



Game-changing Solutions

View from the field: Challenges in international agricultural research

Recent UN estimates project the world's population to swell to 9.6 billion by 2050, chiefly in developing countries. Africa's population growth alone, will account for more than half of this increase. Food production will need to soar by some 70% if it is to feed not simply more people but also a growing, middle-class whose greater purchasing power signals shifts in dietary demands. Many of these same countries already are burdened with high rates of poverty and food insecurity. They also are often the first to experience intensifying climate change and its myriad effects on crop vulnerability, emerging pests and diseases, and other unknowns. The precise impact of these climate-induced challenges remains uncertain. But as their severity and frequency increase, some smallholders may choose to farm elsewhere; some may be forced to abandon their land and livelihoods altogether. Steady increments in yields and dietary qualities are unlikely to be enough to face all food security challenges ahead. Breakthroughs from basic research have to be exploited to develop research "products" to overcome major productivity limitations, reduce product losses, and expand the area under cultivation. It is imperative that science-based, innovative, and greater resource-efficient approaches are discovered as quickly as possible in order to develop and deliver solutions to the bottlenecks in productivity and adaptive traits of potato and sweetpotato.

Institutional competencies in innovative research, science, and technology

Thanks to its unique combination of assets, CIP is leading initiatives to solve the challenges facing potato and sweetpotato production in developing countries. CIP is making strategic investments to ensure that these crops offer a growing human population their fullest genetic potential in order to meet urgent productivity and food security needs. Our innovative research and development programs employ recent, evolving discoveries in genetics, molecular biology, genomics, bioinformatics, plant-pathogen interactions, disease control, developmental biology, and cellular biology. By taking advantage of multidisciplinary approaches, CIP in the next 10 years envisages five game-changing solutions: research outputs that respond to a major agricultural problem with great potential for significant impact on food security. Two solutions address immediate priorities: a disease-free potato and a pest-resistant sweetpotato would offer substantial productivity, health, and economic gains through the use of multiple

genes borrowed from distant species to provide durable resistance. Three other targeted programs are in the pipeline: expanding the cultivation of potato toward warmer and drier land mainly by genomic-assisted breeding, next generation of pathogen diagnostics and disease eries emerge.

Crop improvement remains the heart of CIP's core competencies. And although conventional breeding is firmly established at CIP, the inherent genetic complexity of our crops slows the pace of scientific gains. Pre-breeding, capturing alleles, and quantitative trait loci from wild populations will help to accelerate this progress. Complementary to these efforts, genomics and biotechnologies have revolutionized agriculture. We are well placed to make use of these in crop improvements, in the field of pest surveillance and diagnostics, control of diseases, remote sensing, and soil microbiology. CIP can transfer genes without sexual recombination or edit genomes by site-specific mutagenesis, and use DNA markers to identify the rare but superior genotypes. CIP's modeling capability can generate new knowledge needed by biotechnologists and breeders to accelerate the process for generating expected solutions.

Stronger alliances and partnerships to enrich and sustain impact

These five game-changing solutions rely on enabling technologies and policies, knowledge, CIP capacities, and partner expertise. CIP's genebank houses the greatest genetic diversity in both the primary and secondary gene pool for potato and sweetpotato and lays the foundation for future genetic and potential crop management gains. Exploiting any one of these assets requires multidisciplinary teams that will draw on the expertise in CIP research programs for the development and delivery of crop gains through a global network of local, regional, national, and international partnerships. Advanced research institutions (ARIs) and the private sector are key partners to access the new knowledge and technologies needed to realize these game-changing solutions. Development of disease-free potato will first be tested in Africa using the advanced biotechnology facilities at Biosciences eastern and central Africa and at the National Agricultural Research Organization in Uganda following strict biosafety regulations. These same two partners

figure prominently in the development of pest-free sweetpotato in Africa, where virus diseases and weevils are having the most severe impacts. Together we will collaborate with ARIs and the private sector for research product development and testing. The advent of genomics tools offers new options for exploiting potential sources of resistance to viruses and weevils in cultivated germplasm as well as wild species. We will then adapt the technology for different Asian countries, working closely with the CIP-China Center for Asia and the Pacific. As challenges are resolved, modeling will be used for ex-ante estimation of adoption and impact that will guide further development steps and the use of public-private partnerships to ensure that solutions reach large numbers of farmers in a targeted way.

Tapping the potential

Looking beyond the two first-priority game-changing solutions, through a window of 5–40 years, CIP will focus on efforts to combat degeneration due to viral infection—a major contributor to yield loss in clonally propagated crops

across the globe. We will concentrate on production of TPS through several novel approaches. The game-changing solutions described here represent research that, while risky, offers high returns and benefits.

The CGIAR Research Program on Roots, Tubers and Bananas is an essential platform for Game Changing Solutions

To learn more about Game Changing Solutions go to <http://cipotato.org/game-changing-solutions/>



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