FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

FEED THE FUTURE GLOBAL BIOTECH POTATO PARTNERSHIP

Annual Report

October 1, 2022 – September 30, 2023

Lead University:
Michigan State University
Agreement Number: 7200AA21CA00018

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ACRONYMS

AATF	African Agricultural Technology Foundation
BARI	Bangladesh Agricultural Research Institute
BecA	Bioscience eastern and central Africa
BRIN	National Research and Innovation Agency
CFT	Confined Field Trial
CIP	The International Potato Center
DMP	Data Management Plan
DR	Disease-resistant
FFB	Farming Future Bangladesh
FTA	Flinders Technology Associates
GFSS	Global Food Security Strategy
GM	Genetically modified
IAARD	Indonesian Agency for Agriculture Research and Development
IFPRI	International Food Policy Research Institute
ISBR	International Society for Biosafety Research
ISTRC	International Society for Tropical Root Crops
IVEGRI	Indonesia Vegetable Research Institute
KALRO	Kenya Agricultural and Livestock Research Organization
LB	Late Blight
LBR	Late Blight Resistant
ML	Multilocation
M&E	Monitoring and Evaluation
MSU	Michigan State University
MTA	Material Transfer Agreement
NARS	National Agricultural Research Systems
NBA	National Biosafety Authority
NBMA	National Biosafety Management Agency
NCB	National Committee on Biosafety
NRCRI	National Root Crops Research Institute
PCR	Polymerase Chain Reaction
PI	Principal Investigator
ROAF	Research Organization for Agriculture and Food
SOP	Standard Operating Procedures
TAB	Technical Advisory Board
T-DNA	Transfer DNA
UI	The University of Idaho
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

I. EXECUTIVE SUMMARY

The Feed the Future Global Biotech Potato Partnership is a five-year initiative implemented by Michigan State University (MSU) that focuses on the use of innovative research to promote a robust potato value chain through the commercialization of the 3 R-gene late blight resistant (LBR) potato in Bangladesh, Indonesia, Kenya, and Nigeria.

Highlights of Technical Activities and Results

In Bangladesh the first confined field trials (CFTs) for the transgenic Diamant were approved and planted at multiple locations and repeat trials have been approved for planting in year three. In Indonesia, a required workshop on community risk communication and Standard Operating Procedures (SOPs) for CFT management was completed in two regions and tuber seed of the Granola lines were shipped from the U.S. and planted in the screenhouse in Pangalengan for seed multiplication in preparation for planting the multilocation (ML) CFTs in year three. In Kenya and Nigeria, CFT's were planted and harvested, and scientists started the survey of the late blight pathogen population by collecting samples for genotyping. In Nigeria, tuber seed consisting of transgenic and non-transgenic potatoes from Kenya and the U.S. were shipped and planted in the field for testing resistance to late blight. In all four countries, the in-country partner research organizations and stakeholders selected the potato variety to be transformed for the second-generation research following key criteria (potential adoption, distinct from first-generation, etc.) through local potato and stakeholder consultations. Project-level activities included the Annual Review and Planning Meeting at MSU, the Technical Advisory Board (TAB) meeting, and the participation in the 16th International Society for Biosafety Research Symposium (ISBR). The project organized a workshop at the ISBR symposium on risk assessment for 3 R-gene late blight resistant potato with the participation of partner country biosafety regulatory authorities, project management, and NARS scientists.

Upcoming Planned Activities

In year three, project scientists from each country will continue to evaluate the candidate lead transgenic events through molecular characterization and ML-CFTs. Capacity development activities will consist of another month-long internship at BecA and the scientists will continue the transformation work on the second-generation of disease resistant (DR) potato. The project will also conduct an ex-ante socioeconomic assessment and market analysis for Bangladesh, Indonesia and Nigeria, which will include an in-country expert elicitation workshop. The regulatory dossier for the selected transgenic potato in Kenya will be finalized and submitted to the regulatory authorities in Kenya. The project will continue with the multi-discipline coordinated effort between the project team and the four in-country teams of biotech scientists, plant pathologists, and economists to conduct the research and work with regulatory and communication activities to identify the best transgenic potatoes for deregulation and distribution to potato farmers.

II. PROJECT OVERVIEW

The Feed the Future Global Biotech Potato Partnership is a five-year initiative implemented by MSU that focuses on the use of innovative research to promote a robust potato value chain through the commercialization of the 3 R-gene late blight resistant (LBR) potato in Bangladesh, Indonesia, Kenya, and Nigeria. The project consists of the following partners: The International Potato Center (CIP), The University of Minnesota (UMN), The University of Idaho (UI), The Bangladesh Agricultural Research Institute (BARI), the Indonesia Research Organization for Food and Agriculture (ROAF), The Kenya Agricultural and Livestock Research Organization (KALRO), The National Root Crops Research Institute, Umudike (NRCRI), and The African Agricultural Technology Foundation (AATF). The Global Biotech Potato Partnership project, including its robust team of experts and partners, represents a distinctive contribution to global agricultural biotechnology efforts and addresses the overarching objectives of the Global Food Security Strategy (GFSS). The LBR potato achieves inclusive and sustainable agriculture-led growth by improving the lives of smallholder farmers, both women, and men, through increased technology options, improved crop yields, reduced fungicide input costs, and reduced exposure to harmful chemicals. The project will help strengthen resilience among people and systems through improved crop management from seed to post-harvest storage.

The project's overarching goal is to contribute to sustainably reducing global hunger, malnutrition, and poverty and help Bangladesh, Indonesia, Kenya, and Nigeria accelerate their progress toward self-reliance. The project activities span across five workstreams: 1) 3 R-gene LBR potato field trials, 2) Regulatory submission for general release of the 3 R-gene LBR potato, 3) Product deployment through biotech seed system and stewardship, 4) Second-generation disease-resistant (DR) potato; and 5) Communication and advocacy. This annual report summarizes the achievements and progress towards the project's objectives and covers year two: October 1, 2022, to September 30, 2023.

Country-Specific Updates

Bangladesh

The National Committee on Biosafety (NCB) issued the permit for multilocation confined field trials (ML-CFT). CFTs were planted with two selected transgenic potatoes, DIA-MSU-UB015 and DIA-MSU-UB255, and non-genetic modified Diamant at four Bangladesh Agriculture Research Institute (BARI) research stations [redacted] in February, although this was well past the normal potato planting season of November. Due to the late planting, there was no late blight infection, and minimal performance data was collected from only two of the sites, [redacted] No significant differences in agronomic performance or phenotype between the two events and the Diamant were noted from these two sites. BARI successfully negotiated an extension of the approved ML-CFTS and obtained permission from the NCB to import additional materials from MSU to use as seeds for planting

year three. A study plan for the year three trials, including plans for the collection of regulatory data, was completed and reviewed in detail with the BARI team and trial managers from the four locations. The CFT SOPs were also reviewed.

A project scientist from BARI completed a one-month internship in the laboratories at BecA, which consisted of learning critical techniques to produce biotech potatoes. The scientist will use the skills learned to begin the transformation work on the second-generation of DR potato in the BARI labs and transfer knowledge to other peer scientists. Additionally, a consultation of potato stakeholders was held in September to select the potato variety Asterix and a BARI-developed variety for the second-generation DR potato transformation.

In year two, the BARI team experienced a personnel change when the project principal investigator (PI) from BARI was appointed as the Director of Research at BARI, and a BARI Biotech Division project scientist was named the new head of the Biotech Division and project PI. As this scientist was already a member of the project team, the transition was seamless.

The Global Resource Communication and Advocacy Lead in collaboration with Farming Future Bangladesh (FFB) facilitated a science communication workshop at BARI, aimed at increasing the awareness and understanding of biotechnology and the late blight resistant potato among BARI scientists and communications staff and developing capacity to effectively communicate externally and internally on the technology and the product. Furthermore, Bangladesh partners from BARI and FFB attended the project's annual meeting at MSU, and the ISBR Symposium in St. Louis, Missouri. FFB and BARI also collaborated to hold a stakeholder consultation to provide a public update on project process. The event was attended by key government officials as well as project personnel, and potato value chain stakeholders and key media. Additionally, late in year two, planning began for the expert elicitation workshop for the ex-ante economic analysis of late blight-resistant potato in Bangladesh.

Project and BARI management along with Bangladesh government officials spoke at the event, "Engaging Stakeholders for Development of Late Blight Resistant Biotech Potato in Bangladesh" held in Dhaka, Bangladesh.

Year three planned activities in Bangladesh include planting the CFTs in four locations, including artificial inoculation at one site [redacted] with isolates of the Bangladesh late blight pathogen, and collection of performance and regulatory data. Pathogen surveys and isolate collection will be carried out during the potato season. Continued training of BARI scientist at BecA for the second phase of training, and initial transformation of the selected potato variety Asterix with the second-generation construct in the BARI labs. An expert elicitation workshop will be held

and ex-ante economic impact assessment analysis of the release of the 3 R-gene LBR potatoes in Bangladesh will be made available for internal review.

Indonesia

The project continued to experience significant delays due to government reorganization. A subaward agreement between MSU and the new partner organization, the Research Organization for Food and Agriculture (ROAF), National Research and Innovation Agency (BRIN), was finally signed at the end of year two. A study plan for the ML-CFTs, now planned for planting in year three, was completed and reviewed in detail with ROAF/BRIN. Seed multiplication plots were planted in Pangalengan to produce seed for the CFTs.

A ROAF/BRIN scientist attended the one-month internship program at BecA, which consisted of learning critical techniques to produce biotech potatoes. The scientist will use the skills learned to begin the transformation work on the second-generation of DR potato in the ROAF/BRIN labs and transfer knowledge to other peer scientists. Additionally, a consultation of stakeholders was held to choose the variety Unica for the second-generation DR potato transformation in the labs at ROAF/BRIN. Furthermore, Indonesian partners attended the project's annual meeting at MSU, and the ISBR Symposium in St. Louis, Missouri.

The Project Deputy Director, the Global Resource Lead for Pathology, and Global Resource Lead for Communication and Advocacy visited Indonesia. During the visits meetings were held with the Indonesian team to discuss the design and implementation of ML-CFTs. Trial designs were carried out for each of the four locations: [redacted]. Risk Communication workshops were also held in Bandung and Wonosobo.

Risk Communication Workshop in Bandung, Indonesia

Year three planned activities in Indonesia include planting the ML-CFTs for performance and regulatory data collection, a risk communication workshop will be held in Malang and the ROAF/BRIN scientist will travel to BecA for the second phase of training. Additionally, the transformation of the potato variety Unica with the second-generation contract in the labs at ROAF/BRIN will commence. Pathogen surveys and isolate collection will be carried out during the potato seasons in Sumatra and North Sulawesi.

Kenya

In Kenya, biotech potatoes with complete resistance to LB disease have been evaluated in ML-CFTs in three locations for two seasons [redacted]. All legal permits from national competent authorities were granted and good stewardship practices were followed by CIP and KALRO staff. The evaluation was performed during the short rains season, October through February and the long-rains season, from March to July. The results indicate that all 3 R-gene LBR potatoes (five events) from three popular Kenyan varieties are completely resistant to LB disease and have good agronomic performance. The 3 R-gene LBR potatoes were evaluated for nutritional and anti-nutritional components. No significant differences were found between the 3 R-gene LBR potatoes and their conventional counterparts. Regulatory studies for one of the 3 R-gene LBR potatoes were reviewed by the regulatory affairs team.

Potato variety selection workshop for second generation disease resistance transformation in Kenya.

A consultation of stakeholders was held to select the variety for the second-generation transformation. The stakeholder selected three potato varieties: Wanjiku, Unica and Sherekea. Transformation of the first one has now started. Additionally, an ex-ante economic impact analysis of the 3 R-gene LBR potatoes was conducted. The analysis included a potato expert elicitation workshop and analysis of the data collected to assess the economic benefits of the release of the 3 R-gene LBR potato. The most important result indicates that the highest economic benefit is expected from the 3 R-gene LBR potato from the popular variety Shangi.

A project scientist from KARLO completed a one-month internship at BecA, which consisted of learning critical techniques to produce biotech potatoes. The scientist will use the skills learned to begin the transformation work on the second-generation of DR potato in the KALRO labs and transfer knowledge to other peer scientists. Finally, several blogs, media interviews by project scientists, attendance of scientific conferences and a publication in peer reviewed journal were conducted to promote the benefits and safety of the 3 R-gene LBR potato in the country.

Year 3 planned activities in Kenya include the identification of the best transgenic event, the completion of regulatory study reports, and writing and submission of the regulatory dossier to the National Biosafety Authority (NBA). Seed bulking the selected transgenic potato will begin at KALRO screenhouse facilities. The ex-ante impact assessment of cultivation of the 3 R-gene LBR biotech potato in Kenya will be published and the main findings used in project communication and advocacy efforts. The KALRO scientist trained in year two at BecA will

transform the variety Wanjiku with the second-generation DR gene construct at the KALRO biotech facility. The KALRO scientist will also continue with the second phase of training at BecA.

Nigeria

Biotech potatoes with complete resistance to LB disease (3 R-gene LBR potato) were harvested from one CFT in NRCRI's [redacted] station. Tubers were planted to produce seeds for the next season. All legal permits from national competent authorities were granted and good stewardship practices were followed by NRCRI staff. Two additional CFT locations [redacted] were selected, inspected, and authorized by the national competent authority. The CFTs were then planted at each of the three locations. Complete resistance to LB disease was observed for the 3 R-gene LBR potato while the conventional varieties were heavily damaged. A total of eight 3 R-gene LBR potatoes were tested and evaluated against their conventional counterpart. No significant differences in emergence, growth, and vigor have been observed. The performance of the 3 R-gene LBR potatoes was witnessed by local stakeholders including farmers during field days. In order to develop the next generation of DR potatoes, a genetic engineering lab including tissue culture rooms have been constructed by NRCRI and a research scientist completed a one-month internship at BecA, which consisted of learning critical techniques to produce biotech potatoes. The scientist will use the skills learned to begin the transformation work on the second-generation of DR potato in the NRCRI labs and transfer knowledge to other peer scientists. Furthermore, academic training of three research scientists continued during year 2. Finally, the results of the field performance of the 3 R-gene LBR potatoes were shared in blogs and international scientific conferences.

CFT in Kuru station, Nigeria

Year three planned activities in Nigeria include planting the first ML-CFTs and collecting data on LB disease and agronomic performance. An ex-ante impact assessment study will be conducted using the same methodologies as in Kenya and Bangladesh. A preliminary report will be available towards the end of year three. The NRCRI scientist trained in year two will travel to BecA for the second of phase of training. NRCRI scientists will transform the variety Unica with the second-generation DR gene construct at their new biotech facility. The results of the first ML-CFTs will be used to advocate the 3 R-gene LBR potato as a sustainable solution to control the

devastating effects of LB on potato production in Nigeria. Seed bulking of a select transgenic potato (Diamant) is being planned.

III. TECHNICAL REPORT

3.1. Workstream 1: 3 R-gene LBR Potato Field Trials

The objective of this workstream is to demonstrate the commercial potential of the 3-R gene LBR potato, build technical capacity for late blight resistant potato field trials, and build regulatory capacity for biotech crop field trials. Activities for year two are outlined in the sections below.

Green Field Day in [redacted] Nigeria

3.1.1. Major Activities and Achievements

- Year two MSU NFT production took place and molecular identity checks were completed. Plantlets were transferred to the NFT greenhouse and planted in MSU fields with an anticipated harvest date in early year three.
- 600 NFT of Granola and Diamant tubers were shipped to Indonesia.
- Material Transfer Agreements (MTAs) completed between MSU and CIP-Kenya to obtain tissue culture of the lead CIP-Kenya generation one events. Importation permits were completed, and the events were shipped. Five Solanum accessions are at the USDA APHIS Plant Germplasm Quarantine Program. After preliminary testing is completed, USDA will ship the tissue culture to MSU in 2024. The events will be maintained in MSU regulated tissue culture until fully released and NFT-certified seed production can begin.
- MSU Technologies is in the process of drafting a term sheet for commercialization licensing of the DIA_MSU_UB015, DIA_MSU_UB255, GRA_MSU_UG234 and GRA_UG265 events.
- Maintenance of plants in vitro in the labs at MSU, BARI, and ROAF/BRIN continued.

Bangladesh

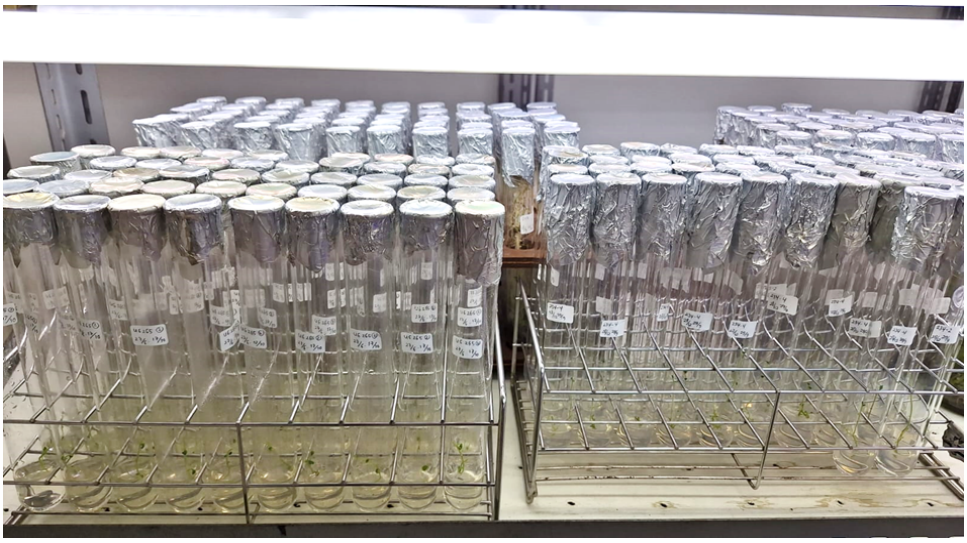
- Field trials were planted in February (after the potato season) when the permit was obtained from the NCB. Four locations were planted with two Diamant events and non-

GM Diamant. Due to the late planting, only trials at two locations, [redacted] produced minimal results at harvest.

- Permission was obtained by BARI to extend the existing ML-CFT permit for planting in year three and for import of minitubers from MSU.
- An import permit was obtained for NFT minitubers to be shipped from MSU to BARI for planting in the CFTs.
- Tissue culture plants of the two events and non-GM Diamant were maintained in the labs at BARI and MSU.
- Deputy Director/Regulatory Lead traveled to Bangladesh to visit two of the planted trial sites, [redacted] and to complete the CFT study plan, including plans for regulatory data collection, and reviewed the study plan and CFT SOPs with the BARI team and trial managers.

Indonesia

- Tissue culture plants of three granola events and non-GM granola were shipped from MSU.
- NFT minitubers of three granola events and non-GM Granola were shipped from MSU.



Tissue culture propagation at ROAF/BRIN in Indonesia.

- Tubers from the seed multiplication trial at IVEGRI were planted in a screenhouse at the Potato Seed Institute (PSI) [redacted]
- Risk communication and biosafety SOP workshops for the CFTs were conducted by the team in Bandung and Wonosobo.
- Deputy Director/Regulatory Lead and the Global Resource Lead for Pathology traveled to Indonesia to review the CFT study plan for all four locations with the project team,

including plans for regulatory and late blight data collection, and reviewed biosafety SOPs and forms.

Risk Communication and Biosafety SOP workshop in Indonesia.

Kenya

- During the short-rains season, regular visits to collect data were made to on-going trials [redacted].
- Potted plants were maintained at KALRO Kabete and BecA for tuber seed production for the next ML-CFT (long-rains season).
- Harvest of ML-CFT-1 was conducted at all three locations in Kenya by CIP and KALRO staff and seed was selected for the next season's planting.
- Molecular characterization of the transgenic events from Jalene was pursued by sequencing the T-DNA insertion sites for nine transgenic events -by Samplix and PCR verification. This resulted in the identification of one candidate lead transgenic event and two backups.
- Dosage of NPTII protein in tubers was performed from the selected transgenic events Vic.172, Vic.185, and Sha.105.
- An easy-to-use molecular diagnostics tool on-field samples was tested for several 3 R-gene LBR potato transgenic events (PCR and lateral Flow-event-specific assays).
- A project meeting with KALRO and CIP staff was organized for technical update and for discussing the ML-CFT (lessons learned, improvements, and data discussion).
- Seed tubers were planted for the next trials in year three in the BecA greenhouse.
- Harvest of ML-CFT-2 was conducted at all three locations in Kenya by CIP and KALRO staff after the long-rains season and seed tubers were selected for next season planting.
- *P. infestans* infected leaf samples were collected from potato growing areas during the two seasons on Flinders Technology Associates (FTA) cards and shipped to UI for pathogen diversity studies. Live cultures isolated from infected leaves at BecA for fungicide sensitivity tests.

- Pathogen surveys were completed successfully in Kenya and results were analyzed and presented at an international meeting.

Nigeria

- Biosafety permits were obtained for the two additional locations in Nigeria from NBMA and USAID.
- Plans and approvals were developed and obtained to implement a genetic engineering facility including tissue culture rooms at [redacted]
- Mini tubers from BecA were shipped to Nigeria to complete seeds produced locally for ML-CFT-1.
- Three locations with eight transgenic events, their five conventional counterparts, and two local varieties were planted during the single rainy season.
- LB and agronomic data were collected by NRCRI staff at the three locations in Nigeria while CIP staff monitored the quality and accuracy of the data collected.
- Limited *P. infestans* infected leaf samples were collected from potato growing areas on FTA cards and shipped to University of Idaho (UI) for pathogen diversity studies.

3.1.2. Implementation Challenges

Bangladesh

- In Bangladesh pathogen surveys were not carried out due to delays in signing the subaward agreement.

Indonesia

- A major implementation challenge for the project in Indonesia has been presented by the unexpected reorganization of the government which took effect in August 2022. The reorganization necessitates dissolution of the existing subaward agreement with the Indonesian Agency for Agriculture Research and Development (IAARD) and the execution of a new subaward agreement for the project with ROAF/BRIN.
- Unable to carry out pathogen surveys to collect isolates of *P. infestans* from the main growing regions in Sumatra and Sulawesi as indicated in workstream one, due to delays in signing of the subaward agreement.

Kenya

- Trial data was not collected properly for LB disease at the three locations and the disease pressure was not strong in one location in ML-CFT-1. Thus, the LB data was incomplete, necessitated the repetition of the trials in order to fill the gaps in the data. This was completed during ML-CFT-2.

Nigeria

- LB pathogen surveys were only of limited success as only 20 FTA cards were collected in Nigeria from around the area of Jos, instead of from the three main potato growing regions as planned. A new batch was finally sent towards the end of year two.

3.1.3. Expected Activities for the Upcoming Year

Bangladesh

- ML-CFTs will be established in Bangladesh with planting occurring in November.
- Plant the ML-CFTs for evaluation of performance and collection of regulatory data.
- Seed tubers of the two 3 R-gene LBR Diamant events multiplied in the greenhouses at the Biotechnology Division in BARI will be harvested and seed from the NFT production system at MSU will be imported for planting in the ML-CFT trials.
- Pathogen isolates will be collected on FTA cards from the potato growing regions during the potato growing season and sent to the UI potato pathology lab for genotyping.

Indonesia

- ML-CFTs will be established in Indonesia, with planting occurring in March 2024.
- CFTs will be conducted in four locations to evaluate performance and collect regulatory data.
- Pathogen isolates will be collected from Sumatra and North Sulawesi and genotyped in the potato pathology laboratory at UI.

Kenya

- ML-CFTs in Kenya will be planted and identification of the best transgenic event based on data.
- Completion of regulatory study reports, writing and submission of the regulatory dossier to the national biosafety authority.
- Seed bulking of the selected transgenic event at KALRO screenhouse facilities.
- Transformation of the variety Wanjiku with the second-generation DR gene construct at the KALRO facilities.

Harvest at KALRO-Njabini after the main rainy season

Nigeria

- ML-CFTs harvest for first season and planting for second season in Nigeria
- Transformation of the variety Unica with the second-generation DR gene construct at the NRCRI facilities.

3.2. Workstream 2: Regulatory Submission for General Release of the 3 R-gene LBR Potato

The objective of this workstream is to prepare and submit a regulatory dossier, obtain approval from the regulatory authorities, and build regulatory capacity for general release of biotech crops. Activities for year two are outlined in the sections below.

3.2.1. Major Activities and Achievements

- Onboarding of a regulatory consultant/expert to assist with regulatory submission planning, reporting, and capacity building. Review of most of the regulatory studies for one event to provide guidance for the next sets of regulatory study reports.

Bangladesh and Indonesia

- Discussed plans for molecular and protein characterization with the regulatory affairs team.
- Continued molecular characterization for the lead events in each country.
- Established plans for regulatory data collection from field trials including agronomic and phenotypic characterization and nutritional composition analysis.
- Two project team members and one invited member of regulatory authority from each country attended the ISBR Symposium and a workshop on risk assessment of 3 R-gene LBR potato for project planning, networking, and capacity building.

Kenya

- Monitor project activity development through biweekly meetings and finalize SOPs using KALRO format.
- Discussions on SOP7 on disposition of harvested tubers based on peeling tubers and burying them in the pit within the CFT. A boiling step was added to SOP7. The simplified version (burying under 3 feet of soil without peeling) was approved by NBA.
- Discussions on the general structure of the dossier, Kenyan application form, and review of completed regulatory studies of Vic.172 by the regulatory affairs team.
- Discussion on molecular characterization of Vic.172 and events from Diamant (methods and results) with the regulatory affairs team.
- Regulatory lead conducted a visit to go over SOPs in Kenya; review of all SOP and provide feedback for improvement of SOP forms recording and archiving.

Nigeria

- Monitor project activity development through biweekly meetings and finalize SOP using NRCRI format.

3.2.2. Implementation Challenges

Bangladesh, Indonesia, Kenya, Nigeria

- There is a significant amount of work and specialized skills and experience involved in collecting the described molecular characterization data for the events. This capacity is not easily transferred to the research partners in-country. However, every effort is being made by the project to use methods that will be either trainable to in-country scientists or methods that can be completed by an accessible affordable service.

3.2.3. Expected Activities for the Upcoming Year

- Continue molecular characterization and conduct protein characterization studies in the labs at MSU and CIP.
- Prepare regulatory reports for regulatory submissions.
- Hold regulatory submission planning meeting/workshops with in-country partners.
- Complete and review all regulatory studies on the best transgenic event and prepare the dossier for regulatory submission in Kenya.

3.3. Workstream 3: Product Deployment Through Biotech Seed System and Stewardship

The objective of workstream 3 is to design and implement a plan for production and distribution of the 3 R-gene LBR potato to farmers. Activities for year two are outlined in the sections below.

3.3.1. Major Activities and Achievements

Bangladesh

- Collection of primary data and initial planning for the potato expert elicitation workshop to be held in Dhaka in year three.

Indonesia

- No activities

Kenya

- Individual training of agricultural economists (CIP and KALRO) on methods for ex-ante socio-economic impact assessment. The training was facilitated by an International Food Policy Research Institute (IFPRI) agricultural economist expert.
- Expert elicitation workshop coordinated by the Socioeconomic and Market Analysis Global Resource Lead, with 20 attendees from the potato value chain in Kenya and CIP staff.
- Development of a subaward agreement to support participation of IFPRI's agricultural economist expert to workstream 3 on methods for ex-ante socio-economic impact assessment.

Potato Expert Elicitation Workshop, Kenya

- Meeting with the project team to review the results of the Kenyan study and develop an activity plan for the upcoming year.
- Conduct ex-ante socio-economic assessment and market analysis for 3 R-gene LBR potato based on literature and secondary data collection.

Nigeria

- No activities.

3.3.2. Implementation Challenges

- Activities were postponed to year 3 due to leave of absence (maternity leave).

3.3.3. Expected Activities for the Upcoming Year

- Publish the Kenya ex-ante socio-economic assessment and market analysis for 3 R-gene LBR potato study.
- Host the potato expert elicitation workshop in Bangladesh and Nigeria.
- The ex-ante socio-economic assessment and market analysis for 3 R-gene LBR analyses for Bangladesh and Nigeria will be drafted and finalized.

3.4. Workstream 4: Second Generation of Disease Resistant (DR) Potato

The objective of workstream 4 is to build the capacity of local scientists for the early development of DR biotech potatoes and contribute to the product pipeline that will result in a second-generation DR biotech potato. This report describes the development of agrobacterium strains carrying DR constructs that will be shared with the project's NARS scientists for the development of second-generation DR potatoes. Activities for year two are outlined in the sections below.

3.4.1. Major Activities and Achievements

Bangladesh

- One-month training at BecA for BARI project scientist. Training included tissue culture, agrobacterium strain characterization, agrobacterium-mediated transformation, and management of genetic stocks using barcode system.
- One week course on gene construct and potato transformation was conducted at BecA.
- Potato stakeholder consultation in each country to select the recipient potato variety for the second-generation biotech potato with resistance to multiple diseases.
- Back-up transformation of selected potato varieties with second generation construct at MSU.
- Preparation of Material Transfer Agreement between MSU with BARI and ROAF/BRIN to transfer second-generation construct to labs for transformation.

Indonesia

- One-month training at BecA for ROAF/BRIN project scientist. Training included tissue culture, agrobacterium strain characterization, agrobacterium-mediated transformation, and management of genetic stocks using barcode system.
- One week course on gene construct and potato transformation was conducted at BecA.
- Potato stakeholder consultation in each country to select the recipient potato variety for the second-generation biotech potato with resistance to multiple diseases.
- Back-up transformation of selected potato varieties with second generation construct at MSU.
- Preparation of Material Transfer Agreement between MSU with BARI and ROAF/BRIN to transfer second-generation construct to labs for transformation.

Kenya

- One-month training at BecA for KALRO project scientist. Training included tissue culture, agrobacterium strain characterization, agrobacterium-mediated transformation, and management of genetic stocks using barcode system.

- One week course on gene construct assembly and potato transformation was conducted at BecA with online participation of Kenyan scientist.
- Agrobacterium strains received from MSU were tested by Polymerase Chain Reaction (PCR) to confirm their integrity.
- Plant materials from the variety Unica (chosen by NRCRI for second-generation products) multiplied and transformed (600 explants) with the second-generation DR gene construct.
- Transplant regenerants from the first batch of agro-infected explants (600) from the variety Unica and putative transgenic events tested on km media and NPTII strips.

Pictured from left to right, CIP Regional Director of Africa, Scientist from BARI Bangladesh, Scientist from ROAF/BRIN Indonesia and the Product Development and Technical Support Global Resource Lead, CIP Kenya.

- Potato stakeholder workshop held and selected Wanjiku as the recipient potato variety for the second-generation biotech potato with resistance to multiple diseases. Acquisition and multiplication of the Wanjiku variety at CIP and KALRO to bulk up for agrobacterium transformation with second-generation gene construct.

Nigeria

- One-month training at BecA for NRCRI project scientist. Training included tissue culture, agrobacterium strain characterization, agrobacterium-mediated transformation, and management of genetic stocks using barcode system.
- One week course on gene construct assembly and potato transformation was conducted at BecA with online participation of Nigerian scientist.
- Potato stakeholder workshop to select the recipient potato variety for the second-generation biotech potato with resistance to multiple diseases. Unica variety was chosen because of it yield performance.

3.4.2. Implementation Challenges

- The one-month time of training was not enough to cover the content. There is a need to strengthen the online technical backstopping by MSU and CIP.

3.4.3. Expected Activities for the Upcoming Year

- MTAs will be fully executed with the NARS partner research organizations, so that the second-generation DR transformation agrobacterium and gene construct can be sent to the individual countries.

- Project NARS scientists will receive hands-on in-person training at BecA.
- Project NARS scientists will conduct genetic transformation of their selected variety with the second-generation DR gene construct.
- MSU and CIP will conduct back-up transformations with selected varieties using the second-generation DR constructs, conduct preliminary molecular characterizations and begin gene function analysis.

3.5. Workstream 5: Communication and Advocacy

Workstream 5 aims to advance the knowledge of biotechnology and the benefits of Biotech LBR potato to potato value chain stakeholders to generate support and acceptance of the product along the entire value chain in the four countries where we work; and to effectively communicate benefits of biotechnology, biotech potato and the project to potato value chain stakeholders globally to gain additional support for the technology. Activities for year two are outlined in the sections below.

3.5.1. Major Activities and Achievements

Project level:

- Website maintained and regularly updated to provide current information and be a resource for biotechnology advocacy. (https://www.canr.msu.edu/biotechpp).
- Social media accounts on Facebook and X (formerly Twitter) maintained with monthly post campaigns. X impact included a 26% increase in followers and total gross impressions of over 42,000. This year was the first for the project Facebook account, which is slowly gaining followers, especially in Bangladesh where the platform in popular.
- Quarterly newsletters were published in year two. The newsletter which is delivered through an electronic platform enjoyed an average 59% open rate.
- Participation of project personnel in numerous global workshops, conferences, and events including feature in episode of the podcast, "Talking Biotech" and World Potato Congress webinar on late blight resistant potato in Africa.

Science Communication Workshop, Bangladesh

Bangladesh

- The project participated in the first Bangladesh Biotech Olympiad organized by Jahangirnagar University. The 986 high school and college students participated in the event focused on building interest and awareness of the benefits of biotechnology.
- Science communication workshop held for BARI scientists.
- The project supported three segments of a Dhaka TV talk show on Deepto Krishi Songlap TV. Two of the segments featured the potato sector in Bangladesh and the third featured the project's Director and Global Resource Lead for Communications and Advocacy as in-studio guests.
- Bangladesh is often featured in the project's overall social media campaign, website, and quarterly newsletters.

Indonesia

- Risk communication workshops were held in Bandung and Wonosobo.
- Indonesia is often featured in the project's overall social media campaign, website, and quarterly newsletters.

Kenya

- AATF begin communications and advocacy activity the second half on year two, six months before originally slated to begin work. This was due in part to the successful CFT results in Kenya and the opportunity to promote the positive results.
- Project personnel participated in several TV and radio interviews promoting the LBR potato and advocating for biotechnology.
- Engaged with social advocacy blogger who posted 11 blogs on GM technology.
- Finalized agreement with a high school science program to promote biotechnology and the LBR potato to begin in project year three.
- Project members from Kenya attended the International Society for Tropical Root Crops (ISTRC) conference in Nairobi and presented on project activities.

Nigeria

- AATF begin communications and advocacy activity the second half on year two, six months before originally slated to begin work. This was due in part to the successful CFT results in Nigeria and the opportunity to promote the positive results.
- Project members from Nigeria attended the ISTRC conference in Nairobi and presented on project activities.
- Green and brown field day events were held to share results of the first CFT in Kuru.
- Nigeria is often featured in the project's overall social media campaign, website, and quarterly newsletters.

3.5.2. Implementation Challenges

Bangladesh

- The delayed subaward agreement with BARI delayed outreach activities however we were able to complete these in year two.

Indonesia

- Specific activities were delayed because of the delayed subaward agreement due to reorganization of government research agencies.

Kenya

- Amendment required for KALRO to include high school advocacy and communication project delayed activity to year three due to the length of time it took to process the amendment.

Nigeria

- Security concerns limited ability for Global Lead for Communications and Advocacy to travel to Nigeria which hampers relationship building for communications and advocacy work.

3.5.3. Expected Activities for the Upcoming Year

Project level

- Continue with digital strategy (social media, website, quarterly newsletter).
- Write and submit articles and news features as the project progresses.
- Manage in-country communications and advocacy groups working with the project.
- Produce educational animation on the benefits of the LBR potato and biotechnology.

Bangladesh

- Photo and video journals of Bangladesh farmers and CFTs.
- Write and submit articles and news features as the project progress.

Indonesia

- Risk communication workshop [redacted].
- Write and submit articles and news features as the project progress.

Kenya

- Coordinate AATF activities including communications strategy planning event in Nairobi.
- Write and submit articles and news features as the project progress.
- Photo and video journals of Kenyan farmers and CFTs.
- Implement high school program.

- Engage with advocacy blogger for targeted blogs.

Nigeria

- Coordinate AATF activities including communications strategy planning event in Nairobi.
- Write and submit articles and news features as the project progress.

3.6. Project Management

In year two, the program operations of the Global Biotech Potato Partnership focused on delivering the technical deliverables and a suite of activities, achieving several milestones listed below.

3.6.1. Major Activities and Achievements

- Subaward agreements with all partners are fully executed.
- Annual Review and Planning Meeting held at MSU.
- Project management and in-country personnel participated at ISBR in St. Louis, Missouri including a panel specifically on the project.
- Training of country partners on monitoring, evaluation, and learning.

3.6.2. Implementation Challenges

- Some project activities were delayed due to the processing of the subawards in Bangladesh and Indonesia.

3.6.3. Expected Activities for the Upcoming Year

- Organize and hold TAB meetings.
- Continue meetings with USAID.
- Continue the management and NARS monthly planning meetings.
- Submit the technical and administrative project deliverables (reports, workplans, etc.)
- Maintain project technical and administrative operations.

IV. DATA MANAGEMENT UPDATE

The Data Management Plan (DMP), grounded in the project's Theory of Change, was approved in March 2022 and is integrated into the project's M&E plan. All data, analytical methods, and findings generated by the project are packaged and stored in the partner institutions' database and in the Global Biotech Potato Partnership Teams Folders. Cleaned and completed data will be shared and made available to the wider scientific and development community within USAID's Development Data Policy. The project will continue to adjust its DMP to adapt data collection or analysis to emerging needs.

V. LIST OF PUBLICATIONS AND PRESENTATIONS

5.1. Publications

Magembe EM, Li H, Taheri A, Zhou S and Ghislain M (2023) Identification of T-DNA structure and insertion site in transgenic crops using targeted capture sequencing, Front. Plant Sci. 14:11, 56665, https://doi:10.3389/fpls.2023.1156665

Phillip S. Wharton, Sandesh Dangi, Most M. Begum, David Douches, Karen E. Hokanson (2023). Genotypic characterization of Phytophthora *infestans* populations in Bangladesh, Plant Pathology, 72:6, 1136-1148, https://doi.org/10.1111/ppa.13725

5.2. Presentations

David Douches (2023). Feed the Future Global Biotech Potato Partnership: 2021-2026 UPDATE: Year One. Presented at:

- Potato Expo 2023
- 2023 UW Extension and Wisconsin Potato and Vegetable Growers Association (WPVGA) Grower Education Conference
- MSU Undergraduate Biotechnololgy class
- UW-Wisconsin Undergraduate Biotechnology class
- Podcast Biotech Potatoes and Food Security - Dr. David Douches, Talking Biotech with Dr. Kevin Folta

Dominic Mogere, Catherine Taracha, Bramwel Wanjala, Li Hui, Zhou Suping, and Eric Magembe. (2023). Development of On-Field Event-Specific PCR Detection Method for Late Blight Resistant Biotech Potatoes. Presented at the 19th International Triennial Symposium of the International Society for Tropical Root Crops (ISTRC), Safari Park Hotel, Nairobi, Kenya.

Janet Fierro. (2023). Feed the Future Global Biotech Potato Partnership Project Overview. Presented at the Feed the Future Global Biotech Potato Partnership Risk Communication Workshop on Biotech Crops Bandung, Indonesia.

Janet Fierro. (2023). Feed the Future Global Biotech Potato Partnership Project Communications and Way Forward. Presented at Feed the Future Global Biotech Potato Partnership Science Communication Training.

Kelly Zarka and project team. (2023). Feed the Future Global Biotech Potato Partnership: 2021-2026. Poster presented at the Society of Invitro Biology Plant and Animal Biotechnology and Genomics Meeting, Norfolk, VA. USA.

Phillip S Wharton, Ineu Sulastrini, Kusmana, A. Dinar Ambarwati, Tri-Joko Santoso, David Douches and Karen Hokanson. (2023). Efficacy of 3 R-gene late blight resistant potato cultivars in preventing infection by Phytophthora infestans in confined field trials in Indonesia. Poster presented at the International Society for Biosafety Research Symposium, St. Louis, Missouri https://cropalerts.org/wp-content/uploads/sites/2/2023/04/ISBR_2023_USAID_CFT-poster.pdf.

Phillip S. Wharton, Katie L. Malek, Alan L. Malek, E. Magembe, J. Odingo, M. Nyongesa, M. Mbiyu, M. Ghislain, K. Hokanson and D. Douches. (2023). Phenotypic and Genotypic characterization of *Phytophthora infestans* isolates from Kenya. International Congress on Plant Pathology, August 20 – 25, Lyon, France.

Marc Ghislain, Eric Magembe. (2023). Deployment of late blight resistant biotech potatoes in Africa. World Potato Congress (WPC) webinar.

Charles Amadi, Shuaibu Kahya, Emmanuel Nnadi, Eric Magembe, Marc Ghislain and David Douches. (2022). Evaluation of Biotech Potato Resistant to Late Blight in Nigeria. Presented at the 19th International Triennial Symposium of the International Society for Tropical Root Crops (ISTRC), Safari Park Hotel, Nairobi, Kenya.

VI. SUCCESS STORY

National conference provides platform to bring biotech regulators together to build collaboration and understanding of late blight disease resistant potato

The International Society for Biosafety Research (ISBR) held their 2023 Symposium recently in St. Louis, Missouri. The event brought together world leaders in cutting-edge biosafety research, technology development, risk analysis, regulation, policy and communications.

The Feed the Future Global Biotech Potato Partnership was excited to participate with a workshop titled, "Safety Assessment of Potato with 3R-Genes for Late Blight Resistance: A Global Perspective." In addition to a project overview, the workshop featured experiences and discussions on the project's biosafety issues in its work to bring a 3R-gene late blight resistant (LBR) potato to Africa and South Asia. The LBR potato was developed using genetic modification.

Potato is the third most important food crop worldwide. Late blight is still the most prominent, ubiquitous, and devastating disease of potato since its outbreak in the 1840's provoked the Irish famine. Genetic engineering using 3R-genes from wild relatives provides durable resistance for existing popular varieties greatly reducing the average 15-30% production loss while cutting the need for fungicides by up to 90%. The 3R-gene late blight resistant potato offers a solution for controlling the disease with significant economic benefit and less risk to human health and the environment.

The Feed the Future Global Biotech Potato Partnership aims to contribute to a sustainable reduction of late blight disease, while helping emerging economies in Asia and Sub-Saharan Africa accelerate their progress towards self-reliance through local leadership and local ownership of product development objectives and implementation.

Unique to the session were presentations by regulatory experts representing each of the four project countries (Bangladesh, Indonesia, Kenya and Nigeria) in which the potato is poised for commercialization. The regulators spoke on their in-country regulatory systems and approach to safety assessments for genetically modified crops.

The Global Biotech Potato Partnership worked to bring the regulators together as an opportunity for collaboration for the not only the project, but also for each other.

"Biotech regulations vastly differ from country to country. Especially in developing worlds where the technology is new," explains project director, Dr. [redacted] from Michigan State University, the lead organization in the partnership. "Having all the regulators in the same room really provided an opportunity for them to learn from each other, as well as provide us with their focused attention on our project. To have this one-on-one time to answer questions and interact is invaluable."

The workshop was designed and organized by the Global Biotech Potato Partnership Global Lead for Regulatory Affairs. Many project personnel attended the event including management from Michigan State University, University of Minnesota, and the University of Idaho in the U.S., the International Potato Center (CIP) Kenya, project personnel from the Kenya Agricultural and Livestock Research Organization (KALRO), the Bangladesh Agricultural Research Institute (BARI), and the National Research and Innovation Agency (BRIN) in Indonesia.

Dr. [redacted], CEO, Kenya National Biosafety Authority, explains the biosafety system in Kenya.

Global Biotech Potato Partnership project personnel pose with biosafety regulators during the ISBR workshop.