BMS a helping hand for realising the potential of modern plant breeding

The Integrated Breeding Platform provides resources that breeders need to design and manage plant breeding projects. At the heart of the Platform is the Breeding Management System (BMS) – a package composed of software applications for breeders to plan, conduct, analyse and assess the outcomes of their work.

The Breeding Management System

The Breeding Management System is specifically designed to help breeders to manage the logistics, data storage, statistical analysis and decision-making for integrated plant breeding.

BMS is composed of a suite of software applications and crop databases, and explanations on how to use them. The software applications are custom-built for breeders to conduct all activities necessary to run their breeding programmes efficiently. All the applications are compatible both in terms of how they function, and the input and output data generated. The crop databases contain publicly available pedigree, phenotypic and genotypic data.

Integrated breeding: blending the old and the new

Planning and running a plant breeding project today is a major undertaking. Doing it properly requires careful preparation, and considerable knowledge and skill.

To speed up the development and release of more resilient and productive crop varieties, today's plant breeders combine modern techniques (like using molecular markers to rapidly identify the genes that they want to target), with the traditional (much slower) method of actually growing promising crop lines to see how they perform under specific conditions. Integrating these different techniques – the modern and the traditional – makes for much faster and more cost-effective breeding programmes.

However, a consequence of this integrated approach is that modern breeders have to gather, carefully store and analyse huge amounts of data. They also need to ensure that their results are well-documented and can be easily shared with other breeders, or used in future breeding work.

A big part of the answer to the complexities of running a modern plant breeding programme is having reliable software to help manage day-to-day activities and processes. The Breeding Management System is custom-built for this.

How does the BMS work?
Obtaining the IBWS

You can download and install the BMS from the Integrated Breeding Platform web portal, with everything you need to immediately start using the System. Users can also request for the IBWS on DVD.

The BMS applications are largely open-source, meaning they can be freely used and modified. However, because they are complex, they are packaged together with customised training and technical support, for which fees may be charged in the future.

Workbench tailored for you – one size does not fit all

Plant breeding projects are complex and, in the real world, there is no 'one-size-fits-all' approach. The BMS, therefore, supports both traditional (conventional) breeding and modern marker-assisted breeding approaches.

BMS also provides tools to support optional workflows:

- conventional breeding
- marker-assisted selection
- marker-assisted recurrent selection and
- marker-assisted backcrossing.
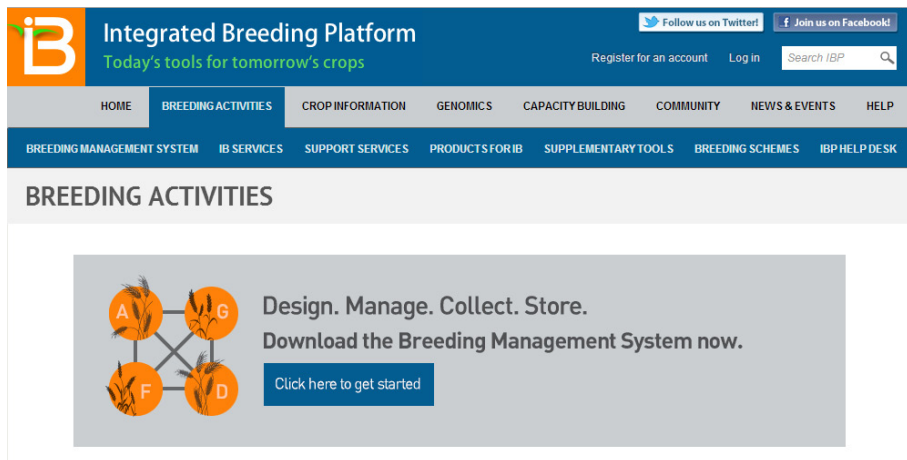
Guidance for breeders, at home and away

Comprehensive technical and professional support and capacity building are part of the BMS package. Efforts are underway to set up regional hubs to optimise this support by bringing it closer to users.

Within the BMS itself, breeders are shown how to access the different project management, data management, statistical analysis and decision-support tools at each stage of their projects.

Not only does the System provide tools and working protocols, it also guides breeders on when and where to use them – from setting up their experiments to deciding which crosses to make based on the data collected. As a result, even inexperienced breeders using the BMS can easily plan and proficiently apply internationally recognised modern techniques.

"Even inexperienced breeders can easily plan and proficiently use internationally recognised modern techniques"

Artwork: R Okono

What BMS does

The BMS provides a software application to support each breeding activity:

(i) project planning,
(ii) data collection and management, and
(iii) statistical analysis and decision support.

The applications work together seamlessly, smoothly transferring data from one tool to the next through successive steps in the workflow.

Project planning

The project planning application in the System helps breeders plan and manage projects (ranging from defining project sites to identifying the key skills that team members need).

Data management

The System is very good for handling breeding data: tools in the data collection and management applications help breeders get to grips with three key tasks:

(i) **managing pedigree and breeding information** (from tracking germplasm samples to managing seed inventories and nurseries), and

(ii) **managing trial and field data** (by creating electronic field books and using tools that make it easier to capture information in databases), and

(iii) **managing genotypic data** (for marker selection, diversity analysis, etc)

The Integrated BreedingFieldBook (IB–FB)

This trial and field data management tool in the Breeding Management System makes it easy for breeders to produce electronic field books for screening, characterising and evaluating germplasm.

Using the IB FieldBook greatly improves data capture and management, and reduces human error in data collection.

The tool also makes it easier to produce field maps and labels (including barcodes) to ensure that samples can be traced from the field to the laboratory and back to the field – a critical element in the selection process.

BREEDING MANAGEMENT SYSTEM
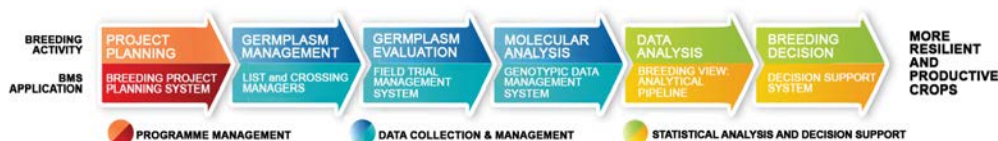
Build on existing databases... or not

The crop databases provided with the BMS contain publicly available historical and current data for nine crops (beans, cassava, chickpeas, cowpeas, groundnuts, maize, rice, sorghum and wheat). Breeders can use these databases and add to them new data that they generate.

Your crop is not covered? No problem!

You can still use the BMS even if your particular crop is not one of our current nine. The System provides an appropriately configured empty database into which you can enter your own historical data as well as data you generate from your current project.

The System also provides links to the crop databases of the CGIAR Centres, as well as to initiatives such as Gramene and GrainGenes.

Find out more about the Breeding Management System at www.integratedbreeding.net/integrated-breeding-workflow-system-1

Analysis and decision support

Statistical analysis tools

The Analytical Pipeline of the BMS gives breeders statistical analysis tools that they need to analyse the data that they generate in a breeding or evaluation experiment. These tools work for the entire spectrum from conventional to advanced molecular breeding. Breeders can use sophisticated statistical methods to assess progenies and make selections for the next phase of development.

Breeding decision-support tools

The breeding decision-support application helps breeders make quick informed decisions on what material to take forward to the next generation; what plants to cross; what plants to keep, and which ones to discard. The tools in this application are not limited to simple biparental populations, but also handle complex multiparental populations.

"The BMS decision-support application helps breeders make quick and informed decisions"

Integrated Breeding Platform
Today's tools for tomorrow's crops

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