Breeding Operations and Phenotyping

Gustavo Teixeira
EiB Module lead
Thinking....

How would you like to have your seed stored?

Same CGIAR station
Thinking....

How would you like to identify your plot?

Same CGIAR station
Thinking....

How would you prefer to register your data?

Same CGIAR station
Thinking....

Which agronomic practice would you prefer?

Same CGIAR center
Thinking....

Which is the safest workplace?

Same CGIAR station
Why am I showing these pictures ???
… We will be more effective

… We will deliver better products

“… The technical aspect is not the biggest challenge….

“The solution is known…. It is a matter of prioritization and cultural change…. “
EiB – Module update
Breeding Operations and Phenotyping

What has been achieved?
Challenges and next steps
Gustavo Teixeira

Breeding Operation and phenotyping Module leader at Excellence in Breeding Platform

I have over 15 years’ experience in the private sector including Syngenta, John Deere and other companies.
What do we want to achieve?
“...breeding programs have the most effective and cost efficient phenotypic process, from field preparation to data collection. With a strong culture of delivery of quality data through continuous improvement. Providing respect and safety for all employees.”

https://excellenceinbreeding.org/eib-annual-meeting/day-1
What does it mean?
What does it mean?

Good field (plotmanship) → Good agronomic practices (field prep., pest control, etc.)

Effective and cost efficient process → Mechanization, Automation, Data collection, Access to service…
What does it mean?

Continuous Improvement → Everybody everyday

Health, Safety and environment → Staff morale, Leading by example, Sustainability

before

after
Background...
What is the current status?
• Technical aspect

• Organizational aspect
Technical aspect
What needs to be done?
Current status – technical aspect

• Breeding operations assessment
Breeding operations assessment

1. Agronomic practices
2. Seed processing
3. Planting and harvesting
4. Phenotyping
5. Continuous improvement

25 research stations
National Programs
CGIAR
Ranking

Stations visited received a report ranking the current status of each sub-category ranging from Marginal to Cutting-edge.

The table on the right illustrates the current status of agronomic practices in Breeding Operations across CGIAR centers.
### Agronomic Practices

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Station / Program</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agronomic Practices</td>
<td>Field Preparation, Fertility, IPM, and agro-mechanization equipment</td>
<td></td>
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<tr>
<td></td>
<td>Irrigation and Weather Data</td>
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<td></td>
<td>Farm Management System</td>
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<tr>
<td></td>
<td>Greenhouse and Controlled Environment</td>
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### Planting and harvesting

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<tbody>
<tr>
<td>Planting / Harvesting</td>
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### Phenotyping

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<tbody>
<tr>
<td>Phenotyping</td>
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### Continuous Improvement

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</table>
It helped us to define what needs to be done…

Our High-level Roadmap
IRRIGATION Projects – key station

IRRIGATION Infrast + Staff Develop.
Irrigation project

- 7 CGIAR stations in Africa
  - Infrastructure upgrade
  - Weather station
  - Soil moisture probes
Irrigation project

• Challenges
  – Internal processes (procurement / legal)
  – Communication / scope definition

• How to mitigate
  – We’ll involve procurement and legal team earlier in the process
  – We got the commitment from CIMMYT team to improve the support
  – We’ll be hiring the Breeding Operation/ Mechanization specialist
Irrigation project

• Next steps
  – Implementing infrastructure (some with CtEH funds)
  – Filling additional gaps / other projects
  – Training staff
    • Breeding operation exchange program
    • Publishing material in EiB toolbox
Soil Management

• Baseline for key CGIAR stations in Africa
  – Project delayed due to COVID-19
  – Report for one station delivered
Soil Management

• Challenges
  – Internal processes (procurement / legal)
  – Communication / scope definition

• How to mitigate
  – We’ll involve procurement and legal team earlier in the process
  – We got the commitment from CIMMYT team to improve the support
  – We’ll be hiring the Breeding Operation/ Mechanization specialist

• Next step
  – Finalizing pending station (visit / recommendation)
  – Implementing recommended plan
  – Training staff
    • Breeding Operation exchange program
    • Publishing material in EiB toolbox
IRRIGATION Projects – key station

Soil Management Projects – key station

Continuous Improvement Structuring concepts and method. IRRI

Continuous Improvement Increase adoption with other centers/ Nars
Continuous Improvement

- Achievements
  - 75 CGIAR staff trained on lean methodologies (32 hour training)
  - 9 projects
  - Over 120 participants (from NARS) on CI webinar
Continuous Improvement

• Challenges
  – Virtual training
  – Follow up projects (Covid-19)

• How to mitigate
  – Reduce the group size
  – Key practitioners / leaders that will help drive it

• Next step
  – Working with IRRI to create the Continuous Improvement system (including e-learning)
IRRI Roadmap

Feb-Jun 2020
Project Selection and Preparation

Jun-Aug 2020
Remote CI Workshop
25 Participants

Aug 2020
Presentations to Leadership

Sep 2020
30-Day Check In

Oct 2020
60-Day Check In

Dec 2020
90-Day Check In

Nov 2020-Oct 2021
Sustainable Continuous Improvement System Development

Oct 2021
CI Assessment

2022
Deploy Model in Other Centers
HTPP

- Phenotyping lab
  - Quality / nutritional
- Phenotyping Agronomic traits
HTPP – Quality and Nutritional trait

• Service – similar as HTPG

• Q2/Q3 identifying demand • We are in the process of selecting vendors / contract

Aldo Rosales
HTPP – Quality and Nutritional trait

• Challenges
  – Understanding the demand per product profile (wish list)
  – We tried to cover too many crops

• How to mitigate
  – Reduce the scope (initiate the project with a limited scope)

• Next steps
  – Contract vendor
  – Define protocols (logistics)
HTPP – Agronomic traits / field phenotyping

- Our goal

  Operation team

  Or

  Service provider

  Tools + protocols

  Generate image

  Upload Images

  3rd party company platform

  Company will send data directly To EBS
HTPP – Agronomic traits / field phenotyping

• What has been achieved?
  – Protocols are available in EiB toolbox
  – Hiphen (private company) was hired to run the first campaign (ICRISAT) – Proof of concept

Vincent Vadez
HTPP – Agronomic traits / field phenotyping

• Challenges
  – Internal processes
  – Regulations (drones)

• Next steps
  – Deliver the PoC
  – Develop the implementation plan (3yp) – considering other centers/ crops/ regions
  – Additional vendors / partners
Costing

• What has been achieved?
  – Bish and Lenin supported 3 NARES to adopt UQ tool.
    • KARLO Maize
    • NARO Maize
    • CRI Rice
    • Starting now the support for Zimbabwe (Maize)
  – CIMMYT maize validated the excel template
  – CIOT (ICRISAT) and IRS (IRRI) – Sharing experience and best practices
Costing

• Challenges
  — Different needs
  — Different operational modality

• Next steps
  — Promote the adoption of available tools (Template and UQ tool)
  — Supporting programs to get the cost defined
2020
IRRIGATION Projects – key station
Soil Management Projects – key station
Continuous Improvement Structuring concepts and method.
IRRI

2021
IRRIGATION Infrast + Staff Develop.
Soil Management implem+ Staff Develop.

2022
Continuous Improvement Increase adoption with other centers/ Nars
HTPP (field + lab)
Phenotyping as a service
Identifying vendors / contract piloting

2023
Building capacity Logistic deployment

2024
Costing
Breeding programs Cost defined
Increase adoption of digital devices
Filling gaps

2025
Increase adoption of digital devices

- Achievement
  - Bulk purchase

17 Packet Printers
21 Seed Counters
22 Label Printers
48 Laser Printers
295 Handhelds
Increase adoption of digital devices

• Challenges
  – Internal processes

• How to mitigate
  – We’ll involve procurement and legal team earlier in the process
  – We got the commitment from CIMMYT team to improve the support

• Next steps
  – Deliver products
  – Train staff (Module V)
  – Start the second round of the project / considering other devices
2020

IRRIGATION Projects – key station

Soil Management Projects – key station

Continuous Improvement
Structuring concepts and method.
IRRI

Costing
Validating methodologies

2021

IRRIGATION
Infrast + Staff Develop.

Soil Management
implem+ Staff Develop.

HTPP (field + lab)
Phenotyping as a service
Identifying vendors / contract piloting

Breeding programs
Cost defined

Increase adoption of digital devices
Filling gaps

GPS / FMS / Planting / Harvesting
Greenhouse / Controlled environment

2022

Continuous Improvement
Increase adoption with other centers/ Nars

Building capacity
Logistic deployment

2023

2024

2025
### Agronomic Practices

- Seed Preparation, fertility, IPM, and seedling emergence equipment
- Irrigation and Weather Data
- Farm Management System
- Greenhouse and Controlled Environment

### Seed Processing

- Seed Processing Infrastructure
- Conditioning, Packaging, and Testing

### Phenotyping

- Planting / Harvesting
- Plant Growth / Phenotyping

### Continuous Improvement

- Continuous Improvement / HIC
• Technical aspect

• Organizational aspect
Organizational aspect
How to implement?
Current scenario

Centralized Operation
- IRS – IRRI
- CIOT – ICRISAT

- Cost control
- Dedicated staff
- Breeders focusing on breeding
- SOPs
- Harmonized results

Operation managed by breeding team
- NARES
- Most of CGIAR programs

This is the operation mode
We believe to be the most appropriate and the one we promote
What is our vision?

CGIAR regional operational team – heads of operation
How would EiB support that?

- From EiB annual meeting - 2019

Breeding Operation / Mechanization specialists
Breeding Operation Alliance of Excellence

CGIAR regional operational team – heads of operation

Breeding Operation / Mechanization specialists
Breeding Operation Exchange Program