



RESEARCH  
PROGRAM ON  
Roots, Tubers  
and Bananas



# Workshop report: Tools for managing seed degeneration in RTB crops

Facilitation: Kathleen Vaughan

Logistics: Julia Zamudio (CIP) James Legg (IITA)

February, 5-8 2013  
Arusha, Tanzania

A broad alliance of  
research-for-development  
stakeholders & partners



[www.rtb.cgiar.org](http://www.rtb.cgiar.org)



## **Workshop report:**

# **Tools for managing seed degeneration in RTB crops**

Facilitation: Kathleen Vaughan

Logistics: Julia Zamudio (CIP)  
James Legg (IITA), East African  
Hotel, Arusha, TZ

## Table of Contents

---

|                                                                                             |    |
|---------------------------------------------------------------------------------------------|----|
| Summary .....                                                                               | 3  |
| I. Workshop Background .....                                                                | 4  |
| II. Workshop Objectives .....                                                               | 5  |
| III. Methodology .....                                                                      | 5  |
| IV. Workshop Outputs .....                                                                  | 6  |
| V. Project Management .....                                                                 | 10 |
| VI. Project linkages and general issues .....                                               | 11 |
| VII. Workshop Evaluation .....                                                              | 12 |
| Annexes .....                                                                               | 13 |
| Annex 1: Workshop participant list .....                                                    | 13 |
| Annex 2: Summary of pre-workshop survey .....                                               | 14 |
| Annex 3: Workshop program .....                                                             | 16 |
| Annex 4. Activity description template .....                                                | 20 |
| Annex 5. Major deliverables for modeling work .....                                         | 21 |
| Annex 6: Seed Degeneration Workshop Participant Research Topics – ongoing<br>feedback ..... | 22 |

## Summary

The outputs from the workshop will move the CRP RTB and its partners closer towards achieving practical solutions for farmers and other stakeholders to address degeneration of planting material, generally considered one of the primary constraints to productivity at a global scale.

The research team decided to structure the project by crops, rather than by centers, to increase inter-center collaboration. To create a greater common knowledge base, the first day was dedicated to presentations on background information related to seed (propagule) production and degeneration for each crop, as well as key issues such as modeling, deep sequencing and results-based management. Specific research plans were developed for each crop, consistent with the existing budget. Two levels of research gaps (essential and important) were identified for additional funding. Communication and project management strategies were identified by the team for implementation, including timelines and responsibilities for project milestones, as well as plans for publication of outputs.

A Project Technical Report based on the work initiated with the project profile in 2012, consolidated and refined in the workshop sessions, is still being refined through virtual team interaction. That report will provide a detailed description of the project content, which is only summarized here.

The workshop profited from a collegial atmosphere in which genuine enthusiasm for the topic was evident. Participants also had the opportunity to share and discuss key concerns related to seed generation in their respective crops and to learn from the experiences of colleagues from other parts of the world working on different crops. The participants left with an enhanced collaborative spirit and a positive outlook toward the project's future.

## I. Workshop Background

Seed degeneration is one of the major challenges to productivity for crops which are vegetatively propagated such as roots, tubers and bananas. This problem has been effectively controlled in wealthier countries by “clean” seed systems, developed early in the 20<sup>th</sup> century. However, clean seed systems have had little impact in developing countries and are largely unavailable to or unused by small-scale farmers.

Degeneration can also be managed by several different on-farm tactics (e.g., positive selection, rotation, sanitation) and also by host plant resistance. Nonetheless, these approaches have not received their due emphasis, nor has agricultural research focused on the multitude of interactions among the three approaches: clean seed, on-farm management and resistance.

To address these R&D gaps, the CGIAR Research Program (CRP) on roots, tubers and bananas is funding a project involving four of its institutional members (CIP, CIAT, IITA and Bioversity) and other partners to develop new ideas and tools for practical use by farmers and seed producers to better manage diseases causing degeneration of planting material. Epidemiologists will use modeling to assess how the approaches described above can be integrated into realistic solutions for developing countries. The project will also deepen our understanding of the nature of pathogens causing the problem, the impact of degeneration on crop yield and the effects of different management strategies on pathogen evolution. The project funding is for three years; 2013 marks the 2<sup>nd</sup> year of the project cycle.<sup>1</sup>

A project start-up workshop was held in Arusha, Tanzania the 5<sup>th</sup> to 8<sup>th</sup> of February 2013. Entitled, “A Scientific Review and Planning Workshop”, the purpose was to have the participants present a brief of the background scientific crop reviews and from this foundation, develop a research project for the CRP objective across the 4 CGIAR institutions and their non-CGIAR partners. This was the first time that institutions and other stakeholders have met to discuss the project.

---

<sup>1</sup> Visit the project webpage for more information <https://sites.google.com/site/seeddegenerationworkshop/>

## II. Workshop Objectives

The specific aims were as follows:

- 1) Share the findings from the background scientific reviews for the five crops and key issues such as deep sequencing, modeling and results based management;
- 2) Create a research project involving the four CGIAR institutions and non-CGIAR partners covering target crops and with a global coverage based on initial funding;
- 3) Identify important research gaps and scaling out opportunities for extended project activities;
- 4) Begin the design process for the project decision support tool (DSS), a model to predict degeneration in the target crops;
- 5) Present opportunities for the staff at the various CGIAR centers and other participants to get to know each other, to enhance collaborative working relations and identify effective mechanisms for collaboration.

To measure progress on these aims, three outputs were expected after the three and a half days.

- A collaborative research project for both core (funded) activities and extended activities
- A draft model design framework
- Agreement on communication and collaborative working

## III. Methodology

A project planning workshop was held from 5 to 8 February in Arusha, Tanzania in the East African Hotel. On average, we were about 23 participants as some people were only present for the first couple days (Annex 1). The first day of the workshop was dedicated to the presentation of background information related to the project, including detailed information on degeneration in the five RTB crops, modeling efforts at Kansas St. Univ. and "virome" description using deep sequencing. The second and third days were used to develop plans for research, both for existing funding and to identify key research areas for which supplemental funding would be sought

The workshop used a variety of methods to create an environment to achieve movement and success towards the anticipated outputs. Prior to the workshop, a survey queried invited participants to share their thoughts on the three things to achieve during the workshop and suggestions. The respondents identified issues related to the project and related outputs, science specific topics and relationships among the project team (Annex 2). The feedback from the survey was used to inform the final agenda (See Annex 3 for workshop program).

To facilitate research planning, the participants were organized by crops which created teams that cut across institutions and regions. During Days 2 and 3, these working groups engaged in dialogue about the preferred focus of their shared research project and then refined the idea given the budget framework, the proposed model output, achievability within the given time frame. A flexible research design template (Annex 4) was proposed to promote harmonization, but groups were also free to respond to the particular demands of each crop. Several times over the workshop, these groups had an opportunity to share their thinking with the larger group and to receive feedback any suggestions for consideration. This interaction was important for the development of interdependent and peer reviewed plans for seed degeneration research through the CRP RTB.

Finally, the last day was dedicated to a strategy for working together - combinations of online services such as Google Apps and Dropbox, joint publications and future meetings were agreed, as well as responsibilities and a general time frame for finishing some of the early milestones of the project.

#### **IV. Workshop Outputs**

The primary objective of the workshop was to develop detailed plans for the execution of the activities to be done with existing funding and also identify major research gaps and needs for scaling out to be addressed in a proposal for supplemental funding. However, there were additional outputs of the workshop, including a confirmation of the communications and public awareness strategy, development of a bibliographic database, development and publication of background papers for each crop, workshop abstracts and presentations and a project impact pathway.

## Background papers and presentations

Detailed background papers were prepared prior to the workshop and made available through the project Dropbox. Presentations based on these reports were given the first day. Abstracts for most of the presentations were prepared prior to the meeting. All these materials are currently available at the project [Website](#) under “Arusha Workshop” (see figure below). The group agreed to publish the background papers and the project coordinators are currently working to identify where, how and when that will be done.

### Presentations and background

A series of presentations were given at the workshop in Arusha. Titles, presenters and PDFs for downloading are available below.

| Item number | Title                                                        | Presenter                        | Presentation        | Abstract            | Full paper          |
|-------------|--------------------------------------------------------------|----------------------------------|---------------------|---------------------|---------------------|
| Sort ▾      | Sort ▾                                                       | Sort ▾                           | Sort ▾              | Sort ▾              | Sort ▾              |
| 1           | Paradigms, concepts and plans                                | Greg Forbes                      | <a href="#">PDF</a> | <a href="#">PDF</a> |                     |
| 10          | RTB: Background, results based management and impact pathway | Graham Thiele                    | <a href="#">PDF</a> |                     |                     |
| 2           | Degenerative Diseases: Cassava in Africa                     | James Legg                       | <a href="#">PDF</a> | <a href="#">PDF</a> |                     |
| 3           | Disease associated viruses in Casava from the Americas       | William Cuellar, Monica Carvajal | <a href="#">PDF</a> |                     |                     |
| 4           | Degeneration in banana                                       | Fen Beed, Miguel Dita            |                     | <a href="#">PDF</a> | <a href="#">PDF</a> |
| 5           | Degeneration in Sweet Potato                                 | Richard Gibson                   | <a href="#">PDF</a> |                     | <a href="#">PDF</a> |
| 6           | Potato seed degeneration                                     | Greg Forbes                      | <a href="#">PDF</a> | <a href="#">PDF</a> | <a href="#">PDF</a> |
| 7           | Degeneration and propagation system in Yam                   | Danny Coyne                      |                     | <a href="#">PDF</a> |                     |
| 8           | Modeling degeneration                                        | Karen Garrett                    |                     |                     |                     |
| 9           | Viral diagnostics                                            | Jan Kreuze                       | <a href="#">PDF</a> |                     |                     |

## Project Technical Report and proposal

A Project Technical Report is under construction which will give detailed information on the content of activities under way in the current funding structure as well as the identified research gaps. Here we present a summary of that document, the main components of which were identified in the workshop.

Participants in the project decided to divide the existing funding by crop, with roughly equal amounts going to each crop. Project descriptions for each of the crops were developed which outline how the activities will be carried out, which are funded with the CRP funds. To facilitate the process and promote harmonization a template was used (Annex 4). In most cases, groups decided to link to existing research activities to reduce costs, but in some cases new experiments were planned.

*Potato.* The potato team identified several on-going projects and decided that the most appropriate use of the money would be to link to these projects, using the degeneration project funds to support the linkage and particularly support the measurement of variables that were not originally contemplated in the existing projects.

*Cassava.* Experimental studies are proposed for both Colombia and Tanzania. Three different sites located in: lowland coast, mid-altitude north-west with low disease pressure or high disease pressure in Tanzania and; lowland north coast, mid-lowland (Llanos) and mid-altitude (CIAT) in Colombia will be studied.

*Banana.* Four sets of experiments will determine the influence of positive selection for planting material of the highest quality (from certified tissue culture) for 2 varieties that are susceptible (Cavendish) and only moderately susceptible (ABB/AAB i.e. Saba) compared to locally preferred variety propagated through macro-propagation. Experiments will test the influence of temperature and reduced plant development by being replicated at a high altitude site and results compared with a low altitude site in Burundi and Nigeria. Another factor to be tested will be the rate of degeneration as influenced by the presence or absence of BBTV in surrounding fields.

*Sweet potato.* In sweet potato it is well understood that the combination of SPCSV and SPFMV and other viruses can cause severe yield losses. However symptoms in such plants are obvious and farmers can thus recognize the plants and remove them during the growing season by rouging, or at the end of the growing season by not selecting them as planting material. However single infections of various viruses are usually much milder and difficult to identify by farmers, and thus they persist in the system. It is unclear to what level these viruses may affect yield, to what level farmers can control them by positive selection and how they build up during propagation of planting material. The proposed experiments will address these by comparing completely clean material and material derived under

farmer practices in two different systems: the triple S method in Uganda in areas with a long dry season and material multiplied under a net house, plus one field multiplication at the lake-zone in Tanzania.

*Yam.* Quantitative information on rate of seed degeneration due to viruses and nematodes are not known. The following experiments are therefore proposed to estimate the rate is designed (i) to estimate the relationship between the seed quality, virus and nematode incidence, yield, rate of degeneration; (ii) to determine interaction of multiple viruses and nematodes, and interaction of virus and nematodes on rate of seed degeneration; (iii) effect of positive selection; and (iv) determine the virus and nematode diversity in popular landraces by deep sequencing. Experiments will be conducted in farmers' fields and research station in two different agroecologies in Nigeria and one location in Uganda.

*Modeling and synthesis.* K. Garrett (KSU) presented the preliminary ideas on modeling, including an overview of previous modeling on viral diseases in RTB crops that can serve as a basis for our project. Over the period of activity design, Karen and Sara visited groups and discuss data needs for modeling. In addition to the activity template (Annex 4), a list of needed variables was also developed and shared among the groups. Finally, the modeling group developed a timeline for the major modeling deliverables of the project (Annex 5).

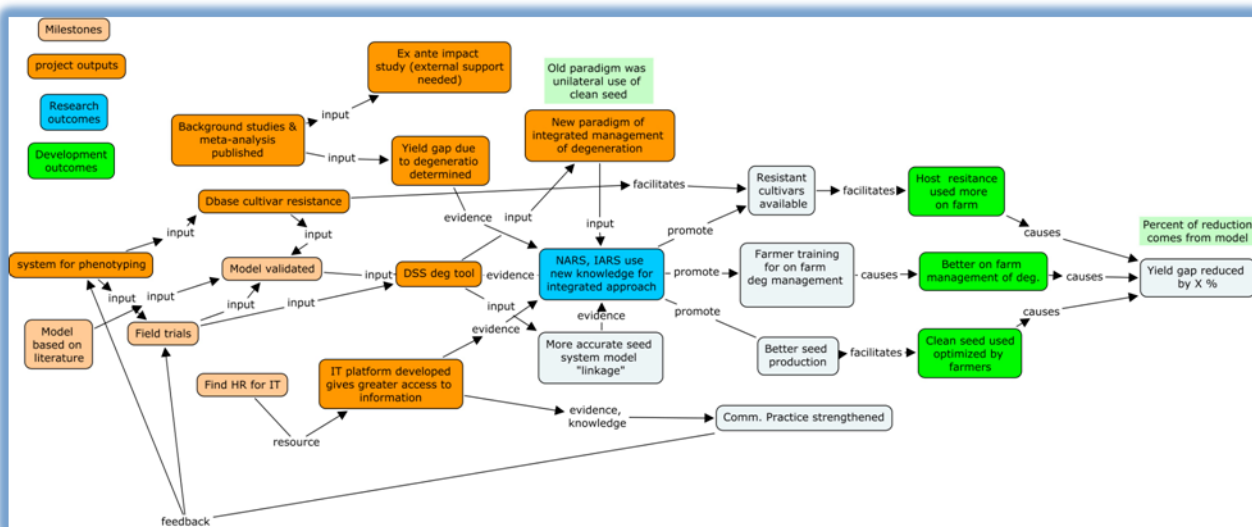
### **Project outputs**

The project outputs will be described in more detail in the Project Technical Report, but these were a focus in the workshop and were particularly viewed when addressing the impact pathway (below). They are listed briefly here.

- Publication of background papers and a meta analysis.
- Ex-ante assessment of the role of degeneration in the yield gap between actual and attainable yields
- A new system for quantifying the resistance phenotype of the RTB relative to the primary degeneration pathogens
- A database of resistance levels of some important varieties of RTB
- General and specific models that predict degeneration under different biophysical scenarios
- Guidelines for a more balanced R&D approach for managing degeneration

## Impact pathway

At the end of the first day of the workshop, the group viewed a live Skype presentation by Graham Thiele on results based management and the impact pathway. A pathway had been previously developed which was then discussed and modified (slightly) in the workshop (figure below, for full online version see [here](#) or project [Website](#)). The response among the participants was surprisingly enthusiastic for both the results based management and the impact pathway.



## V. Project Management

Overall coordination of the project will be handled by G. Forbes (CIP), while all aspects related to deep sequencing will be managed by J. Kreuze (CIP). S. Thomas (KSU) will manage many of the day-to-day details. The project milestones and responsibilities will be managed and monitored (for now at least) on a Viewpath project, in which all participants can be active.

In the last day of the workshop participants discussed how to work together. For the present we decided to use Dropbox for joint development of documents and document sharing but have left the possibility open to use Google Drive under CGXchange; for specific purposes some Google Docs applications are used. The Google Sites [Project Website](#) will be maintained for the time being but this should move to the RTB web site when the latter has been developed. A Zotero database has been started that will

eventually house all the bibliography from the background studies and can be shared with any participants who are interested.

## **VI. Project linkages and general issues**

### ***Linkages***

The CRP RTB project on seed systems indicated an interest in coordinating with the degeneration group. The seed system project team would provide economic analysis within the degeneration trials.

There is a need for greater linkage with Theme 7 of the CRP RTB in the areas of impact assessment and capacity building.

The project coordinators will attempt to develop these linkages in the future and their establishment has been entered in the project structure as a milestone.

### ***Gender***

Management of RTB planting material is an aspect of production with strong gender implications, as well as any solutions identified for managing degeneration. Clear opportunities for integrating a gender focus in the project were not identified during the workshop, but it should be noted that this stage of the project focuses primarily on research aimed at providing the data needed to make an accurate predictive model that guide decision making. Gender issues will undoubtedly become more acute as the project moves into greater capacity building and even advocacy issues. Linkage with gender specialists is required at an early stage to orient the project.

### ***Advocacy***

Advocacy was noted as an important element for the CRP RTB to achieve measurable change for the farmer in terms of crop yield. The value of having a coordinated advocacy approach across the centers was discussed and agreed upon. However, at the present time, the group felt there was a need to achieve valid research results from the project before embarking on

this process. For the present, the collation of the Zotero bibliographic references and achieving the initial project goals were agreed as first steps.

## VII. Workshop Evaluation

During the workshop, the facilitator created space for feedback during dedicated check in times as well as through the use of the parking lot and the 3-2-1 review on Day 2. Additionally, the facilitator employed a bucket technique using different colored paper to capture participant thoughts and input about the project research ideas, personal research topics, quick wins for the project, and suggestions for the model (See Annex 6 for a list of participant research topics).

Based on the experience of the workshop in Arusha, the facilitator made the following recommendations:

- 1) **Build the community ways of working and sharing** across boundaries. For example, possible community calls on specific topics such as the impact pathway.
- 2) **Create a bookmarking function for the internal collaboration space** to share recent readings and news items.
- 3) **Encourage the involved institutions to hold their own internal sharing activities** to generate excitement for the new way of working.
- 4) **Have participant profiles on the internal collaboration space.** These profiles should include research interests, technical expertise and other information such as personal details and hobbies to enhance relationships. One idea is for participants to identify an area they are willing to be a go to person for both technical (e.g. deep sequencing, participatory design) but also other areas (e.g. computer technology, seeking research contacts in a particular geographic area, translation expertise).

## Annexes

### Annex 1: Workshop participant list

| Name                  | Institution                         | Email                                                                                    |
|-----------------------|-------------------------------------|------------------------------------------------------------------------------------------|
| Fen Beed              | IATA (Tanzania)                     | <a href="mailto:f.beed@cgiar.org">f.beed@cgiar.org</a>                                   |
| Monica Carvajal       | CIAT (Columbia)                     | <a href="mailto:m.carvajal@cgiar.org">m.carvajal@cgiar.org</a>                           |
| Wilmer Cuellar        | CIAT (Columbia)                     | <a href="mailto:W.Cuellar@cgiar.org">W.Cuellar@cgiar.org</a>                             |
| Miguel Dita           | Bioversity (Costa Rica)             | <a href="mailto:m.dita@cgiar.org">m.dita@cgiar.org</a>                                   |
| Karen Garret          | Kansas State University             | <a href="mailto:kgarrett@k-state.edu">kgarrett@k-state.edu</a>                           |
| Sara Thomas           | Kansas State University             | <a href="mailto:thomasuga@gmail.com">thomasuga@gmail.com</a>                             |
| Greg Forbes           | CIP (China)                         | <a href="mailto:g.forbes@cgiar.org">g.forbes@cgiar.org</a>                               |
| Jan Kreuze            | CIP (Peru)                          | <a href="mailto:j.kreuze@cgiar.org">j.kreuze@cgiar.org</a>                               |
| Peter Kromann         | CIP (Ecuador)                       | <a href="mailto:p.kromann@cgiar.org">p.kromann@cgiar.org</a>                             |
| Lava Kumar            | IATA (Nigeria)                      | <a href="mailto:l.kumar@cgiar.org">l.kumar@cgiar.org</a>                                 |
| James Legg            | CIP/IITA (Tanzania)                 | <a href="mailto:j.legg@cgiar.org">j.legg@cgiar.org</a>                                   |
| Rogers Kakuhenzire    | IATA (SSA)                          | <a href="mailto:r.kakuhenzire@cgiar.org">r.kakuhenzire@cgiar.org</a>                     |
| Guy Blomme            | Bioversity (Ethiopia)               | <a href="mailto:g.blomme@cgiar.org">g.blomme@cgiar.org</a>                               |
| Pascale Lepoint       | Bioversity (Burundi)                | <a href="mailto:p.lepoint@cgiar.org">p.lepoint@cgiar.org</a>                             |
| Jorge Andrade         | CIP (Ecuador)                       | <a href="mailto:j.andrade@cgiar.org">j.andrade@cgiar.org</a>                             |
| Jonathan Yuen         | SLU (Sweden)                        | <a href="mailto:jonathan.yuen@slu.se">jonathan.yuen@slu.se</a>                           |
| Richard Gibson        | University of Greenwich (UK)        | <a href="mailto:nosbigrw@yahoo.com">nosbigrw@yahoo.com</a>                               |
| Lesley Torrence       | The James Hutton Institute (UK)     | <a href="mailto:Lesley.Torrance@hutton.ac.uk">Lesley.Torrance@hutton.ac.uk</a>           |
| Jim Lorenzen          | The Gates Foundation (US)           | <a href="mailto:jhlorenzen@gmail.com">jhlorenzen@gmail.com</a>                           |
| Hassan Were           | Masinde Muliro University (Kenya)   | <a href="mailto:werehkde@yahoo.com">werehkde@yahoo.com</a>                               |
| Yvan Mathieu          | Vitropic (France)                   | <a href="mailto:vitropic@vitropic.fr">vitropic@vitropic.fr</a>                           |
| Danny Coyne           | IATA (Tanzania)                     | <a href="mailto:D.Coyne@cgiar.org">D.Coyne@cgiar.org</a>                                 |
| Sarina                | Inner Mongolia University (China)   | <a href="mailto:hellosarina@126.com">hellosarina@126.com</a>                             |
| Abdulwahab Abdurahman | Wageningen University (Netherlands) | <a href="mailto:abdulwahab.abdurahman@wur.nl">abdulwahab.abdurahman@wur.nl</a>           |
| Kathy Vaughan         | Facilitator                         | <a href="mailto:Kathleen.vaughan@xponentially.com">Kathleen.vaughan@xponentially.com</a> |

## Annex 2: Summary of pre-workshop survey

What are the three key things that you most want to see achieved at the workshop?

Better understanding of the project

- Better idea of organization of project & future experiments
- Common understanding of key concept

Agreed objectives and a clear work plan

- Agreement on project objectives
- Agreement on common platforms and methodology, responsibilities/roles of partners,
- Clear products and outcomes to be achieved
- Discuss the strategies to fulfill the objectives
- Clear plans to implement the proposal
- Clear plan of activities
- Completion of detailed work plans
- A work plan that would reflect the immediate need of the poor who depend on mainly degenerated seed in addition to a higher caliber scientific research on degeneration
- Work plans and milestones
- Identify tasks of specific centers and people

Interdependent science

- Plan for complementary funding & mapping cross-cutting with other CRP project (e.g. disease monitoring and risk assessment)
- A harmonious linkage among participant scientists working on degeneration of each crop established
- Gain research inputs from others experiences
- A recognition of the importance of reversion
- Establish foundation of key partners for joint activities
- A recognition of the role of the farmer

Scientific specifics

- Flexibility for degenerative pathogens beyond viruses
- More attention given to the notion that regeneration of degenerated seed is possible by simple technologies such as positive selection

- A recognition of the importance of variety
- Understanding of the modeling approach and required data

Get to know the team

- Get to know the people from the project
- Face to face meeting with other project members

Future funding

- Discuss current & future funding constraints & solutions

Any other suggestion of concerns for making a very successful workshop?

- I had no previous role in planning future work and I have no idea how transparent the process of planning it was. I think quite a few people will be coming to the meeting hoping to 'get something out of' the meeting yet I suspect they will find the main decisions about who is going to be funded to do it are already made. Don't worry, I am not someone who 'expects to get something out of' the meeting - but I do suspect some people may not be too impressed by this aspect of it. Otherwise, it seems well constructed and I like the presence of lots of spare time.
- Include some social event in the evening.
- keeping everyone together, especially in evenings for social interaction towards further discussions and interaction on workshop topics etc.
- Nothing really at this stage. Having a facilitator should help greatly.

## Annex 3: Workshop program

| Day 1 Tuesday, February 5, 2013 |       |                                               |                              |                                                                                                                                                                                         |
|---------------------------------|-------|-----------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Session                         | Time  | Activity                                      | Person responsible           | Observations                                                                                                                                                                            |
| 1                               | 8:45  | Introductions and welcome                     | Kathy Vaughan                |                                                                                                                                                                                         |
| 2                               | 9:30  | Background and objectives                     | Greg Forbes                  | Background, history and overview of the proposal on degenerative diseases in roots, tubers and bananas, degeneration concepts, and current vision of objectives, outputs and resources. |
| 3                               | 10:00 | Expectations (modus operandi) of the workshop | Kathy Vaughan                | Agree and design the way in which the workshop will reach its outcomes                                                                                                                  |
|                                 | 10:30 | Break                                         |                              |                                                                                                                                                                                         |
| 4                               | 11:00 | Cassava background                            | James Legg<br>Wilmer Cuellar | Presentations based on background papers and other necessary background information followed by Q & A                                                                                   |
| 5                               | 11:20 | Banana background                             | Miguel Dita                  |                                                                                                                                                                                         |
| 6                               | 11:40 | Sweet potato background                       | Richard Gibson               |                                                                                                                                                                                         |
|                                 | 12:00 | Lunch                                         |                              |                                                                                                                                                                                         |
| 7                               | 13:40 | Potato background                             | Greg Forbes                  | Continued from above                                                                                                                                                                    |
| 8                               | 14:00 | Yam background                                | Danny Coyne,<br>Lava Kumar   |                                                                                                                                                                                         |
| 9                               | 14:20 | Modelling degeneration                        | Karen Garrett                |                                                                                                                                                                                         |

| 10                                | 14:50 | Identification, cataloguing pathogens via deep sequencing | Jan Kreuze                     |                                                                                                                                           |
|-----------------------------------|-------|-----------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
|                                   | 15:10 | Tea                                                       |                                |                                                                                                                                           |
| 11                                | 15:30 | Impact pathway; Discussion of background papers           | Skype Graham Thiele            |                                                                                                                                           |
| 12                                | 16:30 | Discussion of day                                         | Participants and Kathy Vaughan |                                                                                                                                           |
|                                   | 17:00 | Close                                                     |                                |                                                                                                                                           |
|                                   |       |                                                           |                                |                                                                                                                                           |
|                                   |       |                                                           |                                |                                                                                                                                           |
| Day 2 Wednesday, February 6, 2013 |       |                                                           |                                |                                                                                                                                           |
| Session                           | Time  | Activity                                                  | Person responsible             | Observations                                                                                                                              |
| 13                                | 8:30  | Review day one                                            | Kathy Vaughan                  | Review day One                                                                                                                            |
| 14                                | 9:00  | Introduction of budget framework                          | Greg Forbes or Sara Thomas     | Demonstrate database structure we will use to describe work and budget                                                                    |
| 15                                | 9:30  | Split into groups to develop activities for core research | Kathy Vaughan                  | Suggest groups based on crops; Jan may visit all groups - same for Karen and Sara, or maybe they work together with GF on modelling group |
|                                   | 10:30 | Break                                                     |                                |                                                                                                                                           |
| 16                                | 11:00 | Continue working in groups                                | Kathy Vaughan                  |                                                                                                                                           |
|                                   | 12:00 | Lunch                                                     |                                |                                                                                                                                           |
| 17                                | 13:30 | Plenary -                                                 | Participants and               | Points to discuss:                                                                                                                        |

|                                  |       | presentation of work plans from each group           | Kathy Vaughan                  | cross cutting<br>Detail: who, how much, when -smart<br>Gender<br>location (all in one location)<br>deep sequencing (sampling, storage, shipping)<br>partners |
|----------------------------------|-------|------------------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18                               | 14:30 | Return to groups to refine core work plan            | Participants and Kathy Vaughan |                                                                                                                                                              |
|                                  | 15:00 | Break                                                |                                |                                                                                                                                                              |
| 19                               | 15:30 | Continued work in groups                             | Participants and Kathy Vaughan |                                                                                                                                                              |
| 20                               | 16:30 | Return to plenary to discuss work plans              | Participants and Kathy Vaughan |                                                                                                                                                              |
|                                  | 17:30 | Close                                                |                                |                                                                                                                                                              |
| Day 3 Thursday, February 7, 2013 |       |                                                      |                                |                                                                                                                                                              |
| Session                          | Time  | Activity                                             | Person responsible             | Observations                                                                                                                                                 |
| 21                               | 8:30  | Review of day 2 and work to date                     | Participants and Kathy Vaughan |                                                                                                                                                              |
| 22                               | 9:00  | Return to groups to develop supplemental work plan   | Kathy Vaughan                  |                                                                                                                                                              |
|                                  | 10:00 | Break                                                |                                |                                                                                                                                                              |
| 23                               | 10:30 | Continue groups for supplemental work plan           | Participants and Kathy Vaughan |                                                                                                                                                              |
|                                  | 12:00 | Lunch                                                |                                |                                                                                                                                                              |
| 24                               | 13:30 | Plenary presentation of supplemental work plans; and | Participants and Kathy Vaughan | Points to discuss:<br>cross cutting<br>Detail: who, how much, when -smart                                                                                    |

|                                |       | discussion                                                                                                 |                                   | Gender<br>location<br>deep sequencing<br>(sampling, storage,<br>shipping)<br>partners |
|--------------------------------|-------|------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------|
|                                | 15:00 | Break                                                                                                      |                                   |                                                                                       |
| 25                             | 15:30 | Return to groups<br>to refine<br>supplemental work<br>plan                                                 | Participants and<br>Kathy Vaughan |                                                                                       |
| 26                             | 16:30 | Review of proposal<br>in Plenary                                                                           | Participants and<br>Kathy Vaughan |                                                                                       |
|                                | 17:30 | Close                                                                                                      |                                   |                                                                                       |
|                                |       |                                                                                                            |                                   |                                                                                       |
| Day 4 Friday, February 8, 2013 |       |                                                                                                            |                                   |                                                                                       |
| Session                        | Time  | Activity                                                                                                   |                                   | Observations                                                                          |
| 27                             | 8:30  | Ensuring all cross<br>cutting issues<br>have been<br>addressed                                             | Participants and<br>Kathy Vaughan |                                                                                       |
| 28                             | 9:15  | Discussing all<br>items in ' parking<br>lot' (data<br>management and<br>visualization; deep<br>sequencing) | Participants and<br>Kathy Vaughan |                                                                                       |
|                                | 10.3  | Break                                                                                                      |                                   |                                                                                       |
| 29                             | 10:45 | Agreeing an action<br>plan and reviewing<br>workshop                                                       | Participants and<br>Kathy Vaughan |                                                                                       |
| 30                             | 12:30 | Close of workshop                                                                                          | Participants and<br>Kathy Vaughan |                                                                                       |
|                                | 12:45 | Lunch                                                                                                      |                                   |                                                                                       |

## Annex 4. Activity description template

### Justification

*Core*

*Very important*

*Important*

### Experimental design

*Field/laboratory design*

*Measured variables*

| Variables measured, how and where | When, how often | Responsible |  |
|-----------------------------------|-----------------|-------------|--|
|                                   |                 |             |  |
|                                   |                 |             |  |
|                                   |                 |             |  |
|                                   |                 |             |  |
|                                   |                 |             |  |

### Outputs

*Core*

| Output / deliverable | When |
|----------------------|------|
|                      |      |
|                      |      |
|                      |      |
|                      |      |

*Very important*

*Important*

### Others (publications?)

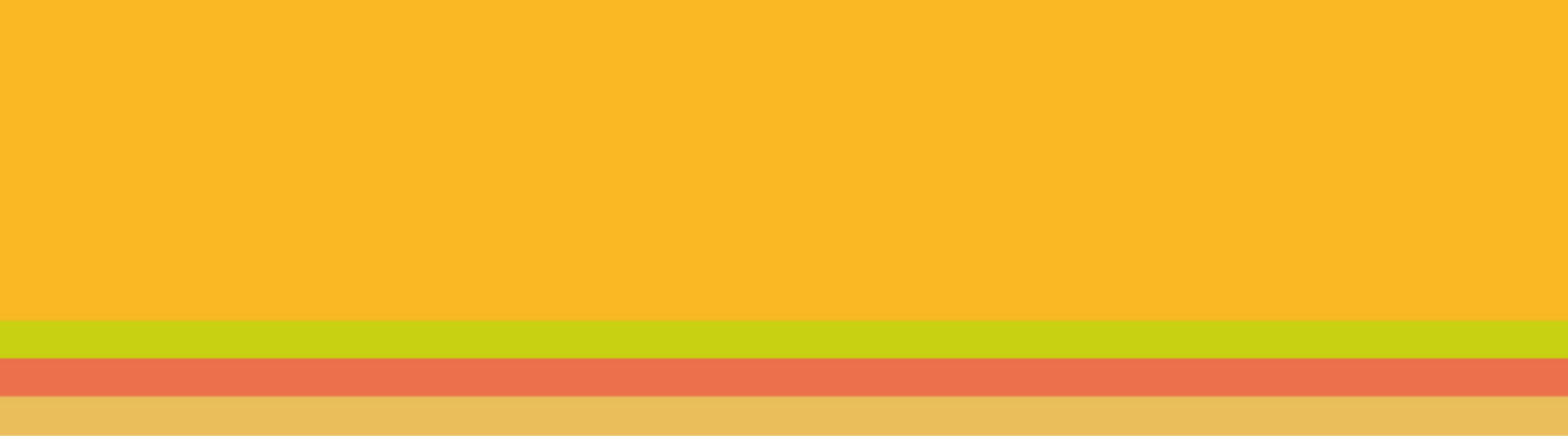
## Annex 5. Major deliverables for modeling work

| Institution | Activity                                                                                                                                          | Deliverable/Milestone/<br>Output (in line with approved<br>Project Profile)                 | Due<br>Date   | Project Manager<br>Responsible for<br>reporting |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------|-------------------------------------------------|
| KSU         | Review existing literature on viruses infecting RTBs in order to provide initial parameter values for models                                      | Initial parameter estimates for models determined and gaps identified                       | 2013          | Karen Garrett                                   |
| KSU         | Develop theoretical framework for predicting health status of planting material under different biophysical scenarios and different interventions | Suite of models predicting degeneration under different scenarios generated.                | 2013          | Karen Garrett                                   |
| KSU         | Test framework above in on-station and on –farm trials; measure parameters for model refinement                                                   | Data showing model performance and variation generated. Data for new parameters identified. | 2013/<br>2014 | Karen Garrett                                   |
| KSU         | Develop simple decision support systems for improved production of planting material (reduced or reversed degeneration)                           | Simple (non- computer or data-logger based) DSS developed                                   | 2014          | Karen Garrett                                   |
| KSU         | Publish new knowledge generated through review described above and project activities                                                             | Research data made available for modeling and wider public access                           | 2014          | Karen Garrett                                   |

## Annex 6: Seed Degeneration Workshop Participant Research Topics – ongoing feedback

| Research Topic/Focus                                                                                                                                | Person                   | Comments                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------------|
| Follow-up on aphid populations (winged & alatae) in plots                                                                                           | Pascale/<br>Biodiversity | Ongoing                          |
| Evolution of BBTD evidence in time using cultural practices & farmer adoption                                                                       | Pascale/<br>Biodiversity |                                  |
| Aphid data on different altitudes/agro-ecologies and varieties                                                                                      | Pascale/<br>Biodiversity |                                  |
| BBTD reinfection rates in farmer conditions using clean experimental conditions                                                                     | Pascale/<br>Biodiversity |                                  |
| Planting material in different sites (% of incidence in regions, different soils from existing plots, different altitudes management systems        | Pascale/<br>Biodiversity |                                  |
| Impact of yam nematode in West Africa on potato ( <i>Solanum</i> ) – varietal screening, distribution – incidence, etc. – temp/climate, - tolerance | Danny/ ITA               | Planning                         |
| Assess impact of potyvirus nematode pest causing damage (serious) on banana                                                                         | Danny/ ITA               | Planning<br>This is likely a new |

|                                                                                                                                                                                                               |             |                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------|
| in coastal Kenya.                                                                                                                                                                                             |             | species                                                                            |
| Impact of Meloidogyne spp nematodes (root knot) on solarium potato in Africa (+ beyond) and potential for introducing sample techniques to enable farmers to positive selection instead of negative selection | Danny/ ITA  | Planning                                                                           |
| Collect viral content in cassava in Columbia and correlate with seed degeneration.                                                                                                                            | Monica/CIAT | Planning<br><br>What is the best sampling design to get the most for modeling too? |
| Effect of temperature on PUY infection in potato in different regions R&S:                                                                                                                                    | Lesley      | Ongoing<br><br>If we get any interesting results we can let you know               |
| Whitefly transmission PYUV at different temp and levels of plant resistance                                                                                                                                   | Jan/CIP     | Planning                                                                           |
| Sweet Potato Virome in Africa                                                                                                                                                                                 | Jan/CIP     | Ongoing                                                                            |
| Assessment of microbial enhancement of yam for improved health, vigour and nematode and disease suppression                                                                                                   | Danny/ITA   | Ongoing                                                                            |



A broad alliance of research-for-development stakeholders & partners

