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Scientists unravel genome and diversity of whitefly vector behind viral diseases devastating cassava in Africa

As part of efforts to control the spread of the two viral diseases attacking cassava in Africa, cassava mosaic disease (CMD) and cassava brown streak disease (CBSD)—scientists have announced a breakthrough whole genome sequencing of *Bemisia tabaci*, the African whitefly that is spreading the diseases.

The African whitefly, Bemisia tabaci, on cassava leaves.

To develop the genome map of the African whitefly, the team drawn from IITA with partners at Cornell University, USA and the United States Department of Agriculture (USDA), collected cassava whiteflies from a single field in Chato, northwestern Tanzania, a region characterized by a super-abundance of whiteflies on cassava and severe CMD and CBSD epidemics. These were confirmed as sub-Saharan Africa-East and Central Africa (SSA-ECA) using single nucleotide polymorphism (SNP)-genotyping.

The *Bemisia tabaci*, a global pest and vector of damaging plant viruses in agriculturally important crops, is a complex species comprising many morphologically indistinguishable species. Cassava *B. tabaci*, confined to sub-Saharan Africa, specialize on cassava, and are rarely found on other host plants. Two other important *B. tabaci* species, Middle East-Minor Asia 1 (MEAM1) and Mediterranean genetic group (MED), colonize many host plants and have spread as

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International info and data body recognizes IITA staff member with a fellowship award

IITA's Institutional Data Manager Olatunbosun Obileye (Bosun), was recently conferred a 3-year fellowship by the International Association for Social Science Information Services and Technology (IASSIST) in Sydney, Australia during its 2019 conference. The fellowship provides free access to its membership network with opportunities to collaborate on funded projects, get technical support, and participate in training and development of cutting-edge tools and apps that can support IITA initiatives.

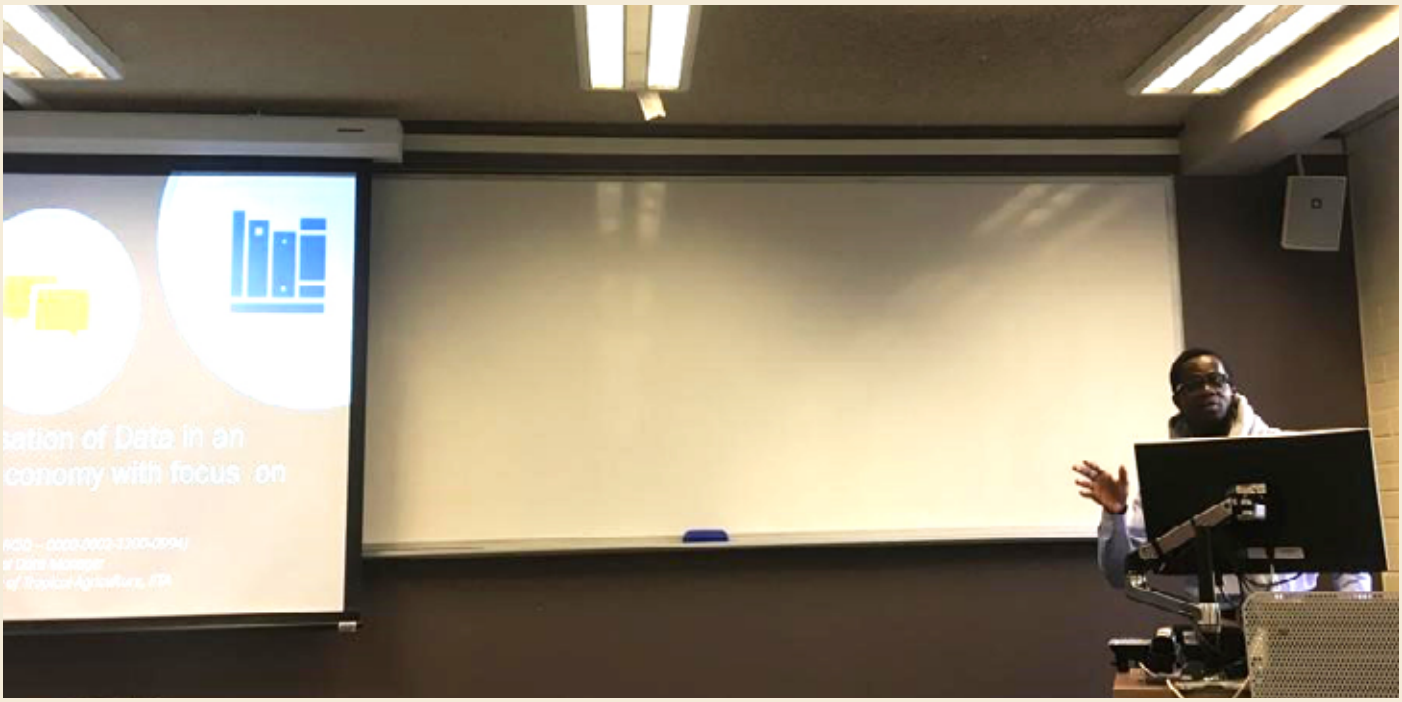
IASSIST 2019 had the theme "Data Down Under" and was attended by leaders from Ivy League schools from all over the world along with high-powered delegates from the Australian government.

IASSIST is an international organization of professionals working in and with information technology and data services to support research and teaching in the social sciences. Its 300 members are from

a variety of workplaces, including data archives, statistical agencies, research centers, libraries, academic institutions, government departments, and non-profit organizations.

Bosun delivered a paper titled "Democratization of data in emerging economies with focus on Africa" at the conference. His paper attracted data leaders from Cornell University, Harvard University, and Stanford University to open discussions on how to integrate IITA's institutional repository CKAN into the Ivy League schools' open access repositories. Meanwhile, the International Federation of Data Organizations (IFDO) offered to accept IITA as a member with a fee waiver. The global body responsible for accreditation of open repositories leadership (Core Trust Seal of Approval) that was present at the conference, encouraged IITA to officially apply for CKAN certification, noting that IITA is already at a level 3 compliance which means that IITA CKAN documentation, data quality, and control is on par with global standards for open access repositories.

The conference showcased efforts from various institutions from Australia, New Zealand, Canada, the US, Europe, and several Asian countries on data archiving, data management, and information science.



Bosun presenting paper at IASSIST 2019.

Scientists unravel genome and diversity of whitefly vector Continued from page 1

invasive populations throughout the tropical regions of the world. They were the first *B. tabaci* species to have their whole genomes sequenced. This adds African cassava *B. tabaci* to this list, making it the third whole genome to be sequenced for this complex species.

The draft genome assembled from Illumina short reads has 78% of core genes fully covered, which is comparable to figures for the other two *B. tabaci* genomes. It has a total size of 513.7 Mb and contains 15,084 predicted protein-coding genes. The SSA-ECA genome has fewer detoxification genes (509) than those of MEAM1 (667) and MED (680). This may be because SSA-ECA specializes on cassava and is not under pressure from insecticides, whereas the polyphagous MEAM1 and MED are under extreme pressure to evolve resistance due to heavy use of insecticides on their preferred annual crops. The divergence between MEAM1 and SSA-ECA appears recent and is estimated at 5.26 million years.

The findings of this paper have been published in the paper *Genome of the African cassava whitefly Bemisia tabaci and distribution and genetic diversity of cassava-colonizing whiteflies in Africa*, a draft published in the insect Biochem journal.

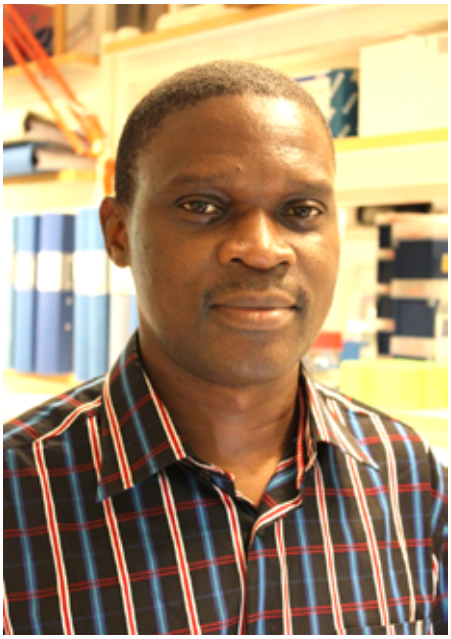
"This is a major step forward for whitefly research in Africa. The availability of the SSA-ECA genome resource presents important new opportunities for further research to understand the evolution of cassava *B. tabaci*. It will be particularly interesting to unravel how these whiteflies adapted to cassava, a crop that cannot be colonized by the other types of *B. tabaci*," says IITA Senior Plant Health Specialist, James Legg.

He adds that understanding the mechanisms, which allow these whiteflies to utilize cassava will help in the design and development of novel control strategies that could involve the deployment of products that disrupt these mechanisms.

Another area of focus will be to understand the mechanisms responsible for virus acquisition and transmission. Disrupting these could reduce or eliminate virus transmission in cassava. Gene sequences obtained from the genome may also allow for the development of high affinity insecticides that target specific pathways in the whitefly, which would make them more environmentally friendly and less harmful to non-target insects/organisms.

Another PhD for the Breeding Better Banana project as Michael Batte successfully defends his thesis

Michael Batte successfully defended his PhD thesis titled *Increasing efficiency of the breeding pipeline for East African highland bananas* on 4 June at the Swedish University of Agricultural Sciences (SLU) Alnarp campus. His studies were sponsored by the Breeding Better Banana project that is led by IITA as part of its capacity building program. This brings the number of completed PhD studies under the project to three.



Dr Michael Batte.

The project seeks to strengthen banana breeding programs in Uganda and Tanzania and speed up the development of high-yielding and disease-resistant hybrid varieties of the East Africa Highland banana (EAHB). Its focus is on the two most popular cooking banana in the two countries—'Matooke' and 'Mchare' for Uganda and Tanzania, respectively.

Dr Batte works with IITA in Uganda and his main supervisor was Professor Rodomiro Ortiz from SLU, co-supervised by Dr Helena Persson Hovmalm and Dr Mulatu Geleta, also from SLU. At IITA, his co-supervisors were Rony Swennen, Brigitte Uwimana, and Allan Brown.

In his study, Batte looked at innovations to tackle the technical challenges of breeding banana that stem the crop's low fertility, low seed germination, long selection cycle period, and large space requirement for field evaluation. He also looked at innovations to improve the efficiency of banana breeding programs to quickly deliver to farmers improved banana, which are high yielding and resistant to production constraints to boost their livelihoods. He analyzed the practices that were used for the first 21 years of the banana breeding program of IITA in Uganda.

He focused on five approaches to tackle this challenge:

1. An assessment of the available minimum descriptor list for suitability to characterize the EAHB germplasm.
2. Analysis of crossbreeding data of EAHB for the first 21 years (from 1995 to 2015) at IITA as a basis for designing future interventions.
3. Path analysis to determine a breeding ideotype for EAHB.
4. Estimation of heterobeltiosis (hybrid vigor) for the NARITA hybrids (mostly secondary triploids ensuing from the 4x × 2x).
5. Phenotyping a diploid banana population for resistance to the nematode *Radopholus similis*.

Of the 31 descriptors studied, 10 were found stable but had similar scores in EAHB cultivars and therefore it was not suitable to distinguish between them. The month of pollination did not result in significantly different pollination success, implying that pollination of EAHB can be conducted throughout the year. However, the seed set and rate of germination were still low. Thus, further research about seed production and germination is required.

Years of collaboration between IITA and the National Agricultural Research Organization (NARO) of Uganda had led to the successful development of the first ever hybrids of EAHB, named NARITAs. Twenty-seven NARITAs were selected for further evaluation in the East African region.

Path analysis undertaken in this study revealed that fruit length, circumference, number of hands, and plant cycle number had a direct positive effect on the bunch weight (a proxy for edible yield). Significant progressive, heterobeltiosis for bunch weight was found in all the NARITAs. Half of the NARITAs had negative heterobeltiosis for stature. The diploid population was found to segregate for resistance to *R. similis* with a phenotypic ratio of 9:3:4 suggesting recessive epistasis.

This research opens perspectives to make the breeding of EAHB more efficient and cheaper.

Michael Batte in a banana field..

ACDI/VOCA Country Representative for Nigeria visits IITA

The Nigeria Country Representative of ACDI/VOCA, Olaf Kula, visited IITA-Ibadan on 24 May. The visit aimed at establishing a partnership between ACDI/VOCA and IITA.

Kula, who is also a Senior Agribusiness Adviser to this Agricultural Development NGO, visited the Institute to get a better understanding of IITA activities and explore the possibility of partnering with the Institute on a new United States Agency for International Development (USAID) project. USAID will be issuing a new procurement project called Nigeria Agricultural Extension and Advisory Services.

"We will be building on this project and we believe that with the right partnerships including partnering with IITA and perhaps AfricaRice or World Fish, we will be able to put together a winning proposal," said Kula.

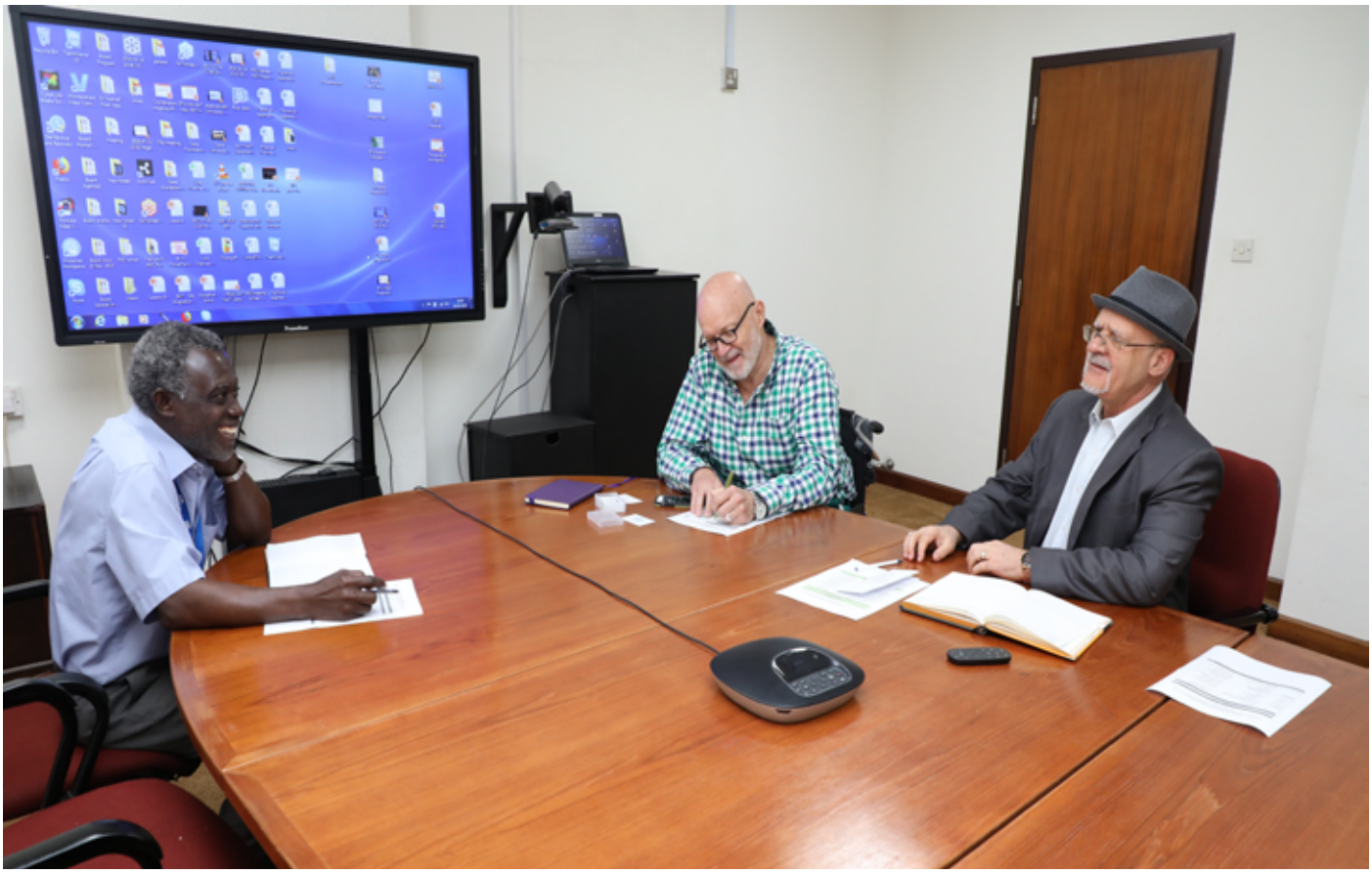
He also noted that Nigeria is one of the countries for USAID's "Feed the Future" (FTF) strategy, emphasising economic growth, nutrition, and resilience. The focus crops are maize, rice, soybean, and cowpea, alongside aquaculture, all found in IITA.

The FTF strategy targets several Local Government Areas (LGAs) within states. However, taking the value chain approach will help farmers or aquaculture producers in those LGAs to become more productive. "USAID has seen lots of entrepreneurial initiatives in Nigeria and through this project plans to help initiatives with the ability to scale, to reach scale," continued Kula.

In his welcome remarks, IITA Director of Research for Development, West Africa, Robert Asiedu, spoke of IITA's willingness to collaborate with both the private sector and government entities. "We have intensified our partnership with the private sector as it is a good avenue to ensure that the Institute's technologies get to farmers," he said.

Deputy Director General, Partnerships for Delivery (DDG-P4D), Kenton Dashiell also spoke of IITA's readiness to explore partnership opportunities. He said, "We have heard and seen some of your work and we would love to partner with you, believing that we would have a very strong partnership."

Kula also met and discussed with other staff in charge of some projects such as Bernadette Fregene for aquaculture; Godwin Atser for extension services; David Ojo for soybean; Tunde Amole for cassava peel; Francis Nwilene for rice; and Dashiell representing Christian Fatokun and Abebe Menkir/Badu-Aprkau for cowpea and maize, respectively. Afterwards, he was taken on a tour of the IITA campus including stops at the facilities for Aflasafe, Nodumax, and Semi-Autotrophic Hydroponics (SAH) for yam.



Olaf Kula in a meeting with Kenton Dashiell and Robert Asiedu.

ACAI capacity building for partners: Nigeria and Tanzania NARS training on data management

The African Cassava Agronomy Initiative (ACAI) has started a series of data management training for staff members from the national agricultural research system (NARS), in the project target countries. The NARS staff from Nigeria and Tanzania are being trained on data collection using the ODK suite tool, data analysis in R, and geospatial information system (GIS) methods and approaches using ArcGIS and QGIS software.

ACAI Project Coordinator Pieter Pypers leading a training session.

The training participants are drawn from the National Root Crops Research Institute (NRCRI) and the Federal University of Agriculture, Abeokuta (FUNAAB), both in Nigeria as well as the Tanzania Agricultural Research Institute (TARI) and Zanzibar Agricultural Research Institute (ZARI).

ACAI Project Coordinator and Senior Agronomist, Pieter Pypers, anchored the first training session held in early March 2019. Pypers conducted training for the NARS partners on digital data collection covering effective agronomy research and database management.

IITA Data Scientist Meklit Chernet led the second session of the training for the partners on data analysis using R software. In April 2019, IITA GIS Specialist, Tunrayo Alabi gave the third session of the training on geospatial analysis using QGIS.

The training is part of the ACAI objective to build the capacity of the NARS for them to engage in transformative cassava agronomy research. The project has lined up nine virtual sessions to equip the NARS participants with necessary skills to handle, analyze, and interpret complex data using digital tools. In September, classroom training will be held in both countries to further advance the skills of the participants.

Dr Busari Mutiu, a senior lecturer in Soil Science and Land Management at FUNAAB, commended the ACAI leadership for the initiative which will diversify the NARS partners' skillset beyond the project needs.

"These training are very well organized and will have a great deal of impact on the plans for the sustainability of the project. We find (the training) useful and satisfactory," said Mutiu. The senior lecturer is also leading ACAI research activities in the South West of Nigeria.

The project together with the NARS partners will evaluate the progress of the training in the 3rd quarter of 2019. The evaluation will guide the team in developing further plans for in-depth detailed training for participants in 2020.

Travel advisory: Tanzania bans single-use plastic bags

The Government of Tanzania has announced a strict ban on plastic bags in the country. The ban, which came into effect on 1 June, prohibits the manufacture, importation, and use of all single-use plastic bags including shopping and garbage bags. Offenders could face heavy penalties including fines and possible jail term.

In an Institute-wide email, IITA Deputy Director General, Corporate Services (DDG-CS), Hilde Koper-Limbourg, urged staff to take note of the ban as it affects tourists and other travelers to the East African country.

Travel company Rickshaw Travel Group advised visitors and residents alike to remove all plastic bags, including the transparent "zip-lock" bags, from their suitcases or carry-on luggage before flying to Tanzania. They added, "Items purchased at the airport before boarding the aircraft should be removed from plastic bags."

CBSD-DRC project trains extension agents in communication and sensitization about cassava brown streak disease

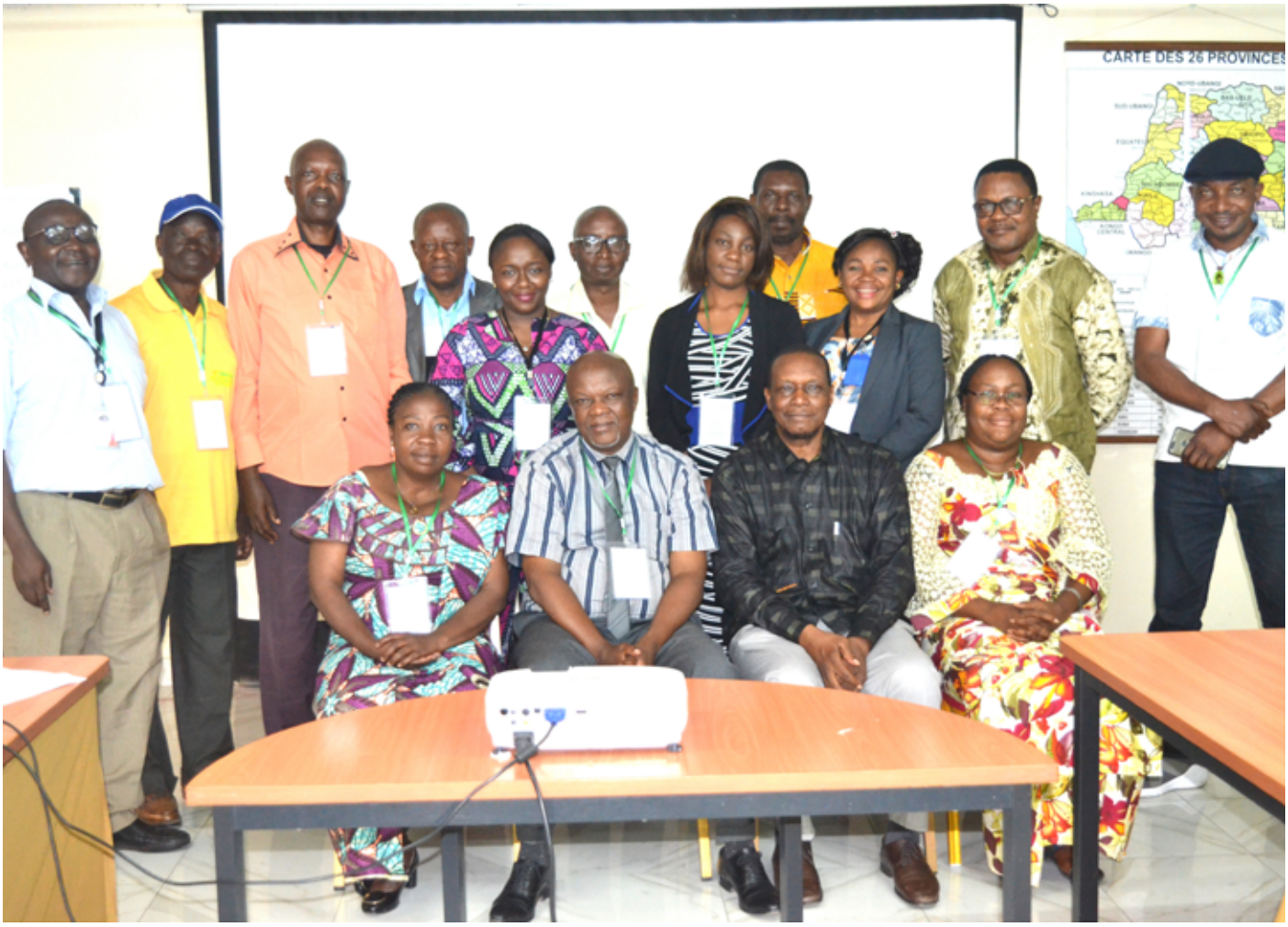
The IITA project to combat Cassava brown streak disease in DR Congo (CBSD-DRC) organized a training workshop for the National Extension Service [in French: Service National de Vulgarisation (SNV)] on Cassava Brown Streak Disease (CBSD), 28-29 May.

The training focused on communication and sensitization about CBSD and the collaboration between SNV and IITA. SNV is the national service in charge of extension on all innovations or interventions such as agriculture and nutrition technologies, as well as public health innovations.

The workshop brought together 10 participants from SNV, six from the National Head Office in Kinshasa and the other four from provincial offices in the project intervention areas comprising Kongo-Central, Lomami, South Kivu, and Tshopo.

The themes developed during the training were: (1) cassava cultivation practices for profitable production; (2) identification and management of major cassava diseases and pests in the DRC; and (3) communication and sensitization approaches.

At the end of the workshop participants developed an action plan for the extension activities to reach out to Congolese farming communities in the fight against CBSD and root necrosis in the DRC.



Participating extension agents at the workshop.

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Please send your story with photos and captions every Tuesday to iita-news@cgiar.org or Katherine Lopez (k.lopez@cgiar.org) and Uzoma Agha (u.agha@cgiar.org) for headquarters and Western Africa, Catherine Njuguna (c.njuguna@cgiar.org) for Eastern and Southern Africa, and David Ngome (d.ngome@cgiar.org) for Central Africa.