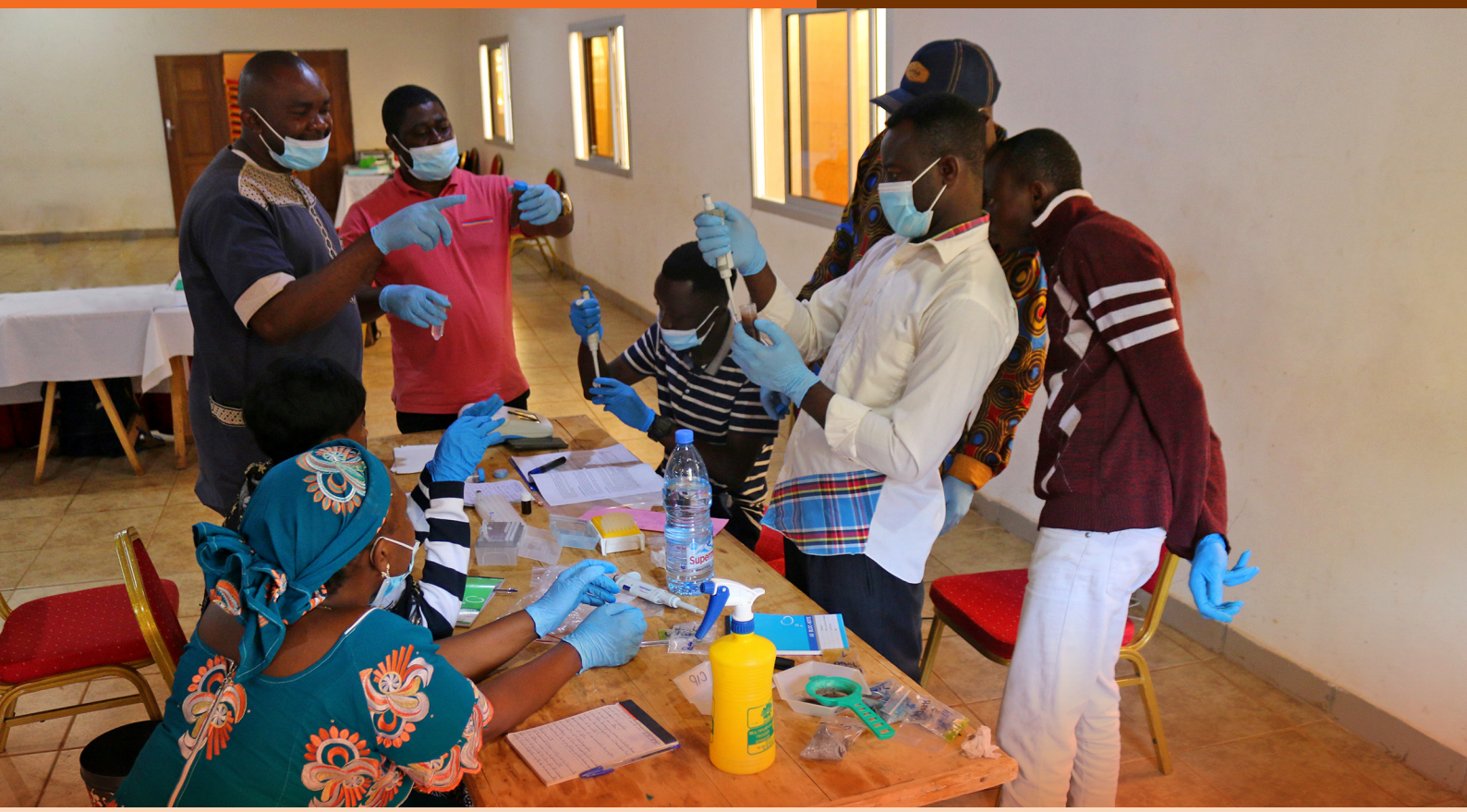


From the lab to the field • Innovations in potato pathogen diagnostics: Policy brief

After successful validation in Kenya, a portable diagnostic assay to detect the soil- and seed-borne pathogen that causes bacterial wilt is set to boost certified seed supply across potato value chains in Burundi, Cameroon, India, Mali, Nigeria, Tanzania, Rwanda, Tunisia, Uganda and beyond.

Three policy recommendations to root out bacterial wilt

Develop seed potato quality assurance framework with specific guidelines for seed inspection, disease testing, and certification.

Increase the efficiency of regulatory bodies on inspection, seed testing, and surveillance through capacity development and accreditation of third-party services to support the seed certification process.

Invest in modern diagnostics technologies such as LAMP Assay for faster, reliable, and affordable diagnostics services.

Background

As potato produces more food per hectare than most crops, it has huge potential to significantly contribute to food security needs around the world. But that potential is often cut short by the pests and pathogens that decimate potato yields, particularly the quarantine pathogen *Ralstonia solanacearum* (RS) which causes bacterial wilt.

Bacterial wilt causes an estimated loss of USD 1 billion globally each year. It spreads through infected seed tubers and is carried by irrigation water, rain runoff, farmers' tools, and livestock into the soil of uninfected fields where it can survive for years. It also poses one of the most significant limitations to certified seed production.

Most national seed certification standards have zero tolerance for RS either in the soil or in the seed potato. This limits supplies of quality certified seed for multiplication and contributes to shortages in many countries. These bottlenecks are compounded by a system dominated by the public sector which often lacks investment in new technologies including newly available diagnostic methods to detect RS leaving many countries in sub-Saharan Africa and Asia exposed to risk of contamination (Table 1).

Table 1. The challenge of providing plant pest diagnostic services for Africa and Asia

Country	Regulatory body	Diagnostics capacity				
		Regulatory framework[1]	Laboratory infrastructure equipment	Technical capacity	Decentralized services	Supply of reagents
Burundi	Office National de Contrôle et Certification des Semences (ONCCS)	Inadequate	Inadequate	Inadequate	Absent	Absent
Cameroon	Direction de la Réglementation et du Contrôle de la Qualité (DRCQ)	Inadequate	Inadequate	Inadequate	Absent	Absent
India[2]	State-based	Inadequate	Inadequate	Inadequate	Inadequate	Adequate
South Sudan	Directorate of Crop Protection	Absent	Absent	Absent	Absent	Absent
Kenya	Kenya Plant Health Inspectorate Services	Adequate	Adequate	Adequate	Inadequate	Inadequate
Tanzania	Tanzania Official Seed Certification Institute	Inadequate	Inadequate	Inadequate	Absent	Inadequate
Nigeria	National Seed Council (NASC)	Inadequate	Absent	Inadequate	Absent	Absent
Rwanda	Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)	Inadequate	Inadequate	Inadequate	Absent	Inadequate
Uganda	Department of Crop Inspection and Certification	Inadequate	Absent	Inadequate	Absent	Absent

[1] Including protocols and laws.
[2] In India, seed certification is voluntary, and labeling is compulsory.

Advances and innovations in diagnostic technology include Loop-mediated Isothermal Amplification (LAMP) assays, which have the potential to be a game-changer in the diagnosis of RS in potato. LAMP assays can detect RS in field conditions, returning reliable results in less than one hour - compared to between 4 and 120 hours for more traditional methods like PCR[1] and ELISA[2] testing. Its use means that decisions on whether to accept or reject potato seed can be made quickly on site. It is cost-effective requiring less expertise and fewer reagents than traditional diagnostic methods and is already attracting interest from private sector investors.

[1] Polymerase chain reaction (PCR) - a test to detect genetic material from a specific organism, such as a virus.
[2] Enzyme-linked immunosorbent assay (Elisa) – a test commonly used to measure antibodies, antigens, proteins and glycoproteins in biological samples.

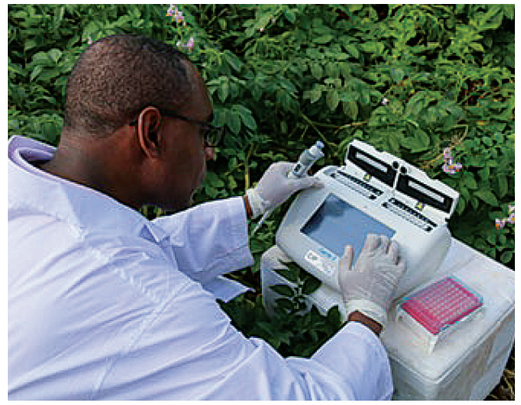
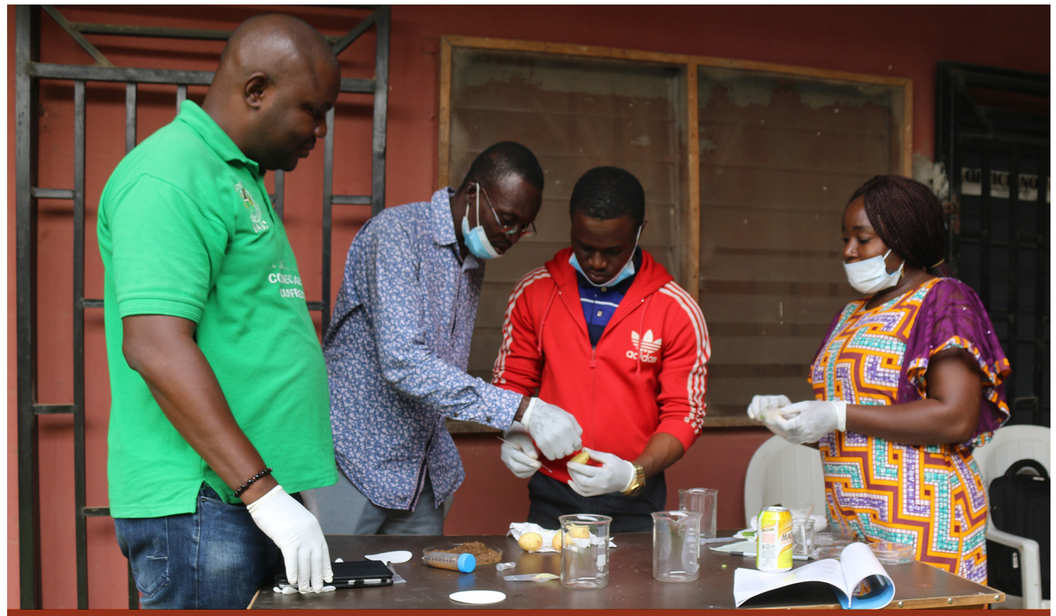


Figure 1. Using the LAMP assay in the field. © N. Rohon CIP)



Objectives

Building on work carried out in Kenya, the International Potato Center (CIP) is working with partners in Burundi, Cameroon, India, Mali, Nigeria, Rwanda, Tunisia, Tanzania, and Uganda:

1. **To build capacity to provide** backstopping, advisory support, and training to increase the use of LAMP diagnostic testing in potato field conditions to detect RS as part of efforts to increase the production of certified EGS and contain the spread of bacterial wilt.
2. **To establish public-private partnerships** to remove bottlenecks to increase seed production including through regulatory bodies' capacity to carry out seed potato inspection, testing, and certification.
3. **To develop seed potato quality assurance** framework with specific guidelines for seed inspection, disease testing, and certification.

Policy approaches

1. **Invest in the increased use of field-deployable diagnostic tools to detect Ralstonia solanacearum (RS) such as the LAMP assay to increase the efficiency of diagnostic services, thereby encouraging the production of certified seed through:**
   - **LAMP assay manual and protocol:** One of the first steps in introducing LAMP assay diagnostics for RS detection in different countries has been to develop the LAMP assay manual, protocol, and real-time video[3] to showcase the stepwise procedure to conduct the LAMP assay.
   - **Capacity-building in LAMP deployment:** To test the effectiveness of LAMP assays in field conditions, it is necessary to build capacity in practitioners. To this end, CIP working with implementation partners in several countries is holding various training sessions on extracting, preparing, and testing stem, tuber, and soil samples for RS.
2. **Enhance third-party capacity for accreditation to offer inspection, testing, and certification services to increase the efficiency and efficacy of the seed certification process in a decentralized manner through:**
   - **Public-private partnerships for LAMP service providers:** For sustainability, it is critical that LAMP testing is self-financing through initial commercial investment and then from fees charged for its use while ensuring that quality assured seed remains affordable to farmers. To attract private sector investment in a sector that has traditionally brought low returns and high risk, the project has sought initial support from donors to purchase necessary equipment and build necessary capacity and is collecting data from

[3] https://www.youtube.com/watch?v=hNdetq5cbRA

Cameroon, Nigeria, and India to better understand the profitable deployment of the LAMP assay for potato disease diagnostics in farmers' field and at ports of entry.

- **Inter-country learning and information sharing:** An important part of the initiative's whole approach is to gather and share lessons from the different countries. Lessons learned from the deployment of the LAMP assay in these countries will be collated for inter-country learning and sharing of experiences.

3. Develop seed certification standards and seed quality assurance services specific to potato under regional seed regulatory frameworks to facilitate cross-country/border seed trade and incentivize public-private collaboration through:

- **National training and support programs on potato-specific seed certification standards:** Many countries certify all crops using the same standards which means that some of the unique considerations for potatoes are not considered. Potato is a living planting material prone to seed degeneration during storage which needs to be factored into related seed certification standards, protocols, and guidelines. CIP is helping selected countries to review, adjust and align their seed certification standards, for example, providing technical and advisory support for Uganda and Nigeria on seed certification standards and procedures via the GPVCWG program.

Figure 2. Participants on a 4-day training course in Cameroon in 2021 collect soil samples during the practical session in the field. 17 participants attended the event.

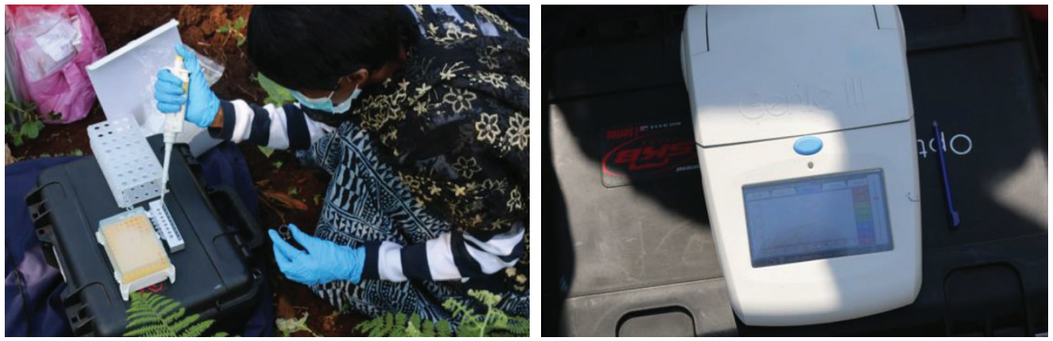
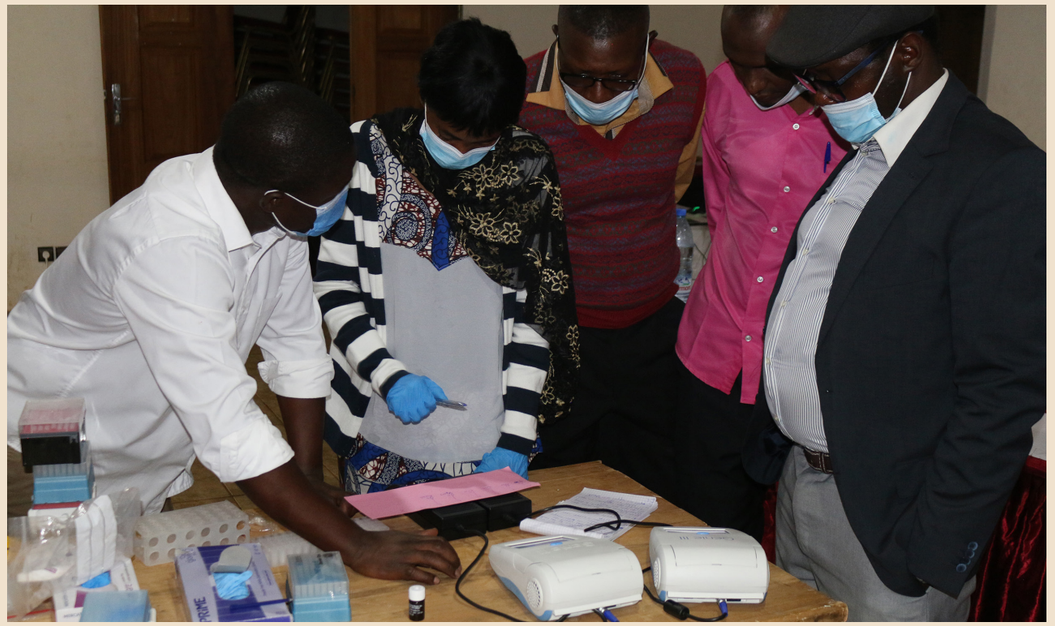


Figure 3. Analysis of samples in the field using the GENIE III machine during training in Cameroon.



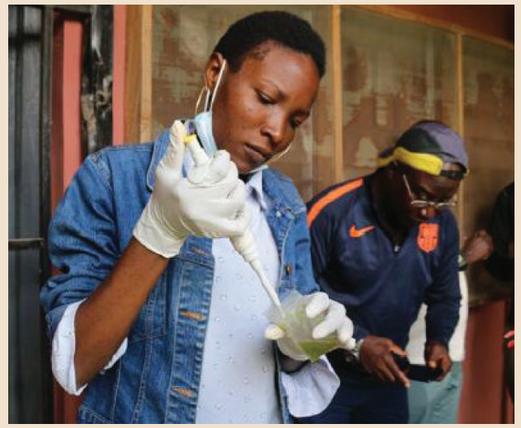
Achievements

Following trials in Kenya carried out by CIP to validate LAMP assays[4] developed specifically to detect RS in potato stem, leaf, tuber, and soil samples, work in several African countries and beyond is showing the potential of LAMP assays to be integrated into national strategies to manage and contain the spread of RS. This is particularly evident as the capacity to deploy LAMP assays in the field is built across different project countries and the work starts to scale, particularly through the emerging public-private partnerships, and ongoing efforts to align seed certification processes across countries.

While some activities have been delayed or limited due to restrictions on travel and mass gatherings, and also due to conflicts and displacement in some of the target countries, achievements so far include:

- LAMP assay protocols developed and shared in Cameroon, India, Kenya, and Nigeria, along with a brochure and manual to train partners in procedures for the diagnosis of bacterial wilt diseases in potatoes.
- Capacity-building in the use of LAMP technologies through training courses. Participants from both public and private institutions have been trained so far (Figures 2 and 3), with more courses planned in the coming months.

[4] A field-deployable LAMP assay consists of Alkaline PEG200 buffer for DNA extraction, GspSSD Isothermal Master mix, real-time fluorescence detection and Genie II and/or BioRanger devices.



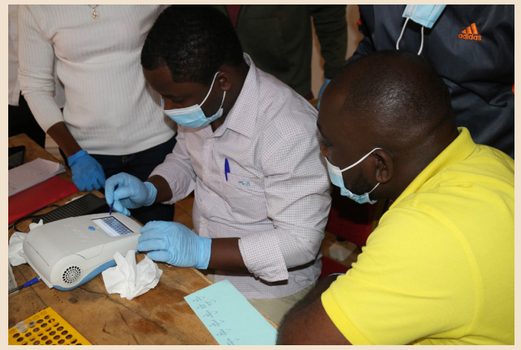


Figure 4. Participants dispense samples, run the Lamp Assay using the Genie III machine, and test for bacterial wilt using a lateral flow test at the training course in Nigeria, 2021.

To build capacity in inspection, testing, and seed certification, CIP is training existing and new seed certification officers to identify and understand the latest potato pests and diseases, including RS, and extending the training to commercial service providers. For example, in Nigeria, 23 participants participated in a 2-day training course on the identification and diagnosis of important potato pests and diseases including staff from the designated seed certification authority (National Agricultural Seeds Council (NASC)), private companies planning to work with potato, and extension agents working with seed producers.

Seed certification standards and quality assurance services specific to potato under applicable seed regulatory frameworks have also been supported for Nigeria and Uganda.

Policy implications

The field-deployable LAMP assay is showing promising results in terms of promoting seed sector investment and growth, helping farmers to succeed in seed and ware potato markets, and encouraging small and medium-scale producers to become certified seed producers due to greater certainty. For example, in Kenya, faster decision-making arising from reliable results returned in less than one hour compared to current practices which can take 14 days to return results, meaning reaching more beneficiaries with certified seed tested internally by the LAMP assay.

Of particular note is the importance of public-private partnerships to scale work and increase the local supply of certified seed for potato and also potentially for other crops, pests, and pathogens, particularly when private-public partnerships are fostered at the early stages of seed production. For example, in Kenya, the Plant Health Inspectorate (KEPHIS) has amended legislation so that certification can be devolved to commercial service providers, engaging Crop Nutrition Laboratory Services (CROPNUTS), a private contractor, to carry out diagnostic services for seed certification. These kinds of partnerships will contribute to the longer-term sustainability of seed certification and quality assurance, and seed value chain development and early indications suggest that seed costs will still be affordable for farmers due to decreased cost for seed certification, and the shortened protocols and processes involved.

It is also important to note that while improved diagnostic techniques and seed certification systems are essential to increase the production of Ralstonia-free certified EGS, they are not enough on their own. Instead, they must be part of a holistic approach that includes investment and training in other priority areas of seed production, for example, in Rapid Multiplication Techniques such as Rooted Apical Cuttings, and in Good Agricultural Practices to contain the spread of pathogens like RS during planting, harvesting, and storage.

Acknowledgements

"Improved Diagnostics and Genotypic/epidemiological Mapping Potato Bacterial Wilt Disease to Enhance Food Security of Smallholder Farmers" funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) project number 16.7860.6-001.00 and contract number 81206684.

"Technical backstopping and advisory support for the global potato value chain partners (TBAS) Phase 2" funded by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) agreement number 81262213.

"Technical support to EAC-NPPO capacity development" funded by GIZ agreement number 81279057.

Contacts

Dr. Kalpana Sharma
Senior Scientist, CIP-SSA
Nairobi, Kenya
kalpana.sharma@cgiar.org

Elly Atieno
Associate Scientist, CIP-SSA
Nairobi, Kenya
e.o.atieno@cgiar.org

Implemented by:

CIP thanks all donors and organizations that globally support its work through their contributions to the CGIAR Trust Fund. https://www.cgiar.org/funders/

© July 2022. This publication is copyrighted by the International Potato Center (CIP). It is licensed for use under the Creative Commons Attribution 4.0 International License