



Seeding Food Security in Nigeria: Four New Potato Varieties to Increase Agri-food System Resilience

Summary

Developing a sustainable and resilient seed system is vital for enhancing agricultural productivity and ensuring food security in Nigeria. This brief highlights the successful implementation of a stage-gate approach in introducing new potato varieties in Nigeria, offering valuable lessons for improving research and development efforts. The collaboration between the Nigeria Potato Seed Security Partnership (NPSSP) project, National Root Crop Research Institute (NRCRI), and Fruit and Veggies Global Ltd. resulted in the successful introduction of four potato varieties, namely Babban, Juriya, Kyau, and Unica with an explicit focus on trait combinations for climate resilience, disease resistance, and processing qualities, targeting differing

agro-ecologies. These varieties received formal approval for registration and release in June 2023, marking a significant milestone as the first new open-access varieties to be introduced in nearly a decade. They are high yielding and carry more robust, market-demanded traits than those currently grown, striking a balance in addressing farmers' limited ability to purchase inputs and meeting diverse market demands. Newly released open-access varieties are pivotal to stimulating market interest and simultaneously uplifting the local seed system. Deployment of newly released varieties is a viable option for variety and seed system development. Increasing farmer access to these varieties that are adapted to different local conditions will help strengthen food and livelihood security in the country.

Key Messages



To adapt to the changing climate and build resilience to pests and diseases,

farmers need access to a range of affordable quality seed of varieties that are adapted to meet local needs, markets, and agro-ecological environments, such as Babban, Juriya, Kyau, and Unica - the four new varieties released in Nigeria.



Innovative public-private partnerships

can help speed up the registration and release of new varieties that can close yield gaps in key food and livelihood crops like potato.



The successful implementation of a stage-gate approach

to introduce new potato varieties in Nigeria offers valuable lessons for improving research and development efforts.

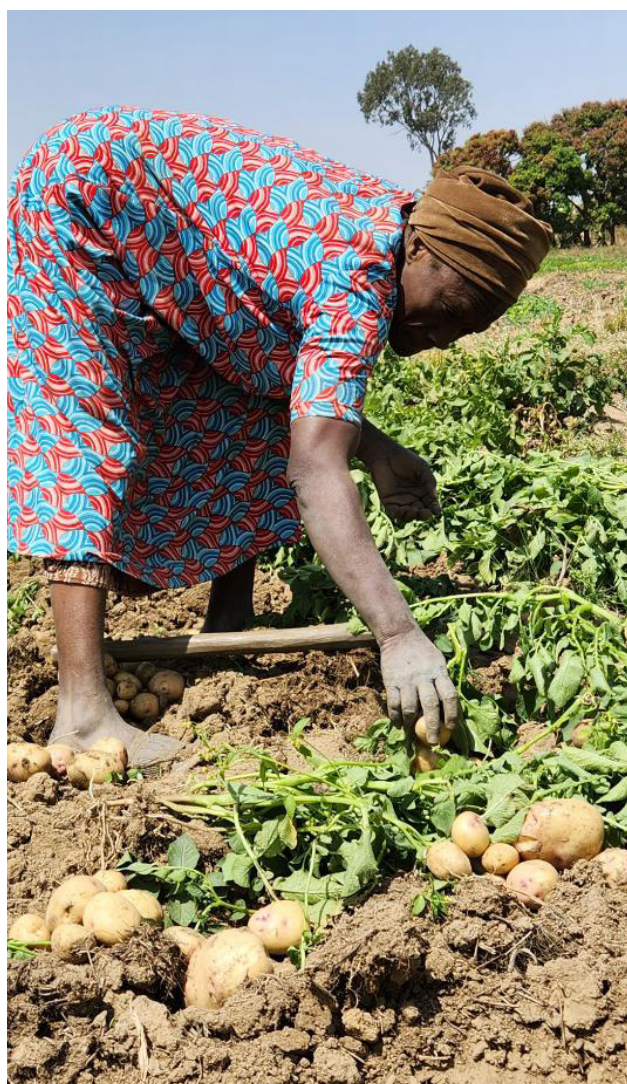
Context

Nigeria is a major potato producer in Africa, with a large cultivation area of about 350,000 hectares and a strong reliance on potatoes as a cash crop. The crop's potential is evident, as it offers nutritional benefits and climate resilience, producing more food per unit of land and using water efficiently compared to many cereals. However, challenges hinder the realization of this potential. Actual yields fall short of demand at just 3–4 tonnes per hectare due to limited access to improved varieties and affordable seed. High incidences of diseases are also a concern, resulting from inadequate crop management and the reuse of infected or low-resistant varieties. The adoption of better-quality seed, improved potato varieties, and Good Agricultural Practices (GAP) could significantly improve yields.

Further, Nigeria's reliance on seed importation has been very unsustainable due to the complex logistics, lengthy process, and huge cost involved making the seed too expensive for farmers. This was aggravated by the disruptions caused by the COVID-19 pandemic, which further reduced seed availability. Production of early-generation seed (EGS) from European varieties is

restricted due to proprietary rights. Without the starter material (tissue culture planting materials), developing new potato varieties and seed systems is not possible. Local seed production is needed to boost seed security, giving producers and policymakers a viable alternative that complements seed imports, to enhance resilience to future natural, political, or economic shocks.

Addressing these issues is vital to unleashing the full potential of potato production in the country, promoting food security and economic opportunities for farmers and communities. To achieve this, the first crucial step is to establish a sustainable and resilient seed system capable of adapting to local conditions. An initiative undertaken by the NPSSP project in collaboration with NRCRI and Fruit and Veggies Global Ltd., with support from GIZ, demonstrated the importance of embracing a holistic approach in introducing new open-access potato varieties that are well-suited to the local environment. Embracing such local-based solutions can significantly enhance agricultural productivity and contribute to the livelihood security and overall development of Nigeria's potato sector.



Adopting a stage-gate approach for the introduction of new varieties in Nigeria

Assessment demand and need for new open-access varieties

For nearly a decade, Nigeria faced significant challenges in its potato seed system as new varieties had not been released during this period. Relying on imported seed, the available stock degenerated and remained unchanged for an extended period. Existing varieties were not open access and were protected by proprietary rights, hindering the seed system and varietal development program in the country. Moreover, proprietary rights restricted seed cleaning and multiplication as the owner's permission was required, further complicating seed system development. This limitation also affected the availability of diverse varieties for various market segments in the country. Recognizing these constraints, stakeholders within Nigeria expressed the urgent need for open-access, climate-smart, disease-tolerant, and market-responsive robust varieties to bolster seed security and agricultural development.

Selection and importation of open-access genetic materials meeting country needs

The International Potato Center's breeding team initiated a collaborative effort with national stakeholders in Nigeria to identify desired characteristics for potato varieties suited to the country's diverse agro-ecologies, and to meet consumer demand and market needs. Utilizing valuable input from stakeholders, the breeding team selected 10 advanced clones from the CIP breeding program that precisely met the identified criteria and needs of the

Nigerian context. Subsequently, the selected advanced clones were presented to stakeholders for consideration. Local partners played a pivotal role in facilitating the smooth importation of the selected materials as tissue culture plantlets by preparing import permit. Once in Nigeria, these valuable plantlets were preserved and multiplied at the International Institute of Tropical Agriculture (IITA) located in Ibadan, ensuring the availability of material for selection through on-station, multilocation, and on-farm testing and evaluation process, and their nomination for variety release and registration process.

Multiplication and bulking of seed for evaluation and presentation for variety release and registration

The collaboration between public and private sector stakeholders proved instrumental in creating a local multiplication mechanism for the imported materials. The National Root Crop Research Institute (NRCRI) and Fruit and Veggies Global Ltd established seed multiplication units within their facilities, adopting the efficient Rooted Apical Cutting (RAC) technology. This allowed for rapid multiplication and bulking of the

introduced material, ensuring a sufficient supply of seed for the release and registration process. While two out of the ten varieties did not survive during the multiplication process and were excluded, the remaining varieties thrived. Remarkably, within less than a year, these two institutions successfully produced the required amount of seed needed for the variety release and registration process.

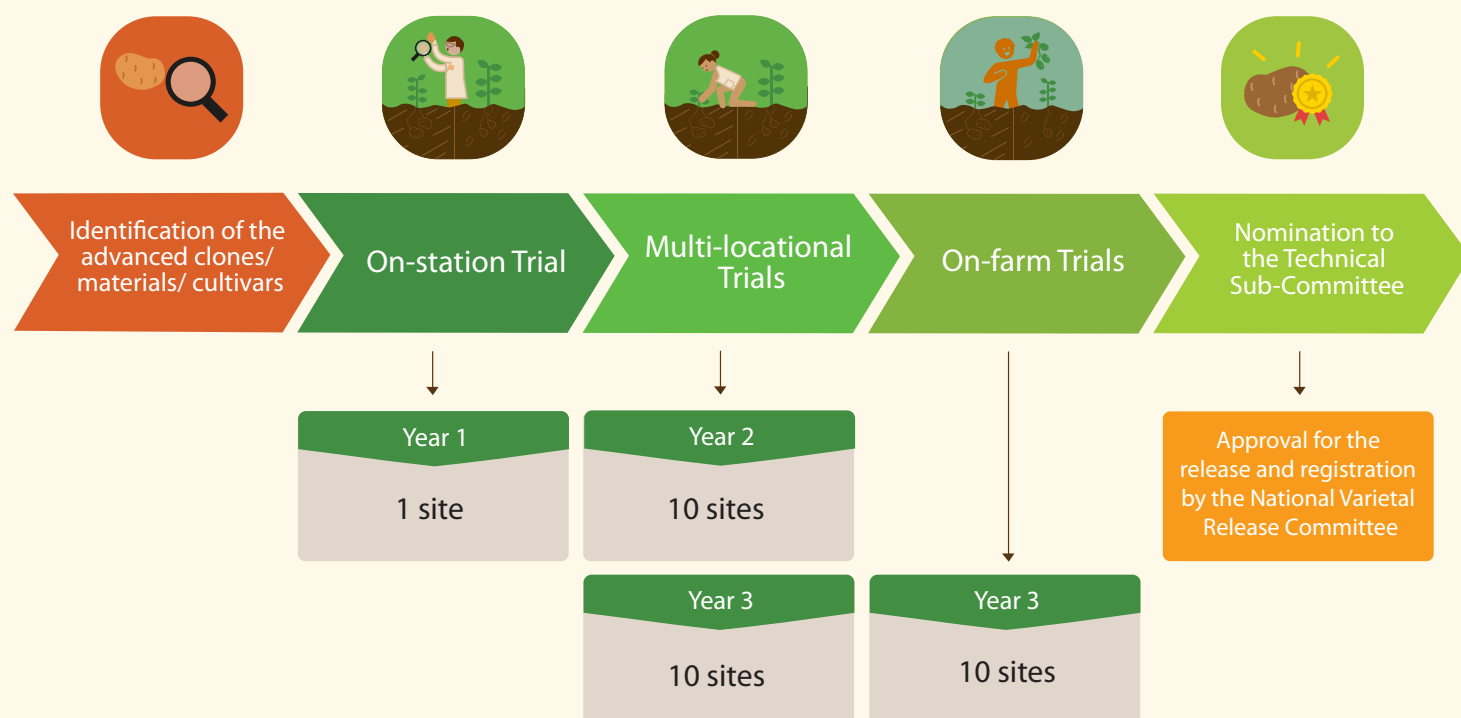
Variety release and registration process

The eight advanced clones were submitted for evaluation for variety release and evaluation following the guidelines for registration and release of new crop varieties in Nigeria by the National Centre for Genetic Resources and Biotechnology (NACGRAB) (Table 1, Flow diagram 1). The National Root Crop Research Institute (NRCRI) - the potato crop-mandated institution - spearheaded the process of evaluations, analysis, and presentation of the dossier, nominating the selected candidate varieties for consideration by the Technical Sub-Committee (crop) for approval for release and registration by the National Crop Varieties and Livestock Breeds Registration and Release Committee.

Table 1. Evaluation and activities undertaken for the release and registration of new potato varieties in Nigeria

Evaluations	Activities involved
On-station trials	Trials took place at NRCRI-Kuru in both the 2022 and 2023 cropping seasons. Planting and field management followed recommended GAP. Nicola and Marabel were used as local checks/controls. Data were collected on growth, canopy size, height, number of leaves and stems, stem diameter, tuber number, and weight as well as its resistance to diseases including late blight and bacterial wilt.
Multi-location trials	Trials took place in both the 2022 and 2023 cropping seasons in eight locations across three states with the eight genotypes, and two local checks/controls, Nicola and Marabel. Planting and field management followed recommended GAP. Similar data were collected to those gathered in the on-station trials.
On-farm trials	Out of the original eight, six were evaluated in fifteen locations across three states. To ensure effective and objective evaluation from farmers, the trials were designed so that individual farmers got the seeds of three test genotypes and the two local checks/control varieties, Nicola and Marabel. This is to indicate the potential acceptability and adoption of test genotypes as substitutes or replacements over local varieties.
Composition analysis and sensory testing	10 kg of tubers from each genotype were subjected to additional testing. Four tubers were analyzed to understand their composition – fat, moisture, protein, fiber, and ash content – while the remaining tubers were processed into boiled tubers, French fries, and chips which were then tested by consumers in a participatory way who rated them in terms of how much they liked (or did not like) the end products.

Flow diagram 1. Steps in new potato variety release and registration process in Nigeria



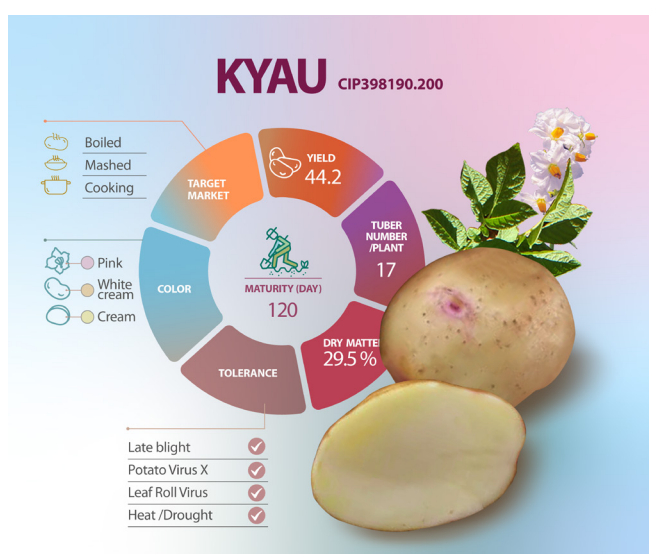
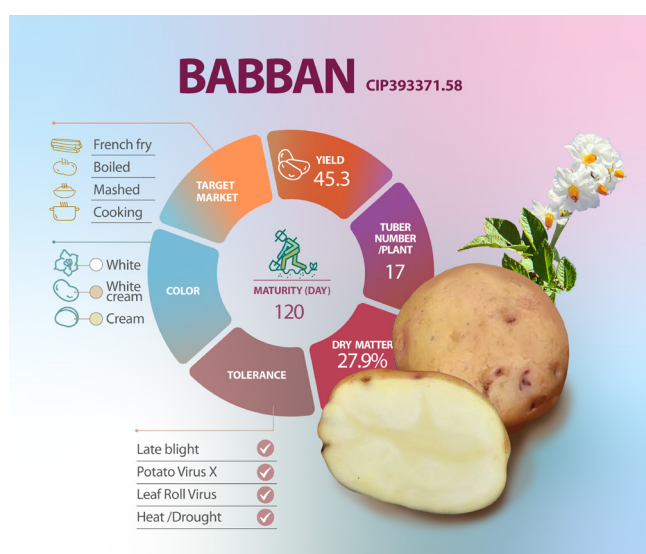
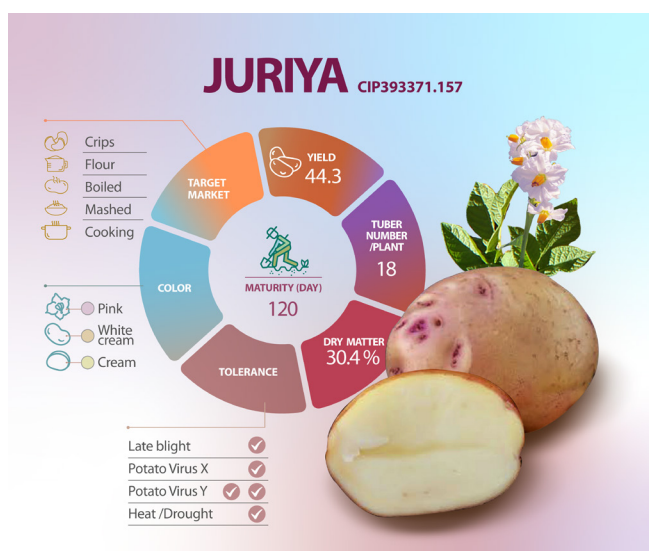
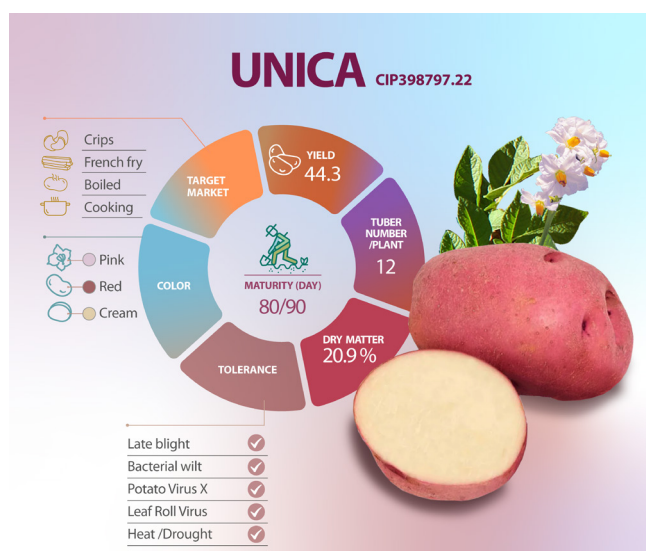
Results

Based on a series of evaluations, the project team recommended the release and registration for commercial use of six best-performing genotypes: CIP381381.13, CIP392797.22, CIP393371.157, CIP393371.58, CIP398190.200, and CIP398208.29 to the National Crop Varieties and Livestock Breeds Registration and Release Committee.

The candidate varieties surpassed the yield of local checks by more than two-fold across all locations of on-station trials and the yields were stable across all the sites and seasons. This is corroborated by comparably higher yields in both multi-location and on-farm trials. Candidate varieties also showed relatively higher levels of resistance and tolerance to most common potato diseases such as late blight, bacterial wilt, and potato viruses compared to the local checks. The proximate composition of these candidates also indicates superiority in terms of ash, fiber, protein, starch, and Vitamin C content compared to the local checks.

The candidate varieties not only have exceptional performance in terms of yield and disease resistance but also have desirable quality traits such as high dry matter content, tuber shape and size, tuber skin, and flesh color, which make them highly promising addition to the Nigerian potato industry based on their adaptability and fitness for different market segments.

Their superior yield, disease resistance, nutritional composition, and organoleptic properties made them ideal candidates for release as new potato varieties, contributing to the sustainability and growth of the potato sector in Nigeria. During the 32nd and 36th meetings of the National Committee and technical sub-committee (TSC) meeting held on 20th and 22nd June 2023, four out of the six nominated candidate varieties were recommended and approved for release and registration as varieties in Nigeria. The released varieties are **Unica** (CIP392797.22), **Juriya** (CIP393371.157), **Babban** (CIP393371.58), and **Kyau** (CIP398190.200).



Lessons

Taking a stage-gate approach to variety introduction

The stage-gate approach adopted ensures a structured and systematic evaluation of candidate varieties at different stages of the introduction process. Each stage serves as a gate, allowing only the most promising varieties to progress to the next phase. This helped in identifying and promoting varieties with a higher potential for success and impact. The approach also ensured that stakeholders, including farmers, researchers, and other experts, are actively involved in the evaluation and decision-making. This participatory approach ensures that the released varieties align with the needs and preferences of the end-users, increasing the chances of successful adoption.

Public-private partnerships

The public-private partnership between NRCRI and Fruit and Veggies Global Ltd. exemplifies the importance of collaborative efforts, stakeholder engagement, and innovative approaches in successful variety introduction,

release, and registration in Nigeria's agricultural sector. The partnership leveraged the expertise and resources of both public and private entities. NRCRI brought its research capabilities and knowledge in breeding, while Fruit and Veggies Global Ltd. contributed its experience in seed multiplication and distribution. This synergy allowed for a more comprehensive and efficient approach to variety introduction.

Locally based solutions

The successful establishment of seed multiplication units at the facilities of both NRCRI and Fruit and Veggies Global Ltd. highlights the importance of local-based solutions in variety introduction, release, and registration in Nigeria. By developing a local seed system, the partnership has significantly improved farmers' access to quality seed and increased the availability of improved varieties. This shift towards local seed production reduces the country's reliance on seed imports, promoting self-sufficiency and resilience in the agricultural sector. Moreover, the local breeding program's development enables a more agile response to



local needs, ensuring the creation of varieties that are well-adapted to Nigeria's unique conditions and market demands. This lesson underscores the significance of fostering homegrown solutions to strengthen Nigeria's agricultural sector and enhance food security for its population.

Conclusions

The registration of these newly introduced potato genotypes as varieties in Nigeria holds significant benefits for potato farmers in the country because of increased productivity. Increased availability of high-yielding and preferred potato varieties will support the development of sustainable seed

production and marketing systems in Nigeria. Increased choice of improved potato varieties that are tolerant to biotic and abiotic factors will close the yield gap and contribute to improved food security in the face of climate change. Also, the increased choice of improved potato varieties for various market segments and to meet consumer demand will expand the potato value chain portfolio thereby creating direct and indirect job opportunities. The success and lessons learned from the public-private partnerships established in this project can serve as a valuable model for future collaborations, contributing to the advancement of agricultural research and development in Nigeria.

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