RESEARCH PROGRAM ON Roots, Tubers and Bananas

CGIAR

Cluster annual report - 2018

CC2.1– Improving RTB Planting Material and Access to New Varieties

Farmer showing sweetpotato planting material from in a traditional cropping system, Southern Nations, Nationalities and Peoples Region (SNNPR), Ethiopia. Credits B Temesgen. https://goo.gl/29xydV

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CIP International Potato Center, A CGIAR Research Center
Bioversity International
CIAT Centro Internacional de Agricultura Tropical, International Center for Tropical Agriculture
cirad Agricultural Research for Development
IITA Research to Nourish Africa

MAIN ACHIEVEMENTS

We consolidated the cross-crop and knowledge sharing perspective of our cluster by publishing two research articles, both based on 13 case studies conducted in previous years (here), which include our five mandate crops. One paper (here) used one of the tools previously developed by our cluster (*multi-stakeholder framework for intervening in RTB seed systems*, here) to analyze the case studies, focusing on the identification of coordination breakdowns when actors fail to develop a shared understanding and vision. The second paper (here, published in January 2019) provided a theoretical analysis showing the importance of understanding the economic sustainability of decentralized seed multiplication models, especially farmers' effective demand for seed and how this affects the supply of quality seed from specialized producers. These papers provided the academic endorsement needed to (1) disseminate more aggressively the framework, and (2) make our RTB seed community more visible in the wider scientific arena.

Regarding the Toolbox for RTB Seed Systems —a collection of tools which address the biophysical and socio-economic aspects of roots, tubers and bananas seed systems which can be used to improve the design, implementation and evaluation of new or on-going intervention— one of the tools, the *multi-stakeholder framework,* was institutionalized by CIP, i.e., all projects aimed at improving potato and sweetpotato seed systems are applying the framework to diagnose bottlenecks and design the interventions. Interventions using the framework include one in Ecuador (here), one India, and one in Bangladesh.

OUTCOME CASES AND POLICY INFLUENCED

Revise and complete the suggested list of outcome cases and policies to be documented

Title of Outcome/ Impact Case Report (OICR) (30 words)	Description (up to 80 words)	Geographic scope
Plan for improving seed potato production in Georgia based on approaches developed by RTB	CIP is implementing the project "Enhancing Rural Livelihoods in Georgia: Introducing Integrated Seed Health (ISH) Approaches to Local Potato Seed Systems, here". The project was designed based on the ISH approach developed by RTB (here). Implementation has been successful and, as result, the Ministry of Agriculture requested CIP to design a plan based on the same approach, but this time at a national scale. This outcome is being documented using bonus funds we received at the end of 2018 (report will be available on late March 2019).	Republic of Georgia
Seed Tracker™: A digital innovation for seed value chain integration for enhancing quality seed production and market access	The Seed Tracker is a comprehensive WebApp for seed value chain integration and management. The Seed Tracker has been piloted for cassava seed systems in Nigeria (www.seedtracker.org/cassava). It is supporting seed production planning, seed traceability (from production to end-use over generations and seasons), seed inventory, seed certification, marketing, etc. Now is being customized in Tanzania and Brazil for cassava seed systems, and for yam seed systems in Nigeria and Ghana.	Nigeria, Ghana, Tanzania, Brazil

Name and description of policies modified in design or implementation, informed by CGIAR research (20-50 words, ideally around 30 words)	Type (policies/ strategies / laws/ regulations/ budgets/ investments/ curricula)	Whose policy is this? The primary organization(s) either designing/promulgating the policy, law, investment (e.g. national government) etc. and/or within which it is operating.	Geographic scope
Regulation for Seed Potato Production. It includes a new seed category (Declared Seed) which is derived from the quality declared seed approach supported by CIP.	Regulation	National Seed Authority under the Ministry of Agriculture	Peru
TOSCI[a] 5-Year Action Plan for Cassava Seed Certification in Tanzania. This will ensure that cassava seed certification is being routinely and sustainably undertaken by 2022.	Plan	TOSCI under the Ministry of Agriculture	Tanzania
Limited Generation Seed Certification Program for Cassava. This includes the semi-autotrophic hydroponics (SAH) propagation method that is expected to boost commercial seed production.	Proposal for new regulation	National Agricultural Seeds Council	Nigeria

[a]TOSCI: Tanzania Official Seed Certification Institute

MAIN ACHIEVEMENTS WITH GENDER RELEVANCE

Kilwinger et al. (2018 deliverable 10239) reported a study on banana seed systems in Central Uganda. They found that agricultural innovations are not stand-alone technical changes which farmers perceive as means to increase their yield and income. For example, in one of the districts (Mukono) elderly and women tended to rather fill up gaps instead of uprooting low productive mats to replace them with a new sucker, a practice that is commonly recommended by projects. Their motivation was that uprooting and replacing a banana mat requires a lot of time and physical strength. In contrast, in other district (Mbarara) all farmers, including elderly and women, said they uprooted and replaced diseased mats. They concluded that agricultural innovations are intertwined with a social network which need to be understood to make the innovations successful. Mulugo and Kikulwe (2018 deliverable 12464) arrived at similar conclusions working in the same area. Interestingly, they mention that tissue culture planting materials are widely believed by farmers to be genetically modified, a perception that hinders their use in cultural functions and rituals, pointing to the need for a robust awareness campaign about the entire process and procedures for tissue culture micro propagation. At a higher scale, Girard (2018 deliverable 13439) reported on a study to mainstream gender in potato seed systems in Georgia. She analyzed how gender is being considered when stakeholders refer to seed quality, seed access and seed availability, with a special reference to the plan for improving seed potato production in Georgia (deliverable 15705). She also provided a set of recommendations, including the promotion of small businesses related to seed production for women, and increase training opportunities for women.

MAIN ACHIEVEMENTS WITH CAPACITY DEVELOPMENT AND YOUTH RELEVANCE

In 2017 we reported that we put together a group of 12 talented young scientists, who are improving their capacities on RTB seed systems. This group is publishing all the way from peer-

reviewed articles to blogs[1] and, as expected, it is becoming a key force for our cluster by testing the Toolbox for RTB Seed Systems under field conditions. Examples of tools being tested include the impact network analysis, degeneration models, the multistakeholder framework, and the means-end-chain analysis. These tools are being used to understand cassava seed networks in Vietnam and Cambodia (Delaquis), model epidemics in sweetpotato seed systems in Uganda (Andersen), develop the concept of management performance mapping (Buddenhagen), understand potato seed degeneration in Ecuador (Navarrete), or understanding the adoption of agricultural innovations among Ugandan banana farmers (Kilwinger and Mulugo). As mentioned in the 2017 report, at a conservative rate of two research papers per student, we maintain our expectation of having more than 20 papers by the end the phase from this group of young scientists.

MAIN ACHIEVEMENTS WITH CLIMATE CHANGE RELEVANCE

Climate change is one of the major drivers of seed degeneration and has a direct impact on RTB seed systems. Changes in temperature and rainfall can affect drastically the populations of vectors and pathogens that cause seed degeneration. A paper written by the Florida team (Garrett et al., 2018 deliverable 13431) reviewed how network analysis can be used to address complex questions such as the effect of climate change on seed degeneration and seed systems, by explaining how information, pathogens, technologies, etc. move across seed networks and ultimately affect seed access, availability and seed quality in a climate change context. Two case studies, one in Cambodia and Vietnam in cassava (Delaquis et al., 2018 deliverable 15384), and one in Uganda in sweetpotato (Andersen et al., 2018 deliverable 13433) applied network analysis to understand complex seed networks and recommend strategies for more efficient dissemination of improved varieties and healthy planting material. Similarly, a framework for an integrated seed health strategy to manage seed degeneration (Thomas-Sharma et al., 2017 reported last year), which considers environmental variables affected by climate change, was used by the Florida team to develop management performance maps to prioritize project interventions (Buddenhagen et al., 2018 deliverable 9241) and identify candidate predictors for seed degeneration management in vegetatively-propagated crops (Thomas-Sharma et al., 2018 deliverable 12697). Finally, more applied research was done by the IITA team who led two publications describing a method to produce virus-free cassava plants (Maruthi et al., 2018 deliverable 15551) and to exchange and manage *in-vitro* elite germplasm to combat Cassava Brown Streak Disease (CBSD) and Cassava Mosaic Disease (CMD in Eastern and Southern Africa, two viral diseases that are becoming critically important as result of climate change.

MAIN GAPS AND CHALLENGES

The main bottlenecks reported in 2017 were: (1) the need to show outcomes, and (2) improve information management. On the need to show outcomes, cluster CC2.1 is already documenting how other partners are using the tools developed in the cluster and therefore are generating outcomes. Examples are described in detail in the section *Outcome cases and policy influenced*"

[1] Peer-reviewed articles (e.g., Delaquis et al., 2018 deliverable 15384); pre-prints (e.g., Buddenhagen et al., 2018 deliverable 9241; Andersen et al., 2018 deliverable 13433); reports (Kilwinger et al., 2018 deliverable 10239; Mulugo, 2018 deliverable 12464; Andersen et al., 2018 deliverable 13432; Navarrete 2018 deliverable 15484); proceedings (Kilwinger et al., 2018 deliverable 13448), posters (Navarrete et al., 2018 deliverable 15482); datasets (Navarrete et al., 2018 deliverable 15483), abstracts (Navarrete et al., 2018 deliverable 15485); and blogs (Delaquis 2018 deliverable 15074).

On the other hand, the challenge of improving information management remains. The web site created for the project (here) and the Zotero databases for references (*RTB Seed Systems*) are good tools, but their use is still not widespread.

MEASURES TAKEN AND ADJUSTMENTS PROPOSED

Measures taken in 2018 to overcome the information management bottleneck included the conduction of two webinars: one on the multi-stakeholder framework (here) and another on the seed tracker, but the participants were mostly from the cluster. J. Andrade-Piedra and L. Kumar were in charge of organizing the session on seed systems on the last ISTRC meeting in Cali (here), but again we felt that the public was mostly from the RTB community.

The adjustments to improve information management include the following (to be discussed during our annual meeting in Ibadan, mid-March 2019):

- Take full advantage of webinars to disseminate the tools being developed by the cluster and update cluster members on the latest progress. A more "professional" conduction of these events is needed, taken as example webinars organized by some of our peers (e.g., the CGIAR Collaborative Platform for Gender Research).
- Short training courses at national or regional level for partners within and especially outside the CG System can be organized as satellite courses during big events.
- For internal communications, although the number of Skype meetings is sometimes overwhelming, cluster CC2.1 needs to have a Skype meeting with key scientists at least three times a year.

PARTNESHIPS: ACHIEVEMENT AND CHALLENGES

Please list up to three important partnerships for 2018, using the following table.

Brief description of partnership aims (30 words)	**List of key partners in partnership (one or more partners). Do not use acronyms.**	**Main area of partnership (may choose multiple), Research/Delivery/Policy/Capacity Development/Other, please specify**
Operationalization of seed quality assurance mechanisms, such as quality declared seed, on RTB crops in SSA	Integrated Seed System Development (ISSD-Africa), Wageningen Centre for Development Innovation, Royal Tropical Institute, AfricaSeeds, IITA, CIP.	Policy and Delivery

Please include collaborations with one or more CRPs or Platforms – or in some cases with other Centers, if these are not already core partners for your CRP.

Name(s) of collaborating CRP(s), Platform(s) or Center(s)	Brief description of the collaboration	Optional: Value added, in a few words e.g. scientific or efficiency benefits
PIM	On 2018 we finalized the field work on a cross crop study in Kenya (potato), Nigeria (cassava), and Vietnam (potato and cassava) to understand and draw out insights on the types of public policies, regulations or regulatory reforms that are in place for seed quality assurance on RTB crops, among other objectives. This work is being done in collaboration with PIM, through the project "Making seed systems and markets for vegetatively propagated crops (VPCs) work for the poor". Publications are not available yet.	The partnership with PIM is bringing expertise on policy analysis and funding.

FUND RAISING

The financial status and health of the cluster was acceptable. The burn rate for non-earmarked funds was 97.6% ($8,009), for type 2 earmarked funds was 101.8% (-8,483), and for type 3 earmarked funds 145.7% (-14.834).

Two fund raising efforts are being pursued within CC2.1:

- A proposal to be submitted to SDC to operationalize seed quality assurance mechanisms on RTB crops in Africa, in alliance with ISSD-Africa and others (see table above). Total budget is $310k for 3 years.
- A proposal for The Netherlands – CGIAR Research Programme (Senior Expert Programme SEP) for supporting C. Almekinders for developing the Toolbox for RTB Seed System. Total budget is € 41k annually or 3 years.

ANNEX 1 – OUTPUTS TO BE REPORTED

Related output(s)	Output leader	Completed in MEL (YES/NO)
CC2.1.2.2 - Impact network analysis (INA) validated as a tool to understand and describe RTB seed systems	K. Garrett	No, but available below
CC2.1.2.3 - General and crop-specific models and decision support systems for understanding and managing seed degeneration	K. Garrett	No, but available below
CC2.1.6.2 - Seed Tracker for RTB Crops	L. Kumar	No – Pending

Impact network analysis (INA) and seed degeneration analysis 2018 (K. Garrett)

Main achievements in 2018

For both INA and seed degeneration modeling, we have laid the groundwork for analyzing the new data sets that are now becoming available in the RTB projects.

Impact network analysis (INA)

- Developed an introduction to INA as a preprint (Garrett 2018), for submission to a peer-reviewed journal soon
- Published an overview of network analysis in plant pathology, including impact network analysis (Garrett et al. 2018)
- Evaluated sweetpotato seed networks in Uganda in an analysis that used some components of INA and introduced some new components for INA (Andersen et al., accepted pending minor revision)
- UF contributed to an analysis of cassava seed networks in SE Asia (Delaquis et al. 2018), the first step toward a full INA of this system, which is underway now with CIAT and IITA
- Made a partial version of the INA R package available on GitHub, with the full version to be made available soon, including a description in a peer-reviewed journal article

Seed degeneration analysis

- Developed the first draft of the R package seedHealth, which makes the seed degeneration model published in 2017 available on GitHub. Phytopathology editors have said they would be interested in reviewing the manuscript about the seedHealth package which is currently in development.
- Management performance mapping (MPM) is designed to apply information about seed degeneration rates at larger scales, to inform decisions about where to invest in interventions and to provide local recommendations on management. Buddenhagen et al (2018) describes an application to potato seed systems in Ecuador and Kenya, and this work will be submitted soon to a peer-reviewed journal. A related manuscript in preparation (Thomas-Sharma et al.) provides more background on data collection and integration for MPM. We have just started analysis of a more extensive seed degeneration data set for potato seed in Kenya.

Main gaps analysis

UF funding was cut in half in 2018, but we continued developing these projects. Assuming the funding rate can be higher in 2019, our main challenge in 2019 will be to make sure that we have

the R packages and user-friendly documentation ready as more data sets become available. Also, long distance communication sometimes makes it challenging for UF to keep up with which data are available, and for others to keep up with what analyses UF has available.

Measures taken and adjustments proposed

We are planning a workshop at the 2019 meeting, with hands-on training for using the RTB R packages. Probably it would be helpful for UF to have targeted Skype/Zoom meetings every 1-2 months with RTB members who have data for which our analyses would be useful.

Main achievements and challenges related to partnership management

The partnerships within RTB have been productive. Enhanced communication would be helpful.

References

Andersen et al. 2018. Modeling epidemics in seed systems to guide management strategies: The case of sweetpotato in Northern Uganda. bioRxiv: https://doi.org/10.1101/107359. Now accepted pending minor revision in Phytopathology.

Buddenhagen et al. 2018. Management performance mapping: the value of information for regional prioritization of project interventions. bioRxiv: https://doi.org/10.1101/380352

Delaquis et al. 2018. Raising the stakes: cassava seed networks at multiple scales in Cambodia and Vietnam. Frontiers in Sustainable Food Systems 2:73. [open access link]

Garrett et al. 2018. Network analysis: A systems framework to address grand challenges in plant pathology. Annual Review of Phytopathology 56: 559-580. [link]

Garrett, K.A. 2018. Impact network analysis: evaluating the success of interventions. PeerJ Preprints 6:e27037v1 https://doi.org/10.7287/peerj.preprints.27037v1

Ogero et al. 2019. Effectiveness of insect-proof net tunnels in reducing virus degeneration in sweetpotato planting material under farmer management. In review.

ANNEX 2 – LIST OF FORMATIVE AND EVALUATIVE STUDIES

Title	Deliverable code
Characterizing local potato seed systems in the province of Cotopaxi-Ecuador	15483. Available in Dataverse.
Assessing gender and socio-economic determinants of access to clean seed in BXW infected banana systems	12726
Comparative study on the Banana Seed System in Mbarara district Western Uganda and Mukono District Central Uganda	10239
Banana seed supply in BBTD affected areas of Burundi	6243
Assessing the degeneration of cassava under high virus inoculum conditions in Coastal Tanzania	6250
Understanding the influence of cultural values on the uptake of banana tissue culture planting materials as a control practice for banana Xanthomonas wilt by smallholder farmers in Central Uganda	12464
Farmers willingness to pay for disease screened and labelled clean banana planting materials in Uganda	12471
Ex-ante acceptance of GM banana planting material in Uganda	12473