Breeding Management System for Grain Legumes Research

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The Breeding Management System is a comprehensive, all-in-one suite of tools to effectively manage your breeding activities throughout all development phases of your programs, from project planning to final decision-making:

Breeding Activities

<table>
<thead>
<tr>
<th>Project Planning</th>
<th>Germplasm Management</th>
<th>Germplasm Evaluation</th>
<th>Molecular Analysis</th>
<th>Data Analysis</th>
<th>Breeding Decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Project</td>
<td>Parental selection</td>
<td>Experimental Design</td>
<td>Marker selection</td>
<td>Quality Assurance</td>
<td>Selected lines</td>
</tr>
<tr>
<td>Specify objectives</td>
<td>Crossing</td>
<td>Fieldbook production</td>
<td>Fingerprinting</td>
<td>Trait analysis</td>
<td>Recombines</td>
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<tr>
<td>Identify team</td>
<td>Population</td>
<td>Data collection</td>
<td>Genotyping</td>
<td>Genetic Analysis</td>
<td>Recombination</td>
</tr>
<tr>
<td>Data resources</td>
<td>development</td>
<td>Data loading</td>
<td>Data loading</td>
<td>QTL Analysis</td>
<td>plans</td>
</tr>
<tr>
<td>Define strategy</td>
<td></td>
<td></td>
<td></td>
<td>Index Analysis</td>
<td></td>
</tr>
</tbody>
</table>

Fourteen crop-specific databases with historical data: bean, cassava, chickpea, cowpea, groundnut, lentil, maize, pearl millet, pigeonpea, rice, sorghum, soybean and wheat, yam
BMS Portal

http://www.integratedbreeding.net
Integrated Breeding Database

- Genealogy Management System (GMS)
  - Germplasm nomenclature, chronology, IP and passport data
  - Pedigrees and breeding history
- Phenotyping Data Management System (DMS)
  - Germplasm characterization and evaluation data
  - Annotated with Crop Research and Crop Trait Ontologies
- Genotypic Data Management System (GDMS)
  - Medium density fingerprinting data
  - Genotyping data for MAS and MABC
  - Genotyping data for Marker-trait association analysis

Databases fully integrated into BMS workbench
## Crop Specific Trait Dictionaries

<table>
<thead>
<tr>
<th>Variate</th>
<th>Description</th>
<th>Trait Property</th>
<th>Scale</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>APHIDR</td>
<td>Aphid resistance</td>
<td>Aphid resistance</td>
<td>0-4 score</td>
<td>Visual rating of</td>
</tr>
<tr>
<td>BB</td>
<td>Resistance to bacterial blight</td>
<td>Resistance to</td>
<td>0-4 score</td>
<td>Visual rating of</td>
</tr>
<tr>
<td>BLCMV</td>
<td>Resistance to blackeye</td>
<td>Resistance to</td>
<td>0-4 score</td>
<td>Visual rating</td>
</tr>
<tr>
<td>CAMV</td>
<td>Resistance to cowpea aphid</td>
<td>Resistance to</td>
<td>0-4 score</td>
<td>Visual rating</td>
</tr>
<tr>
<td>CANOPY</td>
<td>Canopy Height at FLOW50</td>
<td>Canopy Height at</td>
<td>cm</td>
<td>Measurement</td>
</tr>
<tr>
<td>CHECK</td>
<td>Check lines</td>
<td>Check Tag</td>
<td>Local Check</td>
<td>C</td>
</tr>
<tr>
<td>CKTME</td>
<td>Cooking time</td>
<td>Minutes</td>
<td>Time for dry grain</td>
<td>N</td>
</tr>
<tr>
<td>DRYPOD</td>
<td>Dry pod color</td>
<td>0-4 score</td>
<td>Visual</td>
<td>N</td>
</tr>
<tr>
<td>DTFLWR</td>
<td>Floral abscission score</td>
<td>0-4 score</td>
<td>Scoring relative</td>
<td>N</td>
</tr>
<tr>
<td>EYELEA</td>
<td>Pigment bleeding</td>
<td>0-4 score</td>
<td>Degree of</td>
<td>N</td>
</tr>
<tr>
<td>FLDSN</td>
<td>Resistance to Fusarium</td>
<td>Days</td>
<td>Calc. from</td>
<td>N</td>
</tr>
<tr>
<td>FLOW50</td>
<td>Flow color</td>
<td>Flow color</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>FLOWCO</td>
<td>Flowering Date</td>
<td>Flowering Date</td>
<td>Visual rating at</td>
<td>N</td>
</tr>
<tr>
<td>FODMAT</td>
<td>Biomass at harvest</td>
<td>Biomass at harvest</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>FODMID</td>
<td>Biomass at harvest</td>
<td>Biomass at harvest</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>FOLTHR</td>
<td>Foliar drip</td>
<td>Foliar drip</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>FUSWL3</td>
<td>Resistance to Fusarium</td>
<td>Resistance to</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>FUSWL4</td>
<td>Resistance to fusarium</td>
<td>Resistance to</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>GROHAB</td>
<td>Growth habit</td>
<td>0-4 score</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>HI</td>
<td>Harvest index</td>
<td>Harvest index</td>
<td>Calc. from</td>
<td>N</td>
</tr>
<tr>
<td>LYGUSR</td>
<td>Resistance to Nyctinomy</td>
<td>Resistance to</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>MACROP</td>
<td>Macrophomina Tolerance</td>
<td>Macrophomina Tolerance</td>
<td>Visual rating of</td>
<td>N</td>
</tr>
<tr>
<td>MAT95</td>
<td>Days to 95% maturity</td>
<td>Days</td>
<td>Visual</td>
<td>N</td>
</tr>
</tbody>
</table>

**Reporting units or scale:**

- Measurement
- Trait property
- Measurement method
BMS Workbench

The Workbench offers access to multiple breeding programs and allows users to add and remove programs as required.

![BMS Workbench interface](image_url)
Specify the trial design and generate the layout.
Labels

**CHOOSE LABEL FIELDS**
Your labels can include up to five rows, with two fields per row. Drag items from the Available Fields into the Left or Right Side Fields to design your label layout.

- Available Fields
  - Parentage
  - Year
  - Season
  - Location
  - Trial Name
  - Trial Instance #
  - Rep
  - Plot No.

**BARCODE OPTIONS**
Do you need barcodes on your labels?  
- Yes  
- No

You can use a single field for your barcode, or join up to three fields to create a unique ID value of your labels.

- First barcode field:  
  - Trial Name

- Second barcode field:  
  - Trial Instance #

- Third barcode field:  
  - Plot No.

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**Example Barcode**
- **Trial ID:** Trial457-31111
- **Plot:** 45
- **CKT:** CKT025025
- **GID:** 311580
FIELD PLAN

MAKE A FIELD PLAN
1. ENTER FIELD DETAILS
2. ENTER PLANTING DETAILS
3. GENERATE FIELD MAP

SUMMARY OF TRIAL, FIELD AND PLANTING DETAILS

Selected Trials:

<table>
<thead>
<tr>
<th>Order</th>
<th>Trial</th>
<th>Instance</th>
<th># of Entries</th>
<th># of Reps</th>
<th>Plots Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Trial457-3</td>
<td>2</td>
<td>55</td>
<td>2</td>
<td>110</td>
</tr>
</tbody>
</table>

Total Number of Plots: 110

FIELD AND BLOCK DETAILS
Field Location: CIMMYT Harare
Field Name: Field 1
Block Name: Block 2

FIELD MAP
Arrows indicate direction of travel of the planting
seed_name: Kharkof
seed_id: 12GHT00001B
pedigree: Kharkof

height
Trait Details: cm

Range: 1
Plot: 1
Current Value

; 1 2 3
+ 4 5 6
- 7 8 9
* 0

Clear
Breeding View – Analysis

Field Analysis Options
- Display:
  - Model
  - Variance components
  - Estimation effects
  - Heritability
- Constrain variance components to be positive
- Maximum number of iterations for optimization method: 50

Export field trial
Generate report

Breeding View
You are using a link Do not re-distribute
Molecular Markers / Genotyping
Molecular Decision Support Tools

• OptiMAS
  – Developed at INRA, Le Moulon
  – Implementation of markers in a MARS breeding scheme
  – Identify and track favorable alleles through cycles of recombination and selection

• Molecular Breeding Decision Tool (MBDT)
  – Developed by team at ICRISAT
  – Implementation of markers in a MAS and MABC context
Linking to other Plant Breeding Systems

- **Plant Breeding API (BRAPI)**
  - Partners in the definition of a standard Application Programming Interface (API) for plant breeding
  - BMGF is supporting development

- **Will serve to:**
  - Facilitate data exchange among different initiatives
  - Expand the range of tools available to IBP clients
  - Reduce unnecessary duplication of tasks / More efficient use of resources
  - Increase communication among programmers working on similar projects (CoP)
Linking to other Plant Breeding Systems

- Other interested parties
  - GOBII (Cornell)
  - Flapjack, Germinate (JHI)
  - B4R (IRRI)
  - KDDart (Diversity Arrays Technology)
  - BMS (IBP)
  - Triticeae Toolbox (T-CAP)
  - Cassavabase (Cornell/BTI)
Future Developments

• Seed Inventory module enhanced

• Cloud based version (under testing)

• Experimental designs
In a nutshell

- Huge potential impact:
  - crop research data management,
  - crop improvement
  - ultimately, on food security

- Igniting a crop breeding revolution in developing countries

- People drive change: need to encourage a new culture

- Champions + buy-in of upper management

- Partnerships: building a solid and vibrant breeding community

Visit us at IBP Booth at the Technology Marketplace for more information
Acknowledgements

BREEDING MANAGEMENT SYSTEM | WORKBENCH

BROUGHT TO YOU BY:

Generation Challenge Programme

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