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Genomics Application:
Molecular breeding in developing countries

Impacts of Molecular Breeding

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Outline

- Ex-ante impact analysis of MAS technologies

- The Genotyping Support Service – Marker Services
- The Molecular Marker Toolkit

- Molecular Breeding Communities of Practice

Advantages of molecular breeding (MB)

- ✓Time
- ✓Efficiency
- ✓Accuracy

What are the costs of MB versus conventional breeding?

Ex - ante impact analysis

(George W. Norton et al, Virginia Tech, USA)

➔ expected quantitative impact versus investments

– Asia: *Revitalizing marginal lands: Discovery of Genes for Tolerance of Saline and Phosphorus Deficient Soils to Enhance and Sustain Productivity*

A project to develop **rice** varieties more **tolerant to salinity** and **better able to thrive in phosphorus-depleted soil**

– Africa: *Development of Low-Cost Technologies for Pyramiding Useful Genes From Wild Relatives of Cassava into Elite Progenitors*

A project to develop **cassava** varieties with stronger **tolerance against cassava mosaic disease, green mites and whiteflies**

- **Information** on crop yields, farmer adoption rates, market prices, cultivated land area, breeding times, input prices, costs of development, and more for **computing the net present value of using MB rather than CB**

Crop, constraint, country	Incremental net present value over phenotypic selection (USD Million)
Rice	
Salinity	
Philippines	49
Bangladesh	499
India	447
Indonesia	194
Phosphorus deficiency	
Indonesia	282
Cassava	
Cassava mosaic disease, cassava green mites	
Nigeria	817
Ghana	371
Cassava mosaic disease, cassava green mites, whitefly	
Uganda	34

➔ MB has lower research cost and provides greater economic benefits

1) Salt tolerant and P-deficiency rice

- Quicker variety release
- Higher and faster adoption by farmers than of existing varieties
- Increased rice yield and larger rice area for salt tolerant rice
- Lower cost of production for farmers with P-deficiency rice
- Benefits go disproportionately to the poor

2) Improved cassava for tolerance to green mites, white flies, CMD and delayed post-harvest deterioration

- Quicker variety release by moving directly from clonal evaluation to regional trials
- Higher cassava yield
- Savings in post harvest losses
- Benefits go disproportionately to the poor

Other limitations

I. Institutional support
II. Breeding programs
III. Appropriate infrastructure
IV. Access to technologies
V. Up to date HR capacity
VI. Etc…

- We could not make a difference by building labs here and there
- We could not change the infrastructural environment of different regions
- Developed country institutions advance fast because they concentrate on the potential of the technology (type and amount of generated data) and data interpretation
- Breeders should not become laboratory technicians, but remain geneticists that benefit from the combined use of genotypic and phenotypic data

The Genotyping Support Service

- financial and technical support for breeders in developing countries
- access to cost-efficient genotyping, plus training in experimental design and data analysis for diversity analyses and molecular breeding

To date, about 36 services provided, 8000+ samples genotyped representing 12 crops to teams working in 14 countries

- Most services on germplasm characterization,
- A few for marker-assisted breeding

Molecular Breeding Platform

- Breeding Services -- to implement molecular breeding projects
- Support Services – to provide **guidance** and **training** and to build **capacity** for delivery of improved germplasm via molecular breeding approaches

Molecular Marker Toolkit

- A tool which allows rapid access to current effectively used markers for traits in marker-assisted selection of food security crops:

✓ *b*arley, beans, cassava, chickpeas, cowpeas, faba beans, groundnuts, maize, potatoes, rice, sorghum, and wheat

✓ No markers yet for the crops *Musa* spp., coconut, lentil, millet, pigeonpea, sweet potato and yam

✓ Content: A summary of current status of MAS, list of markers used, laboratory protocols, validation process, reference

✓ Most markers for wheat (58), rice (39) and barley (36)

The Molecular Breeding Platform, a new initiative launched to harness biotechnology to improve plant breeding

Patancheru, India

22 February 2010

The Molecular Breeding Platform (MBP) a one-stop shop for information, analytical tools and related services to design and efficiently conduct molecular-assisted breeding experiments aims to increase breeding efficiency in developing countries.

GIPB GLOBAL PARTNERSHIP INITIATIVE FOR PLANT BREEDING CAPACITY BUILDING
harnessing plant genetic resources for development

A PLATFORM FACILITATED BY FAO

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Molecular markers toolkit

Generation Challenge Programme's Subprogramme 5 decided to address the need to establish a tool which will allow rapid access to currently available and validated markers. The response to this growing knowledge gap is the **GCP toolkit**, a compilation of information available via internet sources, public databases and papers that has been verified against plant breeders' experiences. As an easily accessible global public good, this TB marks an important step towards supporting the adoption of modern agricultural technologies for the benefit of the poor in developing countries.

Know more about the toolkit of the Generation Challenge Programme.

SHARE

MB Communities of Practice

A Community of Practice is a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly

CoP members are **practitioners** that engage in joint activities and discussions, help each other, and share information and resources – experiences, stories, tools and ways of addressing recurring problems

CoP often may represent the needed critical mass of peers that researchers lack in their institutions

The cassava CoP

(courtesy of E. Okogbenin)

"A partnership for molecular breeding and product delivery in Africa"

- Nigeria – NRCRI
- Ghana – CRI
- Tanzania – ARI
- Uganda – NACRRI

- Interest on *Farmer Preferred Cassava Varieties Resistant to Pests and Diseases*

Shared experiences, germplasm and information via a website

Breeder to breeder visits

Integration of marker-assisted breeding for CMD with field research

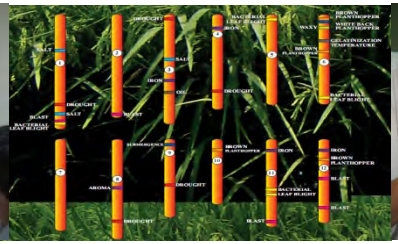
Annual workshops and training

Community of Practice on MAS Rice Breeding Programs for Mekong Region

Rice Gene Discovery Unit BIOTEC a member of NSTDA

RGDU, BIOTEC provides QTL and marker information and laboratory facilities to conduct marker-assisted selection (MAS) for line conversion. The laboratory serves as a research hub for partner institutes because molecular labs do not exist or still non functional.




DAR

NAFRI National Agriculture and Forestry Research Institute

CAMBODIAN AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE

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Partner institutes make decision on target trait for improvement and decide which recipient and donor parents will be used in backcrossing after the appropriate line had been selected.

Target field testing of improved varieties converted using MAS-backcrossing method.

Knowledge and Technology Transfer

Breeding and MAS for improving cooking quality of a drought resistant rice variety at CARDI, of a a glutinous rice variety at NAFRI, salt tolerance and grain quality at DAR and UBU

Protocols

Phenotyping capacity

Farmer participatory trials

An ongoing plan to promote MB CoP

CoP provide an adequate avenue for enabling delivery of molecular breeding tools and approaches

Themes to explore:

- Crops + *Regions*
- Breeding schemes
    - » Clonally-propagated crops
    - » Cross-pollinated seed-propagated crops
    - » Self-pollinated seed-propagated crops
- Different capacity (readiness, level) for adoption

END

Proposed Discussion points

- Is access to marker technologies still an issue for MB in developing countries (Regional vs local laboratories ?)
- What are the major bottlenecks today in MB – within and across institutions? (analytical power, data management)
- How can we ensure good capacity building in developing country breeding programmes (field infrastructure, analytical power, human resources)?
- How do we evaluate the economic impact of MB in the South, given the diversity in size, capacity and structure of breeding programmes in the South?