CIP

INTERNATIONAL POTATO CENTER

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Roots and Tubers - Vital for Food Security and Nutrition

The potato is the third most important food crop in the world after rice and wheat in terms of human consumption. More than a billion people worldwide eat potato, and global total crop production exceeds 300 million metric tons. Potato fills "hunger gap" months, and is both a food security as well as a cash crop. Increasingly, potato is seen as a nutritious crop. When boiled, a single medium-sized potato contains about half the daily adult requirement of vitamin C and significant amounts of vitamin B, iron, potassium, and zinc.

Sweetpotato, particularly orange flesh sweetpotato (OFSP) is an increasingly strategic crop in combatting pernicious nutrition problems in developing countries worldwide. Sweetpotatoes produce more edible energy per hectare per day than wheat, rice or cassava. They are good sources of carbohydrates, fiber, and micronutrients. Just 125g of fresh OFSP root contain enough beta-carotene to provide the daily pro-vitamin A needs of a preschooler.

CIP is a key player in research and development for both of these crops. Further, we have more than 40 years of research and development in both value chains globaly, with established partnerships and implementing partners throughout the value chain. Thus, going forward in the next ten years we have a strategy to scale up and out, to impact households in the developing world at a significant scale.

The International Potato Center, known by its Spanish acronym CIP, was founded in 1971. It is an agricultural research and development (R&D) institution that specializes in roots and tubers to deliver sustainable solutions to the global problems of hunger, poverty, and the degradation of natural resources. CIP is headquartered in Peru with offices in 20 countries globally.

Potato is a high-value food security crop.

Sound science leads to improved livelihoods. Smallholders realize higher yields, in households where mothers and children have improved nutritional health, and at markets where farmers are fetching better prices. Throughout the developing world, CIP's work in root and tuber crops (RTCs) strengthens food and nutritional security and promotes increased yields, climate-smart products, and better post-harvest handling—bedrocks of economic growth and prosperity.

CIP's R&D programs in potato and sweetpotato, together with the delivery of crop science products and best practices, put the tools for better harvests, incomes, and health into the hands of millions of farmers and families in communities around the world. CIP's plant scientists and breeders work with a range of partners and farmers to improve these exceptional RTCs to make them more resilient to the extremes of climate, pests, and diseases, to produce greater yields, and have better nutritional and culinary quality. Our social scientists bring the same dedication to helping rural farmers and communities understand, adopt, and profit from the latest RTC technologies and practices tailored for different agro-ecologies, production systems, and value chains.

Feeding a Crowded and Hungry Planet

In its 2014 publication "The State of Food Insecurity in the World," the Food and Agriculture Organization of the United Nations (FAO) estimates that more than 800 million people around the world are chronically undernourished. Many farmers in the world's poorest regions are beset by poor agronomic practices, overdependence on monocropping, and barriers to market access. As a result, yields of abundant, nutritious food crops are seriously reduced and their availability for rural and urban populations alike is limited. Population growth will add to the urgency of addressing these problems: some 9 billion people are predicted to crowd our planet by 2050, with another 2 billion by 2100.

Climate change will make the challenge of feeding all those people even greater. Low-lying coastal farmland crucial for the production of grains, much of it in Asia, is threatened by climate change-induced flooding. Rising temperatures are expected to increase the incidence and intensity of crop pests and diseases, while wider swaths of the planet experience severe droughts. CIP tackles these issues through partnerships around the world to develop technologies and strategies to help farmers adapt and prosper.

Tapping the Potential of Root and Tuber Crops

In response to the agricultural development challenges of the 21st century, CIP has organized its mission and activities around six programmatic objectives. Three programs focus on R&D efforts to enhance the ability of sweetpotato and potato to improve the cropping, nutrition, and economies of smallholders in different agro-ecologies worldwide. To guide our work and measure its value, we have set aggressive 10-year targets with a timeline that will ensure beneficiaries benefit sooner as scaled-up efforts reach increasing numbers of people who will benefit from the impact of our programs.

Two additional programs move CIP's scientific outputs into the pivotal areas of biotechnology, advanced science and systems research to help solve the food and nutrition security problems that are inextricably linked to our century's two defining challenges: climate change and population growth. Finally, CIP's genebank of sweetpotato, potato, and Andean RTCs functions as the "heart and soul" of the Center's R&D operations and results-oriented initiatives.

Resilient Nutritious Sweetpotato

Sweetpotato will enable at least 15 million resource-poor households in Africa, Asia, and Haiti to improve the quality of their diet by 20% and raise their crop income by 15%.

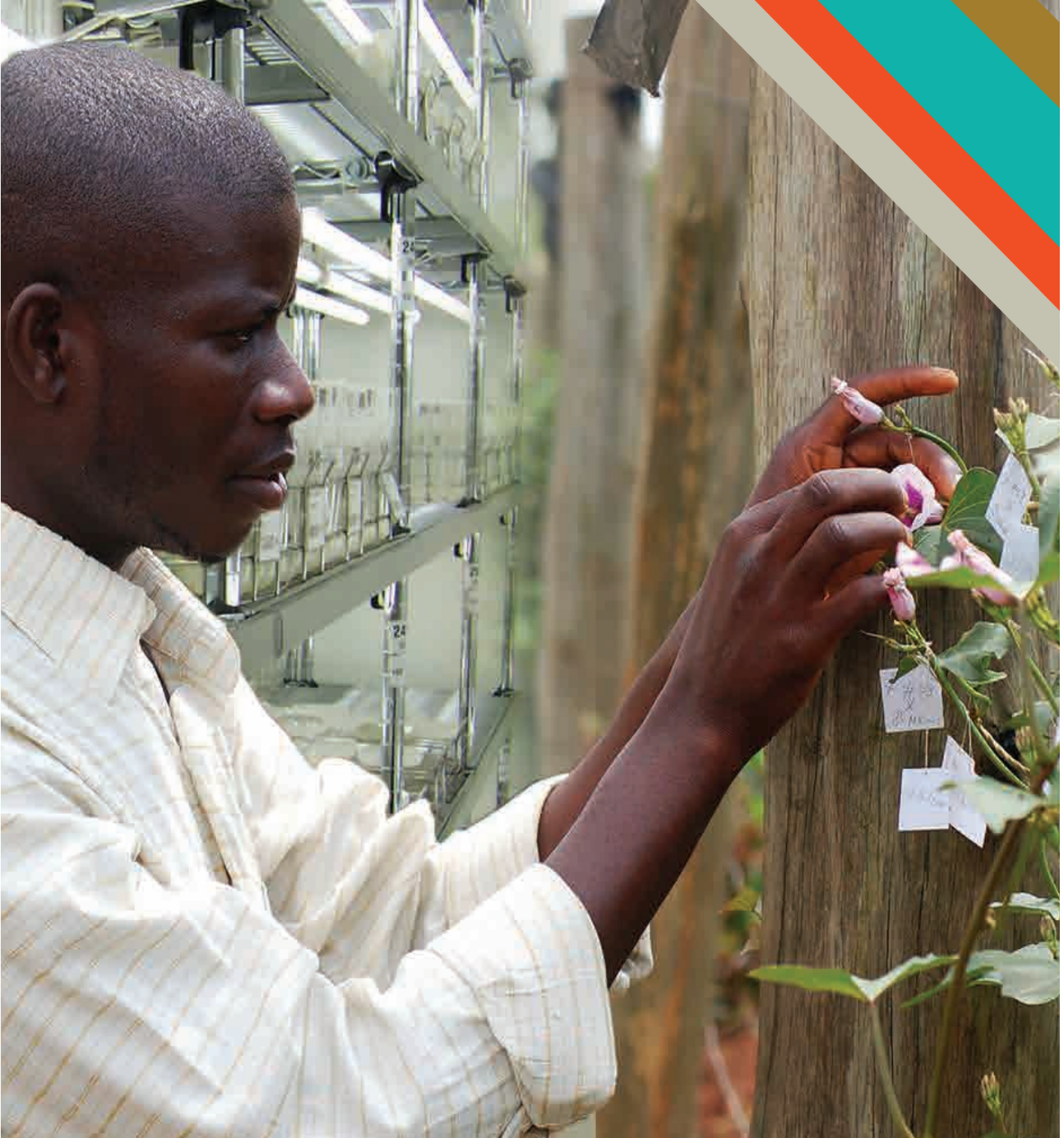
In developing countries, vitamin A deficiency (VAD) is one of the most pernicious forms of undernourishment. It commonly causes stunting, weakens immunity, leads to blindness, and increases mortality. It is also one of the most prevalent: almost 165 million children under 5 years suffer from VAD, primarily in Sub-Saharan Africa and Asia.

Under this program, CIP is conducting research to develop and disseminate biofortified, vitamin A-rich orange-fleshed sweetpotato (OFSP) varieties through a phased scaling-up in Africa, Asia, and Haiti. Biofortification increases micronutrient content through conventional breeding, sustainably boosting the supply of micronutrients for farm families and consumers. By promoting OFSP nutrition education at the community level, we make it a cost-effective source of vitamin A for vulnerable populations, especially women and young children. The crop is also a good source of calories and other key vitamins and minerals that people affected by VAD often lack. In Africa, we also work with large food processors and fresh root traders to develop new value chains for OFSP, and link women to these income generating opportunities.

Agile Potato for Asia

Early-maturing potatoes will improve systems productivity and farm incomes of at least seven million households in China, Bangladesh, India, Vietnam, Pakistan, Nepal, and in Central Asia

To improve food security and income in Asia, CIP's potato breeders are developing early-maturing, "agile" potato varieties that can resist biotic and abiotic stress but have



traits desired by consumers and processing industries alike. They can be grown during the fallow periods of different cereal-based systems, offering a profitable and nutritious complement to low-income cereals in Asia's subtropical regions. Adaptable to a wide range of cropping systems in subtropical, temperate, and highland environments, agile potatoes provide flexibility in planting times and can relieve pressure on scarce land and water resources. They improve incomes from farming and value-added activities, and cushion the impact of cereal price inflation on low-income consumers.

CIP is responding to regional and national demands for healthier, more robust potatoes. But good quality seed for resilient varieties is in short supply in Asia, greatly limiting potato production in the region. To overcome this serious bottleneck, we work with local, regional, and national partners to breed elite, adapted potato candidate varieties, and cropping system technologies. These partners are using our research products to scale up improved seed delivery of suitable varieties, value chain diversification, and ecological management practices.

Proper potato storage technology can moderate supply and stabilize prices.

Seed Potato for Africa

High-quality seed of robust, market-preferred and biofortified potato varieties will improve the livelihoods of at least 600,000 smallholder households in potato-growing regions of Africa, with farmers increasing potato yields by as much as 15t/ha and incomes by at least US $800/ha/season. Through the multiplier effect, an additional 3 million households will benefit from this program.

Farmers in the highlands of Africa tend to grow potatoes in very close rotations or continual monocropping. This allows diseases to accumulate in the seed tubers and yields to decline, and farmers are left with less to sell. Seed potatoes from local markets or farmers' own fields are often infected with viruses and bacteria that build up and spread in farmer-saved seed stocks and seed systems in general. Few farmers know how to select quality seed from their own harvests, whereas a weak potato value chain limits farmers' access to quality seed for suitable, biofortified potato varieties.

CIP's response has been to breed adapted, disease-resistant potato varieties, and use rapid seed multiplication techniques that reduce the number of generations needed from five to three (3G). This accelerates the production of high-quality seed for smallholder potato farmers in Africa, where thousands are adopting 3G quality seed and better agronomic practices, and are seeing higher yields and market prices. Innovatively, CIP has leveraged private sector investment for boosting the supply of quality seed potato. CIP also works with local agricultural R&D partners to conduct adaptive research into technologies for on-farm seed quality management, integrated crop management, and postharvest storage for seed and ware potato producers.

Game-changing Solutions

The pressures that population growth and climate change will place on agricultural productivity mean that genetic gain needs to be accelerated to feed the world. Cutting-edge research, science, and technology will be critical to produce game-changing solutions for potato

and sweetpotato to reach their full potential of helping to meet the world's urgent food security and nutrition needs.

The research for development of game-changing solutions employs recent, evolving discoveries in genetics, bioinformatics, plant-pathogen interactions, disease control, developmental and cellular biology, and other scientific advances. CIP is a leader in crop improvement and conventional breeding, yet the genetic complexity of potato and sweetpotato slows the pace of scientific gains. To accelerate the process, CIP has turned to pre-breeding, genomics, capturing alleles, and other biotechnologies. The Center's scientists are using cutting-edge technologies for crop improvement, pest surveillance and diagnostics, disease control, remote sensing, and soil microbiology. We are working to address medium and long-term priorities—a disease-free potato and a pest-resistant sweetpotato—that offer substantial productivity, health, and economic gains through the use of multiple genes from distant species.

Resilient Food Systems

This science program addresses the many food vulnerability issues faced by marginalized communities in regions where sweetpotato and potato can be grown, and is a natural development of CIP's extensive biophysical and social research on farming and food systems. This initiative includes complex systems science in such areas as agricultural and natural resource contexts, climate–agriculture interactions, predictive modeling, participatory geographic information systems, evaluation of biofortified crops and food-based solutions to nutrition, and in-situ conservation and use of crop genetic resources.

Initially focused in Latin America and Asia, system research sites could be added in Africa in the coming years. As the resilient food system program tools and methods are refined, it will contribute to a more focused, food security and gender sensitive research agenda in CIP's other programs. This program also builds on sound modeling work on agro-ecological factors that are needed to understand future potato and sweetpotato scenarios and plan adaptation strategies.

The CIP Genebank—Conserving Diversity for the Future

In-situ and *ex-situ* conservation of genetic diversity is critical for conserving and monitoring changes in the world's plant genetic resources for food and agriculture. Lost genetic diversity—particularly of crop wild relatives—would restrict the ability of plant breeders, researchers, and farmers to enhance nutrition, income generation, and sustainability. Increasing the efficiency of genetic resources conservation and use will contribute to the development of potato and sweetpotato varieties that can ensure global productivity of healthy food.

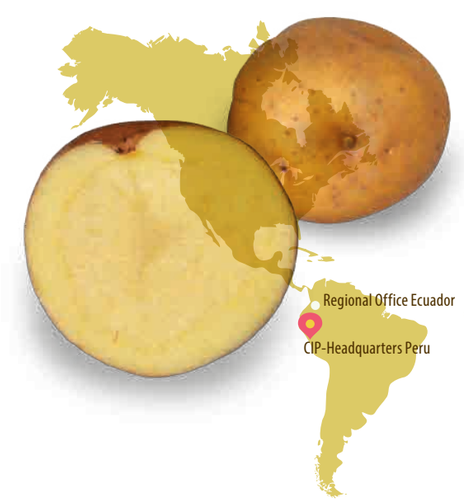
CIP works to conserve the world's genetic diversity of potato and sweetpotato to ensure its availability for breeding and other uses. The CIP genebank serves as a model through advanced research, public database designs, and interactive genomic use of collections, while working with other genebanks on phytosanitary efforts to ensure that clean material is backed-up, to prevent loss of diversity. It plays a critical role in facilitating the release of new technologies and products, particularly suitable varieties for farmers and consumers. The genebank also houses the only secure global collection of Andean RTCs, whose genetic, physiological, and biochemical attributes the scientific community is beginning to explore. The genebank is undertaking genomic fingerprinting of its holdings to clarify the diversity of its accessions. Its ongoing discovery and compilation of trait-associated information will greatly help scientists in their quest to strengthen food security and nutrition in the decades ahead.

Conserving genetic diversity with CIP's genebank.

Powerhouses of Food Productivity and Nutrition

Potato

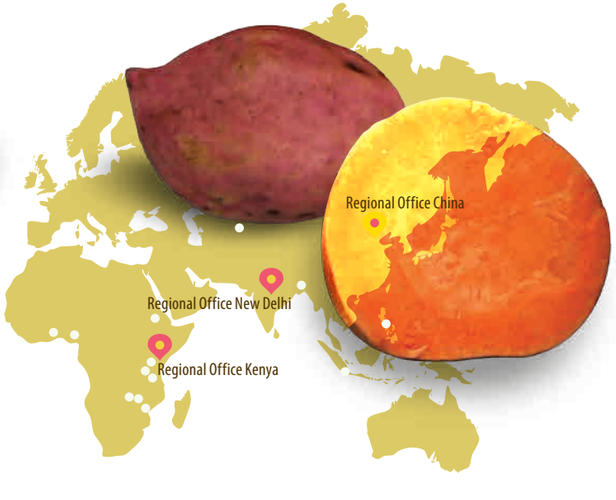
- Grown in about 130 countries, potato is the third most important food crop after rice and wheat (1ha of potato can yield two to four times the food value of grain crops).
- China is the world's largest producer, harvesting more than 73 million tons of potato a year.
- More than a billion people worldwide eat potato.
- There are about 5,000 different varieties of potato, most of which are found only in the Andes.



- Potatoes can grow in almost any climate, from sea level to 4,700 meters above sea level.
- Potatoes produce more food per unit of water than any other major crop.
- When boiled, a single medium-sized potato contains about half the daily adult requirement of vitamin C and significant amounts of vitamin B, iron, potassium, and zinc.

Sweetpotato

- Sweetpotato is a storage root, not a tuber like the potato.
- Sweetpotato can grow at altitudes from sea level to 2,500 meters above sea level, and comes in varieties with colors that range from white to yellow to orange to purple.
- Worldwide, sweetpotato is the sixth most important food crop after rice, wheat, potatoes, maize, and cassava, but it ranks fifth in developing countries.
- More than 105 million tons are produced globally each year; 95% in developing countries.



- Sweetpotato is also a healthy, cheap animal feed. Studies suggest that livestock fed on sweetpotato vines produce less methane, meaning it could potentially mitigate global warming.
- Just 125g of fresh OFSP root contain enough beta-carotene to provide the daily pro-vitamin A needs of a preschooler. The crop is also a valuable source of vitamins B, C, and E.

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The International Potato Center (known by its Spanish acronym CIP) is a research and development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change and the preservation of our Earth's fragile biodiversity and natural resources.
www.cipotato.org

CGIAR
Science for a food-secure future

CIP is a member of CGIAR.
CGIAR is a global agriculture research partnership for a food secure future. Its science is carried out by the 15 research centers who are members of the CGIAR Consortium in collaboration with hundreds of partner organizations.
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