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Transforming African Agriculture
CGIAR

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Project launched to enhance adoption of Conservation Agriculture in Southern Africa

A new project that aims to investigate the drivers and barriers to adoption of Conservation Agriculture (CA) in Southern Africa and to develop strategies for achieving adoption and impact at scale was recently launched virtually by CA stakeholders in the region.

A farmer in a field of maize under conservation agriculture.

CA, a farming system that promotes minimum soil disturbance, permanent soil cover, and diversification of plant species, can efficiently increase agricultural productivity while reducing land degradation and improving soil health for more productive, profitable, and sustainable farming. However, its adoption rate among smallholder farmers remains low.

The project, Understanding and Enhancing Adoption of Conservation Agriculture in Smallholder Farming Systems of Southern Africa (ACASA), will be led by IITA and the International Maize and Wheat Improvement Center (CIMMYT).

It is supported by the Norwegian Agency for Development Cooperation (Norad) and will be implemented in Malawi, Zambia, and Zimbabwe in collaboration with the CA stakeholders and farmers in the region.

The project was officially launched virtually on 16 September by the Zambia Minister of Agriculture, the Hon. Michael Katambo. Hon. Katambo said that it was a timely intervention as the livelihoods

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"Breeding Better Bananas" project excels in developing new 'Matooke' hybrids

In October 2019, the "Breeding Better Bananas" project transitioned into Phase II—"Accelerated Breeding Better Bananas"—to further streamline the conventional breeding of banana in East Africa. This project brings together an international spectrum of partners to transform the national banana breeding programs in Uganda and Tanzania.

This improved banana breeding pipeline has produced more than 231 Matooke hybrids for advanced screening in the field, a stunning 250% overachievement on the project target for its 5-year timeframe. Another significant achievement included developing the first-ever Mchare hybrids, which have been produced in Tanzania.

These project achievements and numerous other successes were highlighted at the first annual planning and review meeting of Phase II by Team leader Prof. Rony Swennen, Head of IITA's Banana Breeding Program.

"We agreed to deliver 95 promising Matooke hybrids but ultimately were able to select 231 for advancement to Preliminary Yield Trials (PYT)," Swennen said.

This adds to the abundance of seeds produced (230,000) and embryos cultured (160,000), which far exceeded projections. For a crop viewed as among the most difficult to breed, this is rewarding progress.

Bananas naturally produce very few seeds, which form the foundation of any breeding effort. Stimulating bananas to produce seeds and successfully culturing or rescuing the embryos is therefore critical to developing successful and efficient breeding pipelines.

The project team has also developed crucial markers to enable breeders to identify the location of desired genes. Digital tools that provide efficient tracking of all steps in the breeding pipeline and facilitate data collection have all contributed to enabling much more efficient tracking and data management.

All this progress helps make banana breeding a viable and feasible undertaking, which can be developed by national programs. The difficulties faced in conventionally breeding banana have previously been problematic in developing banana breeding programs. This has now changed!

First-ever hybrid banana for Tanzania

During the project, the testing of new Matooke hybrids, known as NARITA, was also conducted. NARITAs were jointly developed by Uganda's National Agriculture Research Organisation (NARO) and IITA. The 27 most suitable NARITAs were selected for evaluation in Tanzania and Uganda.

The best agronomically performing NARITAs, which met consumer taste and texture preferences, were identified after assessment in multilocation trials and have now been forwarded to the respective authorities in charge of releasing new varieties. This is an exciting milestone for the project team, who are looking at the possibility of having the first-ever banana hybrids released in Tanzania.

Two of the selected high-yielding Mchare hybrids with resistance to Fusarium wilt.

"The Tanzania Agriculture Research Institute (TARI), in collaboration with its partners, evaluated 27 NARITAs in target regions of Tanzania through Participatory Variety Selection involving farmers and extension agents. This led to the identification of four candidates for official release. These NARITAs will be the first banana varieties to be released in Tanzania from the only banana breeding program in the country," said Dr Mpoki Shimwela, Head of the Banana program, TARI.

Matooke is a part of the East Africa highland cooking banana family that includes Mchare in Tanzania. These are important staple food crops in the region, providing food and income for millions of smallholder farmers.

This project has focused on developing consumer-acceptable Matooke and Mchare hybrids with enhanced resistance against the key pests and diseases in the region. Another exciting project achievement is the development of Fusarium-resistant Mchare hybrids, which are now undergoing further testing.

Reflecting on the success of Phase I, Senior Project Officer at the Bill & Melinda Gates Foundation, Dr Jim Lorenzen said that "This project has progressed impressively in improving breeding efficiency, from core operations through screening for pests and diseases, beginning to work on floral biology, understanding genetics, genomics, and genetic architecture of traits, working with farmers to understand their needs, preferences, and dislikes, and working within the digital ecosystem."

The "Accelerated Breeding Better Bananas" Project annual review and planning meeting was held virtually on 21-24 September. It was attended by over 100 participants who tuned in from six continents, all of whom are implementing partners or scientific advisors to the project or MSc and PhD students supported by the project.

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and food security of smallholder farmers in Southern Africa are increasingly being threatened by climate change and variability.

"Conservation Agriculture has the potential to increase and stabilize crop yields and to support sustainable and resilient production systems and rural livelihoods," he said in a speech read on his behalf by Dr Moses Mwale, Director, Department of Agriculture at the Ministry.

"We should not let the low adoption of conservation agriculture discourage us. Let us use this opportunity to reflect and identify the missing link and come up with more sustainable solutions to the problem," said the IITA Director for Southern Africa, Dr David Chikoye, at the launch.

"There are a number of biophysical, socioeconomic, institutional, and policy factors that promote or hinder adoption of CA. The project, therefore, aims to identify the adoption drivers and barriers and develop pathways and strategies for inclusive scaling of CA practices," added Dr Arega Alene, IITA Agricultural Economist based in Malawi, who leads the project at IITA.

Also speaking at the launch, Christian Thierfelder, Principal Cropping Systems Agronomist at CIMMYT, highlighted some of the bottlenecks for CA adoption, noting they were linked more to socioeconomic and cultural rather than biophysical factors.

"CA is a viable and proven climate smart farming system. Therefore, future research efforts should go towards understanding farmers' decision-making and behavioral change as well as profitability," he said.

Other key partners include the Food and Agriculture Organization of the United Nations (FAO), African Conservation Tillage Network (ACTN), and Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA).

The project launch was attended by policymakers, donors, and members of the national and regional CA taskforces, national and international research institutions, universities, international development institutions, private seed companies, non-governmental organizations, and farmer organizations.

Partnerships boost scaling of legume technologies

Partnerships were identified as one of the major drivers of success of the N2Africa project, which reached over 655,662 beneficiary smallholder farmers, produced and distributed over 504,454 extension reading materials, and produced over 80 tons of soybean and common beans seeds in Tanzania.

Freddy Baijukya.

The success of this large-scale, science-based research-in-development project that focused on putting nitrogen fixation to work for smallholder farmers growing legume crops, was highlighted during a seminar by Freddy Baijukya, Farming Systems Agronomist at IITA and the N2Africa Country Coordinator, held in September, at the IITA Eastern Africa hub.

According to Baijukya, N2Africa could not have reached so many farmers without support from partners. He noted that the project used different approaches to overcome challenges in disseminating improved legume technologies to farmers. Challenges included poor access to improved high-yielding varieties and other inputs, and lack of markets. Another challenge was aflatoxin contamination in groundnut.

Partnerships enabled inputs such as seeds, pesticides, and fertilizers to be more accessible to farmers.

The project also used the media to reach farmers. For example, through over 167 radio programs, a campaign on beans and soybean reached more than 508,000 people who listened to at least one radio program on improved legume technologies.

On lessons learned while implementing the activities, Baijukya further noted that targeting technologies to farm types and farmers' typologies and careful selection of partners were extremely important.

"To have the right partnership, we need to be strategic in selecting partners and targetig those who are like-minded and can provide different tactics of packaging the technologies," said Baijukya.

The aim of the N2Africa project was to increase the benefit from biological nitrogen fixation and productivity of grain legumes among African smallholder farmers, contributing to enhanced soil fertility, improved household nutrition, and increased cash income.

The N2Africa project was implemented in 11 African countries. It was led by Wageningen University and Research (WUR) and IITA in collaboration with national agriculture research systems, seed companies, pesticide/fertilizer companies, output markets, and local and international NGOs. The project ran from 2009 to 2019.

Farmers during a farmers' field day in Tanzania organized by N2Africa to demonstrate technologies that improve legume production.

CGIAR centers applying CRISPR/Cas to improve roots, tubers, and bananas

One CGIAR centers are now using CRISPR/Cas, a form of genome editing, to help speed up the development of improved high-yielding roots, tubers, and bananas (RTB)—these are essential staple food crops in tropical and subtropical countries grown for food security.

Leena Triphati

Genome editing either silences or knocks out a gene of interest in the plant genome without inserting any foreign gene, which means the resulting product will not be a genetically modified organism (GMO).

RTB crops where gene editing is now being used include banana and yam, led by IITA; potato led by the International Potato Center (CIP); and cassava led by the International Center for Tropical Agriculture (CIAT).

These crops have several common challenges such as diseases, pathogens, pests, and slow breeding methods. Genome editing has the potential to accelerate their breeding.

The centers' work on RTB crops was shared at a One CGIAR webinar on genome editing held on 29 September. Leena Tripathi, a principal scientist at IITA, spoke in one of the sessions focusing on the genome editing of RTB crops.

"The system for genome editing of banana and yam is already established," Tripathi told participants. This work is a collaboration between IITA, the University of Iowa, and Michigan State University with funding from the National Science Foundation and Bill & Melinda Gates Foundation under the BREAD project. Tripathi leads genome editing research at IITA and is the country representative for Kenya.

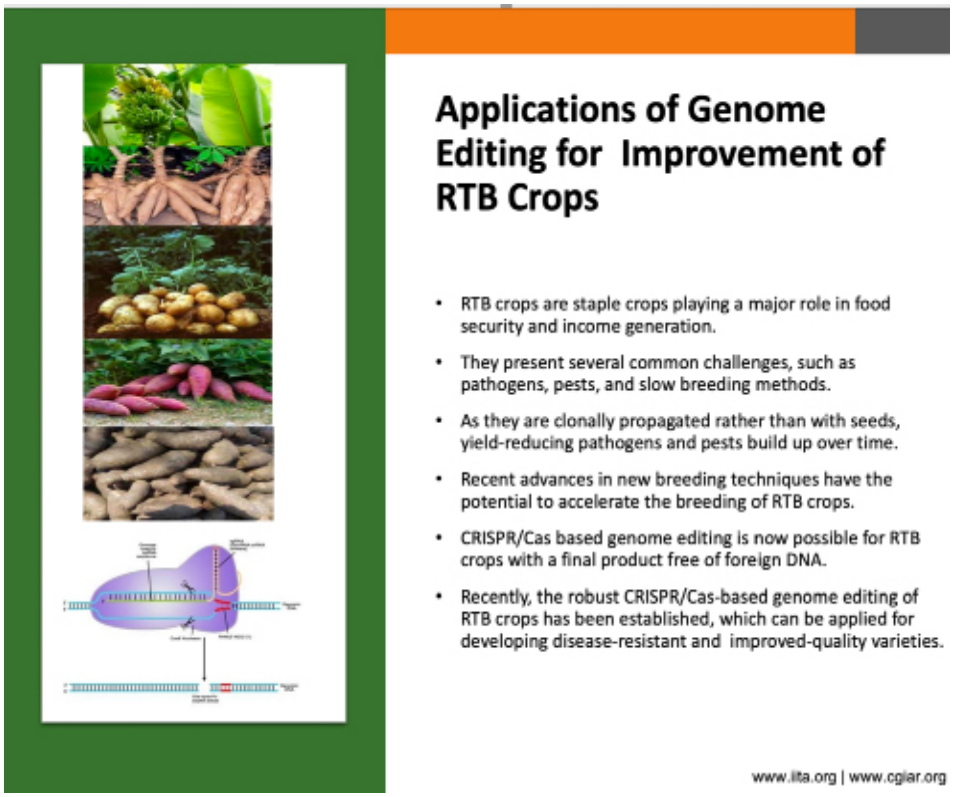
"Whole genome reference sequences and genetic transformation technologies for yam varieties—Dioscorea rotundata and D. alata"—are available, making it possible to apply CRISPR-based genome editing for trait improvement. Subject to funding, yam will be edited for resistance to viruses and anthracnose disease," Tripathi said.

In banana, Tripathi informed participants about the process of genome editing and its regulation in Kenya, where IITA's biotechnology research takes place. Currently, work is ongoing to develop bananas resistant to bacterial wilt, fusarium wilt, and banana streak virus.

These traits are not stacked, i.e., they are not all in the same banana variety but in different varieties, each bearing one trait. If everything goes according to plan, the first field trial of genome-edited bananas will be planted in 2021.

Away from scientific research, Tripathi also talked about genome editing regulations across the world. In countries like Bangladesh, India, Indonesia, Kenya, Nigeria, and the Philippines, discussions are ongoing, whereas Argentina, Australia, Brazil, Canada, Chile, Colombia, Israel, Japan, and the USA already have regulations. In these countries, genome-edited crops that do not have any foreign DNA are not regulated as GMOs.

However, in the European Union and New Zealand, genome-edited crops are regulated as GMOs. Regulating a crop as a GMO has financial, time, and adoption implications. Tripathi informed meeting participants that Nigeria and Kenya would most likely not regulate genome-edited crops as GMO, which is good news for farmers in these countries.



A slide presentation on the CRISP/Cas research at RTB.