	2017	β-carotene: 100 ppm	High yield (>32t/hectare), medium to high dry matter content (28%), good disease resistance
Sweet potato - Xu1021A	2017	Anthocyanin: 70 ppm	Fresh weight >30t/ha, good adaptation, dry matter content: 26%
Sweet potato —Yanshu 5	2001	β-carotene: 89 ppm	High yield, high drought tolerant

*Additional information needed to validate mineral levels in biofortified crops

Crop Multiplication and Dissemination:

- In 2010–2011, 10 vitamin A-rich sweet potato cultivars were planted on demonstration plots in vitamin A-deficient areas (Sichuan, Chongqing, Jiangsu, Shandong, Fujian, Guangdong, and Guangxi). More than 20,000 virus-free sweet potato plants were tissue cultured for dissemination to poor farmers.
- In 2011–2012, orange-fleshed and purple-fleshed sweet potato bases were built on about 60 hectares, and varieties were extended to a total of 2,000 hectares in Sicuan, Chongqing, Jiangsu, and Shandong.
- In 2010–2013, Zhongmai 175, with high zinc concentration, has been cumulatively cultivated on more than more than 500,000 ha and became the check in the North China Winter Wheat Trial.
- In 2013, the inbred parents of provitamin A maize YR 506 were planted in Yunxian and Linxiang districts of Yunnan province, and 1 ton of YR 506 seed was produced in 10 counties of Yunnan province.

Marketing: HarvestPlus-China has conducted extensive outreach and promotion of biofortification, as well as the magnitude of hidden hunger, its causes, consequences, and cost-effective solutions, through newspapers, magazines and internet. The book “Biofortification in China” was published by HarvestPlus-China in 2009 to inform the public about biofortification, and public awareness of the importance of micronutrients is rising.

Stakeholders: There are 9 funded projects with 40 institutions, including universities, Chinese Academy of Agricultural Sciences, Chinese Academy of Sciences, and provincial centers for disease prevention and control, that focus on increasing iron, zinc, and vitamin A content in rice, maize, wheat, and sweet potato.

Potential Impact: According to a survey conducted by the National Statistics Bureau, micronutrient deficiencies in China result in a loss of 30 billion yuan (US\$3.61 billion) annually, accounting for 3–4% of the gross domestic product. An efficacy study of OSP in rural Sichuan province showed that when school children 3–10 years of age ate 110 grams of OSP per day for 40 days, their serum retinol concentration improved, and vitamin A deficiency decreased from 17% to 1%.

Funding biofortification is a cost-effective investment in a more nourishing future. Biofortified crops will improve the overall nutrition status of 300 million “hidden hunger” Chinese and has the potential to lift millions out of poverty.

Delivery Challenges and Recommendations:

- Coordination of research and delivery across programs can be difficult, and approaches differ by crop and region.
- More information is needed about the variation in mineral levels across environments, and iron and zinc levels require additional validation.
- Nutrition evidence is not complete for varieties developed under HarvestPlus-China; HarvestPlus-China will develop a more complete portfolio of evidence around nutrition and adoption.
- Standards development is needed to ensure stable and reliable quality and nutrition of biofortified crops and foods.
- A long-term commitment to mainstreaming biofortified crops in public policies and programs should be made.