Flagship project 1: Discovery research for enhanced utilization of RTB genetic resources

AUGUSTO BECERRA • RTB ISC F2F MEETING
Outline

1. Flagship overview
2. Key scientific achievements 2017
3. Looking ahead: opportunities and challenges
Flagship overview
Objectives

Develop and apply leading-edge science toward faster and more precise development of user-demanded varieties, and to enhance the long-term conservation and use of genetic diversity.
<table>
<thead>
<tr>
<th>Clusters</th>
<th>Discovery research products</th>
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<tbody>
<tr>
<td><strong>Cluster</strong></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td>DI1.1: BCoP - Meredith Bonierbale (CIP) and Trushar Shah (IITA)</td>
<td>Capacity building strategies on clonal crop breeding</td>
</tr>
<tr>
<td>DI1.2: NextGen Breeding - Ismail Rabbi (IITA) and Luis A Becerra (CIAT)</td>
<td>Omics tools for trait definition and selection</td>
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<td>DI1.3: Game-changing Traits - Marc Ghislain (CIP)</td>
<td>Proof of concept of varieties with game-changing traits</td>
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<tr>
<td>DI1.4: Genetic Diversity - Michael Abberton (IITA) Ehsan Duloo (Bioversity)</td>
<td>Analysis and management of in situ diversity</td>
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</tbody>
</table>
Key scientific achievements 2017
DI1.1 – Breeding Community of Practice

RTB Breeding Community of Practice and NextGen Breeding Clusters: Founding and Planning Workshop

(See Annex A for full workshop program)

Place: Hôtel Mercure Antigone, Montpellier, France:

Date: 26-30 June 2017

Participants:
Scientists from the Breeding Community of Practice (DI1.1) and NextGen Breeding (DI 1.2) clusters
Representatives from other FP1 clusters and FP 2, 3, 4 and 5
Outside experts in breeding and breeding support
(See Annex B for full participant list)

Organizing Committee:
Merideth Bonierbale (CIP, Leader Cluster DI1.1), Ismail Rabbi (IITA, Leader Cluster DI1.2), Netsayi Mudege (CIP), Elizabeth Arnaud (Bioversity), Michael Friedmann (RTB PMU)
DI1.1 – Breeding Community of Practice

Purpose:
• Further develop and refine the vision, objectives and outputs of RTB Clusters DI 1.1 and DI 1.2
• Advance on implementing selected deliverables of earmarked funding for DI 1.1, DI 1.2 and Gender

Expected outputs:
• Effective linkages are established and active within DI 1.1 and DI 1.2 and with other clusters and platforms
• Portfolio and selected deliverables of clusters DI 1.1 and DI 1.2 are agreed and built by cluster teams
• Gender relevance of cluster products, deliverables and linkages are enhanced through gender integration and mainstreaming
• Cluster management, governance and coordination are agreed and implemented
• Common commitment and approach to fundraising is built

Report of successful workshop in final draft!
• Significant progress on all outputs
POWB: DI1.2 - Next Generation Breeding for Roots, Tubers and Bananas

• DI1.2.1.2: Trait-linked molecular markers identified through: transcriptomics, metabolomics, genetic mapping (QTL and GWAS)

• DI1.2.1.3: Proof of Concept (POC) and validation of marker-assisted and genomic selection tools
DI1.2 – Next Generation breeding

CGIAR Excellence in Breeding Platform linkages via RTB-BCoP

4 RTB representatives participated in the inaugural EiB meeting in NL, March 2017

Credit: M. Bonierbale
DI1.2 – Next Generation breeding

Marker discovery and deployment (cassava)
DI1.2 – Next Generation breeding

Proof of Concept of Marker-Assisted Selection (Cassava)

• Tier 1 traits: Pest and disease resistance, micronutrient density and dry matter content
  – Resistance to CMD (6 SNPs)
  – Resistance to CBSD (NaCRRI – Uganda) (not finalized yet)
  – Resistance to CGM (NRCRI) (14 SNPs)
  – Provitamin A content (17 SNPs)
  – Dry matter content (15 SNPs)
## SNP verification results

<table>
<thead>
<tr>
<th>Traits</th>
<th>Very good</th>
<th>Good</th>
<th>Medium</th>
<th>Uncallable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGM</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>CMD</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>DM</td>
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<td></td>
<td>1</td>
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<td>DM_CGM</td>
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<td></td>
<td>2</td>
</tr>
<tr>
<td>DM_PVA</td>
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<td></td>
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<td></td>
<td>2</td>
</tr>
<tr>
<td>PVA</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>40</strong></td>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
<td><strong>6</strong></td>
<td><strong>52</strong></td>
</tr>
</tbody>
</table>

**Very good** = This SNP is working well and is easy to score. Good quality results can be expected. **Good** = This SNP is working reasonably well, but is sensitive to DNA concentration. Faulty annotations and less than 95% data recovery can occur. **Medium** = This SNP is working less well. Many unamplified or uncallable data points, with less than 95% data recovery, is expected. **Bad** = This SNP is not working. **Uncallable** = Only one or two clusters of data points are identified and the results are therefore inconclusive. (2x Hom and 1x Het is not present in the tested population)
DI1.2 – Next Generation breeding

Cassava Genome Hub

The Cassava Genome Hub is an integrated web-based database for communicating and sharing genomic, transcriptomic, metabolomic, genetic and breeding resources to enable basic, as well as transformational research in cassava for genetic improvement. The hub provides tools for easy querying, visualizing and downloading research data.
DI1.3 – Game changing traits

**Game-changing traits**- Pre-commercial products with game-changing traits

2 confined field trials completed by NARO Uganda and CIP Kenya demonstrating **GM late blight resistant potato** can be grown without any fungicide spray

M. Ghislain, CIP

KaZARDI, Kabale, Uganda: only the transgenic events survived to late blight disease (control plots and spreader rows are dead)
**DI1.3 – Game changing traits**

**Game-changing traits- (GCTs)**

**Proof of concept of varieties with GCTs (plantain)**

**Pre-commercial products with game-changing traits (banana)**

![Images of plantain and banana roots with text annotations]

- Nematode resistant Gonja transgenic lines

- Weevil resistant
  Gonja transgenic lines

  **E. Karamura, Bioversity**

- GM banana showed resistance to Xanthomonas wilt disease under field conditions.

- Promising transgenic events tested for five generations in two confined field trials (2010-2015) by NARO and IITA

  **L. Tripathi, IITA**

![Image of GM banana field trial at NARL, Kawanda, Uganda]
DI1.4 – Genetic diversity

Game changing traits- New genetic modification technologies

Genome Editing in cassava (proof of concept).

Transgenic blue cells, with four copies of the GUSPlus gene, become white after knocking down these four genes with CRISPR-Cas9. The technology is being used to obtain waxy cassava in relevant cultivars for Asia and Colombia.

P. Chavarriaga, CIAT
DI1.4 – Genetic diversity

Genetic Diversity - Characterization and knowledge management for RTB diversity
Upgraded Musa Germplasm Information System (MGIS)
DI1.4 – Genetic diversity

Genetic Diversity- Analysis and management of in situ diversity

Baseline characterization: Relative Diversity-Potato

MACRO          MESO          MICRO

I. Hotspot identification
II. Richness-Altitude
III. Horizontal dynamics (crop rotation)
IV. Red List

Findings:

- Major diversity between 3800-4300 masl. → this altitudinal belt ascended >250 m during the last 50 years.
- >60% of observed varieties are grown by <5% of farm households. → diversity is highly scattered within the communities.
- >70% of varieties show a very low abundance and frequency in farmers fields. → repeated measuring will reveal how threatened they are.

Indicators

- Endemism
- Richness
- Coexistence wild relatives
- Diversity of cultural and agro-ecological conditions

- Crop rotation pattern
- Abundance
- Frequency
Looking ahead: opportunities and challenges
Opportunities and challenges

Guiding questions

• What are the new funding opportunities that have emerged this year?  
  This is low paucity this year for FP1, but there is huge potential through the BMGF

• What are the existing or new partnerships that have been consolidated?  
  RHUL and NRI

• What are the opportunities and challenges that have appeared with the new management structure and the beginning of the second phase?  
  Communication and response time

• What are the scaling opportunities and challenges that may foster or hinder the achievement of the expected outcomes?  
  Molecular marker use on cassava
  Biomarker use in banana
THANK YOU